FID # 114004220
SF / RPTS

INTERNATIONAL TECHNOLOGY CORPORATION

March 11, 1996

Mr. Jude Hobza
CEMRO-CD-FC
U.S. Army Corps of Engineers
Fort Crook Area
Building 525, Castle Hall
Offutt AFB, Nebraska 68113

RECEIVED
MAR 12 1996
EMERG & REMEDIAL RESPONSE SECT.
BUR OF SOLID & HAZRD WASTE

RE: Final Project Report
Oconomowoc Electroplating Facility
Contract No's DACW45-90-D-9002/DACW45-94-D-0054
Delivery Order No's 91/6

Dear Mr. Hobza:

Enclosed please find one (1) copy of the Final Project Report for the above subject Delivery Orders. All comments have been annotated and incorporated into the text. Also, additional Certificates of Analysis have been provided for inclusion into the appropriate appendices (instructions have been included).

If you have any questions and/or comments, please feel free to contact me during the week of March 11-15, 1996 at (412) 858-3344.

Sincerely
IT Corporation

Frank Magaro
Project Manager

cc T. Williams
P. Kozol
R. Meier
A. Meyers
Project File

Final Report
Creek/Wetlands Contaminated Sediment Removal Action/Phases I and II
Oconomowoc Electroplating Company
Ashippun, Wisconsin

Contract Nos. DACW45-90-D-9002
and DACW45-94-D-0054
Delivery Order Nos. 91 and 06
IT Project Nos. 519059 and 519205

Prepared by:

IT Corporation
2790 Mosside Boulevard
Monroeville, Pennsylvania 15146-2792

Prepared for:

U.S. Army Corps of Engineers
Fort Crook Area
Building 525, Castle Hall, 3rd Floor
Offutt AFB, Nebraska 68113

March 1996

Table of Contents

Page

1.0 Executive Summary .... -1-
1.1 Introduction .... -1-
1.2 Site History .... -5-
1.3 Project Objective .... -7-
1.4 Completed Objectives .... -7-

2.0 Phase I Project Review .... -9-
2.1 Initial Mobilization and Site Preparation .... -9-
2.2 Lagoon Removal .... -10-
2.3 Soil Stockpile Loadout .... -12-
2.4 Vegetation Removal .... -13-
2.4.1 Material Handling/Stabilization .... -13-
2.5 Phase I Sampling Program - Site Delineation and Characterization .... -15-
2.5.1 Sampling Methodology .... -15-
2.5.2 On-Site XRF Screening .... -16-
2.5.3 On-Site XRF Quality Assurance Program .... -17-
2.5.4 Offsite Analysis .... -17-
2.5.5 Offsite Laboratory QA/QC Program .... -18-
2.5.6 Subcontracted Surveying .... -19-
2.5.7 Turbidity Screen Placement .... -19-
2.5.8 Discussion of Results - Phase I .... -20-
2.5.9 Phase I - Analytical Review .... -21-
2.5.10 Phase I - Remediation Support Analysis .... -21-
2.5.11 Decision Logic - Phase I .... -21-
2.6 Problems Encountered/Lessons Learned .... -22-

3.0 Project Review (Phase II) .... -24-
3.1 Introduction .... -24-
3.2 Equipment Mobilization/Setup/Operation .... -25-
3.2.1 Water Treatment Plant Construction .... -25-
3.2.2 Wastewater Management/Water Treatment Plant Design .... -26-
3.2.3 Material Processing/Plant Operations .... -27-
3.2.4 Water Discharge .... -28-
3.3 Dredge Equipment/Setup/Operations .... -30-
3.4 Site Dewatering .... -33-
3.5 Conventional Excavation .... -34-
3.6 Site Teardown .... -35-
3.7 Phase II Sample and Analysis Summary .... -36-
3.7.1 Implementation .... -37-
3.7.2 Procedures .... -37-
3.7.3 Sampling .... -38-
3.7.3.1 Disposal Verification Analysis .... -38-
3.7.3.2 Wetlands and Creek Bed Verification .... -39-

Table of Contents

Page

3.7.3.3 Peat Filtration Analysis . . . . . -42-
3.7.3.4 Backfill Analyses . . . . . -43-
3.7.3.5 Field QA/QC . . . . . -43-
3.7.3.6 Documentation . . . . . -43-
3.7.4 Data Validation . . . . . -44-
3.8 Problems Encountered and Lessons Learned . . . . . -44-

4.0 Regulatory Compliance Summary . . . . . -47-

5.0 Health and Safety/Air Monitoring Summary . . . . . -49-
5.1 Health and Safety Plan Objective . . . . . -49-
5.2 Site Specific Training and Tailgate Safety Meetings . . . . . -49-
5.3 OSHA Training and Medical Surveillance . . . . . -49-
5.4 Site Control . . . . . -49-
5.5 Personnel Hygiene and Decontamination . . . . . -50-
5.6 Equipment Decontamination . . . . . -50-
5.7 Heat and Cold Stress Monitoring . . . . . -50-
5.8 Noise Monitoring . . . . . -51-
5.9 Standard Operating Safety Procedures . . . . . -51-
5.10 Emergency Equipment and First Aid . . . . . -52-
5.11 Phase Safety Plan and Risk/Hazard Analysis . . . . . -52-
5.12 Standard Operating Procedures, Engineering Controls, Work Practices . . . . . -52-
5.12.1 Hazard Communication . . . . . -53-
5.12.2 Lighting . . . . . -53-
5.12.3 Electrical Power . . . . . -53-
5.12.4 Elevated Work . . . . . -53-
5.12.5 Drum Handling . . . . . -53-
5.12.6 Utilities . . . . . -53-
5.13 Personal Protective Equipment/Activity Specific Levels of PPE . . . . . -54-
5.13.1 Respiratory Protective Equipment . . . . . -54-
5.13.2 Levels of Protection . . . . . -54-
5.14 Employee Exposure Monitoring/Air Sampling . . . . . -56-
5.15 Incidents/Injuries/OSHA Recordables . . . . . -57-
5.15.1 Incidents . . . . . -57-
5.15.2 Injuries/OSHA Recordables . . . . . -57-

6.0 Conclusion . . . . . -59-

Table of Contents

Tables

1	Project Points of Contact
2A	Master Schedule/Project Milestones - Phase I
2B	Master Schedule/Project Milestones - Phase II
3	List of Site Visitors
4A	Summary of Sampling/Analytical program
4B	Summary of Analytical Methods
5A	Turbidity Screen Placement Sampling and Analytical Support - Davy Creek
5B	Turbidity Screen Placement Sampling and Analytical Support - Wetland Perimeter
6A	Remediation Support Samples - Lagoon Area
6B	Remediation Support Samples - Stockpile Removal
6C	Remediation Support Samples - Stockpile and Lagoon Removal
7	Site Characterization Sampling - Lagoon Area and Davy Creek
8	Samples Collected for Offsite Analysis
9	Analytical Results for Stockpile Removal Verification Samples
10	Samples Collected for Wetlands Characterization/Verification
11	Samples Collected for Wetlands Screening Characterization
12	Split Samples Collected for Verification of Wetlands
13	Samples Exceeding Human Based Limits for One or More Analytes of Interest for Wetlands and Creek Bed Cleanup Verification
14	Samples Collected for Wetlands and Creek Bed Characterization/Verification
15	Quality Control/Quality Assurance Samples
16	Summary of Water Treatment Plant Discharge Data
17	Water Treatment Plant/Filter Press Production Chart
18	Manifest Tracking Log
19	Waste Transportation & Disposal Checklist

Figures

1	Initial Sample Locations
2A	Eastern/Wetland Perimeter to Lincoln Road Bridge Sample Pattern Overlay
2B	Wetland Area Sampling Pattern Overlay
2C	West Project Limits to Western Wetland Sampling Pattern Overlay
3	Water Treatment Plant/Support Zone Layout
4	Phase I Sampling and Analysis Decision Logic Flow Diagram

Table of Contents

Appendices

Volume II

A Final Scope of Work
B Delivery Orders/Contract Modifications
C Key Correspondences/4025 Engineering Forms
D Quality Control Daily Reports
E Daily Work Orders
F Weekly Reports/Meeting Minutes

Volume III

G Sample Collection Logs
H Analysis Request and Chain of Custody Records
I Miscellaneous On-Site and Off-Site Laboratory Information

Volume IV (3 Binders)

J Certificates of Analysis

Volume V

K Health and Safety Information
L Air Monitoring/Air Sampling Information
M Water Treatment Plant/Filter Press Daily Reports
N Manifests/Certificates of Disposal
O Miscellaneous Project Information
P Photo Documentation
Q Annotated Comments

List of Acronyms

<	=	Less Than
≤	=	Less Than or Equal To
>	=	Greater Than
≥	=	Greater Than or Equal To
Cd	=	Cadmium
CLP	=	Contract Laboratory Program
CO	=	Carbon Monoxide
Cr	=	Chromium
CRZ	=	contamination reduction zone
Cu	=	Copper
CWM	=	Chemical Waste Management
dBA	=	Decibels - A Weighted Scale
DI	=	Deionized
EZ	=	exclusion zone
gpm	=	gallons per minute
GFCI	=	ground fault circuit interrupters
H_2S	=	Hydrogen Sulfide
HCN	=	Hydrogen Cyanide
ICP	=	Inductively Coupled Argon Plasma
IT	=	IT Corporation
LEL	=	Lower Explosive Limit
MRD	=	Missouri River Division
ms/m^3	=	milligrams per cubic meter
MSDS	=	Material Safety Data Sheets
ND	=	non detect
Ni	=	Nickel
NIOSH	=	National Institute for Occupational Safety and Health
NPL	=	National Priority List
O_2	=	Oxygen
OEC	=	Oconomowoc Electroplating Company
OSR	=	On-Site Representative
PFD	=	personal floatation devices
P&ID	=	Process and Instrumentation Diagrams
PID	=	Photo Ionization Detector
PPE	=	Personal Protective Equipment
ppm	=	parts per million
SCBA	=	self contained breathing apparatus
SS	=	Site Superintendent
SSHO	=	Site Safety and Health Officer
SSHP	=	Site Safety and Health Plan
TCLP	=	Toxicity Characteristic Leaching Procedure
TLV	=	Threshold Limit Values
USACE	=	U.. Army Corps of Engineers
WDNR	=	Wisconsin Department of Natural Resources
WTP	=	water treatment plant
XRF	=	X-Ray Florescent
Zn	=	Zinc

1.0 Executive Summary

1.1 Introduction

This Final Report has been prepared by IT Corporation (IT) for the U.S. Army Corps of Engineers (USACE) Omaha District, and presents a summary of remedial operations which were performed at the former Oconomowoc Electroplating Company (OEC) in Ashippun, Wisconsin. Project field activities for Phases I, II, and III were performed during the period of June 13, 1994 (final site visit), through June 16, 1995 (final transportation and disposal of waste), and consisted of the following tasks:

Phase I

- Collected advanced samples for treatability design.
- Prepared the site for remedial activity; i.e., secured and graded the site, removed excess vegetation, delineated the support zone, contamination reduction zone (CRZ), and exclusion zone (EZ), relocated the existing perimeter fence to block a portion of Elm Street, placed administrative trailers, created a parking area for jobsite vehicles, displayed warning signs, conducted preliminary real time air monitoring, located underground utilities, collected samples of discolored soil, constructed an asphalt pad for staging materials and decontaminating equipment, and inspected/installed necessary health and safety equipment (fire extinguishers, emergency eye wash units, first aid kits, lockout/tagout center, etc.).
- Created a truck haul road (complete with full size scales) to the east of the OEC property to load vehicles, and weigh them prior to leaving the site.
- Accepted delivery, and assembled various pieces of amphibious equipment.
- Set up a mobile on-site laboratory inside a converted office trailer.
- Collected initial samples (including those for onsite XRF screening and offsite confirmatory chemical analysis) to both characterize the site, and to establish a route for the turbidity screen.
- Installed an uninterrupted turbidity screen barrier around the circumference of the remedial area, which included both Davy Creek and the connecting wetlands.
- Transported and disposed of the 2600 ton stockpile of F002/006 contaminated soil (which was generated during a previous project), and a certain amount of underlying soil.
- Demolished, excavated, and backfilled the two unlined lagoons. The solid material was also transported from the site and disposed, while the liquid was containerized for processing through the on-site water treatment plant (WTP).
- Excavated and stabilized the substantial vegetative mat, which covered the wetlands and portions of the creek. The material was transported to the asphalt storage pad, segregated

into stockpiles, sampled, loaded onto dump trailers, and shipped to a certified offsite disposal facility.

- Excavated several large tree stumps, which were located within the final delineated area of contamination. The stumps were transported to the asphalt storage pad, and shredded.

- Collected samples from select locations to verify progress, and to confirm clean areas.

Phase I activities were performed during the period of August 8 (initial site mobilization) to December 18, 1994 (final T&D of vegetation) an complied with the Final Work Plan, dated August 1994. Delivery Order No. 91, under Contract No. DACW45-90-D-9002 was originally awarded for $2,930,737 on July 21, 1994. Three modifications (P00001, P00002 and P00003), in the amount of $984,686, were issued to finance transportation and disposal of the vegetative mat (which grew considerably from the initial estimate).* Therefore, the total funded amount for Delivery Order 91 was $3,915,423.

*Modification P00001 was non-monetary and internal to the USACE.

<u>Phase II</u>

- Prepared the base of the WTP by placing stabilization fabric and stone over the entire area.

- Constructed the WTP, and placed related equipment (mix box, two filter press units, Muffin Monster, etc.) to support dredging operations.

- Performed a shakedown of WTP operations, completed repairs as necessary, and modified the system to optimize performance.

- Adjusted the various zones (EZ, CRZ, support) to compensate for changed site conditions.

- Accepted delivery, and installed two hydraulic dredge units and related equipment, and twice attempted to remove sediments from the upper portion of Davy Creek.

- Dewatered sediments with the filter press units, and treated the resulting filtrate through the WTP. The treated water (verified clean by offsite analysis) was then discharged into an approved Davy Creek location, and the filter cake was homogenized with the excavated vegetation.

- Constructed clay dikes, to hydraulically isolate the contaminated portions of Davy Creek/wetlands from the upper watershed.

- Transferred water from the upper watershed to Fireman's Park (bypassing the work zone) with large diesel centrifugal pumps.

- Dewatered the isolated portions of the creek/wetlands with large diesel pumps.

- Constructed a peat berm at the western most edge of the site, to filter creek water as it migrated downstream. A peat filter was also constructed to supplement the berm and increase capacity.

- Prepared the site for conventional excavation by installing a service (gravel) roadway along the northern bank of the upper creek, and mobilizing the necessary track equipment.

- Excavated approximately 125 lf of the upper portion of Davy Creek with the long reach track hoe.

- Dismantled the WTP and the remainder of the site, and decontaminated/disassembled amphibious/heavy equipment

- Unthawed and decontaminated the water storage tanks, discharge hoses (from site dewatering), and other miscellaneous equipment that were frozen during sub-zero weather.

- Collected samples from select locations to verify progress, and to confirm clean areas.

- Installed a grid in the wetlands and creek, and collected samples for full characterization of the site. Assistance in this task was provided by the USACE Omaha District.

Phase II activities were performed during the period of October 5, 1994 (WTP construction) through February 18, 1995 (final demobilization of Phase II field crew), and complied with the Final Work Plan dated November, 1994. Delivery Order No. 06, under Contract No. DACW45-94-D-0054 was originally awarded for $4,010,587 on September 13, 1994. One modification was issued for Phase II operations (P00001) in the amount of $95,000, to raise the total monetary award for Phase II to $4,105,587.

Phase III

- Mobilized Louisiana swamp mats, and conventional excavating equipment to the site.

- Created a sediment collection pond at the westernmost boundary of the site (near Fireman's Park).

- Loaded and disposed of the vegetation/sediments which remained on the asphalt pad from Phase II operations.

- Conventionally excavated the entire length of Davy Creek, and the wetlands. Material was stabilized on the creek bank, loaded directly into dump trailers, and transported to Envirosafe's treatment facility in Oregon, Ohio.

- Collected samples from select locations to verify progress, and confirm clean areas.

- Placed backfill (with Palms Series material) in select locations within the wetlands, and along the creek banks to restore the natural contour of the site.

- Removed and disposed of all temporary gravel roadways (approximately 19,000 tons), and restored the wetlands to near pre-remedial condition. The gravel was donated to local businesses, who provided off-site transportation.

- Installed the wetlands wells, and well pads.

- Performed an inventory of Phase I and II government property, and shipped material to IT's storage yard in Minden, Louisiana. The material was eventually bought by IT Corporation, after bids from outside vendors were determined to be insignificant.

- Removed over 6,000 lf of turbidity boom and miscellaneous debris from Davy Creek and wetlands.

- Dismantled all temporary structures, and demobilized all site equipment and materials.

- Restored the site by dressing and turfing all areas which were disturbed during project activities. Asphalt was replaced on the damaged portion of Elm Street, and in areas around Fireman's Park.

- Final drawings were provided by R.A. Smith, Inc. upon completion of project activities.

Phase III activities were performed during the period of March 6 through June 16, 1995 in compliance with the Final Work Plan dated March, 1995. Phase III was an extension of Phase II, and therefore, was also performed as part of Delivery Order No. 06. Modification P00002 in the amount of $95,000, P00003 in the amount of $2,999,885, and P00004 in the amount of $75,000 were issued to finance Phase III operations. As a result, Delivery Order No. 06 totaled $7,275,472. The total funding awarded to the project including Delivery Order 91, Delivery Order 06 and all seven modifications amounted to $11,190,895.

NOTE: A new IT field management team was assigned to complete Phase III. Therefore, the Draft Final Report for this phase was submitted under separate cover. The entire report will be blended together as well as possible, after annotated comments have been received and addressed.

The remainder of *Section 1.0* of this report discusses a brief site history, the initial project objectives and those which were completed; *Section 2.0* summarizes Phase I project field activities including initial mobilization and site preparation, lagoon demolition, removal of the existing soil stockpile, site delineation (including XRF screening, offsite analysis, and subcontracted surveying), turbidity screen placement, vegetation removal/stabilization/loadout, transportation and disposal activities, and some problems which were encountered and the lessons learned; *Section 3.0* summarizes Phase II field activities including mobilization, preparation and operation of the dredges and WTP, site dewatering, conventional excavation, total site characterization, and some problems encountered/lessons learned; *Section 4.0* summarizes Phase 3 field activities including conventional excavation of contaminated sediments, sampling and analysis, backfill operations, installation of well pads, site restoration and teardown, and transportation and disposal of all removed waste; *Section 5.0* provides a Regulatory Compliance Summary including disposal facility qualifications, manifest tracking, and other relevant transportation and disposal information; *Section 6.0* offers a health and safety/air monitoring/air sampling summary; *Section 7.0* concludes this document.

Due to the amount of data involved, the Phase I and II Final Report has been prepared in 5 volumes. In addition to the text, Volume I will also include Tables and Figures. For a complete listing of Tables, Figures, Volumes and Appendices, please refer to the Table of Contents.

1.2 Site History

The former OEC was situated on a 10.5 acre parcel of land (2572 West Oak Street) in the small town of Ashippun, Wisconsin. Ashippun is located within Dodge County and lies approximately 35 miles to the northwest of Milwaukee. The city is also within 10 miles of Oconomowoc and Watertown. The site, which is located in a light industrial/residential area, is also bordered by Eva and Elm Streets. The Ashippun Town Garage is located due east, with other small businesses to the north (on the other side of Oak Street) and occupied properties (within 200 feet) to the west/southwest.

Davy Creek, which was the focal point of the remedial investigation along with the connecting wetlands, is approximately 500 feet to the south of the OEC facility. The stream is a warm water sport fishery, and a tributary of the Rock River.

Electroplating processes at the OEC began in 1957, and involved the use of nickel, chrome, zinc, copper, brass, cadmium, and tin. Finishing processes have included chromate conversion, coating, and anodizing. The contaminants present were believed to originate from several sources, including the following: Spent process solutions, the drag out of processing baths into subsequent rinses, accidental spills, leaks, plating tanks filter systems, and sludges from the bottom of plating baths. In conjunction with the electroplating process, degreasing operations were also performed, and contributed to the wastestream. Wastewaters were divided into three categories: cyanide bearing, chromium bearing, and acid/alkaline. Prior to 1972, the untreated water was discharged directly into the wetlands, and subsequently flowed into Davy Creek. A wastewater treatment plant was constructed onsite in 1973, but several spills were well documented and the discharge permit was not renewed in 1978.

OEC also constructed two 60 ft long, by 40 ft wide, by 5 ft deep (size approximate), concrete/gravel walled, unlined settling lagoons in 1972, to store the large volumes of electroplating sludges that were generated. The sludges routinely overflowed these settling lagoons, and migrated into the wetlands.

Subsequent investigations by the Wisconsin Department of Natural Resources (WDNR) resulted in OEC subcontracting a firm (Waste Management Inc.) to remove and dispose of 1 million pounds of lagoon sludge (Circa. 1980). The lagoons were later refilled to one third capacity, categorized as hazardous waste surface impoundments, with material listed as F006 in accordance with RCRA, 40 CFR, Part 261, Subpart D, 261.31.

A CERCLA preliminary assessment was performed by the USEPA Field Investigative Team in 1983, and the site received an HRS score of 31.86, to place it on the National Priority List (NPL).

During the mid 1980's, residential wells were sampled, and monitoring wells were installed around the site (specifically near the Lagoons and Town Garage). Elevated concentrations of cadmium, nickel, zinc, 1,1-dichloroethane, 1,1,1-trichloroethane, and trichloroethylene were recorded. The USEPA's subcontracted Technical Assist Team (TAT) collected a limited amount of sediment samples from the wetlands in the summer of 1987, and high concentrations of cyanide and metals were recorded. A followup toxicity investigation was performed by the U.S. Environmental Response Team in December of 1987, and results indicated the wetlands contained severe cyanide and metals concentrations which were considered toxic to fathead minnows and algae. A partial fence was then erected by the USEPA in 1987 in front of the wetlands to minimize access to the contaminated area.

The required cleanup action was divided into four operable units (OU's), as follows:

- OU 1 included the surface water, and contaminated sludges and soils associated with the RCRA lagoons.

- OU 2 included all other contaminated soil around the former OEC facility, not associated with the lagoons or beneath the manufacturing buildings (i.e., the lowlands, the drainage ditches, and the parking lot).

- OU 3 included the contaminated groundwater associated with the site.

- OU 4 included the most highly contaminated sediments in the Davy Creek/wetlands area.

An Emergency Response Cleanup Services (ERCS) project was performed by IT at the site for the USEPA in 1991. Activities included demolishing the OEC facilities, and removing the contaminated soil from the plant property. Some activities associated with this action (i.e., transportation and disposal of the 2500 ton pile of soil) were not completed due to limited funding.

A series of acute toxicity tests were also performed during that period by IT Analytical Services (ITAS) in Edison, New Jersey with three freshwater species (the fathead minnow, the water fleas daphnia magua, and ceriodaphnia dubia). The results are included as **Appendix B** of the OEC Final Work Plan, dated August, 1994.

Three Pre-Delivery Order Site Visits were performed by the USACE/IT during 1992, to view the site, explore remedial options, solicit dredging/water treatment subcontracts, and test (bench scale treatability) the sediments to be removed. However, due to delays in resolving action limits and defining the areas of intended action, the project was postponed for approximately 2 years.

Rapid Response support was again requested of IT by the USACE Omaha, Nebraska group in a letter dated May 6, 1994 (Key Correspondences, **Appendix C**). The final Pre-Delivery Order Site Visit took place on June 13, and 14 of 1994 with the USACE (Rapid Response Group), USEPA, and IT personnel in attendance. The purpose was to re-acquaint all parties with the project, and to address any outstanding issues.

The first Delivery Order (No. 91) (**Appendix B**) was issued on July 21, 1994, and field work began on August 8, 1994.

1.3 Project Objective

The former OEC had performed electroplating operations in Ashippun, Wisconsin for approximately 30 years. The sludges and other wastes generated during this timeframe were mismanaged, and subsequently discharged into the adjoining wetlands area. As a result, the contamination migrated outward, and eventually into Davy Creek.

The primary objective of this Rapid Response Delivery Order was to remove the source and existing contamination, thereby protecting both human health and the ecology. Intended action items were as follows:

- Complete the disposal of the large stockpile of F006/F002 soil, which was generated during the previous project. The plastic covering had deteriorated, and the material was basically not secure.

- Remove the unlined lagoons, which were considered a primary source of contamination.

- Delineate the contamination in the wetlands and creek.

- Secure the site, and prevent further migration of contamination downstream.

- Remove and dispose of the vegetative mat.

- Remove and dispose of 1 to 2 feet (on average) of contaminated sediments.

- Verify conditions through selective sampling procedures.

- Backfill portions of the remedial area (mainly the wetlands) to it's original contour.

1.4 Completed Objectives

IT performed three phases of work at the former OEC over a ten month period (actual field work), which spanned two Rapid Response Contracts, and two Delivery Orders. The source, and residual contamination were removed and disposed, and the following tasks were accomplished:

<u>Phase I</u>

- Installed temporary facilities to support field operations.

- Loaded, and disposed approximately 4664 ton of contaminated soil from the original stockpile. This total included material that was excavated from beneath the pile.

- Loaded, and disposed approximately 75 ton of concrete, and 676 ton of sediments from the two existing lagoons. Approximately 50,000 gallons of water was also containerized, and subsequently treated through the onsite WTP.

- Collected and submitted approximately 555 samples for XRF screening to delineate the site. In addition, approximately 260 samples were sent for offsite confirmation analysis.

- Installed approximately 6,400 linear feet of turbidity screen, to secure the work zone, and contain suspended solids.

- Excavated, stabilized, and loaded approximately 8304 ton of vegetation and sediments (which were attached to the root mass).

Phase II

- Installed two different hydraulic dredges, and various equipment (including discharge hose, cable systems, a chopper pump, a screen box, and two filter press units). Both dredges were relatively ineffective, and only 56 cubic yards of solid material (quantity approximate from filter press production charts) was removed.

- Constructed a fully operational WTP, to treat filtrate generated by dredging operations. Approximately 1,200,000 gallons of water was treated and recycled, and subsequently discharged 580,000 gallons back into an approved location of Davy Creek.

- Installed clay dikes, and dewatered portions of Davy Creek.

- Collected 575 samples (including Q/C samples), and submitted them to a local offsite laboratory for total characterization of the site.

Phase III

- Excavated (by conventional means) and disposed approximately 7,500 cy of sediments from the creek and wetlands.

- Placed approximately 2,500 cy of palms series backfill, to restore the original contour of the creek bed.

- Performed selective sampling to insure the cleanup goals were met.

The following sections of this report provide details to each task listed above.

2.0 Phase I Project Review

2.1 Initial Mobilization and Site Preparation

The project field crew was mobilized to the site on August 8, 1994 to perform the first phase of work. Personnel were assigned from various IT regional offices, and heavy equipment/materials were obtained from the best available source.

The initial activity was to prepare the support zone for remediation. The former OEC property, which was located between Elm and Oak Street was selected for this purpose. The property was surrounded by chain link fence, but was found to be in below average condition for the intended use. The site was overgrown with vegetation, the base was rutted and uneven, the 2,500 cubic yard pile of soil was uncovered/unsecured (the plastic sheeting had deteriorated from the ultraviolet rays of the sun, and changing weather conditions), and stained soil was observed in several locations.

Initial real time air monitoring was performed by the Site Safety and Health Officer (SSHO) prior to beginning site preparation activities, to establish a background profile, and to make certain the atmosphere was suitable for Level D operations.

The weeds, which ranged from 2 to 4 feet high in spots, were mainly concentrated around the lagoons, along the perimeter fence line, and near the proposed office trailer compound. Technicians cut the vegetation with hand sickles and gas powered weed whackers (photo documentation, **Appendix P**). The material was then raked/graded to an "out of the way" location, and allowed to naturally decompose.

A D4H bulldozer was then used to surface grade the rough spots, and strip the remaining vegetation. As grading was being performed, some metal debris was uncovered with the blade of the dozer. From that point onward, precautionary means were employed to make certain the underlying soils were not disturbed. A layer of geotextile cloth/rubber roofing material was laid on the ground (near West Oak Street), and covered with a lift of 2B gravel to create a base for the administrative trailers and parking lot (**Figure 3 - Site Layout**). Five trailers were mobilized to the site, as follows: One 10' x 32' USACE office, one 10' x 48' IT office, one 10' x 32' storage trailer/modified laboratory, one 10' x 32' break trailer, and one shower/decon unit. The USACE office trailer was later replaced with a 12' x 60' unit, which was shared by the USACE and IT management. At that same time, the IT office trailer was converted into a WTP operations trailer. All units were blocked, leveled and anchored, and local subcontractors were utilized to connect power/telephone service.

A layer of 6 mil poly sheeting was also placed over the soil stockpile (and anchored), and caution tape was hung on metal "T" posts around the circumference of the lagoons. Monitoring well risers were spray painted orange for easy visibility, and samples were collected from stained soil for evaluation purposes. The samples were screened by the on-site X-Ray Florescent (XRF) instrument, when calibration of the unit was complete. For a listing of results, please refer to **Table 7** of this document.

The chain link fence surrounding the OEC property was removed along the northern side of Elm Street, and the eastern/western sections were used to block vehicular/pedestrian traffic from entering the site. The Ashippun Town Chairman was very helpful and provided proper road warning signs and assistance in re-routing traffic. In addition, flashing barricades were stationed in key locations along the roadway.

A haul road for disposal trucking was constructed along the eastern side of the site (next to the Town Garage) by placing stabilization cloth and large (2 to 3 inch) stone to bridge the marshy areas. The entire surface was graded and topped off with crushed road base to complete this effort (photo documentation). A full size set of truck weigh scales were then mobilized to the site and set up on the northern end of the haul road by IT technicians, using a subcontracted crane service. Stone ramps were created on both ends of the scales for easy access, and a local vendor was subcontracted to properly calibrate the units.

A temporary equipment decontamination (decon) pad was constructed near the personnel decon trailer, and served the project until the asphalt pad was completed. A depression was excavated into the ground with the D4 dozer, and native soils were used to create four (4) earthen berms. The 30' x 30' pad was then covered with a double layer of 6 mil poly, which was anchored with sand. Sand was also used in the base to support equipment and protect the liner during deconning procedures. As an added precaution, side walls were created with plywood and 6 mil poly sheeting to contain overspray. Decon operations were initially performed with a 2000 psi cold water wash unit, and later converted to a hot water wash (Hotsy).

Amphibious (swamp buggy) equipment was mobilized from Louisiana as follows. One amphibious excavator, one amphibious personnel carrier (a second was added later in the project), one amphibious dump buggy and four pontoons. The vendors which supplied this specialized machinery were Wilco Marsh Buggy's and Marsh Buggy's Incorporated. The amphibious excavator arrived in pieces (for shipping purposes) and was assembled on-site (Elm St.). A 70 ton crane, from Dawes Rental Company was mobilized, and vendor mechanics were assisted by IT personnel to complete this task in a safe manner. Proper lifting/rigging devices were utilized, and assembly was performed without incident.

The XRF instrument and sampling equipment was shipped to the site (via box van), and the modified trailer/laboratory was prepared for onsite soil screening.

2.2 Lagoon Removal

The two 30 foot by 40 foot lagoons (size approximate) were constructed with a concrete wall dividing one side from the other, and a metal walkway attached to the top (for access by workers). Two adjoining walls were made of concrete, while the others were made of gravel and compacted earth.

To prepare the work zone for demolition activities, the surrounding parcel of land was stripped of remaining vegetation with the dozer, and the integrity of the soil was tested with heavy equipment to insure its stability. A CAT 325 excavator was used to remove the walkway, and to excavate/stabilize the bottom sludges.

The walkway was unbolted, and relocated a safe distance from the lagoons. Dismantling was then performed by technicians using an acetylene/oxygen burning torch. A safety standby man was positioned with a fire extinguisher and/or charged water hose, and hot work permits were issued by the Site Safety and Health Officer.

A sump was created in the sludge, a two inch centrifugal trash pump was positioned on the north wall, and surface water was pumped from the impoundment into a 21,000 gallon frac tank. This task was performed on a continual basis as water (suspected groundwater from a perched aquifer) seeped into the pit, and interfered with excavation and demolition activities. Approximately 50,000 gallons (1,600 gallons was originally estimated) were pumped into three tanks throughout the duration of this operation.

Sludge stabilization was performed in the base of the lagoon, by using the bucket of the 325 to homogenize the material with bulk kiln dust. A dust staging cell was created within reach of the 325, and material was grabbed when needed. The equipment operator worked from west to east, and occasionally entered the pit to reach unaccessible locations (photo documentation). The sidewalls were sloped, and a ramp was also developed for safe entry. Excavation progress was verified by onsite XRF laboratory results. The stabilized material was stockpiled in the southeastern corner of the pit, and plastic sheeting was used to protect it when inclement weather was forecast. When a sufficient quantity of material was generated, the stockpile was sampled, aliquots were submitted for offsite analysis, and the material characterized for disposal.

A straight edge was then welded to the bucket of the excavator, and a final scraping of the base was performed.

A temporary roadway was then constructed through the site to accommodate disposal trucking. The road was created by using stabilization cloth and 2B modified gravel. The F002/F006 material was loaded directly onto the subcontracted dump trailers with the excavator, for transport to Envirosafe Services Treatment Facility in Oregon, Ohio.

NOTE: A test load was sent to Envirosafe, prior to initiating full scale T&D operations.

As work progressed to the east, a staging cell was created for the sludge, and positioned adjacent to the excavation. A double layer of 6 mil poly sheeting was laid on the ground, then bermed and anchored. The stockpiled material was covered on a daily basis. A front end loader was later used to load this material onto the dump trailers. The concrete sidewalls were left in place during stabilization and excavation of the base for added support of heavy tracked equipment.

The concrete was then demolished with a 219 Extendahoe, equipped with a 2000 ft/lb hydraulic ram attachment. The 325 excavated the broken pieces, and placed them in the bucket of the 966 wheel loader, for transport to another cell (similar to the sludge cell) for further dismantling. Rebar, which protruded from the concrete, was cut by technicians using a burning torch. Strict hot work procedures were again incorporated and followed.

Coordinating cost effective transportation and disposal of the concrete debris took longer than anticipated. As a result, the material was transferred from the staging cells into 20 cubic yard rolloff containers, and moved to an "out of the way" location next to the asphalt staging pad. This allowed for uninterrupted construction of the WTP, which began during this activity. Final disposal was at Chemical Waste Management's secure landfill in Fort Wayne, Indiana.

The disposal facility stipulated that the concrete pieces be no larger than 18 inches in any dimension. However, some large pieces were mixed in with the loads, the material was returned to the site and demolition was subsequently performed again. For additional details, please refer to Problems Encountered, in *Section 2.6* of this report. A sample of the concrete dust was submitted to the onsite laboratory for XRF screening, prior to offsite analysis.

When concrete removal was complete, one foot of stained soil was excavated from the sidewalls around the circumference of the lagoons, and confirmation samples were collected from the base and lower walls of the excavation. The excavator bucket was decontaminated, and used to collect the samples. Therefore, personnel confined space entry was not required. Samples were collected from the center of the bucket and did not come in contact with any portion of it at any time. For sample results, please refer to **Table 6C** of this document.

The bottom of the pit was sandy, and very soft from groundwater penetration. Therefore, prior to initiating fullscale backfill activities, plastic geo-grid fabric was placed, and the base was bridged with several lifts of number 5 course rock. The stone was compacted in place with the bucket of the excavator. Imported random fill was then spread in 6 inch lifts, and track compacted (85% nominal compaction) with the D4 dozer. Compaction testing was not required in this instance.

Finally, the staging cells were leveled, and the area was graded to prepare for WTP construction.

2.3 Soil Stockpile Loadout

The existing pile of F002/F006 soil was loaded onto dump trailers with the 966 wheel loader, and transported to Envirosafe's Oregon, Ohio, treatment facility. Trucks were weighed with the on-site scales to document the amount of material removed, and to make certain the vehicles were in DOT compliance. To prepare for this activity, a section of cyclone fence was removed (along the eastern boundary of the site), and a ramp was created to access the haul road.

A certain amount of underlying soil was also contaminated, and was excavated with the loader to a depth of 1 foot (north), and 4 feet (south), to remove remaining debris and stained soil. The base became extremely soft as operations continued and the excavation deepened. Maneuvering with the wheel loader became very difficult. Therefore, the activity was completed with the trackhoe.

An IT technician was assigned to process the manifests, while bowing/tarping activities were initially performed by the truck driver. Later in the project, this task was performed by IT technicians to comply with strict on-site health and safety policies.

Operations were again guided by results generated from the onsite XRF laboratory. Confirmation samples were then collected, and submitted to Weston Laboratories for metals, cyanide, and volatiles analysis prior to backfilling (**Tables 6B and 6C**). Soil was then imported from an off-site source, and spread in 6 inch lifts (in the deeper end) with the dozer, to bring the excavation back up to grade.

Finally, crushed gravel was imported and spread over the entire backfilled area. The parcel of land was also sloped somewhat to prepare the base of the asphalt storage/equipment decontamination pad. The stone was spread in lifts with the dozer, and compacted with a CS433B vibratory roller/compactor. Compaction testing was not required for this activity either.

The 100 ft by 270 ft pad* (with curbing) was then installed by C&D Construction, a local asphalt subcontractor. A 4' wide x 6' long x 3' deep water collection sump was also positioned on the southwestern portion of the pad, to collect stormwater and water from equipment decon operations. This material was periodically transferred with an electric sump pump to the pretreatment storage tanks, and subsequently processed through the WTP.

Note: *A change in pad dimensions (from 150' x 180') was necessary to accommodate existing site conditions.

2.4 Vegetation Removal

The wetlands, and portions of the creek were overgrown with a vegetative mat when the project was mobilized in early August. This thick material consisted primarily of cat tails, trees, and swamp grass. Some larger tree stumps were also encompassed within the boundary of contamination, which expanded significantly during XRF screening/site characterization (*Section 2.5.8*). When analytical results were received, a swath of vegetation (considered clean) was removed and cast outside of the remedial area, to create a 5 foot buffer zone (from the contamination), and eventual route for the turbidity screen.

The remaining material was then removed and transported to the asphalt storage pad for stabilization and disposal.

2.4.1 Material Handling/Stabilization

Vegetation was removed from the creek and wetlands with an amphibious hydraulic excavator, with support from an amphibious personnel carrier a hydraulic dump buggy, several pontoons, and the long reach excavator (stationed on the shore at Elm Street).

Prior to initiating full scale removal activities, equipment operators were trained on the safe operation of each individual piece by the respective vendors (Marsh Buggies Inc. and Wilco Marsh Buggies). In addition, the four small barges were prepared for operation by lining them with rubber roofing material, and canopy's were added to the personnel carriers to shield the field crew from the sun.

The pontoons were attached to the personnel carrier by a wire cable, towed to the excavation area, and dropped for loading. The excavator operator then loaded the barge, as the personnel carrier picked up a second barge and towed it into place. Holes were cut into the bucket of the excavator to drain as much water as possible. The full barge was then picked up by the personnel carrier, and transported to a designated area in the wetlands, where it was dumped by the long reach excavator for gross dewatering. A third barge was transported to the excavation area while unloading was being performed, and the cycle was repeated. The fourth barge was used for spot duty, and to transport equipment (pumps, hoses, etc.) and materials to the work zone.

This was a slow and cumbersome operation for the following reasons;

- To remain buoyant in the shallow water, the pontoons could only hold a maximum of three buckets of material. Therefore, additional trips were required. This became very time consuming as operations moved further away from the wetlands.

- Towing the barges with the cables was tricky, and the personnel carrier had to negotiate difficult turns to remain within the turbidity screen. Some portions of Davy Creek were very narrow, especially near Lincoln Road Bridge. As a result, the equipment could only operate at half throttle within the work zone.

- Dumping the barges was awkward with the long reach excavator. Several ideas were explored (welding lifting lugs, modifying the hull, etc.), but abandoned due to time constraints, and unwillingness of the vendors to have the equipment modified.

Operations did improve somewhat when an amphibious vehicle, equipped with a hydraulic dump bed, was provided by Wilco. However, the container mounted on top of the machine was small, and excessive trips were still required. Conveyor systems, and other means of moving the material was explored extensively, but none were deemed cost effective or practical.

When a sufficient stockpile (for gross dewatering) was generated, a second was started. The first stockpile was then cast directly onto the asphalt storage pad with the long reach excavator. Dolimetric kiln dust was imported (in bulk) and homogenized into the material by mixing it with the 966 wheel loader and a grappler. The dried material was segregated into 250 cubic yard stockpiles (size approximate) with the loader, to await disposal. A sample was collected from each stockpile, and analysis for total and amenable cyanides was performed to make certain it met with treatment criteria (material was required to be below 540 ppm total cyanide and 30 ppm amenable cyanide). Approved material was then loaded onto dump trailers (provided by Wills Trucking and Jack Grey Transport) with the wheel loader, and transported to Envirosafe's Services Facility in Oregon, Ohio (Regulatory Compliance Summary, *Section 5.0*). An average of 25 trucks per day were loaded and processed at the site.

Trucks were again weighed on-site during this operation, and information was documented and kept on file. A two/three man team was assigned to vegetation T&D operations to organize paperwork, remove/replace bows, and tarp the trucks. Portable scaffolding, complete with crossbows and toe plates, was erected on both sides of the road to create a chute for the trucks, to expedite operations. Proper safety gear was worn by personnel who were working from elevated surfaces.

During vegetation removal, several large tree stumps were excavated with the amphibious track hoe, and transported to the wetlands by barge. A shredder was mobilized from IT's equipment yard in Minden, Louisiana, and positioned on the southeast corner of the pad. Power (240 volt, three phase) was provided from the WTP area to the unit by Steve's Electric. The stumps were cast onto the pad with the long reach, and subsequently fed into the shredder with the grappler (photo documentation). The resulting sawdust was then utilized as a stabilization media.

The quantity of removed vegetation almost doubled, from an original estimate of 3,900 cubic yards, to over 6,000 cubic yards. This was due in part to the expanded area of contamination, the sediments which were attached to the root mass, the stabilization media, and the fact that the material was not composted (due to unfavorable weather conditions) as originally planned.

2.5 Phase I Sampling Program - Site Delineation and Characterization

One of the main objectives of Phase I was to determine the surface extent of contamination by instituting a sampling and analysis program to quantify the indicator metals: chromium (Cr), copper (Cu), nickel (Ni) and zinc (Zn). Following the delineation of metals contamination, a turbidity screen was then installed around the contaminated areas to isolate them for excavation (Phase I vegetation removal and Phase II sediment removal). The turbidity screen placement was targeted to cover two main site areas:

- South of Elm Street, around the wetland perimeter area defined from the location of OEC's former wastewater treatment plant outfall piping.
- Upstream (east) and downstream (west) of this perimeter area along the Davy Creek bed, from the Lincoln Road bridge on the easternmost end, to the boundary of the federal Superfund project area (Fireman's Park) on the westernmost end.

Additional remediation support samples were also collected and analyzed to confirm completion of the Phase I lagoon closure and soil stockpile removal activities, and from a stained area adjacent to the former lagoons (to ensure that this area was free of contamination prior to mobilizing and staging support zone equipment).

2.5.1 Sampling Methodology

The Phase I soil sampling program consisted of collecting surface soil or sediment samples from a depth of approximately 0-6" below the surface, using a hand auger or split spoon sampling device. Davy Creek bed sediment samples were collected from the uppermost 0-6" subsurface layer of sediment deposits. For all collected samples, the depth of sample take was recorded as well as the depth below surface water (when applicable) on the Sample Collection Log. Copies of these log forms, showing the sample location/identity, sample number, type of sample, depth of take, and other pertinent details and observations made during the collection, is included in **Appendix G.**

Initially, samples were collected only at the surveyed sample points, until analytical data from those samples were reported and reviewed. If additional samples were required, the samples were retrieved at 12.5 foot intervals from the original sample point, in a uniform direction either away from the OEC site (given an exterior or "E" designation) or towards the site (and given an interior or "I" designation). Sampling, and on-site/off-site analyses continued in this manner at 50' intervals around the wetland perimeter south of Elm Street, and linearly upstream/downstream in the Davy Creek bed, until the site perimeter was delineated as clean or contaminated.

Collected soil samples were stored in a designated cooler from the time of collection until transport to the on-site laboratory. At the laboratory, the sample receiving technician would accept custody of the sample, and assign a unique laboratory sample number before preparation. An aliquot of the received sample was removed for preparation and analyzed for the target metals: chromium, copper, nickel, and zinc, using XRF spectrometry. Raw XRF data printouts were reviewed by the XRF technician and the senior chemist, and reported to the sample and analysis coordinator, who also reviewed the data. The coordinator then recorded the data into the Phase I sample database, and the results were compared to ecological and human health-based action levels. If the XRF reported concentrations for the target metals exceeded the ecological-based action limits, then the samples were placed in archive cold storage, and additional sample locations were identified to the sample collection team. If the results indicated that the concentrations were less than the action limits, then the corresponding samples were packaged and shipped to the Weston Gulf Coast Laboratory (Weston) in University Park, Illinois. The confirmation analysis for target metals: cadmium, chromium, copper, nickel, and zinc used Inductively Coupled Argon Plasma spectrometry (ICP) by U.S. EPA Method 6010/Contract Laboratory Program (CLP) protocol (Inorganic Statement of Work 03/90, ILM 03.0). Cyanide was also determined by using calorimetric titration by U.S. EPA Method 9010. When reported from the off-site laboratory, the sample coordinator completed his initial review. The data were then recorded in the Phase I database, and compared to the action limits. If the data from off-site agreed with the XRF screening results, and the concentrations reported were below the action limits, then the sample location was considered to be "clean." However, if the results indicated that the sample concentrations were above the action limits, then the sample point was considered contaminated, and additional sample locations were identified and sampled for further off-site analysis.

When the entire data set for a given area was complete and the extent of contamination defined, a survey stake marking the interior and/or exterior "clean" sample location was painted in fluorescent green. Green stakes were then used by the crew on the amphibious excavator to cut a swath through the vegetation for the turbidity screen installation. Areas inside the turbidity screen were considered contaminated and slated for removal.

Confirmation of the lagoon closure and soil stockpile removal was performed by setting up 25′ sample grids, and collecting a single sample from the center point of each grid area. These samples were collected from 0-6" depth and submitted to the on-site laboratory for field screening with the XRF. Human based action limits, were used instead of the ecological based action limits to compare the XRF data, and determine where further excavation was needed. Re-sampling was performed until the sample concentrations were below these action limits. Select samples were submitted for off-site analysis, which included metals, cyanide, and volatile organic analysis for 1,1-dichloroethane, 1,1,1-trichloroethane, and toluene.

2.5.2 On-Site XRF Screening

A standard operating procedure (SOP) for the preparing and analyzing soil samples was prepared by Quanterra Environmental Services (Quanterra) of Knoxville, Tennessee from the manufacturer's operating instructions and site-specific operational criteria. A copy of this SOP is included in **Appendix I** of the OEC QAPjP which was submitted to the USACE in August 1994. The method is briefly described in this section.

Sample preparation consisted of drying the sample aliquot in an aluminum weigh pan at 115°C until friable, followed by crushing and sieving the sample through a fine mesh screen. Approximately 10 g of dried, sieved sample was then transferred into the XRF analytical cup, and the sample ID was recorded on the outside of the cup with an indelible marker.

The XRF instrument, a Spectrace model 6000, was initially calibrated on-site using site specific soils as specified in the Quanterra Calibration Report, which included in **Appendix I.** Instrument drift from this initial calibration was checked at the beginning and the end of each day of analysis by analyzing select calibration standards, and comparing the daily values to the reference values. Once the instrument calibration was checked in the morning, the XRF analyst would insert each prepared sample cup into the detection chamber of the instrument, and run the analytical program on the instrument's controlling computer. The computer monitored and recorded the pertinent instrument variables, and gathered the sample data. The quantitative result for each analyte was calculated by the computer, which measured the sample response against the linear calibration curve plotted for each targeted element. The results for each element were reported on the summary analysis report printed at the end of each single-sample analytical run. The XRF analyst would review this report, and attach his quantification summary cover page to the raw data. This cover page would then summarize the concentration for each targeted analyte in units of mg/Kg for the analyzed sample. A second level review by the senior chemist was performed before the results were released to the sample and analysis coordinator.

2.5.3 On-Site XRF Quality Assurance Program

In addition to the daily instrument calibration checks, the method was also subject to accuracy and precision checks. These included duplicate analyses, the analysis of field duplicate samples, and split samples sent to the Weston Laboratory. Accuracy and precision were calculated and monitored by the sample and analysis coordinator and the senior chemist in the field, as the QA/QC data were reported and found to be within an acceptable range.

One significant deviation from the anticipated performance of the XRF instrument was observed for the target element nickel. Due to the XRF detection method, iron (Fe), a common earth element which generally had a natural high concentration in the OEC site soils, produced an analytical interference with nickel. The practical result of the interference was that the method detection limit for nickel was elevated to approximately 190 mg/Kg, which is significantly above the nickel ecological based action level of 54 mg/Kg. The implication of this interference was for soils that were reported by the XRF analysis to be below the action level for chromium, copper, and zinc, and reported as below detectable limits (or "ND") for nickel. Confirmation analysis by the off-site laboratory was necessary to verify that the nickel concentration was less than the 54 mg/Kg action limit.

The instrument manufacturer, Spectrace, was contacted to assist in resolving the interference problem. Via modem, they examined the instrument data stored on the XRF computer, and made the recommendation to pull the instrument off-line, ship the detector to their facility in Denver, Colorado, and permit them to install an analytical signal filter. This component would reduce the iron signal strength relative to the nickel signal, which would lower the nickel detection limit. This option was not selected, however, as instrument downtime would have resulted in a three to four week delay in site delineation and turbidity screen installation, and the cost of the service was prohibitive. As an alternative, samples which were analyzed by the XRF and found to be below the chromium, copper, and zinc action levels, and below the detection limit for nickel, were chosen for off-site analysis.

2.5.4 Offsite Analysis

As a result of the nickel interference problem, the sample and analysis coordinator identified the samples from the analytical database that were screened by the XRF to contain less than the action level for chromium, copper and zinc, and a less than detectable concentration for nickel (i.e., typically 190 mg/Kg). These samples were removed from archive cold storage, and prepared for shipment to Weston. Sample shipment from the field to the laboratory occurred via overnight courier service, under custody, using a computer generated version of IT's Request for Analysis/Chain-of-Custody (RFA/COC) form. These forms included a complete sample inventory of each shipment and the requested analysis program. Immediately before shipment, the COC portion of the forms were signed by the sample and analysis coordinator (or his designee), to release the custody of the samples from the field personnel to the laboratory. The samples were submitted for ICP analysis for the target metals: cadmium, chromium, copper, nickel, and zinc. Cyanide (CN) was also quantitated by calorimetric titration analysis. Three volatile organic compounds: 1,1-dichloroethane, 1,1,1-trichloroethane, and toluene, were quantitated by Gas Chromatography/Mass Spectrometry (GC/MS) on lagoon closure and soil stockpile samples.

Upon receipt of the samples at Weston, the laboratory receiving personnel reviewed the contents of each shipment against the RFA/COC form to verify that all of the samples arrived and were in acceptable condition. They then signed the custody portion of the form acknowledging sample receipt. Copies of the signed RFA/COC forms are included in **Appendix H**. The receiving personnel next assigned a laboratory sample number to the received sample, logged the sample and its requested analytical program into the sample tracking system, and notified the laboratory project manager that the samples had arrived. Off-site analyses for Phase I samples were always requested with an accelerated data turnaround (usually 24 - 48 hours from receipt), to have the confirmation data available to support the on-site sampling program.

Sample preparation consisted of the acid digestion of a sample aliquot using U.S. EPA Method 3010 for soils, or 3050 for sediment samples. Microwave-assisted acid digestion (Method 3015 for soils or 3051 for sediments) was also employed to expedite sample preparation. Digestates were then analyzed by ICAP using Method 6010 for the target metals. A separate aliquot of the sample was prepared by Method 9013, and analyzed for total and amenable cyanide by calorimetric titration, using Method 9010. Volatile analysis was performed on selected soil samples from the lagoon closure and soil stockpile removal using GC/MS by U.S. EPA Method 624. The data were internally reviewed and reported by laboratory personnel. The data were sent via electronic facsimile to the site, and the sample and analysis coordinator input the reported data into the database for summarization and tracking. Off-site analytical data were compared to the ecological and human health based action limits, and the sample location was determined to be "clean" or contaminated.

2.5.5 Offsite Laboratory QA/QC Program

Internal method requiring QA checks were performed on all samples submitted for off-site analysis. These checks included calibration, duplicates, matrix spike, surrogate spike, laboratory control sample analysis, and laboratory blank analysis. The results from these checks are documented in the Weston analytical data summaries included in **Appendix J**. This QA/QC data were reviewed by the analyst, the peer reviewer, and the project manager before reporting to verify that the data fell within acceptable levels. Data which were outside these targets were flagged by the laboratory and discussed in the case narrative of each data report.

2.5.6 Subcontracted Surveying

Initially during Phase I, the surveying and architectural firm of R.A. Smith and Associates of Brookfield, Wisconsin were contracted to setup, measure, and mark both the perimeter area and the Davy Creek bed with sample location reference points. The wetland perimeter area was demarcated into a 25′ foot interval sample grid pattern, and node locations along the north, south, east edges of the perimeter were marked at 50′ intervals. These locations were designated using a combination of alphabetical and numerical values, depending on the north-south and east-west coordinates as shown on **Figure 1,** and as specified in the Final OEC Contractor Sampling and Analysis Plan (CSAP). Also along Davy Creek, sampling locations at 50′ intervals were identified and marked by the surveyors. Davy Creek locations were given the prefix "CK-", followed by a sequential numerical designation from CK-02 to CK-78 in even numbers, representing the 50′ (not 25′) intervals as described in the CSAP. Additional numbers were needed by the survey team to complete the downstream numbering of the creek bed to the western boundary of the site. Therefore, the surveyors began numbering these locations as CK-02′, CK-04′, etc., to CK-24′ at the westernmost terminus of the site. The original surveyed sample locations are shown on **Figure 1**.

These surveyed intervals represented the starting point for determining the extent of contamination. Initial samples were collected at each of these staked locations and, depending on the results of that sample, additional samples were collected either interior (towards the OEC site) or exterior (away from the OEC site) until sample results were below the action limits. The concluding sampling points (both interior and exterior for Davy Creek locations) were surveyed and marked on a map to define the route for the turbidity screen, as shown on **Figures 2A, B, and C**.

2.5.7 Turbidity Screen Placement

Sample results from on-site and off-site laboratories were tracked with the Phase I analytical database. This data was sorted and printed in summary form to allow the screen placement crews to identify the clean and contaminated sampling points, and dig the support trenches necessary for installation of the turbidity screen. Once the screen was placed, the extent of contamination was defined as within the screen. **Figure 2 (A, B, and C)** shows the final installation location for the completed screen. Sample results have been tabulated, and are included as **Tables 5A and 5B**.

The turbidity screen was a Marafi 18 ounce fabric, provided by American Boom and Barrier. The curtain was manufactured in 100 foot sections, and was impermeable in nature. The plastic like fabric was fitted with 6 inch floatation devices on top to provide ballast, and a 1/4 inch chain on the bottom to keep the screen in contact with the creek bed sediments.

The screen was transported from the staging area on Elm Street, to creek/wetlands locations on the amphibious personnel carrier and/or pontoons. A swath was cut in the vegetation with the amphibious excavator, and the fence was placed 5 feet away from the designated clean sample point (to provide an adequate buffer zone). The fencing was installed by hand, and attached to trees, shrubs, and other fixed objects within the creek and wetlands. When necessary, fence posts were driven into the sediments with a sledge hammer. In all instances, nylon rope was utilized as a fastener. Grommets were also installed, and the ends of each section of fabric were laced together to provide additional containment. The 4-5 foot high screen proved to be oversized in most locations, but did serve the intent and purpose of the scope of work.

Turbidity screen installation proved to be a slow process as work was performed in hot August weather, and technicians had to lean off of the amphibious machine to perform the tedious work. Work progressed as the plume of contamination was defined by the onsite sampling staff. The operation was an intermittent activity, and took 24 days to accomplish.

2.5.8 Discussion of Results - Phase I

The Phase I database has been organized into six separate tables for presentation in this final report:

- **Table 5A** shows the on-site and off-site metals and cyanide data from Davy Creek samples, which were collected in support of the turbidity screen placement.
- **Table 5B** shows the on-site and off-site metals and cyanide data from the wetland perimeter area samples, which were collected in support of the turbidity screen placement.
- **Table 6A** shows the on-site and off-site metals and cyanide data from the lagoon closure samples, which were collected in support of that remedial activity.
- **Table 6B** shows the on-site and off-site metals and cyanide data from the soil stockpile removal samples, which were collected in support of that remedial activity.
- **Table 6C** shows the off-site volatile data from the lagoon closure and soil stockpile removal samples, which were collected in support of those tasks.
- **Table 7** shows the on-site metals data from general site characterization samples, which were collected to confirm site support zone areas and perimeters were free of contamination (to address health and safety concerns).

As these tables indicate, approximately 555 total samples were collected; 518 samples were analyzed on-site with the XRF instrument, and 260 samples were analyzed by Weston Laboratory for confirmation.

Table 5A results show that in Davy Creek locations upstream of the wetland area, metal contamination was mostly limited to the creek bed sediments, and little contamination was found in the outlying areas to the north and south of the upstream creek bed. West of the wetland perimeter and downstream however, a wider area was impacted by the general broadening of the creek bed. Metals contamination in some low lying areas was above ecological limits at distances greater than 100 feet from the original surveyed "CK" location stake. At location CK-26, near the northern intersection of the wetland perimeter and Davy Creek, the highest concentration of target metals screened by the XRF were collected, with chromium ≥ 7,200, copper ≥ 6,700, nickel ≥ 8,000, and zinc ≥ 12,500 mg/Kg detected in one sample.

Table 5B shows that for the wetland perimeter, the area of highest contamination was limited to the area immediately south of Elm Street, near the original outfall pipe location. Location C1, adjacent to the outfall pipe, recorded the highest concentrations in this area, with chromium ≥ 4,400, copper ≥ 3,000, nickel ≥ 6,400, and zinc ≥ 5,500. Along the western and southern edges of the perimeter, the concentration was distributed over the widest area, with some locations above the ecological action limit at distances greater than 100 feet beyond the original marked location. On the eastern and northern perimeter, contamination seemed to be more localized, indicating that the wetland metals contamination plume was effected by the general flow (east to west) of Davy Creek.

Figure 1 illustrates the original surveyed locations before sampling, **Figure 2 (A, B, and C)** show the final turbidity screen placement location based on the data presented in **Tables 5A and 5B.**

Data from **Tables 6A** through **6C** were used to provide immediate remediation support. As the data show, some results were higher than the ecological based action limits, but below the human health based action limits. Decisions made to continue or terminate excavation based on these data are documented in the Field Activity Daily Logs, and discussed elsewhere in this report.

Table 7 shows the results from samples collected in the support zone and below the Lincoln Road bridge in Davy Creek. These results indicate that the none of these areas were greater than the human health based action limit. Only one sample below the Lincoln Road bridge showed contamination greater than the ecological based action limit.

2.5.9 Phase I - Analytical Review

The Phase I analytical program consisted of on-site screening for Cr, Cu, Ni, and Zn by XRF spectrometry, and off-site analysis for Cd, Cr, Cu, Ni, Zn, and CN^- by ICP methods for the metallic analytes, and CN^- by calorimetric titration. Screening services were provided by the Field Analytical Services Group of Quanterra Environmental Services from Knoxville, Tennessee. The XRF analysis was performed in accordance with the SOP, and is based on the method specified by the instrument manufacturer, Spectrace Instruments, Inc. of Denver, Colorado.

Weston Laboratory, located in University Park, Illinois, is a unit of Roy F. Weston Environmental Engineering, approved off-site chemical analysis. Weston employed standard USEPA methods taken from the document, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, SW-846, November, 1986 (and updates) and the CLP SOW (03/90 ILM 03.0).

2.5.10 Phase I - Remediation Support Analysis

Lagoon closure and soil stockpile samples were collected and analyzed by both on-site and off-site laboratories for the same list of target metals as the turbidity screen placement samples, including cyanide and volatile organic compounds.

2.5.11 Decision Logic - Phase I

Data generated from the field sampling team, the on-site analysis laboratory, and the off-site laboratory were reported to and managed through the sample and analysis coordinator. The coordinator accepted and reviewed the data, summarized the data into the Phase I database, and sorted and compared the reported data to the ecological and human health based action limits. The sample results were summarized visually on a color-coded scaled site map, noting the sample location and whether the concentrations exceeded the action limits. Additional sampling was required for areas where the extent of contamination was not yet defined, and the analysis and reporting process repeated until either clean or contaminated results was indicated. **Figure 4** shows a decision logic flow diagram of the sampling and analysis process, which was used to delineate site contamination and place the turbidity screen.

Remediation support data for lagoon closure and soil stockpile removal was generated primarily by the XRF instrument, and confirmed by the off-site laboratory. In the grid areas which were sampled, analyzed and determined to contain metals concentrations over the human health based action limits, additional remediation was performed, and the area was then re-sampled. This process continued until a depth was reached that tested below the established action limits.

2.6 Problems Encountered/Lessons Learned

Phase I experienced problems of varying significance.

The single most important problem experienced during this phase of work was associated with the XRF instrument. As discussed in Section 2.5.3, the iron concentration in the OEC soil was naturally high, and produced an analytical interference with nickel. For future activities involving the use of the on-site XRF, a longer method preparation schedule would allow the analyst time to configure the instrument in the laboratory, and complete a full site-specific soil calibration prior to on-site mobilization. If this is permitted, an investigation into each of the targeted analytes, including the anticipated method detection limits, could be performed. In this manner, the analyst could confirm with more certainty that the project action levels are within the quantitative range of the instrument. In addition, a more extensive site soil sampling program, to more fully characterize the site before mobilization of the XRF, may yield enough native soil data to make a more accurate determination of elemental interferences, which may impact the project objectives.

Also, the swamp buggy/heavy equipment experienced a variety of mechanical problems on more than one occasion. The schedule for vegetation removal therefore, was impacted significantly as parts were ordered, and flown in. To compensate for this, an inventory of high risk parts (hydraulic lines near the bucket, bushings, pins, etc.) should be obtained from the vendor at the beginning of the project, and maintained on-site at all times. Also, down time, resulting from inoperative machinery (under warranty), should be negotiated into the subcontract as a credit to the Delivery Order, and thereby lessen the cost impact.

Finally, a full time mechanic, with a well equipped utility truck, should be considered on projects of this magnitude to both repair and maintain (oil changes, grease, etc.) trucks and equipment.

Some smaller problems were also experienced, as follows:

- The XRF lost power (from the utility company) on several occasions, and approximately 2 to 3 hours were necessary to get back "on-line" in each instance. Backup power sources (generators, etc.) should be considered when the schedule is driven around important electrical equipment. In addition, an associated problem with the XRF power control panel was experienced on one occasion. Therefore, standby instruments should be considered on future sample intensive projects, where on-site screening is performed.

- The exhaust hood for the converted laboratory did not fit the trailer window opening properly, even though the trailer vendor provided the dimensions to IT. As a result, the unit was not used, and was shipped back to Verona at no additional charge to the project.

- The ground beneath the staged soil pile (from the previous project) was soft, and difficult to manage as the excavation progressed to lower depths. Consequently, the rubber tire loader could not maneuver properly. A good practice is to order track equipment whenever excavating near marshy, swampy areas, or where the groundwater table is expected to be shallow.

- The truck scales did not work properly on a full time basis, due in part to the soft subbase on which they were set. In the future, all truck scales should be positioned on a firm road base (asphalt, concrete, etc), and full size units should be installed/calibrated by the vendor. On-site scales are generally a problem on all remedial projects, and should only be used when necessary. Trailers with built in air gauges can be helpful, and should be considered as a weighing alternative. However, the final certified scale tickets at the disposal facility must confirm the total quantity shipped.

- Vegetation/sediment removal was slow and cumbersome with the equipment provided. Towing and dumping the small pontoons (barges) created the most difficulty. Additional time should be allowed during the planning and procurement stages, to research the best available technologies on a project of this magnitude.

3.0 Project Review (Phase II)

Phase II operations addressed the remediation of Davy Creek, and the wetlands area adjacent to the former OEC facility. Principle activities centered around dredging/excavating contaminated stream and wetland sediments.

3.1 Introduction

Cleanup goals for this phase of work focused on remediating the contaminated sediments in Davy Creek and the wetlands, after the removal of the vegetative cover. The transition from Phase I to Phase II occurred in mid October. However, some Phase I operations (vegetation removal for one) continued through mid December. Primary Phase II activities were as follows:

- Mobilize, and set-up equipment necessary to perform the Scope of Work (i.e., the dredge, pumps, hoses, filter press units, and the WTP).
- Remove contaminated sediments with a hydraulic dredge, and conventional excavating equipment.
- Dewater removed sediments with two filter press units.
- Homogenize the filter cake with the staged vegetation, to minimize waste streams.
- Dispose of all solid waste at an approved offsite facility.
- Treat all filtrate generated from filter press operations through the onsite WTP. Storm and decontamination water was also treated in a similar fashion.
- Discharge treated water into an approved (WDNR) location of Davy Creek.
- Dewater contaminated sections of the creek/wetlands, and prepare for full scale conventional excavation operations.
- Perform selective sampling to chart progress, and to confirm clean areas and materials.

The project remediation limits included a stretch of Davy Creek, extending westward approximately 2000 lf from Lincoln Road Bridge to Fireman's Park. Also included was a 32,500 sf wetlands area directly adjacent to the former OEC property. Approximately 6,899 ton of contaminated sediments was targeted for removal, at depths ranging from 1 to 2 feet.

Facilities and components installed to support operations included the following:

- Two hydraulic dredge's, and pipe/fittings/hardware associated with each unit
- A 27,000 sf asphalt storage pad (installed during Phase I)
- A mix/screen box
- A debris grinder (Muffin Monster)
- Two 100 cf capacity plate and frame filter press units
- A complete wastewater treatment plant

- Water storage vessels
- Specialized amphibious and heavy equipment

3.2 Equipment Mobilization/Setup/Operation

3.2.1 Water Treatment Plant Construction

To prepare the support zone for WTP construction, the entire process area was graded with a bulldozer, covered with geotextile cloth, and topped off with a 3 inch layer of gravel (to provide an even bedding for equipment and components). This activity was completed by the first week of October, 1994. Immediately thereafter, the 26 portable storage tanks (pre-treatment and post treatment) were obtained from Baker and Rain For Rent, and were staged as shown on **Figure 3**. The two filter presses were also staged and inspected for operability. Initial operational training on the press units was provided by Mobile Dredging. When the carbon adsorption treatment unit arrived onsite, a crane was mobilized (Dawes Rigging and Crane Rental) to erect the reaction tank (T-108) and the clarifier.

The initial attempt to construct the clarifier was interrupted due to damage that had occurred to the unit during shipment. The legs of the piece were strengthened and straightened by IT mechanics, and the crane was again utilized to assemble the remaining components. (Refer to Problems Encountered in *Section 3.7.1* for additional details.)

Once the major equipment pieces were in place, other associated tasks were completed over a 10 day installation period. These activities included the following:

- Installed the power supply, control panels, and all electrical hook ups (assistance in this task was provided by Steve's Electric, a local subcontractor)

- Placed the small equipment, i.e., the bag filters, and process water pumps

- Installed the interconnecting pumps between the treatment units and filter press units

- Installed the effluent tank pipe, and connections

- Setup, and tested the chemical feed systems

- Placed the two diesel powered pumps for slurry recirculation and filter feed

- Placed the screen box for dredge slurry management

- Installed secondary containment systems around the filter presses, chemical feed storage areas, process pumps, and bag filters.

The set up of the treatment system and filter presses were completed on October 19, 1994. System testing (with clean water) and shakedown was performed over the following four day period. Routine leaks were repaired, and the system began processing water on October 24, 1994.

3.2.2 Wastewater Management/Water Treatment Plant Design

Water treatment efforts involved the implementation of two systems: a) to manage dredged slurry and, b) to treat the process filtrate and stormwater.

Dredged slurry was managed with an inline debris grinder, a screen box to eliminate oversized material and/or vegetation from the slurry, a 100,000 gallon slurry (treatment) storage system, and two mobile filter press units.

Water treatment activities included processing filtrate from the filter press units and stormwater collected onsite. An approximate layout of these systems as completed in the field is provided on **Figure 3.**

The debris grinder was placed in the dredge discharge line to reduce the size of material entering the system, and to minimize the load on the debris screen. The screen box was necessary to receive incoming dredge slurry, and to act as a wet well for the slurry system feed pump.

The slurry storage system consisted of five 20,000 gallon portable Baker tanks, interconnected by an 8 inch PVC header system. Dredged slurry was kept in suspension, and recycled through these tanks with a 6 inch, 1,000 gpm diesel trash pump. The stored inventory was then metered to the two trailer mounted filter press units, which were positioned less than 30 feet away.

Both filter presses were plate and frame units, with 100 cf of capacity. Unit 1 (positioned east) was an R and B press, and Unit 2 (west) was a J-press. Both were manufactured by JWI Inc., and provided by Mobile Dredging and Pumping Company of Chester, Pennsylvania. Dried filter cake from both units were dropped onto underlying conveyor belts, transferred into waiting dump hoppers, then transported via forklift to the asphalt staging area (approximately 50′ away). The small quantity (54 cy) which was generated during dredging operations allowed the material to be homogenized directly in with the vegetation, and minimize waste streams. Resulting filtrate was then discharged to Tank T-106, which was used to feed water treatment system holding tank T-107.

The on-site water treatment system was setup to remove inorganic and organic constituents from the water, prior to it's discharge back into Davy Creek. The system, was designed to handle a nominal flow of 80 gallons per minute (gpm), and a maximum flow of 180 gpm, for a daily average of approximately 100,000 gallons.

The system design was based upon analytical results available at the time, and bench scale testing performed by both IT and various subcontractors solicited to perform the work. The Process and Instrumentation Diagrams (P&IDs) for the system were provided in the Phase II Final Work Plan. Operations consisted of feeding water, which was stored in T-107, to pH adjustment tank T-108. At this point, the pH was raised to between 10.5 and 11.0 to initiate the precipitation of metals as a hydroxide. Sodium hypochlorite was also introduced into this tank for cyanide destruction. The waste stream with precipitated solids was then transferred to an inclined plate clarifier for solids removal, with the aide of a coagulant (ferric sulfate) and a polymer (NalClear 7768). The clarifier consisted of three treatment chambers as follows: a flash mix chamber with mixer, a flocculation chamber with mixer, and an inclined plate settling chamber. The discharge from the reaction tank then passed through the flash mix chamber where polymer and ferric sulfate were added to coagulate the metal hydroxide precipitate. Coagulants were flash mixed for a short period of time, and the overflow passed to the flocculation chamber. In this chamber the precipitate was allowed to flocculate together to form larger particles, which settled out in the clarifier. Settled solids were periodically recycled to one of the slurry storage tanks for re-processing through the filter press units. A 3,000-gallon filter feed tank was used to store the clear overflow from the clarifier. The tank was designed to provide a 10 minute detention time. A 100 gpm (nominal) centrifugal pump, capable of a 180 gpm maximum capacity, was used to feed the wastewater at a constant rate to the bag filters.

Clarifier effluent was pumped first through two bag filters in series, to remove residual suspended solids to the 5 micron size. Two sets of bag filters were used in series to remove the small quantity of metal precipitate, and/or the suspended solids which overflowed the clarifier. The bag filters were also used to prevent the carbon adsorbers from clogging. Effluent from the bag filters was processed through two activated carbon beds (in series) to remove trace organics. The carbon adsorbers were 6-foot diameter units, containing 4,000 pounds of granular activated carbon each (raw material was provided by Calgon Corporation). The adsorbers were downflow contactors, with a volumetric transfer rate of 4 gpm per square foot, and a contact time of 15 minutes. Final processing included pH neutralization, to allow discharge at the target pH of 7.0. Treated water was then transferred to one of 20 portable storage tanks, and held pending the approval for discharge (when the water met the analytical requirements for discharge to Davy Creek). The twenty-20,000 gallon effluent holding tanks had a total storage capacity of 400,000 gallons, which provided for 4 days of uninterrupted operation (3 days, plus a 1 day buffer for retreatment).

3.2.3 Material Processing/Plant Operations

Waste water treatment and filter press operations were begun in concurrent fashion, immediately following initiation of Nessie dredge operations on October 19, 1994. Production from both dredge units were inconsistent throughout the entire period, and dredging operations were eventually discontinued on November 16, 1994. The wetlands, and the remedial portion of Davy Creek were then hydraulically isolated from the upper watershed, and several diesel pumps were utilized to dewater the work zone to prepare it for conventional excavation.

The analytical results for each batch of water treated was reported on the discharge approval forms and the supporting analytical data, which is summarized in **Table 16**. These data indicate that filter press production lagged behind the WTP start-up by 10 days, which was attributed to the small amount of solids produced by the Nessie. The press units generated in excess of 200,000 gallons of water for treatment, with little filter cake production. The process was slow and cumbersome for the following reasons;

- The material contained a high organic matter, and a low solid content from the dredge (% solid in the range of 2) due in part vegetation problem and lack of the required shroud (*Section 3.3.2*).

- The very fine sands settled out in the feed tanks, and caused a problem when there was a change in flow velocity. The silt remained in suspension, and plugged the filter cloth, causing the flow-through capacity to be reduced from 150 gpm to approximately 40 gpm, with the press chamber only partially full. Therefore, the cycle time to produce a full cake was increased dramatically from the predicted 90 minutes to almost 12 hours. Modifications to maximize efficiency included introducing air lances into the feed tanks to keep all materials in suspension. However, the low solid content of the material, and slow cycle times persisted.

Increased filter cake production was not realized until the second dredge began excavating on November 8, 1994. During Mudcat operations, nearly all of the 54 cubic yards of filter cake were produced.

Material from wetlands dewatering operations was also pumped in and processed through the WTP. As a result, of the 685,000 gallons of water treated during this period, approximately one half was from dewatering efforts.

Also, a discharge problem occurred due to an elevated level of cadmium recorded in the post treatment tanks. The system was modified to optimize for cadmium removal. However, since the action limit for cadmium was already below the hydroxide solubility limit, the only available approach was to remove it through the carbon bed. This mechanism had only a very limited capacity for cadmium removal, and was indicated to be exhausted when the elevated levels were reported. The water was retreated under optimal system conditions, but the cadmium levels remained elevated. This indicated that the only option was to change out the primary carbon bed, to produce a water quality that would meet the discharge requirements.

The first carbon bed was replaced with virgin carbon over the weekend of December 4, 1994. Water treatment resumed on December 5, and the entire volume of retained water was re-treated the following two days. The associated discharge authorization logs (**Appendix M**) confirm that the water then met all disposal requirements. The final 200,000 gallons of treated water was discharged into the creek on December 16, 17, and 18, of 1994.

The Phase II wastewater treatment system process operational schedule is illustrated on **Table 2B**. Wastewater treatment and filter press production during that period of operation is further detailed in **Table 17**. This table also illustrates the volume of water which was initially treated, and the volume of water retreated prior to discharge (the water which was required to be recycled through the entire system due to the excessive cadmium levels).

3.2.4 Water Discharge

Discharge approval was obtained by implementing the following two steps:

- The receipt of lab results were recorded on a discharge approval sheet. This document was completed for each tank of water that was stored and discharged.
- The signatory approval of the Water Treatment Manager, Site QA Representative, Site Manager, and the USACE Representative was obtained prior to discharge.

The discharge point was established in Davy Creek on the stream side of the silt screen. The exact location was approved by both the USEPA, and Wisconsin DNR prior to initiating this activity.

Since discharge was performed under Superfund authority and the ultimate supervision of the U.S. EPA, no additional permits were required. However, the intent of all standard permits were met and followed. The discharge standards used were those developed for Davy Creek by the Wisconsin DNR.

As an added precaution, discharged material was directed to flow into a perforated drum to lesson the effects of erosion.

A sample from each 20,000 gallons of treated water was obtained after the material was transferred to discharge holding tanks T-113 through T-132. Analytical testing of treated water was required to assure that the water met all contaminant specific Davy Creek discharge criteria. Samples from each 20,000 batch of water were taken for verification. Once a storage tank was completely filled, a grab sample was collected for shipment to Quanterra and Suburban laboratories. Quanterra was responsible for organics and metal analysis, while Suburban completed testing for cyanide, BOD and hexavalent chromium. The grab sample was collected with a clean dip tube or dip jar through the manway located on top of the tank, and placed in preserved (as applicable) sample containers. Approximately 3 liters of water was obtained with bailers, and/or clean sample dip jars for each sample. The time that each sample was taken was recorded on the sample collection log, along with field measurements of pH and temperature. A group of samples from one or more tanks was then packaged in sample coolers, and preserved with ice for shipment to the respective labs. Samples were shipped to Quanterra via overnight courier service, while Suburban (a local lab) picked them up.

Data for every 20,000 gallon lot is presented in the Certificates of Analysis in **Appendix J.** These data represent information used to determine if batch of water could be discharged to the stream.

Discharge approval was originally requested in one day turnaround time. However, the following was experienced:

- The receipt of analytical results often took longer than the 24 hour allotted time.

- The validation of the data initially took a day to process, but later was streamlined to 2-4 hours.

- With the onset of cold weather, discharge was hampered by the freezing conditions (i.e., a significant amount of time and effort was expended to keep the discharge header and hose from freezing)

- To discharge the final 200,000 gallons, each tank had to be pumped out separately using a two inch pump/hose. Some of the tanks were encrusted with several inches of ice, further complicating this operation.

When the analytical data indicated that the treated water failed to meet the discharge requirements, the material was held for retreatment. Approximately 565,000 gallons of water was retreated to meet the discharge requirements for cadmium. This quantity was much higher than expected, and also increased the demand on the system. As a result, the lead carbon bed was changed out earlier than anticipated.

3.3 Dredge Equipment/Setup/Operations

Stream sediment removal was attempted with two different types of hydraulic dredge units. Initial operations were performed with a 6 inch Nessie suction dredge (rented from Aspen AAA of Franklin, Wisconsin), followed by a Mudcat Model SP 815 (provided by Ellicott Machine Company of Baltimore, Maryland).

The Nessie was a self propelled machine, which included a unidirectional suction head capable of removing a 12 inch lift of material, and producing an operational capacity of 600 gpm. The discharge head of the machine was able to push material over 1,800 lf at the maximum flow rate. Prior to placing the Nessie into the water, many preliminary tasks were necessary to successfully implement operations.

Set-up activities included laying over 1,200 lf of 6 inch dredge discharge line, from the banks of the upper creek (near Lincoln Bridge) to the material processing area. Some of this hose was solid, but a majority of it was of the "lay flat" variety. This task was performed by hand, over soft, marshy ground where footing was treacherous. As a result, safety was a concern and installation moved at a rather slow pace. Plastic floatation devices were also attached every 100 lf to keep the line buoyant when it entered the water.

A debris grinder (Muffin Monster) was added to the dredge discharge line near the material processing plant, prior to entering the mix box. This component, supplied by Crane Engineering, was necessary to reduce the size of vegetative matter prior to it entering the system. The Muffin Monster was capable of processing a maximum flow rate of 600 gpm, without creating significant backflow.

The mix box (provided by Metropolitan Environmental) was staged on the southwest corner of the asphalt storage pad, and was equipped with a screen and two 5 hp agitators (to keep sediments in suspension for transfer to the slurry feed/storage system).

A 70 ton crane was subcontracted from Dawes Rental to place the Nessie into the water on October 17, 1994. Final connections were made, and operations began on October 19 at the upstream point CK 78.

The first two 50 grid sections of the creek bed were dredged. Efforts were concentrated over a 7 day operational period, which ended on October 29, 1994. Activities were discontinued for several reasons, including the following:

- The cutting head of the Nessie was operational in only one direction. Since the head continued to operate on the return sweep, excess water (to be treated) was generated. This would have placed undue burden on the downstream treatment facilities, which were installed to access a higher solids concentration.

- Production was too slow, given the onset of Winter was close at hand. Several operational difficulties were encountered. The rotating head on the Nessie was continually plugged with "hair like" vegetation and debris, and the sediments were more or less agitated, rather than vacuumed as the vendor represented. Also, maneuvering for a decent cut was difficult, if not impossible without cables.

- Mechanical problems were also experienced, as the starter and other components did not function properly. The unit was worn and old, and would have required a good bit of maintenance to enable it to perform satisfactorily. An investigation into this matter (after the project was completed) revealed that major problems were previously experienced with the unit (especially the hydraulics), and some vital maintenance information was withheld by the vendor as the subcontract was put into place.

Therefore, the USACE/IT jointly decided to remove the machine from the water on October 29 with the 70 ton crane, and temporarily placed on the banks of the creek (near Lincoln Bridge). It was later transported to the decontamination pad (on a trailer provided by Aspen), where it was thoroughly cleaned for demobilization from the site. The unit was then staged in the parking lot for immediate pick-up. However, the vendor did not transport the Nessie from the site until December 4, 1994.

Draining and removing the units accompanying 6" discharge hose was difficult, due mainly to the weight of the hose and the sloppy conditions. Some hose was left in place and used for site dewatering, and some was removed at a later date.

Note: IT has attempted to negotiate a half month rental rate from Aspen, but to date, the issue has not been resolved.

The second attempt at dredging was made with a Mudcat. This unit was equipped with a bi-directional service head, and a rotating cutter head which had an operational capacity of 1000 gpm (maximum). This machine traveled on a cable system, and installation was performed when the proper hardware arrived onsite. Most components arrived in piece-meal fashion, and delayed the scheduled startup somewhat. This dredge was launched into the water over wooden mats, which were laid on a shallow bank, to access the upper stream.

The anchoring system was installed on the northern banks of Davy Creek. Rods were driven into the ground with a sledge hammer, and the cables were attached using shackles, triangles, and various types of clevises. The intent was to allow the Mudcat to travel downstream, and leap frog from one set of cables to the other.

An 8 inch discharge hose was also installed over the previous route, and served to replace the 6 inch line. A larger hose was required to handle the increased volume of material (1,000 gpm versus 600 gpm) that was anticipated to be generated. The hose was positioned to curl and float behind the unit as work progressed toward the wetlands. It would then be in position to unfurl as dredging moved downstream.

The cutter head was set at 12 inches, and dredging proceeded from east to west. Operations were performed during an 8 day period (from November 8 to November 16) over the same two sections of creek. Again, problems were encountered and the activity was discontinued due to ineffectiveness, with the following documented reasons:

- A significant amount of vegetation was being transported through the dredge discharge line, and was subsequently clogging downstream equipment. Most of the grassy material was vacuumed from the bottom of the creek bed, where it settled after removal operations (the light vegetation had a tendency to flow around the excavator bucket instead of into it, even though the bucket was perforated). The mix box screens, therefore, required quite a bit of cleaning and/or maintenance to keep the system operational. The debris grinder helped some, but did not totally eliminate the problem.

- The dredge could not operate at full capacity due to the flow restrictions created by the Muffin Monster (600 gpm). This hindered dredging capacity, since the suspension of the dredged material was optimized for full speed operation. As such, a higher water to solid slurry was realized, and continued operation would have significantly increased water treatment operations, and tankage requirements.

- The vegetation continually wrapped around the cutter head, thereby creating a rolling effect versus the desired cutting effect. This contributed to the overall low solid concentration that was experienced. The only expedient way to remove the material from the cutter would have been to cut it by hand. This was deemed to be too dangerous (by the SSHO) and time consuming.

- The water present in the creek was not of sufficient depth to successfully operate the dredge. The Mudcat requires a minimum of 2 feet of water above the suction head of the pump. A Mudcat representative was onsite, and stated that the water capacity in the creek was marginal, but sufficient to successfully perform the task at hand. However, this was not the case. The Ashippun area had experienced a prolonged dry spell during the fall of 1994, and there was less than two feet of water (on average) in the creek channel when dredging activities were performed.

- A shroud was suggested to funnel the material into the cutter head. However, one was not immediately available for this unit from the manufacturer, and fabricating an effective one onsite would have been time consuming.

Ellicott did send a representative to the site to assess the problems, and he suggested an operator who was very experienced with this particular unit, to compensate for problems as they occurred. However, in consideration of the other problems and with Winter quickly moving in, a joint decision was made between the USACE and IT to terminate the Mudcat, and remove it from the water with a 70 ton crane on November 16, 1994. The machine was decontaminated and staged on the banks of the creek for demobilization from the site.

Table 2B presents a summary of the operational schedule for the two dredge units.

At this point, the most logical alternative was to dewater the site and conventionally excavate the creek bed and wetlands.

3.4 Site Dewatering

Dredging, and water treatment activities were suspended due to minimal progress, and operations were modified to incorporate conventional excavation.

The water level in the creek was slightly under 2 foot deep over the entire 2000 foot length. Therefore, first task was to dewater the site, and hydraulically separate the upper watershed from the work zone. This was accomplished by creating four clay diversion dikes, in the following locations:

- One to the immediate east of Lincoln Road Bridge
- One to the immediate east of the wetlands
- One to the immediate west of the wetlands
- One at the westernmost point of the site, near Fireman's Park

A check dike was also considered to separate the wetlands from Davy Creek. However, enough solid material could not be found within the contaminated zone (wetlands material was soupy and soft), and importing a large amount of clay would have further increased disposal quantities. Instead, channels (windrows) were cut through the wetlands with the amphibious excavator to improve drainage, and to enhance downstream flow.

The upstream dike was 3 to 4 foot high (el 844), approximately 6 foot wide at completion, and was used to restrict the flow of water downstream. Geotextile fabric was placed in the creek bed to create a solid foundation, and imported clay was then spread into place (in 1 foot lifts), and track compacted with the D4 dozer. The dike was widened (from the original 4' width) to allow for placement of the large diesel pumps.

Two check dikes were also installed on either side of the wetlands (near CK 60 and CK 24), to create pumping stations, and to provide additional hydraulic separation between the creek and wetlands. The check dikes were also created with imported clay material, which was placed in one foot lifts with the D4 dozer. The dikes were approximately 2 feet high (el 846) and 4 feet wide at completion. The third dike (mentioned above), near CK42 was considered, but not installed.

A final dike was installed downstream at Fireman's Park, in much the same manner as the upstream one. Clay was imported, and placed in one foot lifts with the D4. The dimensions finished out at approximately 4 foot high (crest el of 846), and 6 feet wide.

Four, six and eight inch diesel trash pumps were then placed on the upstream dike, and used to pump clean water around the contaminated area. Discharge hose was laid along the southern bank of the creek, and stretched from above Lincoln Road Bridge to below Fireman's Park. This operation continued with a skeleton crew through the Christmas/New Years Holidays. However, it was eventually terminated in early January due to frozen lines, and an unexpected early thaw of snow and ice, which threatened to wash out the upper dike (Problems Encountered, *Section 3.7.1*).

A peat berm, positioned in the downstream dike to filter water as it left the site, was installed in accordance with specifications provided by STS Consultants LTD (included in **Appendix O**). This device was placed to demonstrate the filtering capabilities of the peat to the Wisconsin DNR, who planned to use it on their downstream project later in the year. The berm was installed in the following manner:

- A cut was made in the center of the completed dike with the amphibious excavator, but the east and west walls were temporarily allowed to remain intact.

- The excavation was lined with geotextile fabric, which was overlain to cover the top at completion.
- The raw peat material was then placed in the lined excavation with the rubber tire loader.

- The peat was wrapped (completely encapsulated) with the geotextile fabric, and staked into place.

- Finally, the east/west walls were cut to restore flow through the berm.

Construction is highlighted in the photo documentation, **Appendix P.** Water from the upper creek, and wetlands was then transferred to the lower section with diesel powered centrifugal pumps. This increased the downstream water significantly. The material traveled through the peat very slowly, due in part to equalized head pressure on either side of the berm. Several modifications to the system were attempted to increase productivity. The geotextile wrap was cut on one/then both sides to maximize flow, the peat material was uncovered and sifted in place, and a filter-like apparatus was constructed (with metal cattle panels and stainless steel tie wire) for use as a secondary unit. This peat filter was approximately 6' high and was situated to the immediate west of the downstream dike. A 4 inch centrifugal pump was used to pump water from the downstream pool through the filter.

However, none of these applications were completely successful. Cutting the filter cloth helped somewhat but not totally, and the base of the filter became unstable with use, because it was not tied into solid ground. Repairs were attempted near the end of Phase II, but were discontinued when dewatering efforts were terminated.

Both the influent and effluent water was sampled on a regular basis to determine the peat's effectiveness.

3.5 Conventional Excavation

To better access the upper creek and wetlands with trucks and/or heavy equipment, a haul road was constructed from Elm Street, along the northern bank (50 feet to the north) of Davy Creek to CK76, which was located near Lincoln Bridge. The 15 foot wide, by 1100 linear foot road (size approximate) bisected the northeastern sector of the wetlands, and was constructed in the following manner:

- Plastic geo-grid fabric was laid in the soft base, and tied together to create a stable foundation.

- Number 5 stone was imported, and placed in lifts with the D4 over the geo-grid.

- Crushed base was spread with the D4 as a top coat to tighten the larger stone, and provide a smooth route for trucks.

- The roadway was widened in two spots, to allow a passing lane for vehicles and equipment.

Conventional excavation was initiated in the uppermost portion of the creek with a modified long reach (50') trackhoe, which was positioned between the roadway and the creek. From there the sediments were cast directly into two waiting Moxy dump trucks. The two-12 cubic yard vehicles, which were provided by CMC Construction, transported the material to the asphalt storage pad for stabilization. The first two dredged grids were re-excavated in this manner, and operations proceeded for approximately 150 linear feet. Verification samples were collected from the completed areas and shipped via overnight courier to the contract CLP laboratory (Weston).

As cold weather continued, ice was encountered during this operation. However, the "clean" material was simply cast to the northern bank of Davy Creek with the trackhoe.

At this point, activities were terminated due to minimal remaining authorized funding, and the need to perform a total site characterization to define the remaining limits of contamination. Conventional excavation was then resumed and completed during Phase 3 operations (*Section 4.0*).

3.6 Site Teardown

At the conclusion of Phase II operations, an enormous site teardown task was undertaken. Some key activities were performed as follows:

- Dismantled the WTP by:

  - Disassembling all the pipes/fittings/vessels/components, decontaminated those which were necessary, performed a detailed inventory (to separate IT property from government property), and packaged the entire lot for shipment to IT's storage yard in Minden, Louisiana. An initial attempt was made to sell government merchandise in the Milwaukee area. However, there were no interested parties. In Minden, the IT yard manager solicited bids for the inventory from three different vendors. However, none of the offers were acceptable. IT then made a counter offer to the USACE and subsequently purchased all of the material for use with it's WTP.

  - Chiseled the frozen carbon from inside the adsorber units with an air hammer. The loosened material was then shoveled onto the asphalt pad, and mixed with the vegetation/sediments

  - Disconnected all electrical supply lines, including heat tracing and the power control panel.

  - Dismantled all used PVC pipe and fittings, crushed them, and homogenized them into the vegetation/sediment pile as construction debris.

  - Dismantled the secondary containments under key plant components. The plastic liners were homogenized in with the vegetation/sediments, and the clean wood was placed in the general debris container.

- Decontaminated the two filter press units, and prepared them for demobilization. The secondary containers were again dismantled and properly disposed, and electrical connections were terminated.

- Unthawed the 3 frozen pre-treatment storage tanks, and cleaned/decontaminated the interiors. This was a confined space entry for IT technicians, and proper safety protocol (entry permit, entry supervisor, ventilation, etc.) was employed (see photo documentation). The material was chipped with a jackhammar, shoveled out of the tank, and transported to the asphalt staging cell with the Bobcat. Loose semi-liquid material was vacuumed from the vessels with a "super sucker" vacuum truck, provided by National Tank.

- Removed clean, frozen discharge hoses from the banks of Davy Creek, and transported them to the support zone. "Heat tents" were constructed with plastic and small torpedo heaters and approximately 40% of the lengths were thawed and prepared for vendor pick-up. The remainder were stretched, somewhat damaged from ice, and frozen to the ground. Therefore, the rental charges were negotiated into purchase prices with each respective vendor.

- Thoroughly cleaned the break/storage trailer, and the operations trailer for demobilization from the site. Project paperwork, analytical data, cost reports, and field logs were boxed and shipped to IT's regional office in Pittsburgh, Pennsylvania.

- Thawed and decontaminated the "clean" water storage tanks, and demobilized them from the site.

- Packaged tools, and miscellaneous small equipment for shipment from the site. Two of the three Conex boxes were emptied, and demobilized.

A concerted effort was made to sell leftover merchandise (ie. WTP chemicals, road stabilization fabric, gravel, heat tracing, discharge hose, etc.), with a marginal rate of success. Vendors eventually bought back the WTP chemicals, road fabric, heat tracing, and some discharge hose. Proceeds from this effort were credited to the project budget, after a restocking fee was paid.

Site teardown and demobilization was performed simultaneously with total site characterization in early to mid February, 1995. This activity was costly and time consuming, and significantly reduced the remaining project budget. Work was performed by technicians in extremely harsh weather conditions. But the tedious tasks were completed in an effective manner.

3.7 Phase II Sample and Analysis Summary
Over 700 samples of various origins and purposes were collected and analyzed to support the remediation and verification efforts for dredging and excavating the wetlands, and treating and disposing of the excavated materials. The sampling and analysis program for the OEC project primarily followed the Final Work Plan for Phase II - Dredging, Dewatering, and Wastewater Treatment, November 1994 and the Quality Assurance Project Plan, August 1994.

3.7.1 Implementation

The sample program was initially implemented by a team comprised of a Senior Sample Coordinator, with two alternates and three technicians. Sampling activities which were conducted in February 1995 (to totally characterize the wetlands and Davy Creek) were supported extensively by U.S. Army Corps of Engineers Rapid Response personnel.

Daily project activities generated several characterization and verification matrices, which required sampling and analysis. Field sampling included soil and sediments for verification of excavated areas in the wetlands to meet human based exposure limits for cadmium, chromium, copper, nickel, zinc, and cyanide. Stockpiled materials excavated from the wetlands and Davy Creek were sampled and analyzed to verify compliance with shipment and disposal requirements. The stockpile removal verification analyses followed the Toxicity Characteristic Leaching Procedure (TCLP) Method 1311, to determine the mobility of organic and inorganic analytes present in liquid, solid, and multiphasic wastes. TCLP analysis was conducted at the Quanterra Environmental Services Middlebrook Pike Laboratory in Knoxville, Tennessee. Subsequent analyses of disposal samples for cyanide, amenable cyanide, and metals, as well as wet chemistry analysis of the WTP samples, were performed by Suburban Laboratories of Wisconsin Inc. located in Waukesha, Wisconsin. On-site procedures for water quality parameters (including temperature, pH, and specific conductivity) were performed by qualified personnel. Paint filter tests were conducted on-site on stockpiled soils, to control the presence of free standing liquids in materials being transported from the site. Other miscellaneous sampling events included offsite characterization of residential soils, backfill material (Palms series) excavated from another wetlands area, influent and effluent water samples from the peat filtration system, and melted ice from the wetlands. Each type of sample event was unique in methodology and data quality objectives; therefore, the samples are shown in the reports by purpose as stated in the Work Plan, and shown on the sample collection log.

3.7.2 Procedures

Sample collection procedures throughout the project followed strict criterion as established by IT's Sample Management Group and the EPA's standard operating procedures. All equipment was thoroughly decontaminated, and constructed of materials compatible to the matrix being sampled, and the analytical program specified. Equipment cleaning was conducted in a decontamination building, that was constructed at the edge of the CRZ. This location was chosen to minimize potential cross contamination between the areas being sampled, and the staging area for clean/new sample equipment and containers. All sample bottles were new, at a minimum met EPA level 2 cleaning and quality assurance certification, and were maintained under security in the sample team's (on-site) field office. Deionized (DI) water, processed to ASTM Type II standards by Culligan Water Services, was delivered to the site and used exclusively for all sample equipment decontamination procedures. Liquinox® phosphate free detergent was used to wash sample equipment, prior to two steps of DI water rinses. Equipment which was used to collect samples for metals analyses, had an additional rinse step of nitric acid, and a final rinse with deionized water. The pieces were then wrapped in aluminum foil, with the shiny side next to the surface, for transport to the sample collection location. Extra precautions were taken to ensure each sample's integrity during collecting, handling and shipping. Disposable, dedicated Teflon® bailers were utilized for collecting water samples from the water treatment system storage tanks. New, nylon twine was used each time to lower the bailers into the water. New, latex gloves were worn by all sample team members each and every time samples were collected.

3.7.3 Sampling

3.7.3.1 Disposal Verification Analysis

The asphalt pad, which was constructed for processing and loading excavated/dredged material, was marked at its perimeter, and assigned grid coordinates for locating piles to be sampled. Grid markers were placed at intervals every twenty feet on long poles that were clearly visible to the heavy equipment operators working the material (photo documentation). As kiln dust or other sorbent was added to solidify the mix, the pile was marked with red stakes and flagged to indicate that it was ready to be sampled.

If the pile exhibited a wet consistency, a sample was collected for a paint filter test. A representative sample of the "worst case scenario" material was collected, placed into a new aluminum pan, and homogenized thoroughly. An aliquot was then grabbed from this material, was placed into a number four paint filter cone, suspended over a calibrated beaker, and allowed to remain for more than five minutes. If any liquid was present in the beaker, the stockpiled material was rejected for shipment and stabilized again until conditions were acceptable. If the material passed the paint filter test for free liquids, it was sampled for chemical analysis.

Each pile was measured to estimate the cubic yardage to determine the number of grabs or aliquots that would be composited. A minimum of five grabs were collected from a 500 cubic yard (maximum volume) pile. Stainless steel collection scoops and/or bucket augers were shoved into the pile at varying depths to collect the sample.

The aliquots were placed into new, disposable aluminum pans for homogenizing. The sample was mixed with a stainless steel implement or a laboratory grade hardwood blade, then mixed thoroughly and divided into quarters. The quarters were mixed individually, and blended together. The process was repeated, and an aliquot was collected in a clockwise order from each quarter, then placed into the sample bottle. The bottle was labeled with a black indelible marker, overpacked into a plastic freezer bag and maintained under sample team security in the sample storage refrigerator, located in the field lab. It remained there until shipped for analysis.

The sample location was documented on the sample collection log and on a grid map, to show the position of the pile on the pad. The sample number was written on a long wooden stake and placed into the pile to inform the operators that the pile had been sampled, and additional material should not be added. Samples for stockpile removal verification were submitted to the offsite laboratory, and analyzed for selected total metals, cadmium, chromium, copper, nickel and zinc. Samples that exceeded ecological limits for copper, nickel and cyanide were analyzed for RCRA based limits for disposal (by TCLP). Results of the analysis for stockpile and disposal are shown on **Table 9**, *Analytical Results for Stockpile Removal Verification Samples.*

Filter cake, the fine material that accumulated on the filter press plates during sludge dewatering and treatment, was placed on the disposal pad with the vegetation/soil excavated from the creek and wetlands. The filter cake was mixed with the vegetation/sediments, and sampled under the same protocol. Sample results indicated levels so conservative for disposal, the analytical program was revised to selected inorganics, or cyanide only. Envirosafe was also equipped with their own analytical program, and performed further analysis on select loads.

One sample was collected and analyzed from every other 250 cubic yards of material stabilized. The disposal facility agreed to also sample every other 250 cubic yards to spread the cost and share the burden with the project. In addition, the first load was tested for treatment standards. The material passed, and every 72nd load was again subjected to testing to ensure a proper mix design. This scenario held true for all materials shipped from the site.

3.7.3.2 Wetlands and Creek Bed Verification

Two grid systems were devised to incorporate all possible sampling points within the boundaries of the wetlands and Davy Creek. CK numbers were located approximately every twenty-five feet alongside the defined creek, and on the west side of the wetlands area, adjacent to the turbidity screen from Lincoln Road bridge to Fireman's Park. The CK numbers served as a cross-section to the creek, and the area between CK numbers and the turbidity screen was represented by a sample collected (approximately) in the center. If the distance between the turbidity screens allowed for more than one cross grid, additional samples were taken to represent the greater area. The first CK number at Lincoln Road bridge was CK-78, and the last number at Fireman's Park was CK-24'. The full range of the CK numbers were used as the demarcation for the federal portion of the project.

Water and sediment samples were only collected at the beginning of Phase II above Lincoln Road Bridge, to establish background levels of contaminants of concern. Since the lower boundary represented the limit of the state project, background samples were collected upgradient of Lincoln Road. Results of the background samples did not indicate any contamination above the method detection limit.

Sediment samples for characterizing the creek bed below CK-78 were collected near the center of the creek between CK number grids, using several methods. Samples taken at depth intervals were collected by inserting core samplers into the creek bed material, and extruding the sample from the designated depth. This sampling technique was used after vegetation removal to determine if contaminants were present in lower levels, and might required excavation deeper than the one foot. Excavation and dredging confirmation samples were also collected directly from the excavator bucket. The sample location was identified to the operator, and either the trackhoe or amphibious trackhoe moved into position to collect the sample. The sample team member then removed the material directly from the bucket, at a point that had not been in contact with any portion of the bucket. Several aliquots were removed from the bucket, and a composite sample was then homogenized for submittal to the lab for analysis. The sample point was marked by labeling the wooden stake with the sample number (black indelible ink) and driving it into the creek bed with a mallet. The stake remained in place until the results were received. Either the grid was acceptable to the established cleanup criteria, or further excavation was necessary.

When the scope of work changed to constructing berms and dividing the creek bed/wetlands into cells, the section of creek between the Lincoln Road bridge and the first dike was dewatered and sampled with the track hoe bucket. Samples were collected from CK-78 to CK-48 to characterize the upper portion of Davy Creek, prior to delineating the wetland. The results indicated that a majority of the creek bed met the cleanup criteria for human based limits; however, they did not meet the ecological based cleanup criteria. Therefore further excavation or capping with one foot of clean backfill material, was necessary. In this instance, further dredging or excavating was required to ensure a final contour (of the Davy Creek bed) that would maximize flow. Therefore, the original scope of work was modified to include the creek bed verification sampling, along with wetlands sampling.

Changes in scope, weather and site conditions prompted three objective sampling events to direct wetlands remediation activities. The first event was to sample all grids that had been excavated to their final depth, as directed in the original WP. The consistency of the wetlands material was very fluid, and the excavated area could not be well defined. When a grid was excavated, the bordering material immediately flowed back over the lower area, making confirmation sampling difficult. Areas that required deeper excavation based on previous analytical data, or were needed for access, were also targeted for immediate verification. The parcel of land in the northeast corner of the wetlands, parallel to Elm Street, was used as a route for the temporary gravel haul road. A total of 28 grids in this area were sampled and verified to be below the established action levels, and removal was considered complete. The areas were marked accordingly, and the transport road was installed over a portion of this tract. Results of the samples with their respective locations are reported in **Table 10**, *Samples Collected for Wetlands Characterization/Verification.*

The second distinct sampling event was conducted as a screening to evaluate random portions of the overall wetlands area from Elm Street to Fireman's Park. Since the entire area was excavated to some degree during the vegetation removal, it was necessary to obtain data to determine the remaining levels of contamination. The event was considered screening because the laboratory conducting the analyses, Suburban, was not certified for the project by CLP specifications, or validated by the USACE Missouri River Division (MRD). However, the lab did meet the requirements for the State of Wisconsin, and the analytical methods which were performed exceeded the quality assurance requirements met by the XRF (Level 2 analysis had been approved for screening samples). Based on the information gathered during this sampling event, the decision could be made to either stop the project and re-evaluate the scope of work, or to better define the quantity of soil to be excavated. Rather than sample in a pattern and bias the limited number of samples, USACE/IT mutually agreed that a higher confidence level could be obtained by sampling at random grid locations. The sample team was shuttled by the amphibious excavator to these locations, and the machine's bucket was used to collect samples. The excavator made several passes across the wetlands in a zigzag course, and continued in this manner downstream to Fireman's Park and back. Thirty grids were sampled and analyzed for selected metals and cyanide at Suburban, to support the characterization effort. Of this total over fifty percent were within the acceptable cleanup levels for human based limits. Results of the screening characterization samples are shown in **Table 11**, *Samples Collected for Wetlands Screening Characterization.* Assuming that approximately fifty percent of the remaining soils and sediments were within acceptable levels for cleanup, a confident cost estimate could be prepared for characterizing the entire site (for excavation and disposal). A joint agreement between the USACE and IT was made to sample every grid in the wetlands and Davy Creek, to ensure that an accurate assessment of the site was made to support further cleanup.

The third major sampling event of Phase II was to characterize the wetlands and Davy Creek. This process was initiated on January 6, 1995, with a preliminary evaluation of equipment, logistics, and sampling techniques. Extremely cold temperatures, with wind-chill factors at 35°F below zero left the wetlands frozen solid, and conventional auguring was all but impossible. Small excavators could not penetrate the frostline to gain access to the material to be sampled, and all heavy excavator tracks were frozen to the ground. Jackhammers were brought in, and with a little effort, were capable of digging into the ice. But this was very labor intensive under very adverse conditions, and therefore was not considered a practical approach. Cemetary operators, and companies which specialize in geophysical surveys in arctic conditions, were consulted. Suppliers and manufacturers of carbide tipped frost augers and power equipment were identified through this effort, and the recommended equipment was ordered for the frozen wetlands sampling.

On February 8, 1995 the sample team, equipped with the specialized equipment, drove metal spikes into the ice for grid markers, and augured through the frozen layers to access the sample material. The sample team was comprised as a partnering concept between the USACE and IT to define the grids, auger through the ice, and to collect and process the samples for delivery to the lab. Sample points were at the center of each grid, in accordance with the Phase II Wetland Area Sampling Pattern Overlay (**Figure 2B**), which was prepared by R.A Smith & Associates. The grid reference points were marked along the full length of the wetlands with Solo® plastic plates, mounted on 8' high wooden stakes at 25' intervals. The reference points were aligned across the entire wetland body, and survey flags were inserted into the ice to mark the grid lines and sample locations. Two sample team members, equipped with gas powered auguring equipment, located each sample point and augured a 4" diameter hole through the ice. They continued across the wetlands from row to row to expose the sample points for the next team. The next group immediately obtained measurements to determine the thickness of the ice, the depth of the water and an approximate depth to the top of the sludge. These measurements were necessary to determine the sampling equipment to be used, and to document the conditions at the time of sampling. This information was also valuable to help determine which type of equipment would be required to excavate the sludge and move the ice. Once the measurements were documented, the samples were quickly collected with the most appropriate device for the existing conditions. Bucket augers, probes, pipes and scoops were used to accommodate the various conditions. All equipment was thoroughly decontaminated prior to use at each location. A transportable decon shelter was fabricated, and dragged over the ice to accompany the sample teams.

As the samples were collected, they were placed in a freezer bag, sealed, and placed on the ice next to the sample hole. Each freezer bag was marked with the sample number, grid location number and the time the sample was collected. The sample coordinator routinely collected the sample bags and transported them to the field lab trailer for thawing and processing. The bags were placed in large aluminum steam table pans, and dry heat was directed over the materials. The sample bags were then allowed to settle while thawing. The containers were rotated several times to break up the ice, and material was mixed by kneading it inside the freezer bag. After thawing, the water layer was decanted from the bag. The sample was then thoroughly homogenized and aliquots were placed into clean laboratory sample jars. Sample collection logs were completed based on the field information written on the sample bags, and observations made during sample processing. Visual characteristics were noted, such as the dominant soil/sediment classification, color, odor, debris, clay target fragments, etc. The sample numbers were recorded on a master map to determine which samples were designated as a quality control split. The split sample locations were predesignated on the overlay drawings (**Figures 2A, B, and C**). The CSAP indicated that the sample collected closest to the grid, and labeled with a solid circle symbol, dictate the sample be split as a confirmatory sample to the CLP laboratory for (analysis and CLP data package). A total of 55 samples were split for CLP analysis, and six of the 55 splits were again split in triplicate for analysis by a designated EPA lab (Industrial Environmental Analyst [IEA] located in Cary, NC). The sample results of the CLP samples along with their counter analyses are shown in **Table 12,** *Split Samples Collected for Verification of Wetlands.* (Note: Results of the EPA split samples have not been provided, and are not available for this report.)

The sample team worked under harsh weather conditions for five days, and were able to collect 577 samples in a 36 hour period. The sample event was representative of the entire wetlands and creek bed project boundaries for Phase II characterization, which included approximately 522 grids. Only ten percent (51) of those grids failed the human based limits established for this phase of the project, with forty-seven due to high levels of cyanide, thirty-five for chromium, nineteen for cadmium, fourteen for nickel, and three for copper. Zinc was not found in levels that exceeded the cleanup criteria or verification sampling for Phase II. Results of these samples are shown in **Table 13,** *Samples Exceeding Human Based Limits for One or More Analyte of Interest, for Wetlands and Creek Bed Cleanup Verification/Confirmation.* **Table 14,** illustrates *Samples Collected for Wetland and Creek Bed Verification.*

3.7.3.3 Peat Filtration Analysis

The peat filtration system was constructed at Fireman's Park on December 14, 1994 (*Section 3.4*) and was monitored weekly to maintain the efficiency of the system. The pump discharge (from the wetlands/upper creek) was funneled into the center of the berm/filter, and allowed to flow through to the outside, where it was discharged downstream. The influent samples were collected directly from the discharge hose, in order to better characterize the influent water. Effluent samples were collected at various points around the outside of the system walls. The effluent sample was collected as a composite, to provide a better performance characterization of the entire system. The initial samples were analyzed for selected metals, cyanide and VOCs. The VOC analysis was eliminated after the first characterization, due to the lack of volatiles in any of the water samples which were previously analyzed. Once the system was determined it efficiently removed the metals, the monitoring continued with analysis for selected metals and cyanide. The task was performed throughout the dewatering of the wetlands (and through the Christmas/New Year's break), and the results verified that the system performed as designed.

The following table summarizes the associated analytical data.

Influent and Effluent Water Samples Collected at Peat Filtration System
Oconomowoc Electroplating Company, Phase II, Delivery Order No. 6, Ashippun, Wisconsin
Results are Reported in PPM

Sample Date	Sample Number	Sample Location/Description	Cadmium	Chromium	Copper	Nickel	Zinc	Cyanide
12/14/94	AS1921	Influent at Peat Filter	0.0088	0.02	0.02	0.04	0.069	0.01
	AS1922	Effluent at Peat Filter	0.0086	0.02	0.02	0.04	0.06	0.01
12/21/94	AS1967	Influent at Peat Filter	0.02	0.05	0.05	0.05	0.11	0.02
	AS1968	Effluent at Peat Filter	0.1	0.23	0.18	0.22	0.34	0.05
12/28/94	AS1969	Influent at Peat Filter	0.007	ND(0.01)	0.0104	0.057	0.12	ND(0.01)
	AS1970	Effluent at Peat Filter	0.009	0.0105	ND(0.010)	0.067	0.083	ND(0.01)
01/04/95	AS1971	Influent at Peat Filter	0.0066	0.01	ND(0.010)	0.04	0.06	ND(0.01)
	AS1972	Effluent at Peat Filter	0.014	0.04	0.02	0.06	0.098	0.01

3.7.3.4 Backfill Analyses

A representative for the State of Wisconsin Department of Natural Resources identified a possible source for backfill material. A road construction project involved the removal of large amounts of material from a wetlands area that was free from any industrial activities and displayed the same typical geotechnical characteristics for material needed for backfill. The site was located alongside Highway 41, approximately five miles north of Highway 33 near Allentown. Two large stockpiles approximately 15 feet high had been created on the sides of the access road to the construction area. Two composite samples were collected from the stockpiles for chemical analyses to verify that the material was free of contamination. The composites consisted of 15 aliquots each taken from the piles at random intervals and from ground level to the top of the piles at 15 feet. The samples were analyzed for metals, cyanide, pesticides, herbicides, and polychlorinated biphenyls. The analytical results indicated that the material did not contain contamination above the method detection limits for the analysis and was deemed acceptable for backfill. The two samples were identified as AS1904 and AS1905. The Certificates of Analysis for these samples are located in Volume IV, Appendix J of this report.

3.7.3.5 Field QA/QC

Quality control samples were collected to lend support to the accuracy of the analytical data and the field collection procedures. Background samples were collected to establish a baseline for any naturally occurring inorganics which could contribute to the site findings. Split samples were collected at predesignated grid locations as shown on **Figures 2A, B, and C**. Split samples followed the same preparation procedures as duplicates, except that they were analyzed at two or more different laboratories. Split sample partners were identified with the same sample number. In the event that the analytical results were extremely different, validated sample data provided by the CLP lab took precedence over the screening lab data in soil removal decisions. A total of 55 samples were split for CLP analysis and six of the 55 splits were split in triplicate for analysis by the designated EPA lab (IEA). The sample results of the CLP samples, along with their counter analyses, are shown in **Table 12,** *Split Samples Collected For Verification Of Wetlands.* Duplicate ("replicate" in the WP) samples were collected at a frequency of ten percent during the course of the wetland verification sampling. The duplicates served three purposes, 1) to verify uniform distribution of contaminants in the sediments, 2) to confirm the efficiency of the field homogenization procedure, and 3) to determine the lab's capability for consistent and reproducible analyses. Each duplicate sample was prepared by removing aliquots of sample material from the pan in which it was mixed. The duplicate samples were collected from the same source, at the same time, and by the same team member. Duplicate samples received their own unique alpha-numeric number, and were submitted to the lab without being identified as a quality control sample. A total of forty-seven duplicate samples were taken during Phase II. The results were scrutinized upon receipt and if any anomalies were apparent, the lab was contacted for confirmation of results or re-analysis. The data for the duplicates did not indicate that field procedures or laboratory data was deficient. Duplicate samples, with their counter original samples, are reported on **Table 15,** *Quality Control/Quality Assurance Samples.* Original and duplicate samples are shown in the QA/QC code column as orig. and dupe., respectively.

3.7.3.6 Documentation

Information gathered during sample collection activities was recorded on the sample collection log, as shown in the WP. Field conditions, observations and field parameters were noted as appropriate for the matrix being sampled. Samples were identified by unique, sequential alpha-numeric numbers that were pre-printed in triplicate on tape. The sample numbers were attached to the lids and sample bottles, and the sample number was then written on the sample label. A Chain of Custody (COC) form was prepared to identify the sample to the lab with the requested analytical program specified. Each laboratory supplied their own forms to be completed. The original white copy of the COC accompanied the samples and the colored copies were kept on site in a three ring binder (**Appendix H**). The primary purpose of the COC is to document that the sample was maintained under secure conditions of the personnel responsible for the samples' integrity and possession. A Master Sample Log was maintained to show the status of each sample destination, sample location and to acknowledge receipt of any analytical data. A sample ledger was also kept to record all information available concerning each sample. The hardbound ledger was completed daily, and will be submitted for the USACE project files when the contract is completed. Sample data was maintained in an ORACLE® relational database.

3.7.4 Data Validation

Selected data for Phase II samples were validated by the project Senior Chemist, who was located at IT's regional office in Pittsburgh, PA.,as per requirements described in *Section 8.0* of the previously submitted QAPJP. Site validation procedures followed Level D validation outlined in "National Functional Guidelines for Evaluating Organic and Inorganic Analysis", US EPA 2/88 and 7/88.

3.8 Problems Encountered and Lessons Learned

Most of the problems encountered with the start-up and operation of the WTP at the OEC site were institutional in nature, as follows:

- The sheer size of this effort under a "Rapid Response" scenario presented numerous mobilization difficulties, and procurement/manpower requirements were somewhat underestimated. The nature of the Rapid Response Contract dictates that equipment and supplies be obtained quickly, and for immediate use. However, in this instance, there was a significant amount of material and equipment that had to be ordered, including valves, fittings, pipe, bolts, nuts, tools, raw materials, lumber, etc. Considering that the government requires three competitive bids on most purchases, plenty of lead time was required to accomplish the aforementioned task. Also, it took time to establish credit with key vendors, and most larger fittings/pipe were not immediately available, requiring a special order be placed. Timely procurement of equipment was further hampered due to the limited resource base in the geographic area. A special effort was often required to obtain even small items for that same reason. As a result, WTP start-up was delayed.

- The Delivery Order for Phase II was awarded on September 13, 1994 (please refer to Master Project Schedule, Table 2B), and Phase II development progressed while Phase I was being performed. Dredging and WTP bids were solicited from five other companies, in addition to the IT bid, with two responding (Mobile Dredging - high bid and McClaren Hart - low bid). The outside bids were evaluated thoroughly (one bid review is included in Key Correspondences, Appendix C), and USACE/IT determined them to be out of the competitive range. Due to the lengthy review process, a late award was then made to IT, allowing very little time for proper planning of Phase II.

- The budget for engineering was minimal for a project of this magnitude, and some critical areas could not be addressed in advance (ie., material take-offs, pipe routing diagrams, etc.). As a result, items were addressed in the field, at additional time and cost.

- Some equipment obtained from the IT equipment storage yard (clarifier, pumps, meters) was not fully operational when it arrived on-site. The clarifier was dropped during delivery and required onsite repairs (legs/frame), and some pumps were not suitable for this application. Required repair/replacements were made at no cost to the government.

- Due to the complex nature of the project, and the treatment requirements imposed on the site, it was difficult to tailor the system to maximize efficiency.

Once these difficulties were resolved, the operation of the water treatment system proceeded with little difficulty. All water was effectively treated, with the only exception being the cadmium problem. Otherwise the treatment process was well executed. This was an achievement, considering the plant was operated on a continuous basis (24 hour per day, 7 days per week) and required a significant amount of oversight (necessary because the system, by design, included minimal instrumentation).

The operation of the dredges/filter presses was problematic from the start (details are included in previous sections of this report (3.3 and 3.2.3). The combination of silty clay and sands is a difficult matrix to manage.

Some lessons were learned, as follows:

- The pump recirculation system served only to fluidize the lite materials, while the heavy sands clogged the holding tanks. Mixing tanks would have served much better in this application.

- The fine silty material blinded the filter cloths almost instantly, greatly increasing the cycle times. In retrospect, material pre-conditioning with lime or polymer may have increased efficiency.

- When looking into available technologies, budgeting time to plan and procure may have alleviated some related problems which were experienced in the field.

Finally, frozen pumps, hoses, tanks and amphibious equipment tracks were commonplace during the cold winter months. Some lessons learned are as follows:

- Dewatering efforts should have been performed with hard pipe (PVC, drainage culvert, or otherwise), sloped to a point to facilitate drainage. As it was, the soft discharge hose had too many low points over the uneven terrain. When a portion of hose froze, the ice built up quickly in the entire line. Also, small wooden sheds should have been constructed to keep pumps out of the elements. The heat generated from the pump motors/exhaust would have been sufficient to keep most connections from freezing.

- Tarps, radiant heaters, and a wooden base should be used to keep heavy equipment tracks from freezing in cold temperatures.

- Storage tanks with heating elements, and/or heat pumps should have been installed in the tanks prior to the onset of winter. (NOTE: An initial effort was made to find tanks that were both epoxy lined, and heated. However, these units were difficult to locate. Since the project was initially scheduled to be completed before a hard freeze, efforts were discontinued).