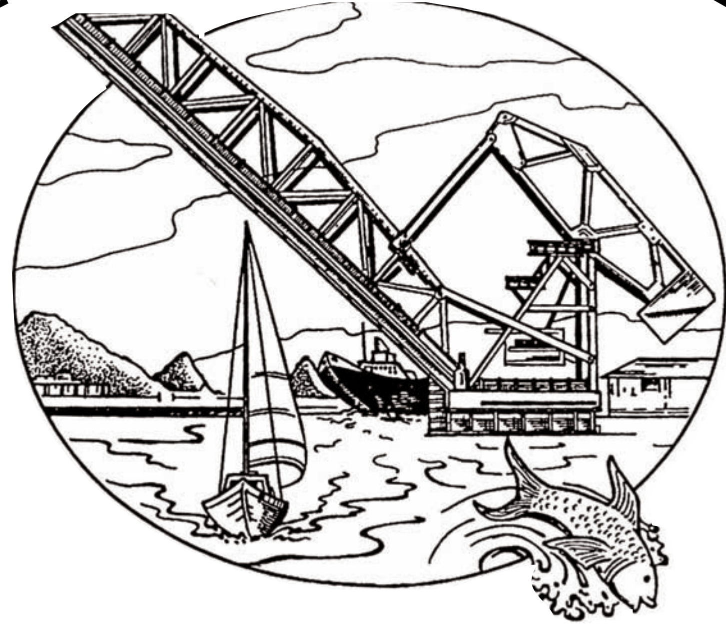
ASHTABULA RIVER PARTNERSHIP



Part of the Solution

Ashtabula River & Harbor • Ashtabula, Ohio

Final

Comprehensive Management Plan

Volume 2 of 2 • Comprehensive Management Plan Technical Appendices

June 2001

Remedial Actions for Environmental Enhancement and General Navigation, Dredging & Disposal of Contaminated Sediments

United States Environmental Protection Agency
Region 5

Ohio EPA

US Army Corps of Engineers
Buffalo District

U.S. Fish & Wildlife Service
Department of the Interior

Remedial Action Plan
Ashtabula River

VOLUME II: TECHNICAL APPENDICES

VOLUME II: TECHNICAL APPENDICES (cont.)

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

ASHTABULA RIVER PARTNERSHIP STRUCTURE

ASHTABULA RIVER PARTNERSHIP

Background

The lower Ashtabula River and Harbor was designated an Area of Concern (AOC) in 1985 by the International Joint Commission (IJC), characterizing it as a area with impaired beneficial uses and environmental degradation. Along with such designation, a Remedial Action Plan (RAP) for restoring beneficial uses is to be developed for each AOC. Stage One of the RAP for Ashtabula was completed by the Ashtabula RAP Advisory Council and Ohio EPA in 1991, and approved by the IJC. Contaminated sediments in the Ashtabula River and Harbor contributed to a fish consumption advisory, reduced recreational boating and commercial shipping, habitat loss, and biota impacts. Removal of these sediments will be the key to environmental remediation and beneficial use restoration.

Only limited dredging of the Ashtabula River has been possible due to the contamination that precludes open water disposal. Interim dredging of some top layers of sediment in the Ashtabula River occurred in 1993; however, a permanent location for these dredge spoils needs to be confirmed. Outer Harbor sediments, although less contaminated, may require confined disposal in the future. U.S. Army Corps of Engineers (USACE), with the authority for maintaining the navigation channel, is considering building a confined disposal facility for housing harbor sediments.

Additionally, contaminated sediment disposal is an issue at Fields Brook, an active Superfund site within AOC. Fields Brook is a tributary of the Ashtabula River, and is heavily polluted and considered a source of downstream contamination. The Superfund program is considering sediment remediation alternatives and is encountering similar contaminated sediment disposal issues.

Realizing these common objectives, the RAP Advisory Council convened a meeting in January 1994 to discuss forming a partnership to be made up of the diverse community interested in Ashtabula River and Harbor sediment remediation. The possibility of a cooperative project to address common sediment disposal issues could provide a more comprehensive and efficient solution.

ASHTABULA RIVER PARTNERSHIP

CHARTER

The Ashtabula River Partnership is dedicated to the goal of exploring how to effectively remediate the contaminated sediments in the Ashtabula River and Harbor. To achieve this goal, the Partnership has developed this Charter which outlines the premise of the Partnership and indicates the commitment of all of the involved Partners to achieve the common purpose of remediation.

Our goal is to look beyond traditional approaches to determine a comprehensive solution for the impairment of beneficial uses posed by the contaminated sediments not suitable for open lake disposal.

The signatories plan to develop a consensus-based partnership that will do the following:

- Define contaminated sediments to be addressed. This will be done utilizing the existing data on sediment contamination and any additional data that may be determined necessary.

- Develop a detailed plan for sediment remediation. To devise this plan, the Partnership will explore the various potential options for remediation and sediment disposal and advance an environmentally sound and efficient solution.

- Identify resource needs for implementation. A project of this scope is expansive and requires significant resources to realize. No one party can reasonably sponsor the entire project.

- Generate a timeline of milestones and activities. This timeline will provide a framework for the Partnership and allow the Partners to evaluate the effectiveness of the project.

The following, by signing this Charter, agree to volunteer their time, resources, knowledge, technical skills, and best efforts, to the extent of their ability, to forward the goals of the project. This commitment will include attending meetings, participating in document development, and planning for the implementation of the ultimate remediation strategy. This Charter is a public statement of intent designed to foster good faith among the parties; it is understood and agreed by the undersigned that this Charter shall not legally bind anyone or any organization to this or any other agreement. This agreement does not limit or in any way restrict the statutory or contractual obligations of the signatories in carrying out their private and/or public responsibilities.

Charter Member Signature: ______________________________________

Type or Print Name: ____________________ Date: ________________

Organization: ______________________

ASHTABULA RIVER PARTNERSHIP

Committee Goal Statements

1. **Coordinating Committee**
The Coordinating Committee is a group of representative Partners which meets on a monthly basis. The functions of the Coordinating Committee include:
- review and approval of the work of standing work groups,
- setting and monitoring of schedules of the work groups for the sake both of timeliness and of coordination with other Partnership activities,
- coordination of activities of the work groups and serving as a point of contact for the transfer of information between the work groups,
- rendering day-to-day decisions regarding the operations of the work groups an of the Partnership in general, and
- reporting to the full Partnership on a quarterly basis to provide information and to get approval for final work group projects.

2. **Siting Committee**
The purpose of the Siting Committee is to locate an appropriate sites (or sites) for a multi-use upland disposal facility to contain the dredged contaminated sediments. The committee will accomplish this goal by undertaking the following tasks:
- review and revision of criteria for evaluating candidate sites,
- review of historical information on candidate sites (e.g., USACE 1987 EIS),
- identification of new candidate sites,
- evaluation of all candidate sites according to established criteria,
- selection of the disposal site and reporting of the selection process to the Partnership in a manner commensurate with the USACE EIS process.

3. **Project Committee**
The purpose of this committee is to develop the dredging project plan. This will involve several tasks, such as determining the scope of the project and the design criteria for a disposal facility.

The initial task of the Project Committee is to generate sediment volume data to be used in generating a series of volume estimates for designing the dredging project(s):
- review of existing sediment volume information,
- evaluation of existing volume data sufficiency and proposing additional volume estimate investigation,
- initiation of any supplemental volume investigation,
- generation of volume estimate(s) for distinct reaches and depths within the project area and reporting to the Partnership in terms commensurate with the USACE EIS process.

This committee will also develop design criteria for any disposal facility:

- determination of applicable federal, state, and local construction and design requirements,
- characterization of sediment for determining disposal design criteria and disposal options (e.g., TSCA, RCRA),
- generation of final design criteria for a multi-use disposal facility and reporting to the Partnership in terms commensurate with the USACE EIS process.

4. **Outreach Committee**

The purpose of this committee is to provide information to the community and to the partners, as well as to recruit new members:

- creation of potential partners list,
- development of strategies for community/partnership relations,
- forwarding facts sheets to Partnership mailing list,
- reporting to Partnership on a quarterly basis.

5. **Resources Committee**

The purpose of this committee is to develop the resources necessary to implement the Partnership project. Resources include services, equipment, land, as well as short- and long-term funding:

- development of a list of projects or tasks requiring funding (feedback from other committees),
- development of a budge and list of resources needed for each project or task,
- development of an asset-management strategy for the Partnership (e.g., bank account, trust fund, 501(c)(3) status),
- development of a plan for obtaining needed resources and funds,
- reporting to Coordinating Committee.

ASHTABULA RIVER PARTNERSHIP

BYLAWS

Article 1 - Name and Purpose

This organization will be known as the Ashtabula River Partnership. The Partnership has been formed for the purpose of exploring how to effectively remediate the contaminated sediments in the Ashtabula River and Harbor. The Partnership will look beyond traditional approaches to determine a comprehensive solution for the impairment of beneficial uses posed by the contaminated sediments not suitable for open lake disposal.

Article 2 - Membership

2.1 Composition

The Ashtabula River Partnership, hereinafter referred to as the "Partnership," shall be composed of representatives who have a common interest in accomplishing the goal of the Partnership as defined in its Charter. Signing the charter is a condition of membership.

2.2 Resignations

Shall be written and acknowledged for documentation in the minutes at the next regularly scheduled Partnership meeting.

Article 3 - Leadership

3.1 General Powers

The Partnership shall be managed by the Coordinating Committee.

3.2 Leadership

The Coordinating Committee of the Partnership shall be the Standing Committee Chairs, and/or representatives from Ohio EPA, US EPA, Ohio 19th District Congressional office, US Army Corps of Engineers, Ashtabula River Remedial Action Plan Council, and other individuals as agreed by the membership and shall be limited to fifteen (15) active members. (An active Committee member or their qualified representative can miss no more than two (2) consecutive scheduled Committee meetings.)

3.3 Election

Election of the Committee Chair shall take place at the regular committee meeting in March of each year. The Chairs shall be elected annually by the Committee members.

3.4 Vacancies

Vacancies of the Committee Chair shall be filled by a vote of the Committee members for the remainder of the unexpired term.

3.5 Duties of Officers

3.5.1 Coordinating Committee Chair

The Chair shall preside at all meetings of the Partnership and Coordinating Committee, sign the records thereof, and perform generally all the duties usuall incident to such office and such other and further duties as shall be from time to time required by the Partnership and Coordinating Committee.

3.5.2 Chairs of the Siting, Project, Outreach, and Resource Committees

These Chairs shall select among themselves a Chair Pro Tempore and perform all the duties of the Coordinating Committee Chair in case of the absence or disability of the latter, and shall also perform such other duties as shall be from time to time required of the Coordinating Committee Chair by the members. In addition, these chairpeople shall be responsible for submitting and attesting minutes and status reports of their respective committee meetings to the Coordinating Committee Chair within seven days following such meetings. In the event that all Committee Chairs are absent or unable to perform their duties, the members may, as the case may be, appoint a Chair Pro Tempore.

3.5.3 Secretary

The Secretary shall be appointed by the Coordinating Committee Chair, and shall be responsible for preparing and distributing all external communications of the Partnership. Such communications shall be reviewed and approved by the Chair in advance of external distribution. The Secretary shall keep minutes of all Partnership and Coordinating Committee proceedings of the members and make a proper record of the same which shall be attested and submitted by the Secretary to the members of the Partnership and Coordinating Committee respectively, within seven (7) days following the meeting. The Secretary shall generally perform such other duties as may be required by the members. At the expiration of the term of office, the Secretary shall deliver all books, records, and property of the Partnership to the successor or to the Coordinating Committee.

Article 4 - Committees

It is anticipated that, from time to time, ad hoc committees and possibly other standing committees will be appointed and approved by the Coordinating Committee.

Article 5 - Meetings

5.1 Notice of Meetings

Notice of all Partnership meetings shall be given at least seven days before the date of such meeting to each member by mail or fax at their last known address, and all such notices shall state the time, place, and purpose of the meeting. Partnership and committee meetings should be held at a frequency to ensure schedules and goals of the Partnership are met, but not less than semi-annually for the Partnership and quarterly for committees. Any member may waive any notice required under these regulations, and by attendance at meetings, shall be deemed to have waived notice thereof.

5.2 Special Meetings

Special meetings may be called from time to time in accordance with Section 5.1, Notification above, exclusive of the seven day advance notice with the concurrence of the Coordinating Committee.

5.3 Quorum

A quorum shall consist of no less than ten (10) members for Partnership meetings, and three (3) members for committee meetings.

5.4 Method of Voting

Partnership decisions requiring membership input shall be made by majority vote and only by members each having one vote. Standing committees (Project, Resource, Siting, and Outreach Committees) shall vote on issues as necessary with majority vote ruling. An affirmative vote will require a corresponding recommendation to the Coordinating Committee, which shall in turn vote to accept or reject the Standing Committee recommendation with a majority vote ruling. Issues and recommendations brought before the Coordinating Committee which, in the Committee's opinion, requires a Partnership decision, shall be brought before the Partnership members for consensus.

5.5 Minutes

Minutes shall be recorded and voted on for approval in the next regular meeting. Minutes shall serve as an official record of the Partnership.

Article 6 - Miscellaneous

Article 7 - Amendment of Bylaws

These Bylaws may be amended, suspended, repealed, or superseded, in whole or in part, only by a majority vote of no less than two-thirds of the members.

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B

FEDERAL PROJECT
AUTHORIZATIONS AND PAST STUDIES

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B

FEDERAL PROJECT AUTHORIZATIONS AND PAST STUDIES

1. PROJECT LOCATION

a. Ashtabula Harbor is on the south shore of Lake Erie, at the mouth of the Ashtabula River. The harbor is 59 miles northeast of Cleveland, Ohio and about 37 miles southwest of Erie, PA.

b. Communities near the Ashtabula Harbor include the City of Ashtabula and the six surrounding townships of Ashtabula, Austinburg, Kingsville, Plymouth, Saybrook and Sheffield. These seven communities represent 43 percent of the approximately 100,000 residents of Ashtabula County.

c. The City of Ashtabula is situated on the East and West Bank of the Ashtabula River, near its mouth. A portion of the city is located in Ashtabula Township and a portion in Saybrook Township.

d. The Ashtabula River drainage basin covers approximately 137 square miles. Contained within this drainage basis is the highly industrialized Fields Brook watershed which is believed to have been the major source of pollutants to the Ashtabula River sediments.

2. PROJECT AUTHORIZATION

The project, as currently maintained, is authorized by Section 103 of the Rivers and Harbor Act of 1965 (Area E, House Document Numbered 269, Eighty-ninth Congress), Section 101 of the Rivers and Harbor Act of 1960 (Areas A, B, C, and D, House Document Numbered 148, Eighty-sixth Congress), Section 2 of the Rivers and Harbors Act of 1945 (That portion of Area G above the Turning Basin, House Document Numbered 321, Seventy-seventh Congress), and Section 1 of the Rivers and Harbors Act of 1937 (Areas F and G, House Document Numbered 78, Seventy-fourth Congress). The requirement for local cooperation are as follows:

a. Area E (H.D. 269, 89th Cong.):

1). Hold and save the United States free from damages due to the construction and maintenance of the improvement; and

2). Provide and maintain, without cost to the United States, depths in berthing areas adjacent to the east outer harbor piers and the access thereto commensurate with the depths provided in related project areas.

b. Area A, B, C, and D (H.D. 148, 86th Cong.):

1). Hold and save the Unites States free from damages due to the construction and maintenance of the improvement; and

2). Provide and maintain, without cost to the United States, access channels and berthing area adjacent to piers and docks to depths commensurate with the depth of the Federal project, and provided further, that no dredging shall be done by the United States within 50 feet of any wharf, dock, bulkhead, or other structure.

c. Area G, that portion above the Turning Basin (H.D. 321, 77th Cong):

1). Give assurances satisfactory to the Secretary of War that they will deepen to a like depth and maintain the area between the channel and bulkhead; and

2). Hold and save the United States free from claims for damages resulting from the improvement.

d. Areas F and G (H.D. 78, 74th Cong.):

1). No dredging shall be undertaken in the 18- and 16- foot depth sections of the river channel until local interests have provided adequate bulkheads for channel protection, or released the United States from all claims for damages to riparian property that may occur in carrying out the channel improvement.

3. **EXISTING PROJECT**

The existing Ashtabula Harbor Federal project is 100 percent complete. An overview of the Federal harbor's major project components follows:

1). An outer harbor, an area of about 185 acres, protected by east and west breakwaters, Figure 2.

2). An entrance channel from deep water in lake Erie, 29 feet in soft material and 30 feet in hard material, Area A.

3). A navigation channel generally 1,100 feet wide through the outer harbor, parallel to and 100 feet from the west breakwater, extending from the entrance channel to just opposite the inner breakwater, 28 feet in soft material and 29 feet in hard material, Area B;

(4) A navigation channel extending from inside the inner breakwater to Conrail's Minnesota slip and also to a point 2,000 feet upstream from the mouth of the Ashtabula River. This area is 27 feet in soft material and 28 feet in hard material, Area C;

(5) Deepening and enlarging of turning basin in easterly portion of outer harbor to depths of 22 feet in soft material and 23 feet in hard material;

(6) In the outer harbor, a 700 foot access channel leading south-eastward from the harbor channel and terminating in a basin having a width of 1,200 feet and a length of 1,500 feet, all dredged to a depth of 28 feet in earth and 29 feet in rock, Area E;

(7) A channel in the Ashtabula River upstream of the terminus of the lower 27 foot deep channel, to a depth of 18 feet to the upper car ferry slip, Area F, continuing with a channel 16 feet deep to a point 1,550 feet upstream of the turning basin;

(8) All depths are referred to Low Water Datum for Lake Erie, elevation 568.6 feet above mean water level at Father Point, Quebec (International Great Lakes Datum, 1955);

(9) A Major Rehabilitation project was completed in Fiscal Year (FY) 82 on the Breakwaters. Approximately 3,200 linear feet of the west and 3,700 linear feet of the East Breakwaters were rehabilitated utilizing a rubble-mound stone design. In addition, the East Breakwater head-section was repaired.

Dredging of the Outer Harbor Areas (portions of Area C and the total of Areas B, D, and E) will continue to proceed with disposal of sediments containing less than 1 ppm PCB's in open-lake areas.

To date, the Buffalo District does not have an environmentally acceptable disposal facility for the polluted sediments that needs to be dredged from the Federal navigation channel to maintain the required depths. The restrictions on dredged material disposal have prevented the District from maintaining adequate river navigation depths and, more significantly, is anticipated to restrict the commercial operations in the lower river, and possibly, the Outer Harbor, as the polluted sediments are anticipated to migrate and move downstream.

The last contract to dredge approximately 100,000 CY from completed the Ashtabula Harbor and lower river (downstream of River Station 120+00), which included open lake disposal, was awarded August 17, 1994 and the Notice to Proceed (NTP) was issued September 7, 1994 with dredging completed 31 October 1994.

Buffalo District had dredged portions of the Ashtabula River, upstream of the Fifth Street bridge and above -6 feet LWD in the channel and -4 feet LWD in the upper turning basin, in 1993. This interim dredging was authorized on a one-time basis. A temporary upland disposal site for the upper river dredgings, provided by a City of Ashtabula owned lease, was located and and a containment facility was constructed on Conrail property with onsite materials, adjacent to the river south of Slip 5A. The lease the City has with Conrail requires that the dredged sediments are to removed to a permanent site, after allowing time for material drainage and consolidation for easier transport to the permanent site.

Dredging of either Ashtabula Harbor or River beyond 1997 will be dependent on environmental constraints sediment quality and acceptable disposal area. If USEPA/OEPA disallows open-lake disposal of harbor/river sediments, maintenance dredging will need to be discontinued until a Confined Disposal facility (CDF) is available.

4. **PREVIOUS REPORTS**

The following is a sequence of reports addressing the design/construction of a confined disposal facility (CDF) at Ashtabula Harbor, Ohio for the harbor/river sediments presently classified as polluted and not acceptable for open-lake disposal.

a. Construction of Confined Dredging Disposal Area, Ashtabula Harbor, Ohio, - Alternate Studies prepared by Tippets-Abbett-
McCarthy-Stratton for Buffalo District, December 1974. A synopsis of this report is as follows:

- Study describes 2 alternative CDF designs with location outside harbor's east breakwater (Site No. 3 as identified in this letter report).

- Design for steel sheet pile cellular structure or zoned stone embankment (rubblemound) designed for containment of 1,400,000 CY of sediments to be dredged over a 10-year period.

- Zoned embankment recommended based on lower costs (construction costs for zoned embankment was $12.6 million versus $13.5 million for the steel sheet pile structure, 1974 price levels).

- No overflow structure required to decant excess water/drain sediments due to permeability of the stone design.

b. Construction of Confined Dredging Disposal Area, Ashtabula Harbor, Ohio - Letter Report Buffalo District, January 1975. A synopsis of this report follows:

- Incorporated designs and recommendations for CDF per Tippets, et al report.

- USEPA 1974 sampling/testing classified bottom river sediments as "grossly" polluted and harbor sediments were considered less polluted.

- Hopper dredges to be used.

- After construction of CDF, open lake disposal to be discontinued.

- Along with proposed site, 13 other alternative sites studied including several upland sites, sites within the harbor area and alternative site on lake side of the east breakwater were reported on West breakwater site rejected based on proximity to public beaches and city water intakes. Other sites rejected based on objections by local property owners and insufficient capacity.

- Ecological considerations strongly favored rubblemound dike type construction.

- Report presents construction sequence for CDF, total first cost $13.0 million (1974 price levels), and items of local cooperation.

c. Ashtabula Harbor Letter Report and Appendices, Buffalo District, December 1983

- Examines 19 potential sites/disposal options and settling/leachate tests of river/harbor sediments.

- Suspended sediment levels or weir overflow should be able to be maintained at about 50 ppm or less given 16 to 24 hour settling. Properly managed suspended sediment removal will effectively prevent heavy metal and organic pollutant discharge as these pollutants are chemically bonded with suspended sediments.

- The column leachate tests indicate that barium would be the only heavy metal pollutant that might be contained in the leachate from an upland disposal site at concentrations approaching the Federal primary drinking water standard of 1 ppm. Of the 16 organic compounds analyzed in leachate, only 1,3

Dichlorobenzene and Chlorobensenes are apt to consistently appear at detectable levels within the leachate. A clay liner coupled with a leachate collection system will practically eliminate leachate from contaminating an aquifer. PCB's not detected in leachate.

- Of the 19 original alternatives studies, the report examined 4 alternatives in detail.

- The selected plan (Alternative IV in the December 1983 report) was recommended based on it being considered the National Economic Development (NED) Plan, providing a secure containment site for toxic/heavily polluted materials and acceptability to all parties (Federal, state, local and private) involved in the study area.

- The plan consisted of dredging by a special watertight clam bucket, sediment placement in scows and transport of same to a land-based transfer facility, and sediment transferred to/transported by truck to contractor furnished toxic containment facility.

- The detailed design is discussed in Paragraph 4.d.

d. Ashtabula Harbor Design Analysis, Buffalo District, November 1984, Ashtabula Harbor, Ohio Final Environmental Impact Statement, Buffalo District. Detailed design consisted of the following main elements:

- Dredging using a special enclosed clam bucket to minimize pollutant dispersement.

- Dredged material would be placed on scows and transported to a specially designed transfer facility to prevent loss of contaminants.

- On Government furnished lands, the contractor would construct transfer facilities for dewatering and treating dredged material.

- Dredged material would be removed from scows and processed through the facility.

- Effluent meeting water quality standards would be returned to the natural waters.

- Remaining sediments would be loaded onto trucks and hauled to an upland disposal facility.

- The contractor would provide the required toxic containment facility for the sediments dredged. This included furnishing all lands and obtaining all permits necessary to properly contain the polluted and toxic sediments dredged from the river.

- After all dredged material is deposited in the CDF, the transfer facilities would be demolished and also placed in the CDF.

- Staging area includes drainage system, decontamination facility, settling basin and filter cells and is designed to prevent release of contaminant to the environment.

- If effluent suspended solids concentration > (greater than) 50 ppm, the contractor would either add polymers to settling basin inflow or effluent will be passed through filter cells containing anthracite and sand.

- Design of haul roads.

- Temporary dredged material storage facility to account for time differences between dredging operation/transfer and trucking (basin holds 4,000 CY, equivalent of 1 day of dredging volume, includes 25,500 CF/day of supernatant).

- Pumps provided to move water.

- Dredging to start at most upstream end deep enough to accommodate dredging equipment (Areas F and G). Turning basin not to be dredged until Superfund work on Fields Brook is completed.

- Schedule 6 months for construction of staging area and disposal facility and 6 months for dredging operation.

- Project costs of $10.9 million (1983 price levels) with BCR of 3.57.

e. <u>Ashtabula Dredging and Confined Disposal - Summary Report - Dredging of the Ashtabula River</u>, Buffalo District, November, 1988:

- Update of December 1983 Letter Report, includes revised project cost estimate of $25.1 million (June 1988 price levels) based on all new environmental restrictions involved in disposal of toxic materials; BCR - 1.20.

- River sediments USEPA tested/classified (toxic or heavily) polluted, not acceptable for open-lake disposal. USEPA has prevented government dredging of river due to polluted classification of sediments.

- Report studies economic incremental approach to dredging.

- Sediment transport simulations conducted using HEC-6, "Scour and Deposition in Rivers and Reservoirs," were performed to determine dredging intervals for each of the alternatives: Commercial navigation (-20 ft LWD) - 5 years; combined commercial/recreational navigation - 7 years; total clean-up - 25 years.

- USEPA has objections to the incremental plan since it would possibly resuspend heavily polluted/toxic sediment and/or expose lower depths/layers of heavily polluted/toxic sediments to the water column.

- Report further recommends one time clean-up plan.

f. The Buffalo District, under its general Operations and Maintenance (O&M) authorities, had prepared a Letter Report and Draft Environmental Impact Statement (DEIS) for a CDF, dated December 1992, to contain sediments dredged from the harbor and river that are unsuitable for unresticted open lake disposal but not classified toxic as determined by the Toxic Substance Control Act (TSCA) (sediments that contain PCB levels below 50 part per million (ppm)). The reports presented the preliminary design, cost estimates, environmental and economic analyses for three alternative CDF sites and various volume capacities. The new CDF would be the first constructed for Federal navigation channel/harbor maintenance dredging operations in Ashtabula. The CDF recommended for further study/design would be located approximately three miles east of Ashtabula Harbor along the lakeshore and have a capacity for 2,300,000 cubic yards (CY) of dredged materials (20 year project life). In conjunction with the Letter Report, Buffalo District conducted the necessary geotechnical field investigations for the recommended site. The District had expended between $500,000 and $600,000 for the preparation of the Letter Report and subsequent geotechnical investigations.

In addition, the District prepared a "Report of District Position of Funding Confined Disposal Facility, Ashtabula Harbor, Ohio," dated October 1992, addressing non-Federal cost sharing of CDF's. The report for Ashtabula Harbor was submitted by North Central Division (NCD) to the Office of the Chief of Engineers (OCE) for review/comment/guidance.

Presently, Buffalo District, as directed by NCD, has halted any further preparation of the Letter Report/DEIS or project design pending OCE guidance on non-Federal cost sharing of the CDF.

g. Buffalo District prepared (at a cost of $26,600) a report addressing Environmental Dredging, authorized by the Water Resources Development Act of 1990, Section 312. Per North Central Division memorandum dated 27 January 1995, inhouse discussions determined that Section 312/Environmental Dredging authorities are not applicable and that the Corps can participate in the preparation of a comprehensive management plan to address the ARP goal of complete sediment remediation. North Central approved the study's cost sharing by 3rd Endorsement dated June 29, 1995. Buffalo District, using funds made available from USEPA, OEPA and the General O&M Program, has taken the lead/project management role in the preparation of the ARP's feasibility level study, to include a Comprehensive Management Plan (CMP) and Environmental Impact Statement (EIS) presently estimated to cost $1,800,000, to address overall sediment remediation and required cost sharing to fund the project's effort.

The overall success of the Partnership effort will be dependent on the involvement of all other partners. Their commitment of available resources and collectively taking ownership of the conclusions/recommendations resulting from each study or design stage (report) is important. The Buffalo District is only one of the ARP's partners and is totally dependent on full partnership involvement/commitment to fulfill its task as the project manager in preparing the CMP/EIS.

h. Fields Brook Responsible Parties Organization (FBPRPO)

As stated in a letter dated November 16, 1995 from Steven C. Johnson, Director of Purchasing, Olin Chemicals, the FBPRPO has expended $2.2 million to sample and test the sediments in the Ashtabula River in 1990. These results were used to augment the 1995 sediment sampling/testing being performed by the ARP. A list of the companies that contributed to the 1990 FBPRPO sediment sampling/testing program are as follows:

Cabot Corporation	Centerior Energy Corporation
Detrex Corporation	Elkem Metals Company
GenCorp, Inc.	Mallinckrodt Group
Occidental Chemical	Ohio Power Corporation
Olin Corporation	Viacom International
RMI Titanium Company	SCM Chemicals
Sherwin Williams Company	Union Carbide Corporation
Consolidated Rail Corporation	

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C

ASHTABULA RIVER SEDIMENT SAMPLING AND ANALYSIS OF EXTENT OF CONTAMINATION

PREPARED BY:

Environmental Engineering Section
U.S. Army Corps of Engineers, Buffalo District
August 1997

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LIST OF ACRONYMS

ARP	Ashtabula River Partnership
COE	Corps of Engineers
GLNPO	USEPA Great Lakes National Program Office
GMS	Groundwater Modeling System
GPS	Global Positioning Satellite
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
mg/kg	Milligram per kilogram
MRD	Missouri River Division
MS/MSD	Matrix Spike/Matrix Spike Duplicate
OEPA	Ohio Environmental Protection Agency
OVA	Organic Vapor Analyzer
PCB	Polychlorinated Biphenyl
ppb	Part per billion
ppm	Part per million
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
RPD	Relative percent difference
RSD	Relative standard deviation
TCLP	Toxicity Characteristic Leaching Procedure
TSCA	Toxic Substances Control Act
ug/kg	Microgram per kilogram
ug/l	Microgram per liter
USEPA	U.S. Environmental Protection Agency
WES	Corps of Engineers Waterways Experiment Station

1.0 PROJECT DESCRIPTION

1.1 Ashtabula River Partnership

The Ashtabula River Partnership (ARP) was formed with local, State and Federal agencies and local industries to study a basinwide solution to all the polluted sediment problems in the Ashtabula River and Harbor. An ARP Charter with the goal of sediment remediation or removal has been signed and endorsed by representatives from all concerned partners who will use available resources to implement overall partnership activities. This appendix is part of the Comprehensive Management Plan and Environmental Impact Statement for the proposed work in Ashtabula.

1.2 Project Objectives

The 1995 sampling of the Ashtabula River was conducted to determine how dredged sediments would be classified under the Toxic Substances Control Act (TSCA) and the Resource Conservation and Recovery Act (RCRA). Sampling locations were selected to fill data gaps from the Woodward-Clyde Study conducted in 1990 (Woodward-Clyde, 1992) and provide information on contamination outside of the navigation channel. Polychlorinated biphenyl (PCB) Sampling locations for the Woodward-Clyde Study and the 1995 Sampling are shown in Figure 1.1.

A determination of the RCRA characteristics of the river sediments was made by conducting Toxicity Characteristic Leaching Procedure (TCLP) analysis of the sediment for metals and volatile and semivolatile organics at selected hot-spots and comparing the results to regulatory thresholds listed in 40 CFR Part 261.24. Sample locations and depths were determined by selecting locations that had the highest potential for failing the TCLP based on earlier testing. Sediment samples were also analyzed for total metals, volatiles and semi-volatiles. Sample locations for RCRA classification are shown in Figure 1.2

The PCB sampling information was added to existing data from the Woodward-Clyde Study to make determinations on the levels and volumes of PCB contaminated sediments that would be regulated under the Toxic Substances Control Act (TSCA) upon dredging and disposal. A two-dimensional analysis of the data is presented in Part I of this appendix using Mapinfo® desktop mapping software. A three-dimensional analysis on the extent and volume of PCB contamination was done by the Corps of Engineers Waterways Experiment Station (WES) using the Department of Defense Groundwater Modeling System (GMS). The results of this study are included as Part II of this appendix.

GMS provides a comprehensive graphical environment for numerical modeling, tools for site characterization, model conceptualization, mesh and grid generation, geostatics and sophisticated tools for graphical visualization. Buffalo District used GMS to develop and evaluate different dredging scenarios for the Ashtabula River. The results of these analyses are presented in Appendix D.

The sample preparation for the 1995 Sampling was conducted by Engineering and Environment, Inc. (EEI), under contract with, and under the supervision of, the U.S. Army Engineer District Buffalo (Buffalo District). Samples were analyzed by Laboratory Resources, Inc., a subcontractor of EEI. Engineering and Environment's Final Report of October 1995 contains the details of the field sampling activities and analytical results. The sampling and analysis was conducted in accordance with the Quality Assurance Project Plan (QAPjP) dated June 1995 which was prepared by Buffalo District.

1.3 Purpose and Organization of this Appendix

The purpose of this appendix is to summarize the PCB and RCRA analytical data from the 1995 Sampling of the Ashtabula River and also bring together PCB sampling data from the 1995 Sampling and the 1990 Woodward-Clyde Study. TCLP data was not collected during the Woodward-Clyde sampling, so 1995 results could not be compared to earlier data.
The remainder of the appendix is organized as follows:

- Section 2 - Provides background information on the Ashtabula River.
- Section 3 - Contains an overview of the 1995 Sampling, including a summary of the PCB and RCRA results from the sediment samples.
- Section 4 - Combines and analyzes the PCB data for both the 1995 Sampling and the Woodward-Clyde Sampling.
- Section 5 - Summarizes the information presented in this appendix.
- Tab A - Includes a summary of the detectable PCBs from both the 1990 and 1995 Sampling Events.
- Part II - Contains a report on the extent and volume of PCB contamination in the river prepared by WES using GMS.

2.0 ASHTABULA RIVER BACKGROUND

The Ashtabula River basin is located in northeastern Ohio (Figure 2.1). The Ashtabula River enters Lake Erie at the city of Ashtabula, which is approximately 55 miles (89 kilometers) east of Cleveland, Ohio and 40 miles (64 kilometers) west of Erie, Pennsylvania. The Ashtabula River extends about 18 miles (29 kilometers) from the river mouth to the confluence of the East and West Branches, which are each about 12 miles (19 kilometers) long. The East Branch originates in extreme western Pennsylvania and flows northwest, and the West Branch begins in Ashtabula County and flows north. The Ashtabula River has a drainage area of about 136 square miles (352 square kilometers), and an average flow of 152 cubic feet per second (4.3 cubic meters per second) in the vicinity of the City of Ashtabula (OEPA, 1991). Major tributaries to the Ashtabula River include Fields Brook, East Branch, West Branch, Hubbard Run, Ashtabula Creek, and Strong Brook.

The existing Ashtabula Federal Navigation Project consists of two converging breakwaters protecting an outer harbor area in Lake Erie of about 0.3 square miles (0.75 square kilometers). The Federal channel in the river begins at the mouth and extends 1,549 feet (472 meters) upstream of the upper turning basin.

The Ashtabula drainage basin is located on the glaciated Lake Plain section of the central lowlands province. The topography of the basin is characterized by rolling hills with deep and narrow valleys. From an elevation of 1,033 feet (315 meters) above sea level in Richmond Township near the headwaters, the stream falls at an average slope of 11.6 feet per mile (2.2 meters per kilometer) to an elevation of 573 feet (174.65 meters) above sea level at Lake Erie (COE Buffalo District, 1983).

Discharges in the river basin have polluted the sediment within the Ashtabula River. The primary source of these pollutants appears to be past industrial discharges to Fields Brook, a tributary which joins the Ashtabula River in the vicinity of the upper turning basin. Dischargers to Fields Brook have significantly improved the quality of their effluents in recent years, but the sediments have become so contaminated that clean-up of the Brook is being addressed under the Superfund program. Fish and wildlife habitats in the Area of Concern have been degraded by alterations to the river, including modification to the shoreline such as bulkheading. Other potential sources of pollution to the Ashtabula River include landfills and other point and non-point sources. Eighteen industries and one municipal wastewater treatment plant discharge to the Area of Concern (Woodward-Clyde, 1992). Sediment testing in recent years has found that surficial sediments deposited more recently are generally less contaminated than in earlier years. (Buffalo District, 1994).

3.0 1995 SAMPLING

3.1 Sediment Sampling Procedures

Sediment samples were collected daily from 26 June 1995 to 2 July 1995 using a Rossfelder P-4 Vibra-corer aboard the USEPA Great Lakes National Program Office (GLNPO) R/V *Mudpuppy*. A 4 inch (10.16 centimeter) diameter aluminum tube with a butyrate core liner was used to collect the samples. The length of the tube which was used varied between 10 and 16 feet (3.05 and 4.88 meters) depending on the water depth and projected depth of sediment. A second boat was used to transport the samples back to shore to the sample preparation area at Jack's Marine (Figure 3.1). The following procedures were used for each vibracore sample.

- The captain maneuvered the boat as close as practical to the location identified in the QAPjP. The vessel was then triple anchored and the actual sampling location was recorded from the Global Positioning Satellite (GPS) system.

- The depth of the water was measured and an appropriate tube length was selected. A butyrate core liner was inserted into the core tube and the nose cone was attached with rivets. The assembly was then inserted into the vibrating head.

- The entire assembly was lowered into the water until the sampling tube reached the sediment water interface. At that time the vibrating unit was turned on and vibrated at a frequency of 3,600 cycles per minute.

- When the vibra-corer ceased penetrating or the vibrating head was near the sediment surface, the depth to the top of the vibracore unit was measured to determine the depth of sediment penetration. After this was documented, the winch was reversed and the unit was pulled to the surface.

- While the tube was still vertical, the recovery length of the sample was measured, the core liner was cut to the length of the recovered sediment sample and both ends of the core liner were covered with a red cap plug. Duct tape was used to secure the caps to the liner.

- Each core was then labelled with an arrow showing the top of the core, the station number and the elevation, relative to low water datum, of the top of the core and the bottom of the core. For samples where the recovery length was greater than about 6 feet (1.83 meters), the core was cut in two on the boat and each section of the core labelled as described above.

- A sampling team member would radio the station number and sample top and bottom elevation to the onshore sampling crew so that sampling containers and labels could be prepared.

- Sampling location, length of sampling tube, depth of water, depth to refusal, sediment penetration depth, recovery length of sample, and the elevation of the top and bottom of the core relative to Low Water Datum were recorded in the field notebook. Figure 3.2 shows how these parameters were measured.

- The core was then offoaded and transported by the support boat to the sample preparation area at Jack's Marine.

- Once the core was received on shore, the station number and core top and bottom depths were recorded in the sampler's field notebook. The core was cut, using a hacksaw, into the desired sampling intervals, as directed by the Project Engineer. The length of the intervals to be sampled varied at times from those defined in the QAPjP based on the recovery length of the sediment core.

- Water that drained from the core, when the end cap was initially removed, was collected and returned to the river. Once a given core segment was cut, it was sliced down the middle using a utility knife, screened with either an Organic Vapor Analyzer (OVA) equipped with Flame Ionization Detector (FID) and/or a Photoionization Detector (PID), sampled for volatiles (as necessary), photographed, and had a physical description of the sediment profile recorded. Following this procedure, composite or discrete samples were taken.

3.2 Polychlorinated Biphenyls (PCBs)

3.2.1 PCB Sample Collection

Samples were collected from forty-one locations including one field duplicate core in the Ashtabula River as shown in Figure 1.1. Each core length recovered was cut into either one or two foot segments. One foot segments were collected for all samples under 5 feet (1.524 meters) in length. Additionally, several cores longer than 5 feet (1.524 meters) in length were cut into 1 foot (0.305 meter) segments because of field observations. This was generally done in areas with suspected high contamination, as evidenced by a strong odor, or unusual sediment striations. Each sample was comprised of at least ten aliquots from various areas of the composited material. Table 3.1 lists the sample station numbers, their respective coordinates (NAD 83), the number of samples per sample station, and the number of QA/QC samples collected for the PCB sampling.

3.2.2 PCB Analytical Results.

Polychlorinated biphenyls (PCBs) analyses for sediment samples were conducted using Method 8080 as cited in USEPA SW-846. Detections for total PCBs in the sediment samples ranged from 0.066 mg/kg to 160 mg/kg. No detectable levels of PCBs were found in samples from Station Number 192-A. The predominant PCB Aroclor detected was Aroclor 1248 and the mean concentration for total PCBs was 14.2 mg/kg, including the QA and QC samples.

In order to show the horizontal distribution of PCBs in the River, Mapinfo® was used to graphically display the sampling results. Figure 3.3 shows the maximum and the mean concentration of PCBs for each sampling site. Figure 3.4 is a thematic map that graphically displays the sampling results. The area of the circle around each sampling point correlates to the magnitude of the PCB concentration. All locations have concentric circles since samples were taken with depth at each sampling location. There are multiple analytical results at some depths because QA/QC samples were taken as shown in Table 3.1. The map also shows TSCA contamination levels (>50 mg/kg PCBs) in red, while non-TSCA levels are in green.

The maximum PCB concentrations are located near the confluence of the Fields Brook and the Ashtabula River. No PCBs were detected from the sample located furthest upstream in the River, Sample Station Number 192-A. In general, PCB concentrations decreased with distance downstream, although there were some exceptions. These areas of higher concentration further downstream are likely associated with sediment depositional areas that have collected sediment over the years.

The vertical extent of contamination in the Ashtabula River is depicted in Figure 3.5. This figure shows the depth at which sediment was collected with a shaded area. The level of PCB contamination at each depth is shown inside the box, with TSCA contamination levels shown in a darker shade. The depth shown on the side of the figure is relative to low water datum. The top elevation on the chart is 3 feet (0.914 meters) above LWD which was about the average elevation of the water surface during the sampling. For samples that were composited over a two foot interval, the analytical value is shown at each 1 foot (0.305 meter) interval.

TABLE 3.1 PCB SAMPLE STATIONS AND QA/QC

Sampling Date	Sample Coordinates	Sample Station	No. of Samples	QA/QC Samples		
				No. of Duplicate	No. of QA Splits	No. of MS/MSD
25 June 95	41 53.3867 N 80 47.8886 W	192-A	2	-	-	-
25 June 95	41 53.4057 N 80 47.8641 W	192-B	6	1	1	1
25 June 95	41 53.4055 N 80 47.8758 W	191-A	4	-	-	-
25 June 95	41 53.3967 N 80 47.9335W	191-B	4	1	-	-
25 June 95	41 53.4110 N 80 47.9229 W	191-C	3	-	-	-
25 June 95	41 53.4289 N 80 47.8857 W	190-A	5	1	1	1
25 June 95	41 53.4319 N 80 47.8889 W	190-AFD	4	-	-	-
25 June 95	41 53.4072 N 80 47.9673 W	190-B	6	-	-	-
25 June 95	41 53.4657 N 80 47.8979 W	189-A	6	1	-	-
26 June 95	41 53.4552 N 80 47.9148 W	189-B	4	1	-	-
25 June 95	41 53.4287 N 80 47.9835 W	189-C	3	-	-	-
27 June 95	41 53.4996 N 80 47.9162 W	186-A	6	-	-	-
27 June 95	41 53.5530 N 80 47.9456 W	182-A	3	1	1	1
2 July 95	41 53.5234 N 80 47.9092 W	181-A	11	2	1	1
30 June 95	41 53.5415 N 80 47.8986 W	181-B	10	1	1	1

TABLE 3.1 PCB SAMPLE STATIONS AND QA/QC (Continued)

Sampling Date	Sample Coordinates	Sample Station	No. of Samples	QA/QC Samples		
				No. of Duplicate	No. of QA Splits	No. of MS/MSD
30 June 95	41 53.5403 N 80 47.9093 W	181-C	3	1	-	-
30 June 95	41 53.5504 N 80 47.9213 W	181-D	8	1	-	-
30 June 95	41 53.5664 N 80 47.8947 W	180-A	6	-	-	-
2 July 95	41 53.5581 N 80 47.8733 W	179-A	5	-	-	-
30 June 95	41 53.5666 N 80 47.8789 W	179-B	9	-	-	-
27 June 95	41 53.5959 N 80 47.8632 W	178-A	3	-	-	-
27 June 95	41 53.5843 N 80 47.8410 W	177-A	6	-	-	-
27 June 95	41 53.6533 N 80 47.8316 W	176-A	6	1	-	-
2 July 95	41 53.6456 N 80 47.7980 W	174-A	4	1	1	1
27 June 95	41 53.6667 N 80 47.8153 W	173-A	5	1	1	1
1 July 95	41 53.6696 N 80 47.7857 W	172-A	6	-	-	-
1 July 95	41 53.7012 N 80 47.7718 W	168-A	4	-	-	-
27 June 95	41 53.7387 N 80 47.7724 W	168-B	5	1	-	-
28 June 95	41 53.7626 N 80 47.7542 W	166-A	4	-	-	-
29 June 95	41 53.7897 N 80 47.7323 W	164-A	5	-	-	-

TABLE 3.1 PCB SAMPLE STATIONS AND QA/QC (Continued)

Sampling Date	Sample Coordinates	Sample Station	No. of Samples	QA/QC Samples		
				No. of Duplicate	No. of QA Splits	No. of MS/MSD
1 July 95	41 53.7914 N 80 47.7408 W	163-A	3	1	1	1
1 July 95	41 53.8306 N 80 47.6719 W	160-A	4	1	1	1
30 June 95	41 53.8729 N 80 47.6527 W	158-A	4	1	1	1
30 June 95	41 53.8800 N 80 47.6311 W	157-A	4	-	-	-
26 June 95	41 53.9322 N 80 47.6968 W	156-A	3	1	1	1
28 June 95	41 53.0384 N 80 47.6581 W	155-A	4	1	-	-
30 June 95	41 53.9412 N 80 47.6098 W	152-A	4	-	-	-
26 June 95	41 53.9790 N 80 57.6451 W	149-A	3	-	-	-
29 June 95	41 53.9551 N 80 47.6606 W	149-B	3	-	-	-
26 June 95	41 54.0059 N 80 47.7060 W	147-A	3	-	-	-
26 June 95	41 53.9900 N 80 47.7155 W	146-A	2	-	-	-
TOTAL		41	193	20	11	11

This chart shows that the TSCA contaminated sediments are generally located between 10 and 17 feet (3.05 and 4.88 meters) below LWD, with the exception being Sample Station 190-B, which had TSCA contamination down to 20 feet (6.1 meters) below LWD. In general contamination increases with depth and then decreases towards the bottom of the core. This is as expected since a clean layer existed on the bottom of the river when the most contaminated material was deposited in the 1960's and 1970's. As stated previously, sediment testing in recent years has found that surficial sediments deposited more recently are generally less contaminated than in earlier years.

3.3 Resource Conservation and Recovery Act Classification

3.3.1 RCRA Sample Collection.

Samples were collected from nine locations, including one field duplicate core, in the Ashtabula River as shown in Figure 1.2 . The sampling locations were selected from areas that exhibited the highest concentration of RCRA regulated compounds in previous studies. The sediment core was collected using the vibracore as described earlier. As per the QAPjP, a 5 foot (1.52 meter) sample was collected for analysis. If the recovery length of the sample was less than 5 feet (1.52 meters) then the entire core was used. A TCLP extract analysis and total sediment analysis were conducted for each sample retrieved.

An attempt was made to determine the most contaminated section of the core by screening the length of the core with either an OVA and/or a PID. The most contaminated section was generally defined as the area of the core that registered a reading at least twice the next highest measurement. If this was inconclusive, the samples were taken from a depth range as described in the QAPjP, which was from the depth of maximum contamination as described in the Woodward-Clyde Report.

Prior to compositing, a grab sample from the most contaminated, or QAPjP defined, area of the core was collected for total and TCLP extract analysis of volatile organics. Following the grab sample for volatile organics, a composite sample of the remainder of the core was taken for non-volatile (metals and semivolatiles) RCRA sampling.

Table 3.2 lists the Sample Station Numbers, their respective coordinates (NAD 83), the number of samples per sample station, and the number of QA/QC samples collected for the RCRA sampling.

3.3.2 RCRA Analytical Results

A summary of the detected RCRA TCLP extract sample results compared to the regulatory levels is presented in Figure 3.6. This comparison shows that no TCLP extract analysis for the RCRA regulated compounds found concentrations exceeding the regulatory levels. Only the metals arsenic, barium, cadmium, and chromium and volatile organics 1,4-dichlorobenzene and chlorobenzene were detected in the TCLP extract analyses.

TABLE 3.2 RCRA SAMPLE STATIONS AND QA/QC

.			Sample Depth[1]		Samples			QA/QC		
Sample	Sample	Sample	Volatile	Non-Volatile	Volatiles	Semivolatiles	Heavy Metals	Duplicates	QA Splits	MS/MSD
1 July 95	41 53.3953 N 80 47.9247 W	190-C	2.6	2.3 - 4.9	2	2	2	2 (Total SVOAs and Metals)	2 (Total SVOAs and Metals)	2 (Total SVOAs and Metals)
1 July 95	41 53.3932 N 80 47.9247 W	190-CFD	2.6	2.3 - 4.9	2	2	2	-	-	-
1 July 95	41 53.4431 N 80 47.8824 W	189-D	5	3.2 - 8.2	2	2	2	-	-	-
1 July 95	41 53.4302 N 80 47.9313 W	188-A	5	2.4 - 7.4	2	2	2	2 (TCLP SVOAs and Metals)	2 (TCLP SVOAs and Metals)	2 (TCLP SVOAs and Metals)
1 July 95	41 53.4719 N 80 47.9140 W	186-B	4	1.4 - 5.4	2	2	2	1 (TCLP VOAs)	1 (TCLP VOAs)	1 (TCLP VOAs)
29 June 95	41 53.5254 N 80 47.9121 W	181-E	5	4.4 - 9.4	2	2	2	-	-	-
29 June 95	41 53.7150 N 80 47.7880 W	168-C	5	3.0 - 8.0	2	2	2	1 (Total VOAs)	1 (Total VOAs)	1 (Total VOAs)
29 June 95	41 53.9825 N 80 47.6540 W	149-C	5	2.6 - 7.6	2	2	2	-	-	-
29 June 95	41 53.9825 N 80 47.8783 W	139-A	3.9	2.2 - 6.1	2	2	2	-	-	-
TOTAL		9	-	-	18	18	18	6	6	6

[1]Samples for volatile organic compounds were collected either from the location specified in the QAPjP, or from the most contaminated portion of the core if identifiable by the PID or OVA. Depth is Feet below LWD.

Arsenic at Station Number 186-B was closest to the regulatory limit at roughly 57% of the RCRA regulation level of 5 mg/l. Only one other sample station, Station 188-A, contained detectable arsenic in the TCLP extract. At this location, arsenic was detected at 0.028 mg/l in a QA sample, but was not detected in the investigatory sample or the QC sample.

Barium was detected in the TCLP extract at 6 sampling locations with a highest result of 4.3 mg/l at Station Number 168-C. This level is approximately 4% of the regulatory limit of 100 mg/l.

Chromium was detected in the TCLP extract at 2 locations with a highest result of 0.24 mg/l at Station Number 189-D. This level is approximately 5% of the regulatory threshold of 5 mg/l. Cadmium was detected only at Sample Station 189-D at 0.12 mg/l, which is roughly 12% of the regulatory limit of 1 mg/l.

1,4-Dichlorobenzene was detected only at Station Number 188-A at 0.04 mg/l. This result is well below the regulatory threshold of 7.5 mg/l. Chorobenzene was detected only in one sample from Station Number 186-B. The QA sample at this location contained chlorobenzene at 0.059 mg/l while no detectable levels of chlorobenzene were found in the investigatory or QC samples. The level detected in the QA sample is well below the regulatory limit of 100 mg/l.

As would be expected, the highest levels of contamination in the TCLP extract were generally found at the Sampling Stations nearest Fields Brook. No TCLP compounds were detected in samples from the furthest downstream location, 139-A, or the field duplicate for sample 190-C.

The TCLP test is designed to determine the mobility of certain regulated compounds in the environment. The procedure consists of an 18 hour extraction process using a dilute acid solution followed by extract analysis. The amount of extraction fluid used is 20 times the sample weight, which results in a 20 fold dilution. Total analysis of metals in sediment uses a digestion procedure with a very strong acid, such as nitric acid that extracts virtually all of the metal.

A comparison of the extraction efficiency for the investigatory samples where TCLP compounds were detected, with the total analysis of the same sample was performed. This information is summarized for metals in Table 3.3.

Table 3.3 Analysis of Total and TCLP Results for Metals.

Sample Location	Contaminant	Regulatory Level (ppm)	TCLP Result (ppm)	Total Result (ppm)	Ratio of Total Result to TCLP Result
186-B	Arsenic	5.0	2.9	9.3	3.2
Arsenic Average					**3.2**
149-C	Barium	100.0	1.7	190	112
168-C	Barium	100.0	4.3	810	188
181-E	Barium	100.0	2.7	340	126
188-A	Barium	100.0	3.3	420	127
189-D	Barium	100.0	4.0	330	83
190-C	Barium	100.0	1.5	470	313
Barium Average					**158**
189-D	Cadmium	1.0	0.12	1.9	16
Cadmium Average					**16**
181-E	Chromium	5.0	0.21	440	2095
189-D	Chromium	5.0	0.24	450	1875
Chromium					**1985**

If the TCLP extraction efficiency was equal to the extraction efficiency of the total analysis the last column in the table would be equal to 20. The higher the number the less effective the TCLP leaching is or the more likely the contaminant is to stay with the sediment. As can be seen from the table, arsenic and cadmium were extracted rather efficiently with the TCLP process. The ratio of total result to TCLP result less than 20 for arsenic and cadmium samples could be explained by heterogeneity within the sample. Barium was moderately leachable while chromium was not very leachable under the conditions of the TCLP leaching procedure.

This is circumstantial evidence that chromium may be present in the sediment as the more toxic hexavalent chromium which is less mobile in the environment than trivalent chromium. The extent to which the metal was leached during the TCLP process is likely related to the solubility curve for each metal, with less leachable metals being soluble only at a very low pH.

Figures 3.7 thru 3.9 show the results of total analysis of RCRA regulated metals, semivolatiles and volatiles, respectively. While these levels cannot be compared to regulatory levels, they are provided for general information. Some of the RCRA regulated compounds (hexachlorobenzene, hexachlorobutadiene, mercury and chromium) are particular contaminants of concern as described in the Stage I Investigation Report of the Ashtabula Remedial Action Plan. The total concentrations of these contaminants are shown graphically in Figures 3.10 through 3.13. Again, the area of the circle represents the magnitude of the contamination level. For all of the compounds, it is clear from these figures that contamination is generally highest near Fields Brook and decreases with distance down the river. No detectable levels of mercury, hexachlorobenzene or hexachlorobutadiene were found upstream of Fields Brook and chromium was only detected at a very low level.

3.4 General Geophysical Characterization of Sediment

Ashtabula River sediments from the 1995 Study generally ranged from clayey sand with organic material at the upstream end of the navigation channel to a silty clay or clayey silt near the 5th Street Bridge. The sediments in the upstream reaches have generally been described as gray silty clay with organic materials underlain by gray silty clay with sand and gravel. Near the upstream end of the navigation channel, close to the Conrail Lift Bridge and near Fields Brook, the sediments are characterized by gray colored oily silty clay with stratifications and some organic materials. The stratification includes distinct bands of off-white and brown colored sediments.

The sediments of the lower turning basin are mostly characterized by gray silty clay underlain by clayey fine grained sand along with shale and iron debris. The mid-channel basin sediments at the lower turning basin contain stratified clay characterized by dark brown, white, and black (dark) stratas. Towards the downstream end of the lower turning basin, fine to medium grained sand with clay characterizes the sediments. Individual Core Logs are included in the Summary Report of the Sampling (Buffalo District, 1996).

4.0 COMPILATION OF 1990 AND 1995 PCB SAMPLING RESULTS.

4.1 Data Summary

This section provides a summary of the PCB data from the 1990 Woodward-Clyde sampling and the 1995 ARP Sampling. This data can be grouped and compared since similar collection sampling techniques and analytical methods were used. Figure 1.1 shows the sampling locations for both sampling events.

Tab A shows a summary of the all the samples with detectable levels of PCBs from both sampling events. Total PCBs listed in this table are a sum of all the PCB Aroclors detected. For the vast majority of samples from both events only Aroclor 1248 was present. Table 4.1 shows various descriptive statistics for both events.

Table 4.1 Statistical Analysis of 1990 and 1995 PCB Sampling Events

Statistical Parameter	1990 Sampling	1995 Sampling
Number of Cores Taken	89	41
Number of Samples Taken (Including QA/QC)	362	237
Maximum PCB Concentrations	660 mg/kg	160 mg/kg
Number of Samples with Detectable PCBs	277	215
Percentage of Samples with Detectable PCBs	77%	91%
Average Concentration all samples	13.9 mg/kg	14.2 mg/kg
Standard Deviation of all samples	46.6 mg/kg	24.6 mg/kg
Average Concentration of detected samples	18.2 mg/kg	15.7 mg/kg
Standard Deviation of detected samples	52.6 mg/kg	25.4 mg/kg

Several things are evident from this table. Although the average PCB concentration for both studies is similar, the 1990 sampling had a much greater maximum PCB concentration. This difference in the maximum concentrations is likely due to heterogeneity of the sediment and not biodegradation over the last five years. This can be presumed from the fact that Aroclor 1248 was the predominant PCB Aroclor detected in both studies. Biodegradation of PCB is preceded by dechlorination of the PCB molecule which likely would have resulted in frequent detection of a less chlorinated Aroclor, such as Aroclor 1242, in the 1995 study, which did not occur.

The percentage of samples with detected PCBs were greater for the 1995 sampling when compared with the 1990 sampling. There are two reasons for this. First, the 1995 sampling was focussed in the area between the 5th Street Bridge and the Upper Turning Basin, in order to better define the area of TSCA contamination. Consequently, the selection of sampling locations in the area of the river with the greatest contamination biased the results slightly higher for the 1995 sampling. Additionally, more samples contained detectable levels of PCBs in the 1995 sampling because of lower detection limits achieved in the later study.

Overall, the average concentrations were relatively close and an analysis showed that the data sets are statistically equivalent. The standard deviation for the 1990 sampling is much higher because that study had several data outliers with PCB concentrations greater than 200 mg/kg. Additionally, Woodward-Clyde used a zero value for samples where no PCBs were detected and since 23% of the samples from the Woodward-Clyde Study were non-detect, this resulted in a lower average sediment PCB concentration being presented than actually exists in the river. Using a zero for non-detects in the 1995 sampling did not significantly affect the average concentration because of the low detection limits and few samples that fell into this category.

4.2 Horizontal and Vertical Distribution of PCBs

The horizontal extent of PCB contamination as determined from the 1990 study is shown in Figure 4.1. Figure 4.2 shows the horizontal extent of contamination when the 1990 and 1995 data are combined. On these maps, each circle represents one sample, with the area of the circle related to the magnitude of the PCB concentration. Concentric circles around one sampling point indicates that samples were taken at different depths. This figure also shows the samples where TSCA regulated levels of PCBs were detected with red circles, and non-TSCA samples with a green circle. Sample Stations ending in a letter are from the 1995 sampling, while those ending in a number are from the 1990 sampling. The area where TSCA contaminated sediments were found are further shown in Figure 4.3 which shows the depth and concentration levels of samples from both studies with PCB concentrations greater than 50 mg/kg.

As previously stated, the 1995 sampling was intended to fill-in data gaps from the Woodward-Clyde Sampling, including taking additional samples from the sideslopes of the channel. Only one sample taken from the sideslopes in 1995 showed TSCA contamination. This was sample 173-A which had a maximum concentration of 80 mg/kg at 16 feet (4.88 meters) below LWD. This area is immediately west of Sample Station 172-01 from the Woodward-Clyde sampling that also showed TSCA levels of contamination at similar depths.

In the Upper Turning Basin of the River, the 1995 sampling more clearly defined the extent of the TSCA contamination. Station 190-B was selected to determine the extent to which the contamination had spread towards Jack's Marines slips. PCB samples from this core slightly exceeded TSCA levels which more clearly defined the level of contamination in this area.

Similarly, there was no Woodward-Clyde data available in the area of Sample Stations 189-B and 190-A. Sample 189-B and the field duplicate for sample 190-A (190-A-FD) contained TSCA contaminated sediments between 14 and 16 feet (4.3 and 4.88 meters) below LWD. Sample Station 190-A located slightly upstream from the field duplicate (190-A-FD), and Sample Station 191-A, did not contain TSCA sediment, so the upstream extent of contamination is identified with more certainty. Interestingly, a 1995 sample taken directly at the mouth of Fields Brook contained PCB samples at all depth of less than 6 mg/kg. This might be explained by scouring that has occurred at the mouth of Fields Brook and in the Upper Turning Basin that transported the contaminated sediment downstream in the Ashtabula River.

Downstream of the Upper Turning Basin, Samples 181-A, 181-C and 181-B identified additional areas of TSCA contamination. These samples filled in the data gaps in the central portion of the channel between Woodward-Clyde samples 182-01 and 179-01. Sample Station 177-A also found TSCA contamination and helped to fill in the data between Woodward-Clyde Sample Stations 178-01 and 176-01, and provide additional information on the sediment characteristics near the eastern boundary of the channel limits.

No TSCA contaminated sediments were detected in the 1995 sampling downstream of Sample Station 173-A, while the Woodward-Clyde sampling had TSCA contamination at Sample Stations 170-01, 169-01, 167-01, and 158-01. The 1995 Sampling Locations with the highest concentration in these areas were Station 158-A (adjacent to station 158-01) with a PCB concentration of 40 mg/kg and Station 168-A (adjacent to Station 169-01) with a PCB concentration of 49 mg/kg both at a depth of 18 feet (5.5 meters) below LWD .

Given the uncertainty and variability of PCB analyses, both of these 1995 samples serve to confirm the relative levels of PCBs identified in the Woodward-Clyde study at these downstream locations. Consequently, what may have appeared as anomalies in the Woodward-Clyde results, especially, the TSCA contamination downstream at Station 158-01, have been confirmed with this study.

4.3 Rodding and Compression

Perhaps the most vexing problem associated with reviewing and analyzing the 1995 sampling data is that the length of core recovered was generally somewhat less than the penetration depth. The phenomenon is considered to be a result of rodding and/or compression that occurs as the vibracore tube passes into the sediment. Rodding occurs when friction inside the core tube exceeds the bearing strength of the sediments. When this occurs, the core and tube behave as a solid rod, pushing sediment to the side rather than collecting it. Compression results from the compaction of gaseous sediments as the core penetrates. Additionally, the top several inches of sediment may be agitated and dispersed as the vibrating tube enters the sediment (Smith, et. al., 1992).

Because of this rodding and compression in the core, it was impossible to exactly pinpoint the depth at which a sample was collected. The possible error in the depth is equal to the amount of rodding and compression in the core. This effect that rodding and compression have on determining the actual sampling depth is shown Figure 4.4 Figure 4.5 shows graphically rodding and compression versus penetration depth for the 1995 Sampling. While the correlation coefficient for the best fit line is not good (0.3095), this graph shows that rodding and compression generally increase with depth of penetration. Since compression generally occurs only in the uppermost part of the sediment, increasing loss of the sediment core for deeper penetration is likely due to the effects of rodding. Consequently, this seems to be circumstantial evidence that rodding is the primary reason that the recovery length of the core was less than the penetration depth.

Unfortunately, the Woodward-Clyde report does not contain detailed information on the extent of rodding and compression encountered during the 1990 sampling. However, they used only aluminum tubes and no butyrate liners for their study. This is important because the use of a core liner tube has been shown to reduce the core length recovery by up to 12%. The diameter of the core liner is 1/4 inch (0.635 centimeters) more than the entrance to the nose cone and therefore it is more compact in the nose cone than in the tube, which results in increased resistance to sediment collection. Moreover, the composition of the butyrate core liners tend to dampen the vibrations associated with the vibra core. This inhibited vibration could reduce the ease of moving the tube through the sediment and result in premature refusal (Bolattino, 1995).

5.0 SUMMARY AND CONCLUSIONS

5.1 Polychlorinated Biphenyls (PCBs)

The 1995 Sampling effectively filled in PCB data gaps from the 1990 study and confirmed and refined areas of TSCA contamination from the previous study. Both the 1990 and 1995 sampling events strongly suggest that Fields Brook is the source of contamination in the Ashtabula River. Overall, the 1995 sampling better defined the vertical, and horizontal extent of contamination in the river and resulted in a more accurate volume computation by WES.

5.2 RCRA Regulated Compounds

RCRA samples were taken from the most contaminated areas of the river as defined by the Woodward-Clyde sampling. No compounds were detected that exceeded the regulatory threshold. With the exception of one sample at the mouth of Fields Brook that had arsenic at 57% of the regulatory level, no samples were even close to failing the TCLP. Consequently, since none of the samples from the most contaminated sections of the river failed the TCLP test, it logical to conclude that dredged sediment from the river would not be subject to RCRA regulations.

5.3 Analysis of Extent of PCB Contamination

The 1990 and 1995 sampling data was used to determine the volume and extent of PCB contamination in the river. The results are included as part II of this appendix. Buffalo District is currently using the sampling data along with GMS to develop and evaluate dredging alternatives. The result of this study will be included in subsequent reports.

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Figures

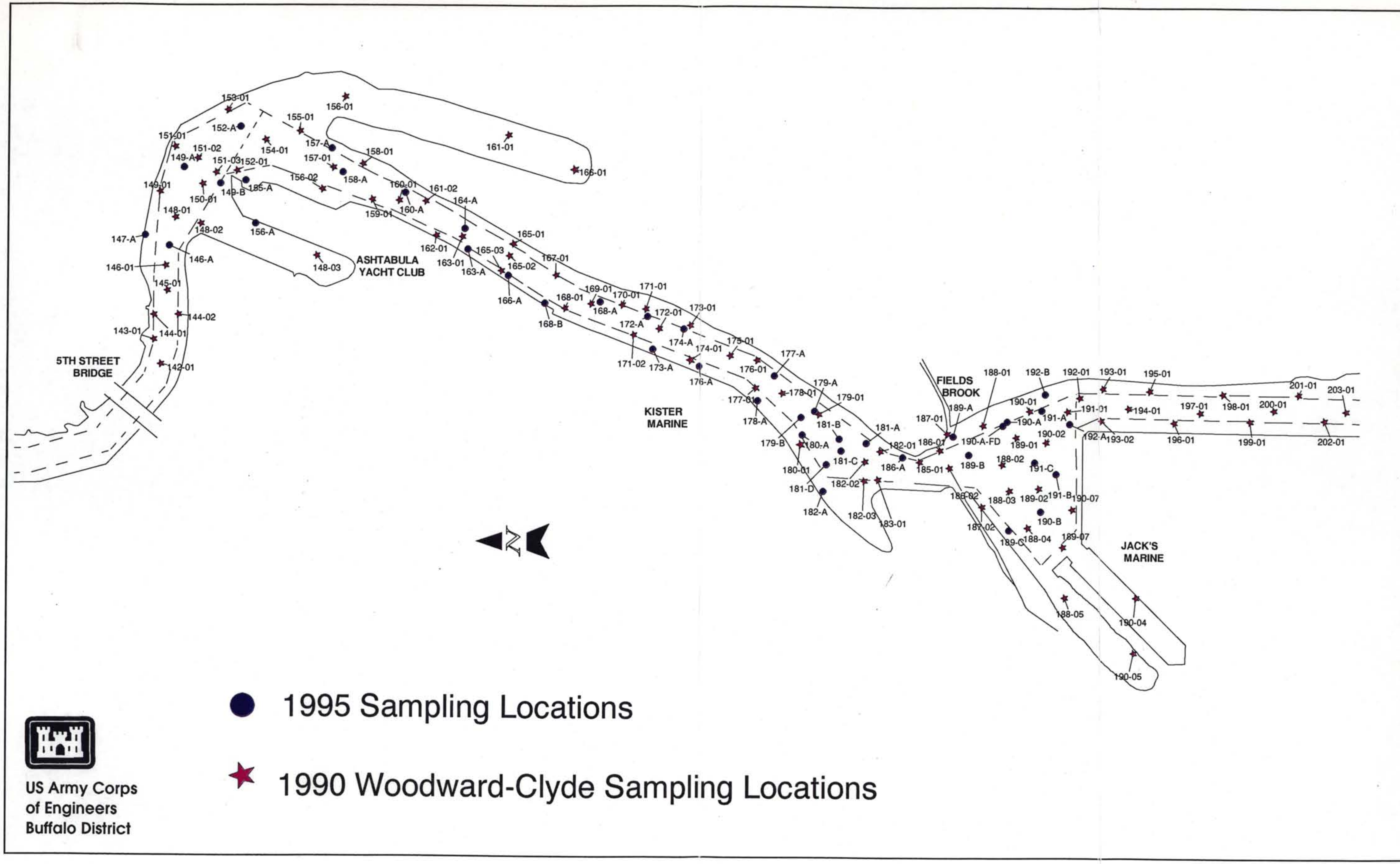


Figure 1.1. 1990 and 1995 PCB Sampling Locations

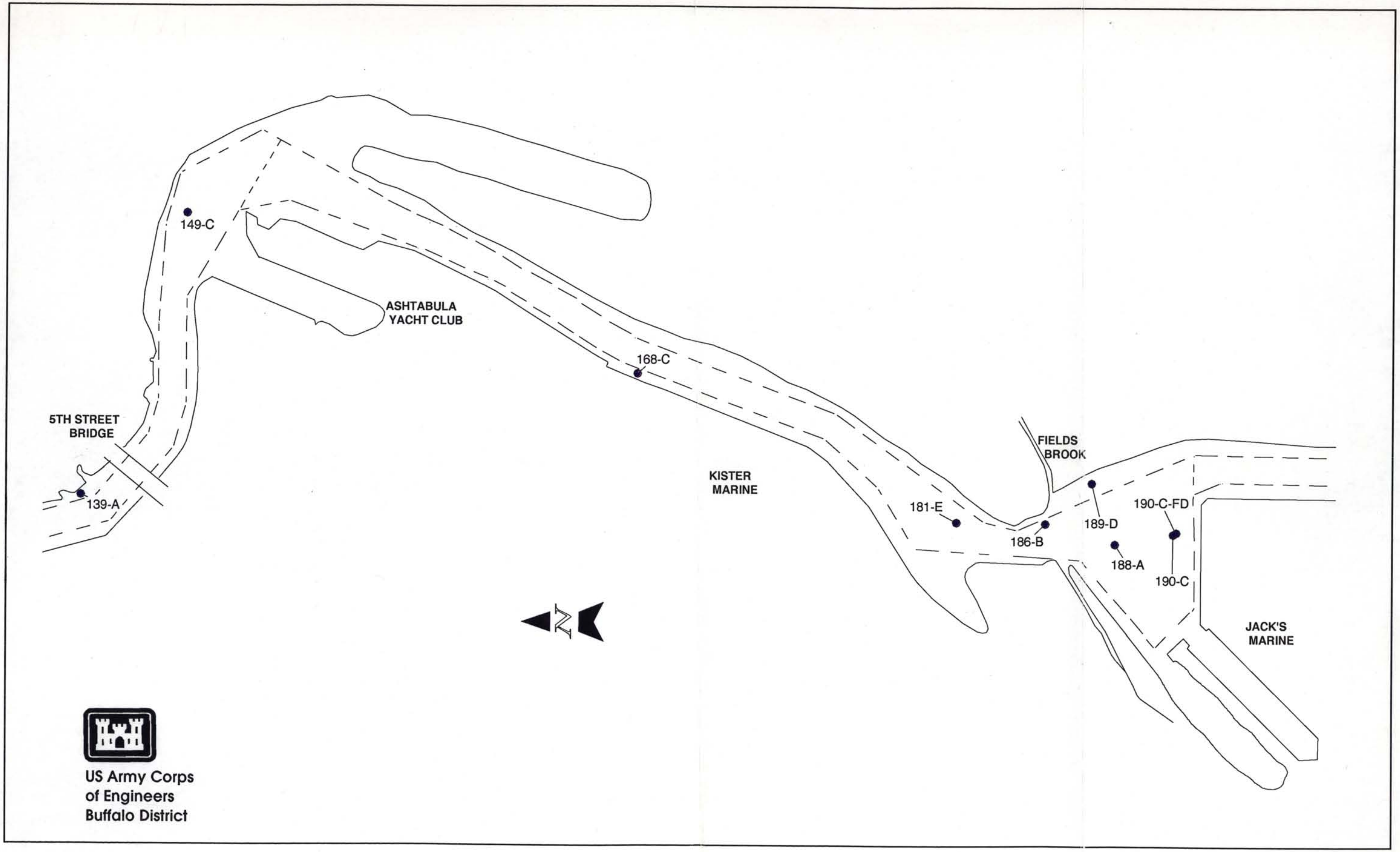


Figure 1.2. 1995 RCRA Classification Sampling Locations

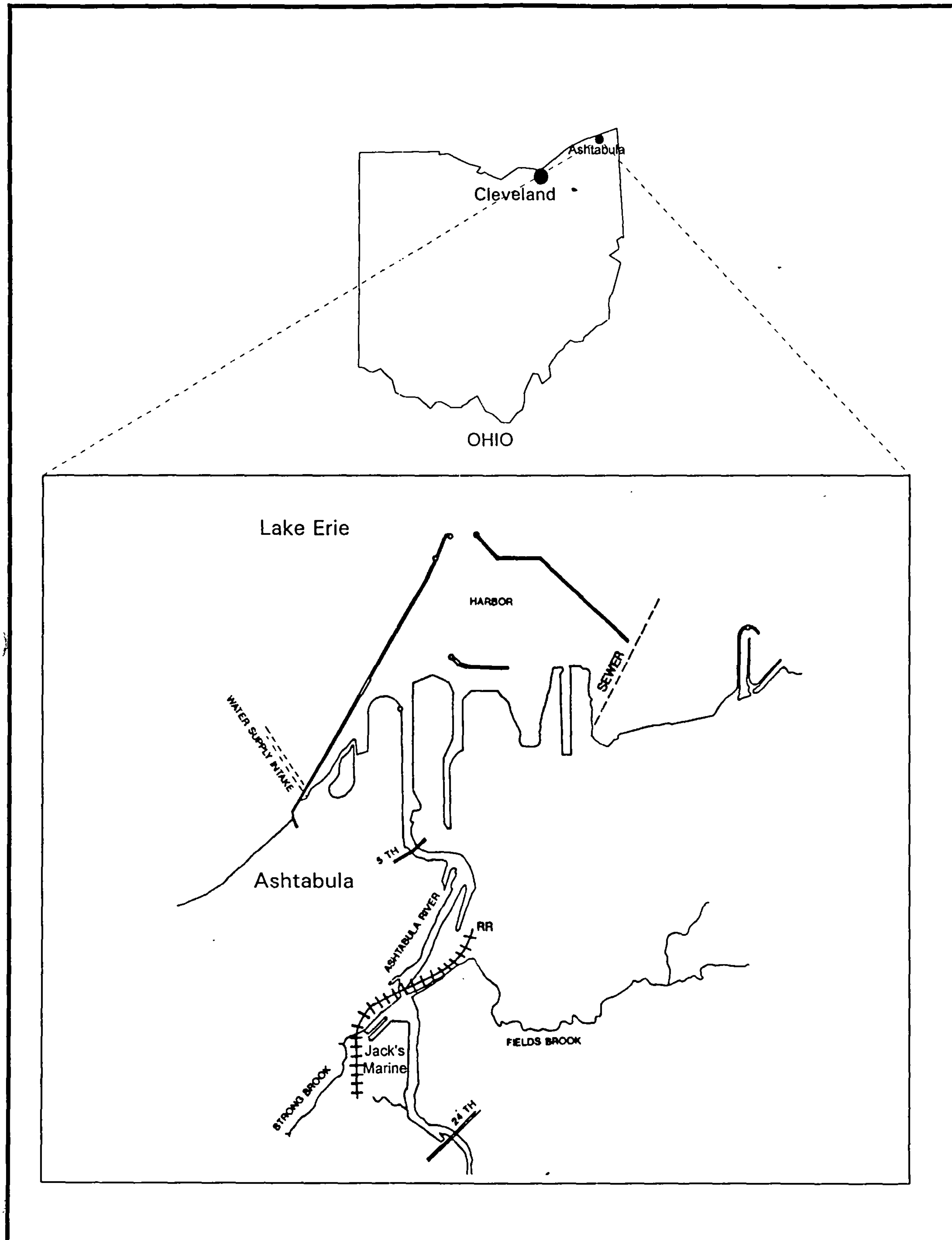


Figure 2.1 Vicinity Map of Ashtabula River

Table 6: Projected Tonnage Shipped Through Ashtabula Harbor

Project year	Tonnage All Commodies	Percent of initial
1	8974.0	100.0%
2	8973.4	100.0%
3	8972.9	100.0%
4	8972.0	100.0%
5	8971.1	100.0%
6	8941.6	99.6%
7	8912.2	99.3%
8	8881.3	99.0%
9	8878.3	98.9%
10	7729.1	86.1%
11	6579.9	73.3%
12	5429.9	60.5%
13	5426.4	60.5%
14	5422.3	60.4%
15	5418.2	60.4%
16	5413.5	60.3%
17	5408.8	60.3%
18	3605.8	40.2%
19	1802.9	20.1%
20	0.0	0.0%
21	0.0	0.0%
22	0.0	0.0%
23	0.0	0.0%
24	0.0	0.0%
25	0.0	0.0%
26	0.0	0.0%
27	0.0	0.0%
28	0.0	0.0%
29	0.0	0.0%
30	0.0	0.0%
31	0.0	0.0%
32	0.0	0.0%
33	0.0	0.0%
34	0.0	0.0%
35	0.0	0.0%
36	0.0	0.0%
37	0.0	0.0%
38	0.0	0.0%
39	0.0	0.0%
40	0.0	0.0%
41	0.0	0.0%
42	0.0	0.0%
43	0.0	0.0%
44	0.0	0.0%
45	0.0	0.0%
46	0.0	0.0%
47	0.0	0.0%
48	0.0	0.0%
49	0.0	0.0%
50	0.0	0.0%

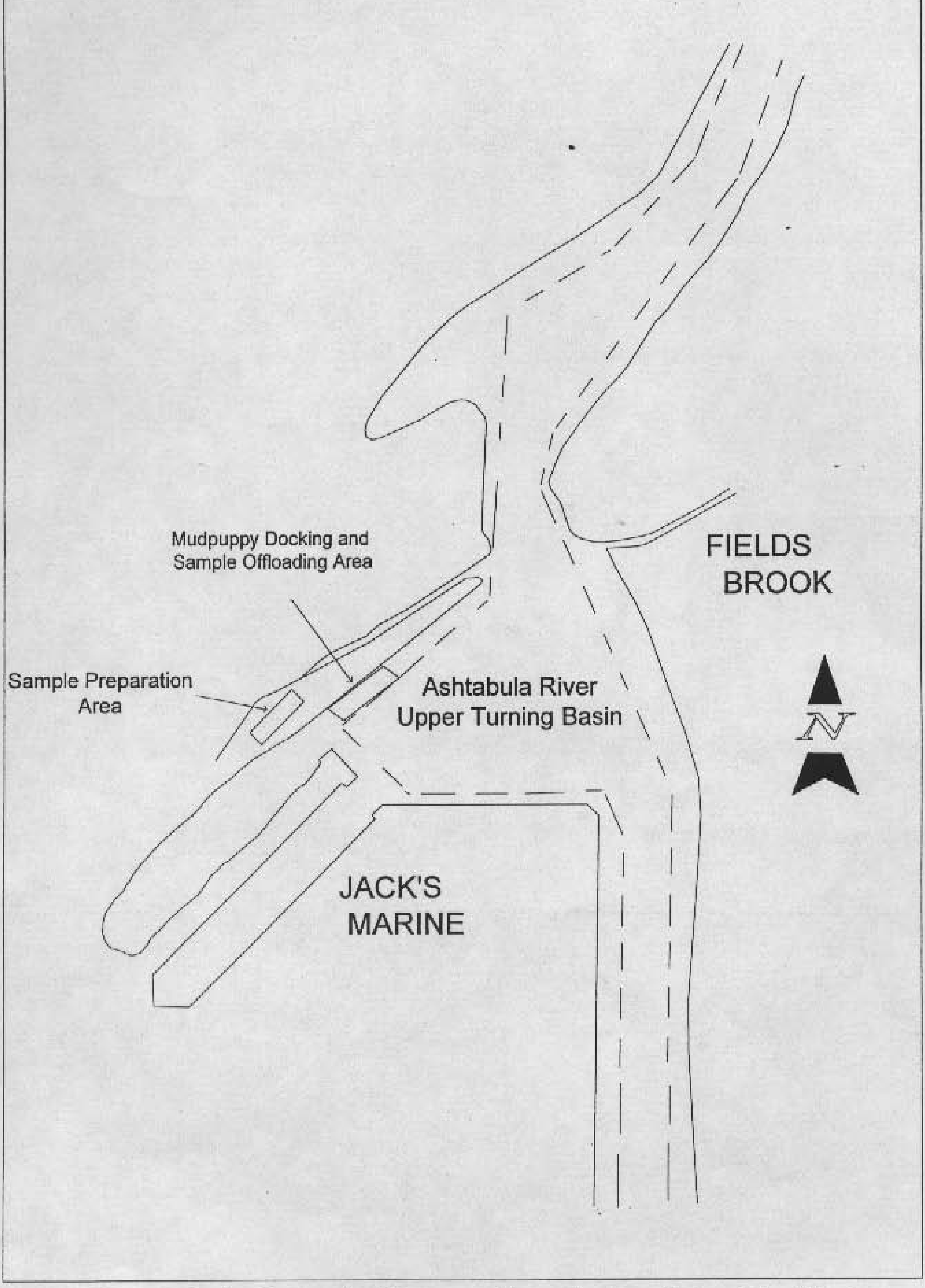
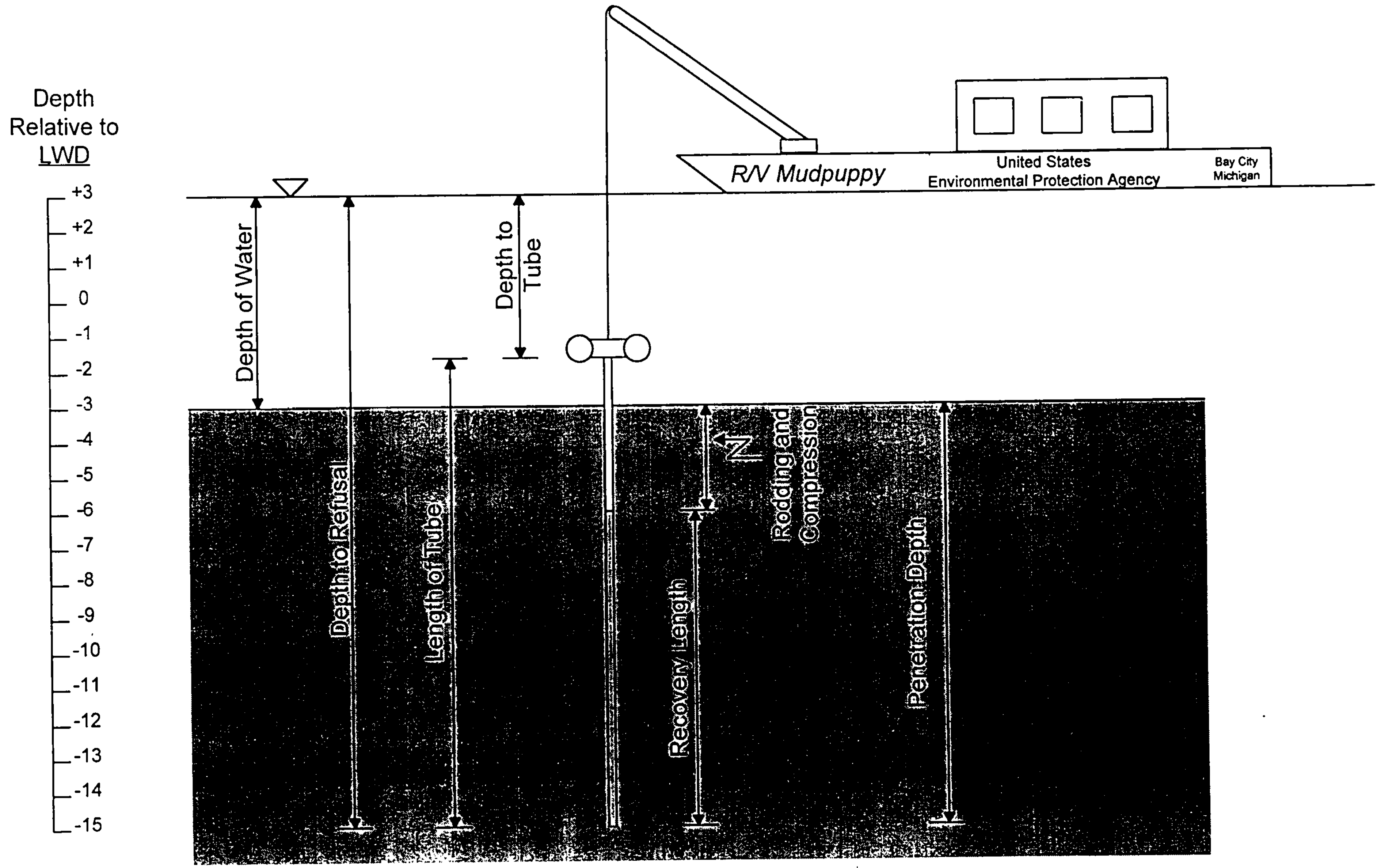


Figure 3.1 Sample Preparation Area at Jack's Marine



Water elevation relative to Low Water Datum was taken twice daily from the gage at the U.S. Coast Guard Station

Depth to Refusal = Depth to Tube + Length of Tube

Penetration Depth = Depth to Refusal - Depth of Water

Figure 3.2. Example of Physical Parameters Measured and Calculated for Sediment Cores

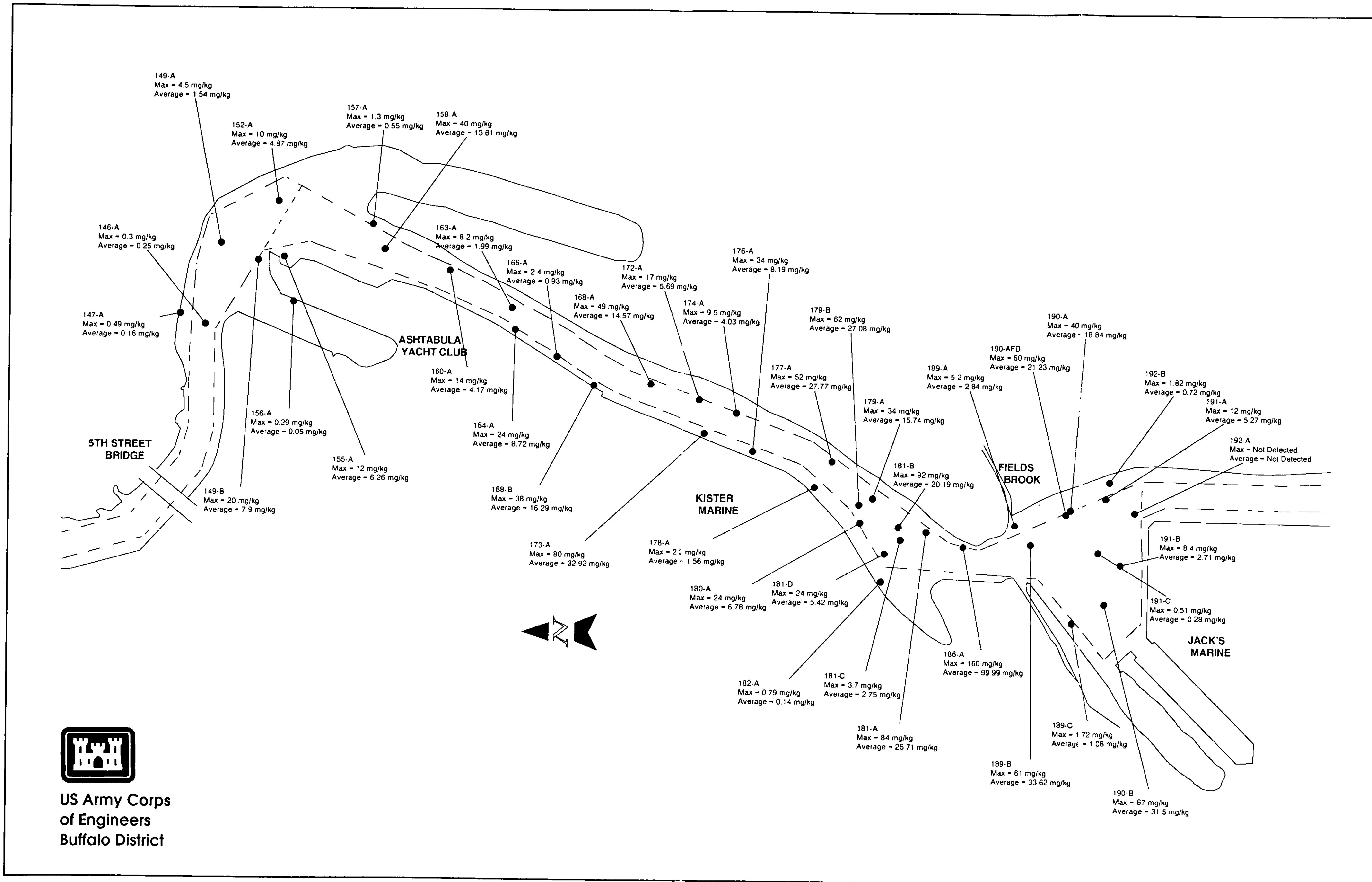


Figure 3.3. Maximum and Average PCB Concentrations for 1995 Sampling

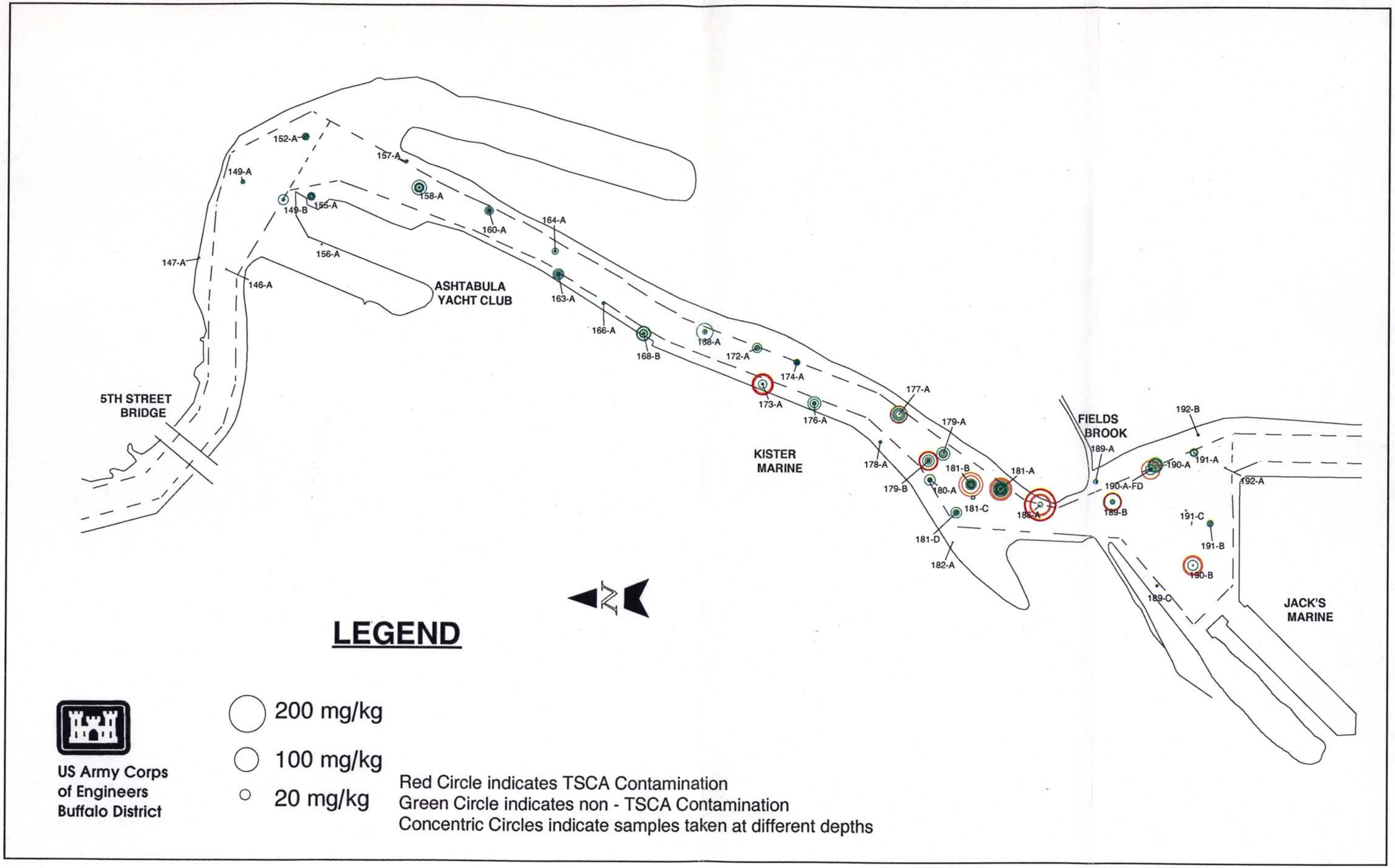


Figure 3.4. Thematic Map Of 1995 PCB Sampling

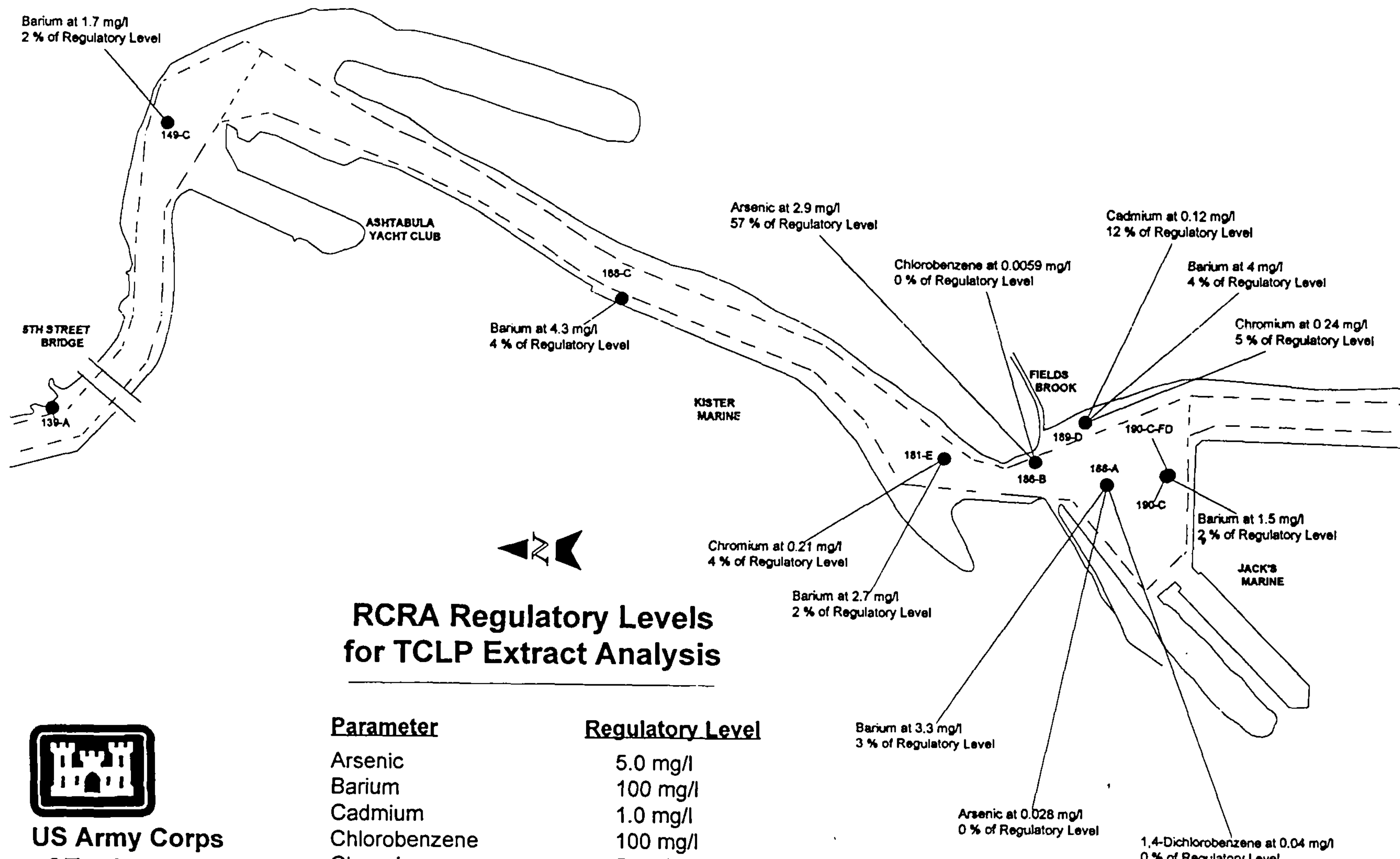
Figure 3.5 PCB Concentrations (mg/kg) in Ashtabula River Sediment Shown with Depth in Core [1]

Depth (ft.) (Ref. to LWD)	146-A	147-A	149-A	149-B	152-A	155-A	156-A	157-A	158-A	160-A	163-A	164-A	166-A	168-A	168-B	172-A	173-A	174-A	176-A	177-A	178-A
3																					
2																					
1																					
0																					
-1																					
-2																					
-3																					
-4																					
-5																					
-6																				9.60	
-7																				9.00	
-8						1.60	0.29													18.00	
-9						9.40	ND	0.23												30.00	
-10						9.40	ND	0.35												48.00	
-11						12.00	ND	1.30									ND				
-12				0.89		12.00		0.31									0.85		0.44		
-13	0.19			2.80	0.27	2.10				0.26					0.46		0.85		0.89		
-14	0.30			20.00	2.10	2.10			1.00	1.30	1.30		0.18		14.00		15.00		0.89		
-15			0.11		2.10				18.00	1.30	1.70	0.20	2.40		14.00		15.00		2.60		
-16		ND	ND		10.00				18.00	6.60	1.70	2.10	2.40	0.66	10.00	0.39		4.70	2.60		
-17		0.49	4.50		10.00				40.00	6.60	8.20	24.00	0.90	49.00	10.00	7.60		9.50	34.00		0.27
-18		0.49			7.10				40.00	14.00	8.20	12.00	0.90	49.00	38.00	17.00	1.40	9.50	34.00		2.20
-19		0.00			7.10				8.00			5.30	0.24	4.80	38.00	3.60	1.40	5.50	16.00		2.20
-20									8.00					3.80	ND	5.20		5.50	16.00		
-21															ND	0.35					
-22																0.35					
Maximum	0.30	0.49	4.50	20.00	10.00	12.00	0.29	1.30	40.00	14.00	8.20	24.00	2.40	49.00	38.00	17.00	80.00	9.50	34.00	52.00	2.20

Depth (ft.) (Ref. to LWD)	179-A	179-B	180-A	181-A	181-B	181-C	181-D	182-A	186-A	189-A	189-B	189-C	190-A	190-AFD	190-B	191-A	191-B	191-C	192-A	192-B	Maximum	Depth (ft.) (Ref. to LWD)
3																						3
2																						2
1																						1
0																						0
-1																						-1
-2																						-2
-3																						-3
-4																						-4
-5																						-5
-6				0.74	2.20																9.60	-6
-7	3.70			1.70	2.60			0.79													9.00	-7
-8	14.00			3.60	8.40			0.08									ND	ND		ND	18.00	-8
-9	14.00			9.60	8.70	2.20		ND	6.00	4.20		0.92				ND	0.67	0.34		ND	30.00	-9
-10	34.00	0.51		38.00		3.70				2.10		0.60	0.64		0.32	0.07	0.67	0.34	ND	ND	65.70	-10
-11	34.00	2.50			7.60	2.80				2.00	1.50	1.72	12.55	0.90	0.32	12.00	4.20	0.51	ND	0.55	150.00	-11
-12	11.00	3.70		16.00	16.00					1.60	5.60	1.72	12.55	3.80	0.69	9.00	4.20	0.51		1.82	160.00	-12
-13	11.00	11.00		28.00	11.00		2.40			5.20	5.60		40.00	3.80	19.00		8.40			1.44	79.00	-13
-14	16.00			45.00			0.34			3.10			40.00	20.20	19.00						140.00	-14
-15	16.00						3.10			3.10			24.70	20.20							140.00	-15
-16		27.00	2.80	13.00			8.60				47.00		24.70								80.00	-16
-17			5.00				24.00				47.00		4.60								80.00	-17
-18			4.80				3.10														52.00	-18
-19			24.00				3.40														67.00	-19
-20			3.50				0.25														67.00	-20
-21			0.60																		0.60	-21
-22																					0.35	-22
Maximum	34.00	62.00	24.00	84.00	92.00	3.70	24.00	0.79	160.00	5.20	61.00	1.72	40.00	60.00	67.00	12.00	8.40	0.51	0.00	1.82	160.00	

[1] Shading indicates sediment. Dark shading indicates TSCA Concentration Levels

ND = Not Detected



RCRA Regulatory Levels for TCLP Extract Analysis

Parameter	Regulatory Level
Arsenic	5.0 mg/l
Barium	100 mg/l
Cadmium	1.0 mg/l
Chlorobenzene	100 mg/l
Chromium	5 mg/l
1,4-Dichlorobenzene	7.5 mg/l

US Army Corps of Engineers Buffalo District

Figure 3.6 TCLP Analysis of Ashtabula River Sediment Compared to Regulatory Levels

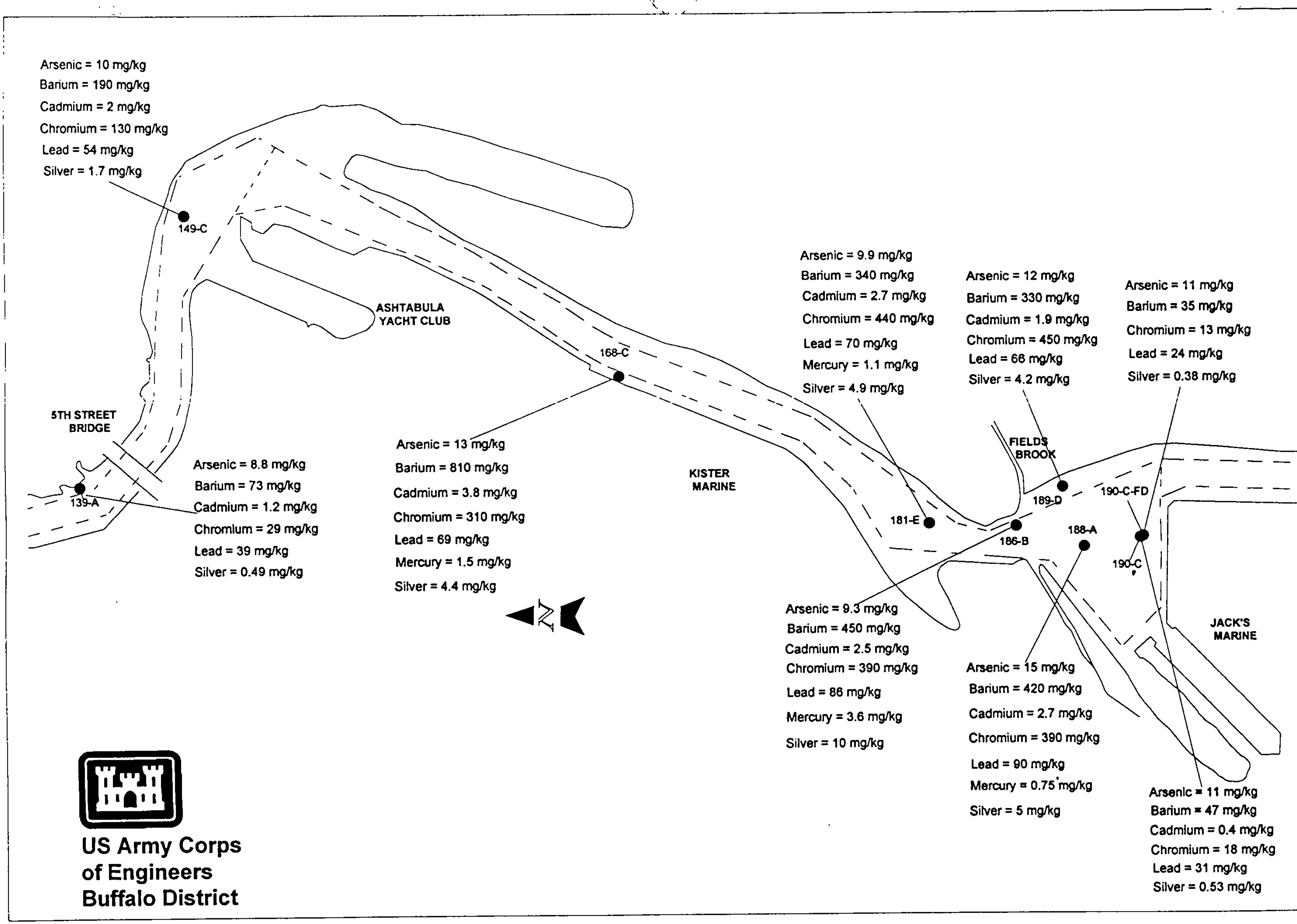


Figure 3.7 Total Analysis of RCRA Regulated Metals

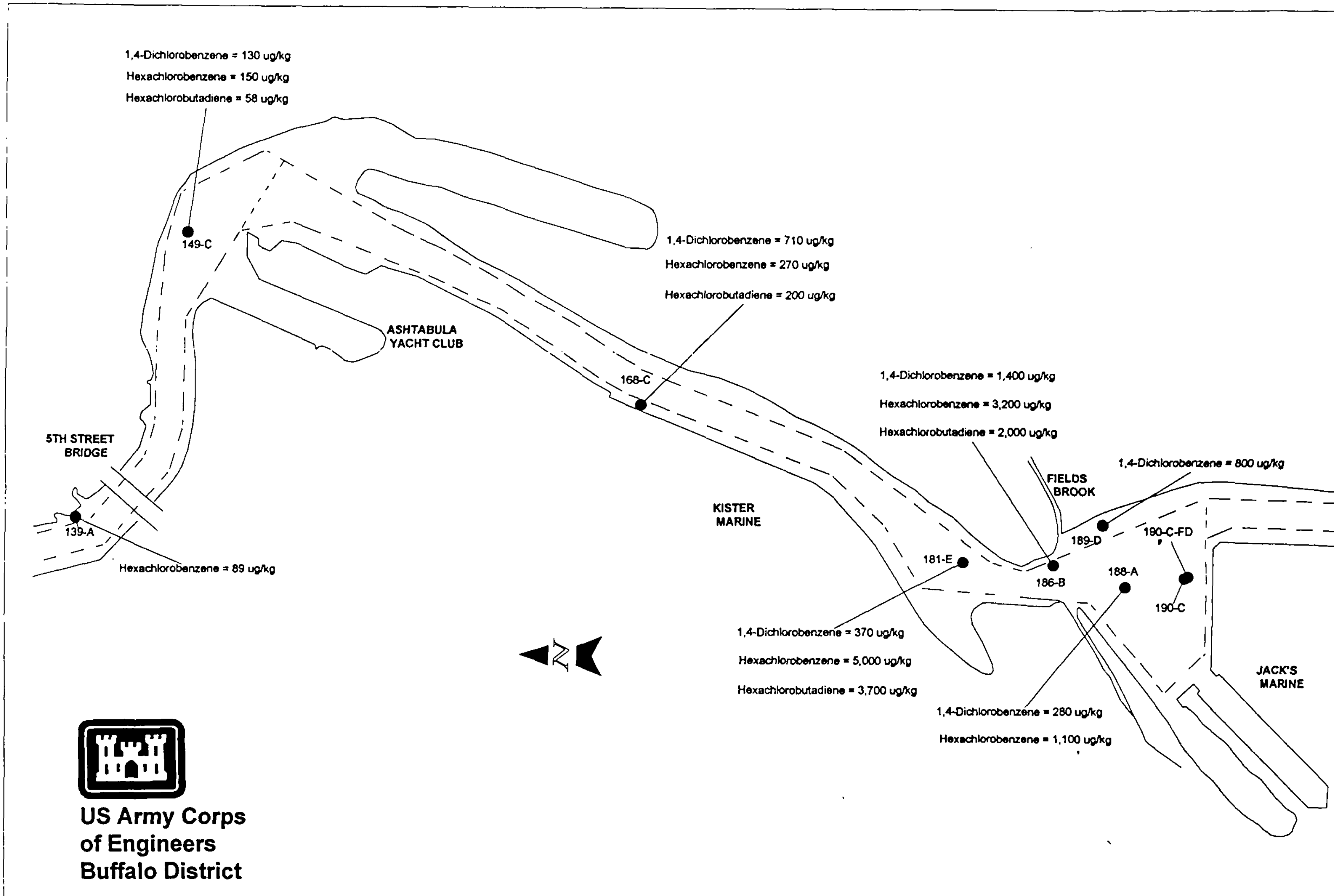


Figure 3.8 Total Analysis of RCRA Regulated Semivolatile Compounds

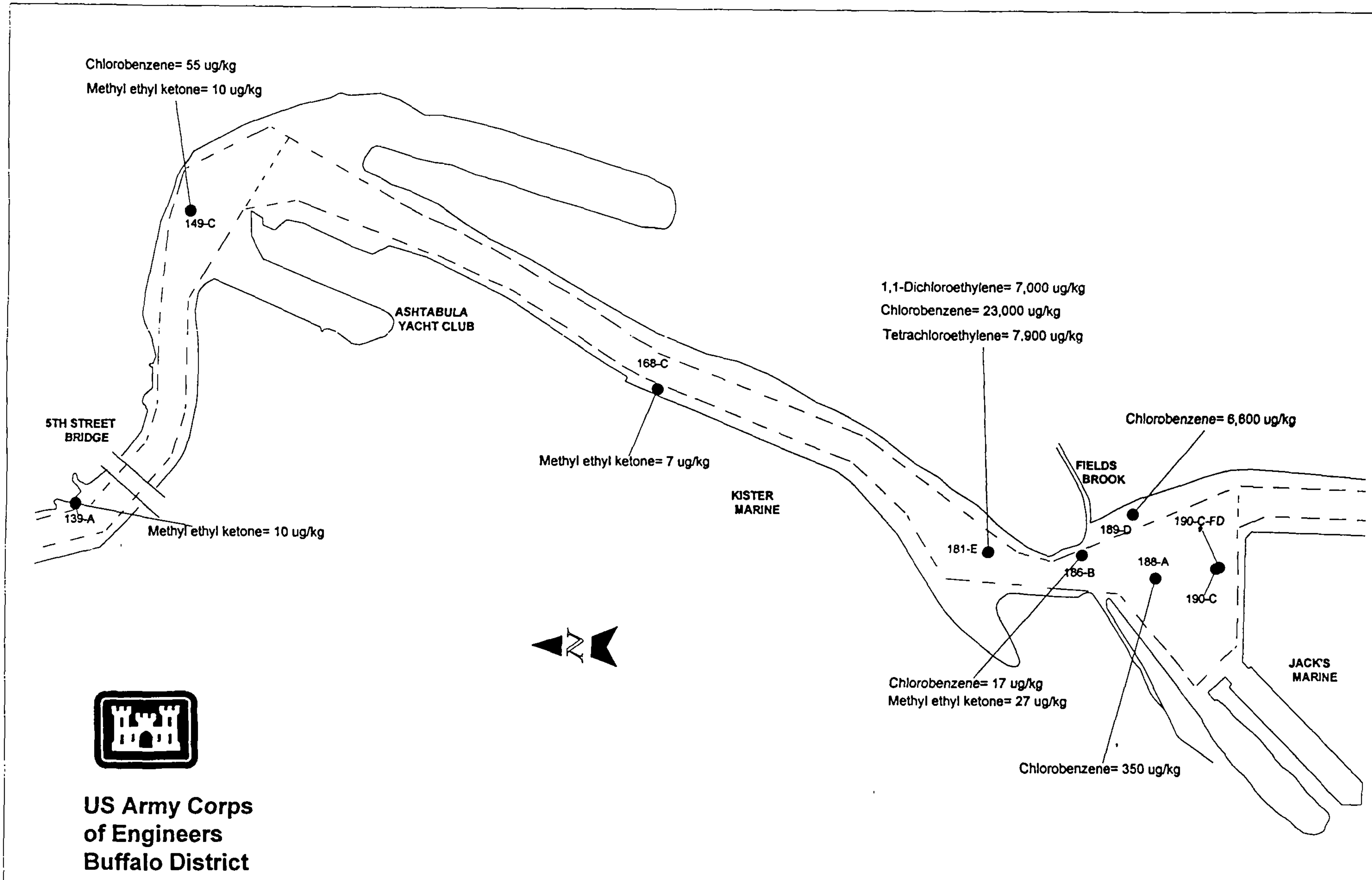


Figure 3.9 Total Analysis of RCRA Regulated Volatile Compounds

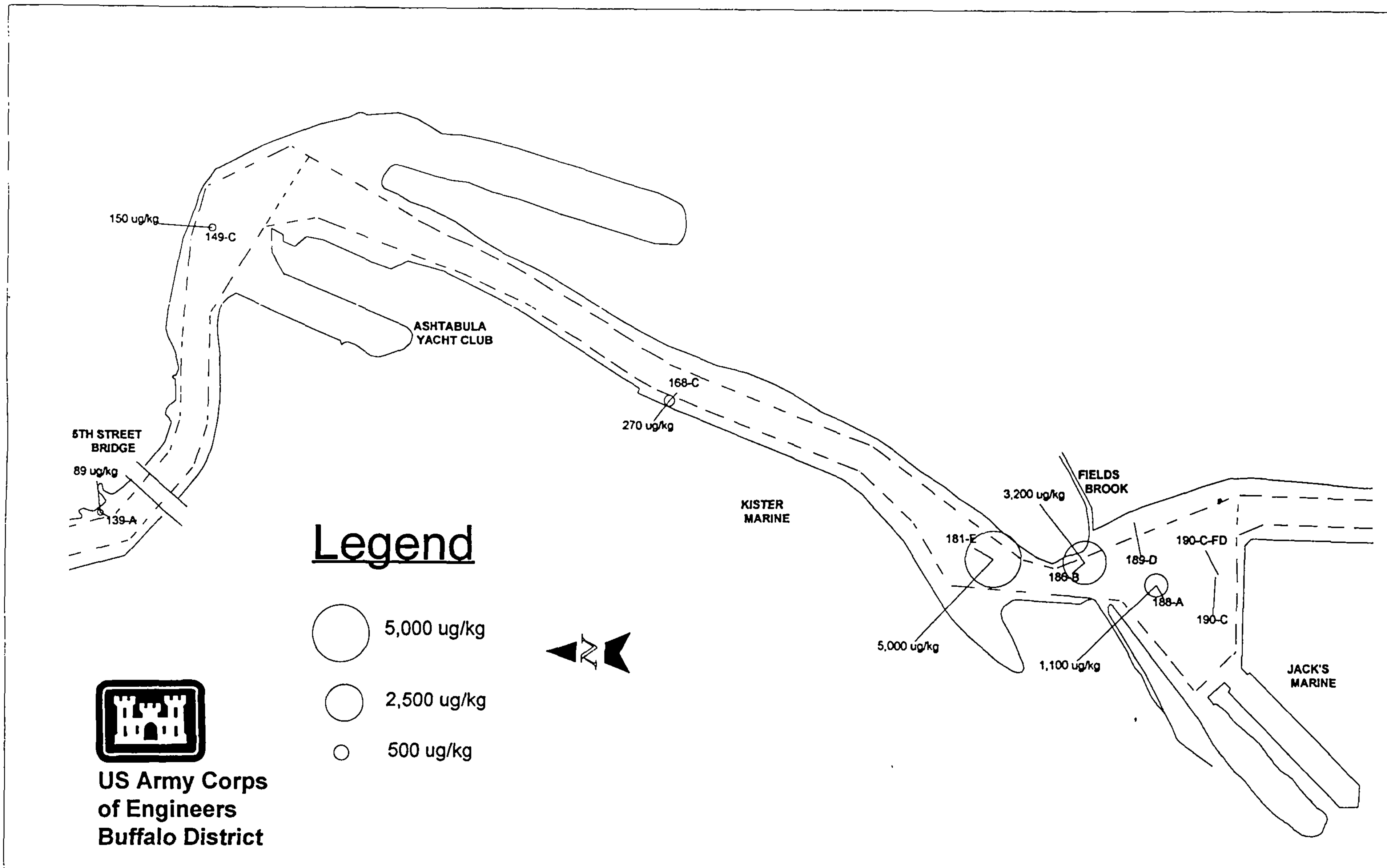


Figure 3.10 Total Hexachlorobenzene Concentration in Ashtabula River Sediments

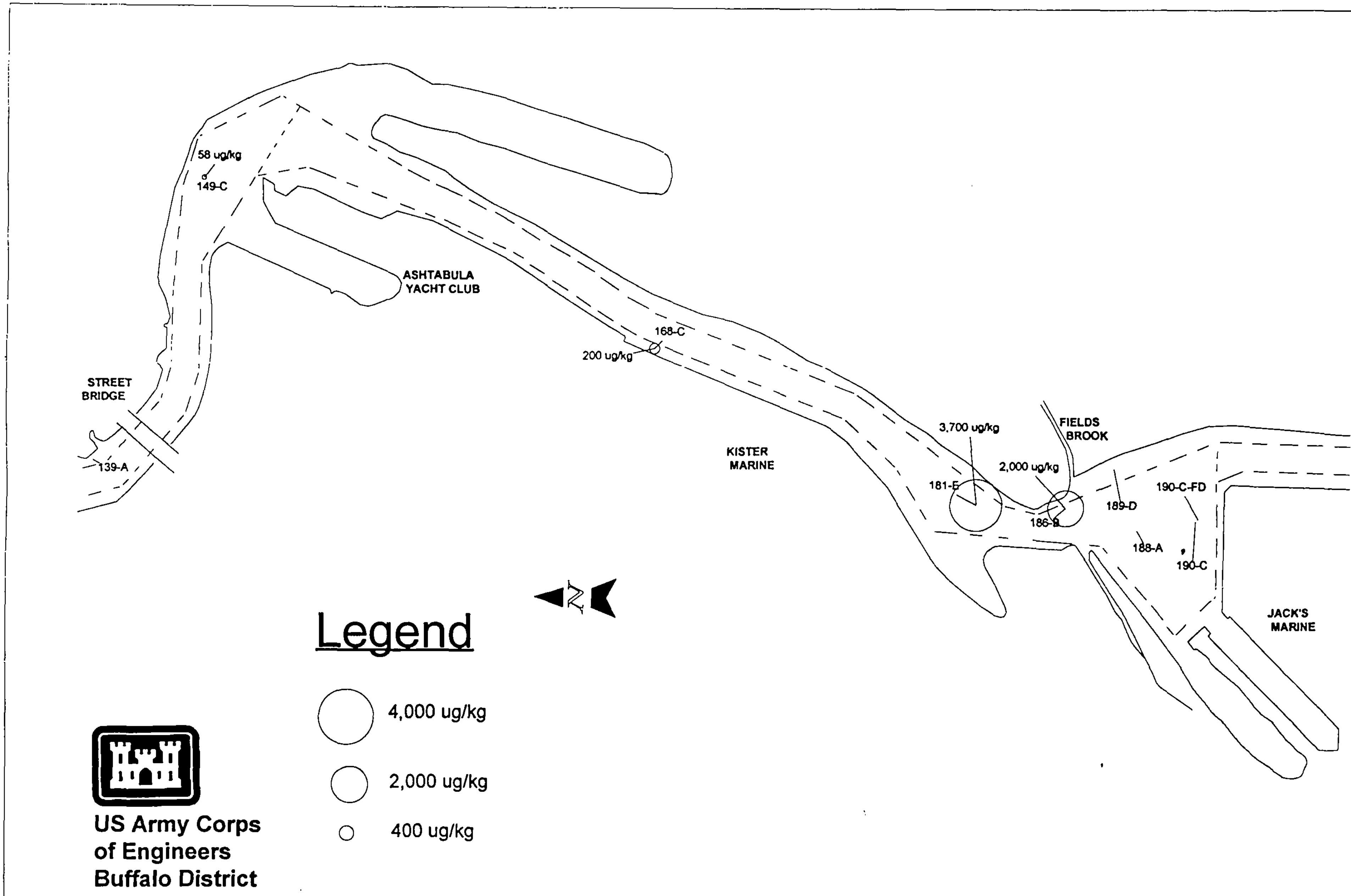


Figure 3.11 Total Hexachlorobutadiene Concentrations in Ashtabula River Sediments

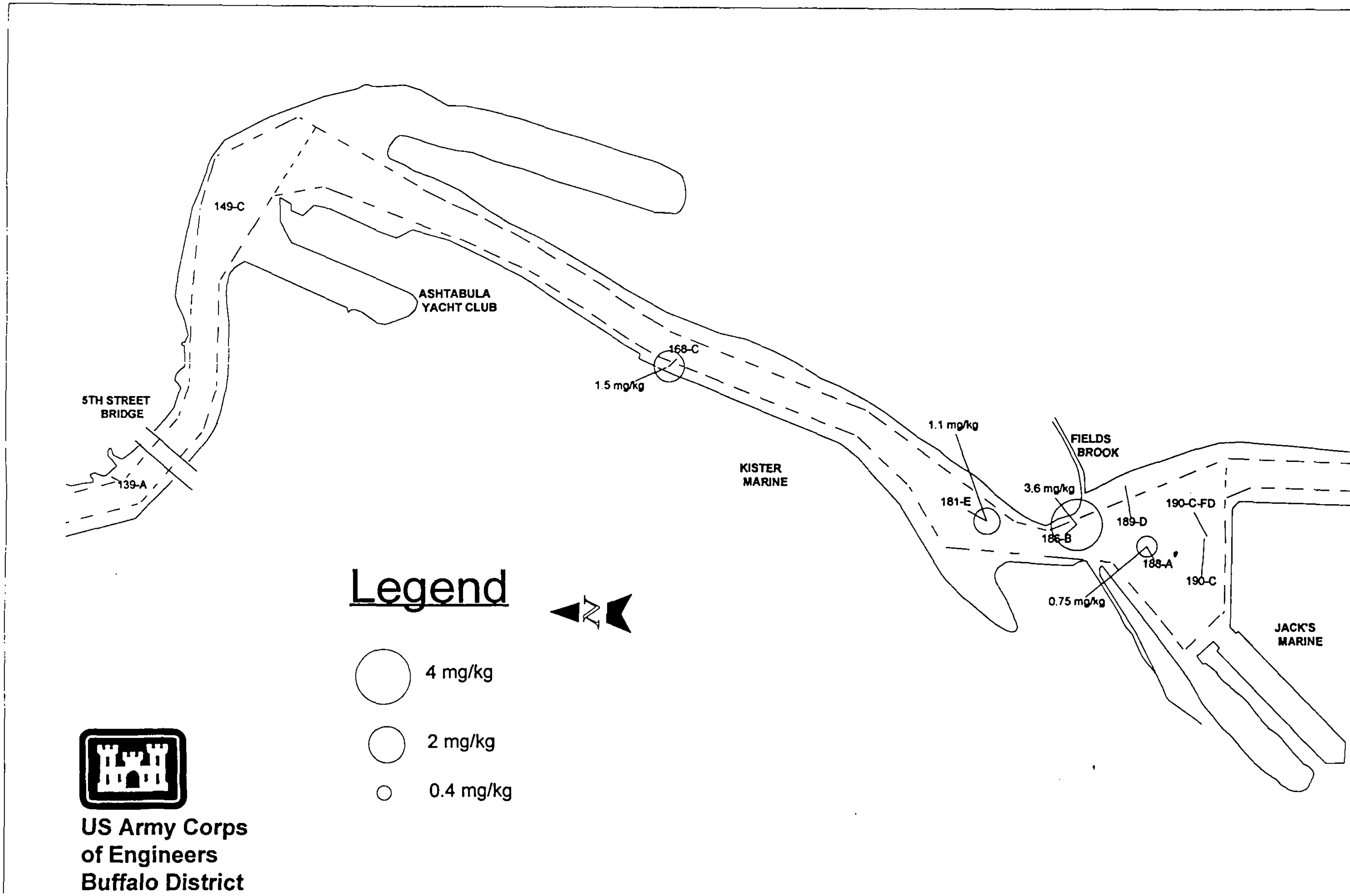


Figure 3.12 Total Mercury Concentrations in Ashtabula River Sediments

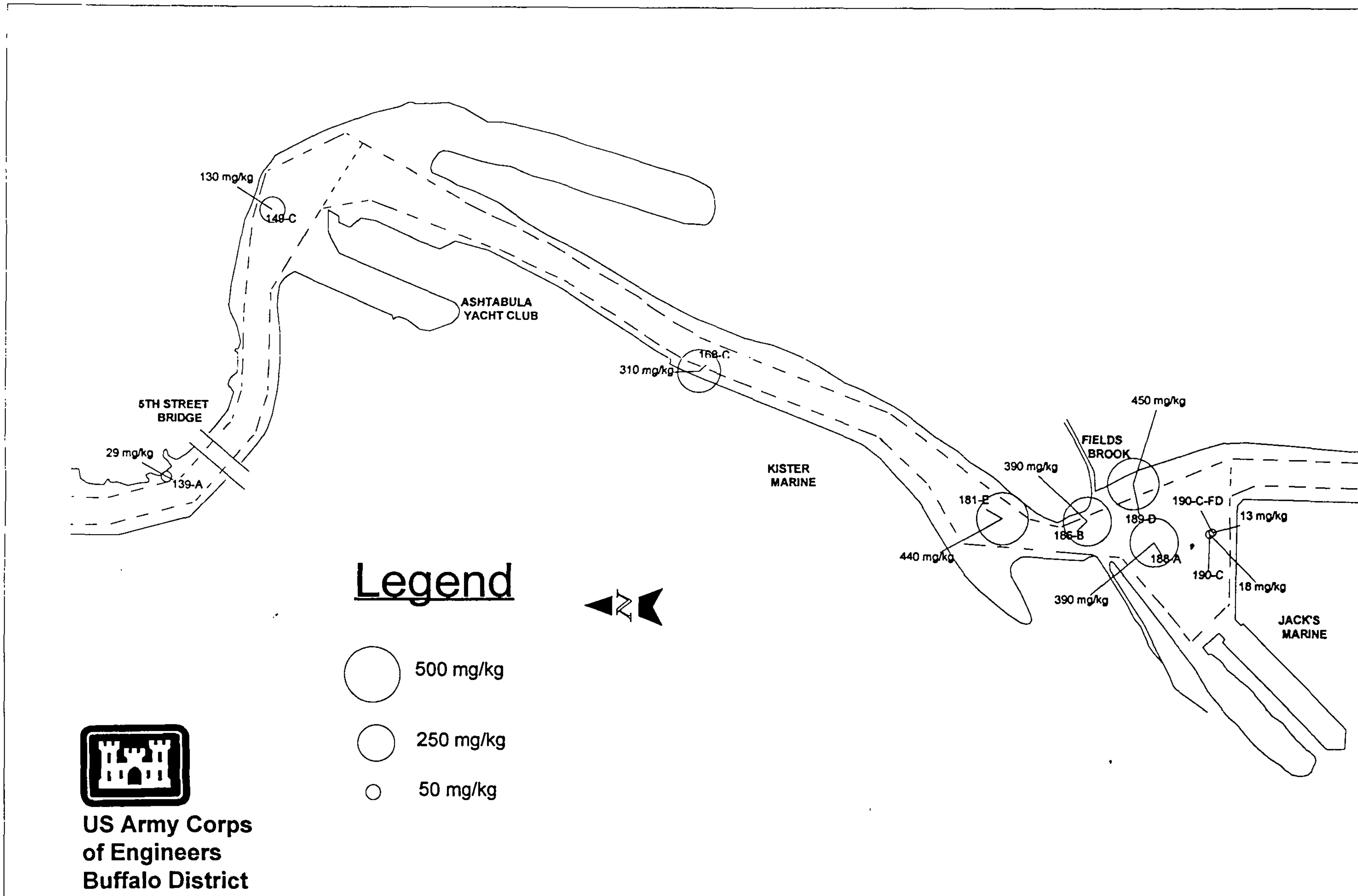


Figure 3.13 Total Chromium Concentrations in Ashtabula River Sediments

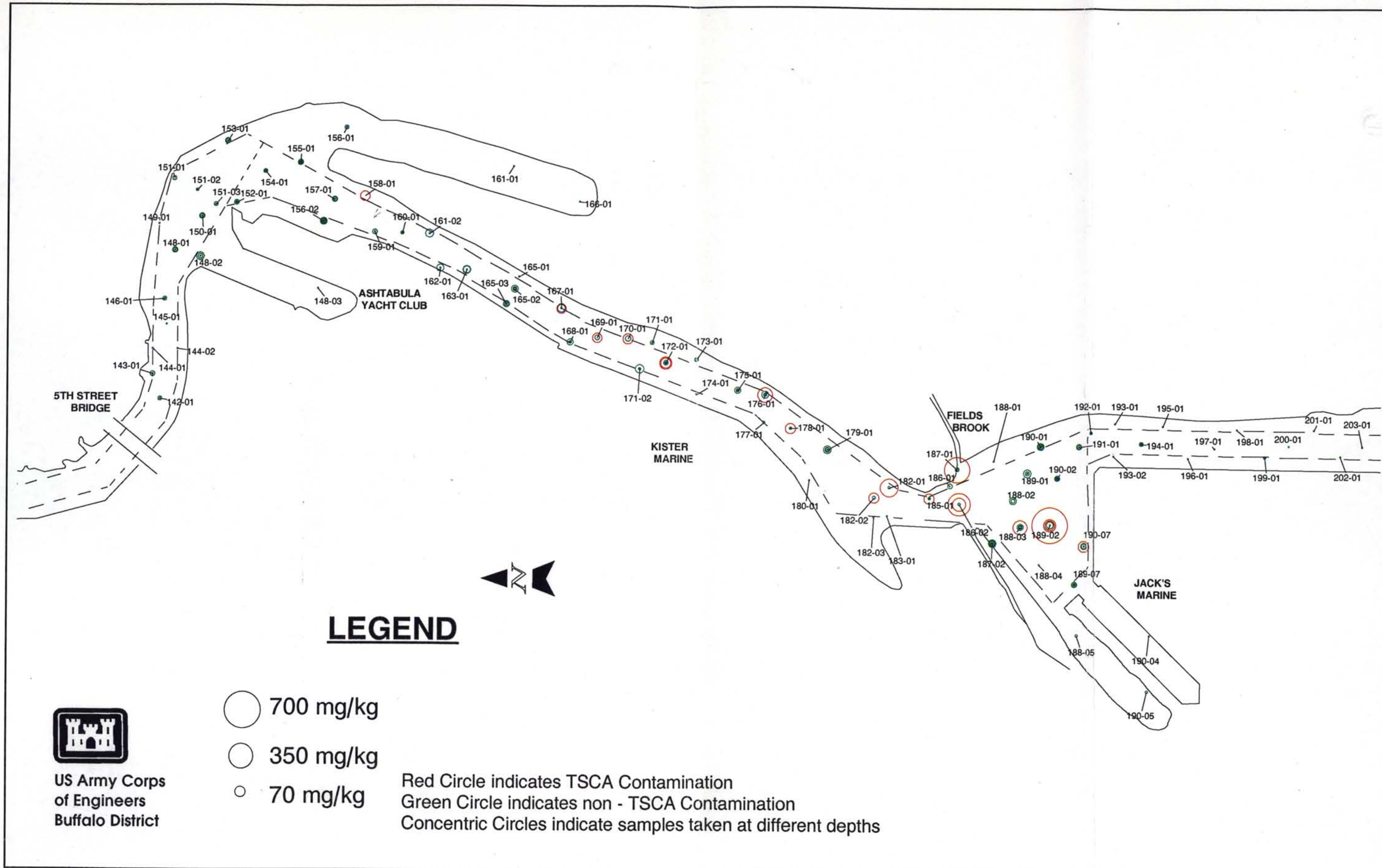


Figure 4.1 Thematic Map Of 1990 PCB Concentrations

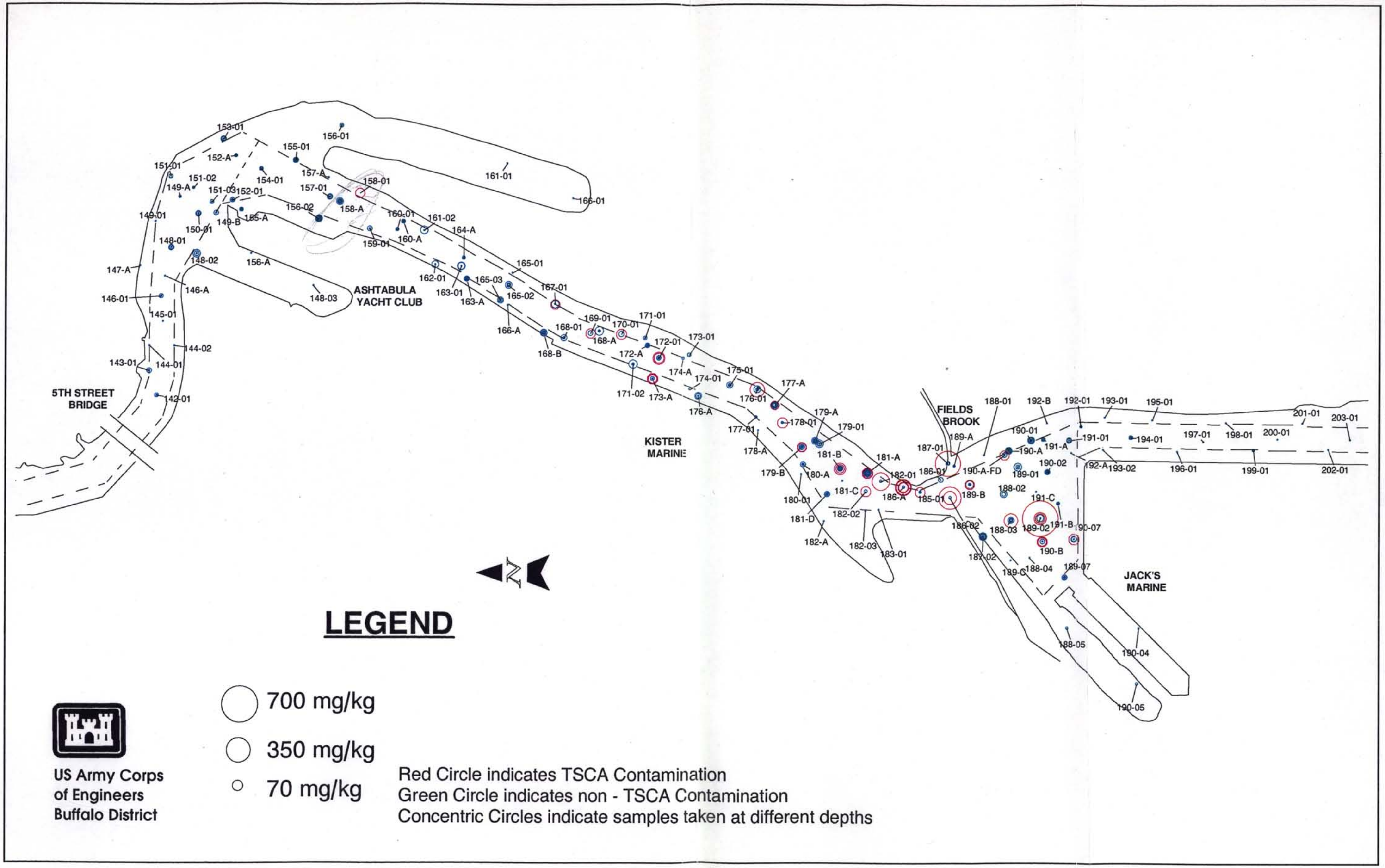


Figure 4.2 Thematic Map Of 1990 and 1995 PCB Concentrations

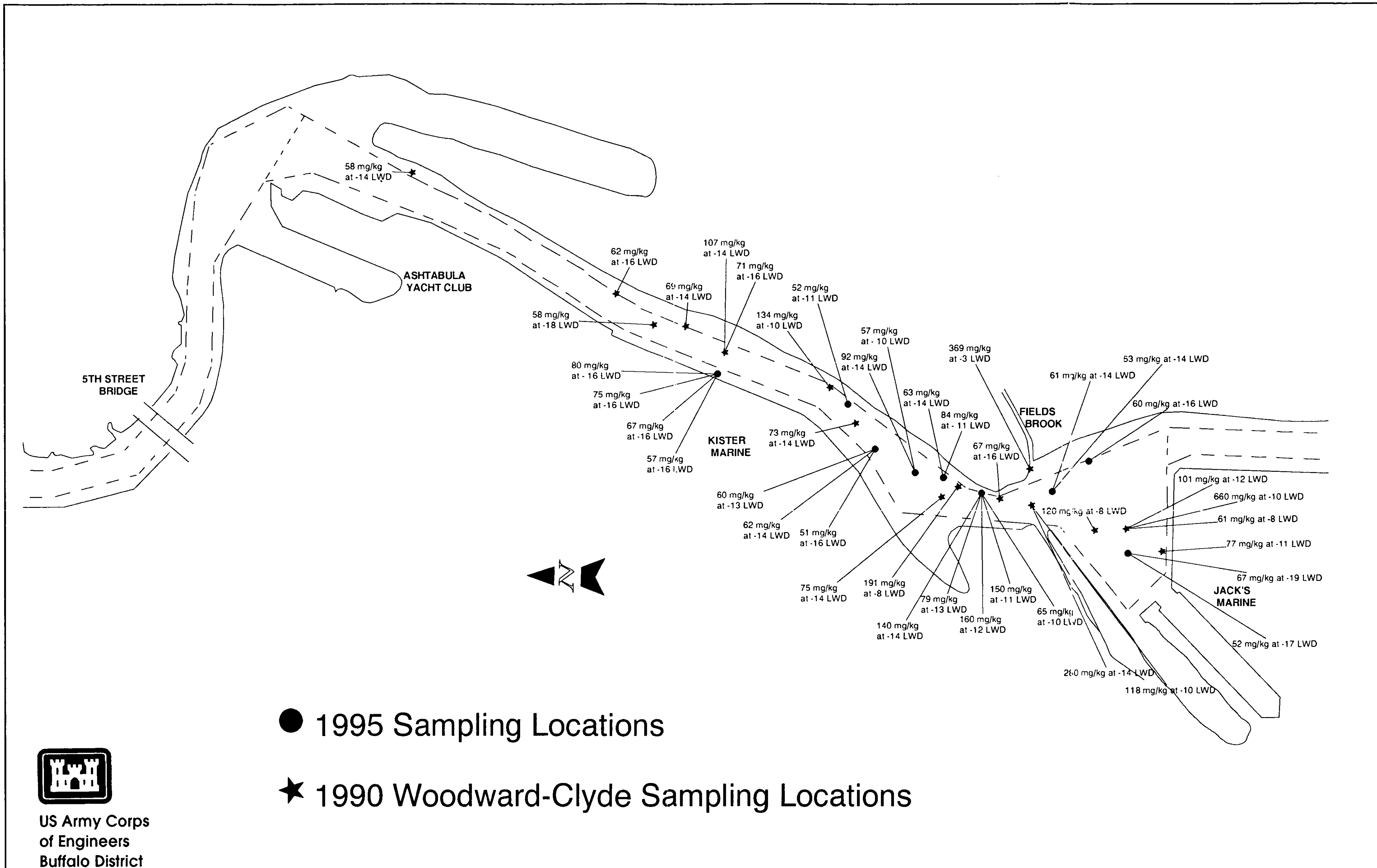


Figure 4.3 1990 and 1995 TSCA Contamination Levels and Depths in the Ashtabula River

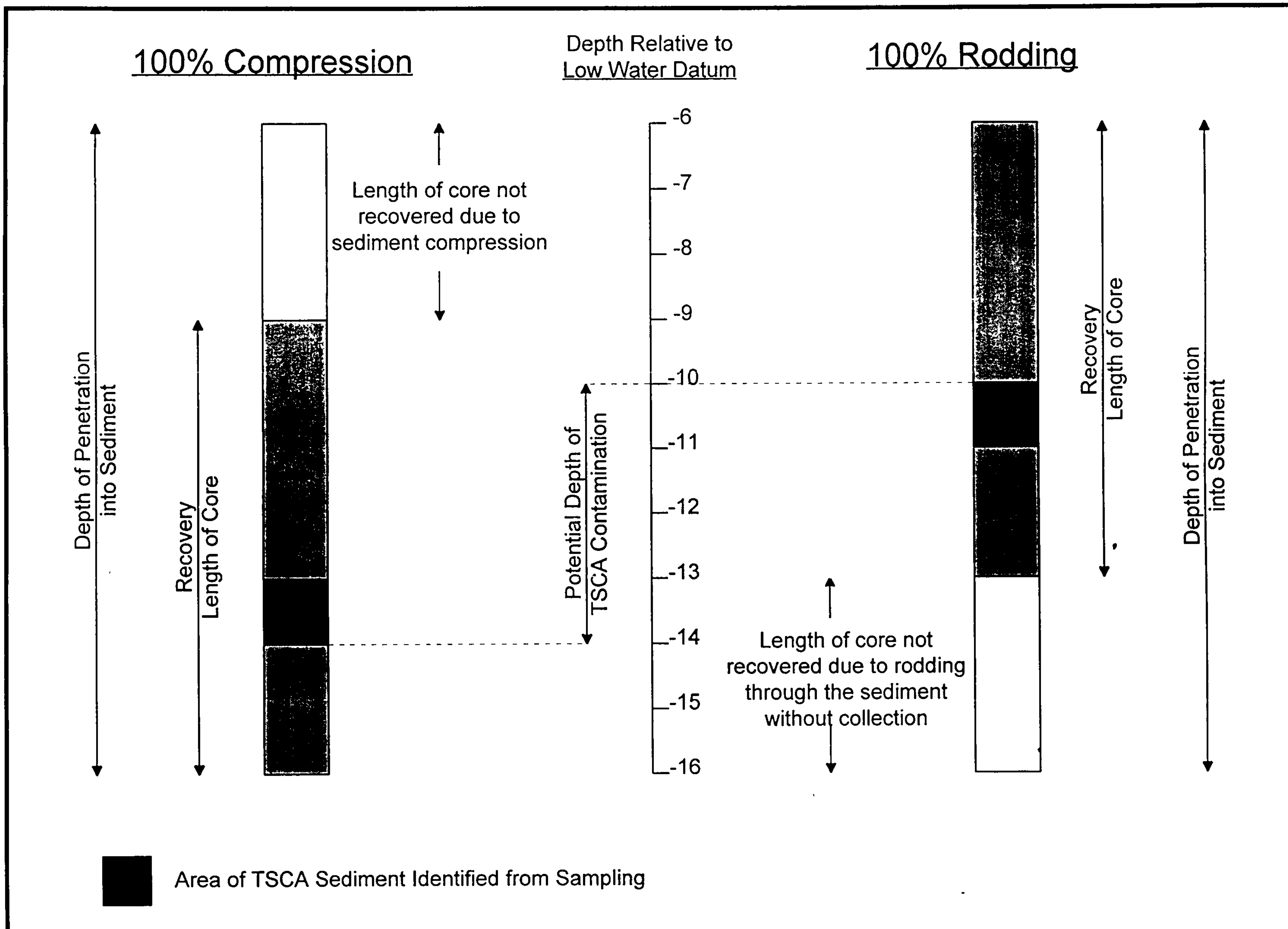
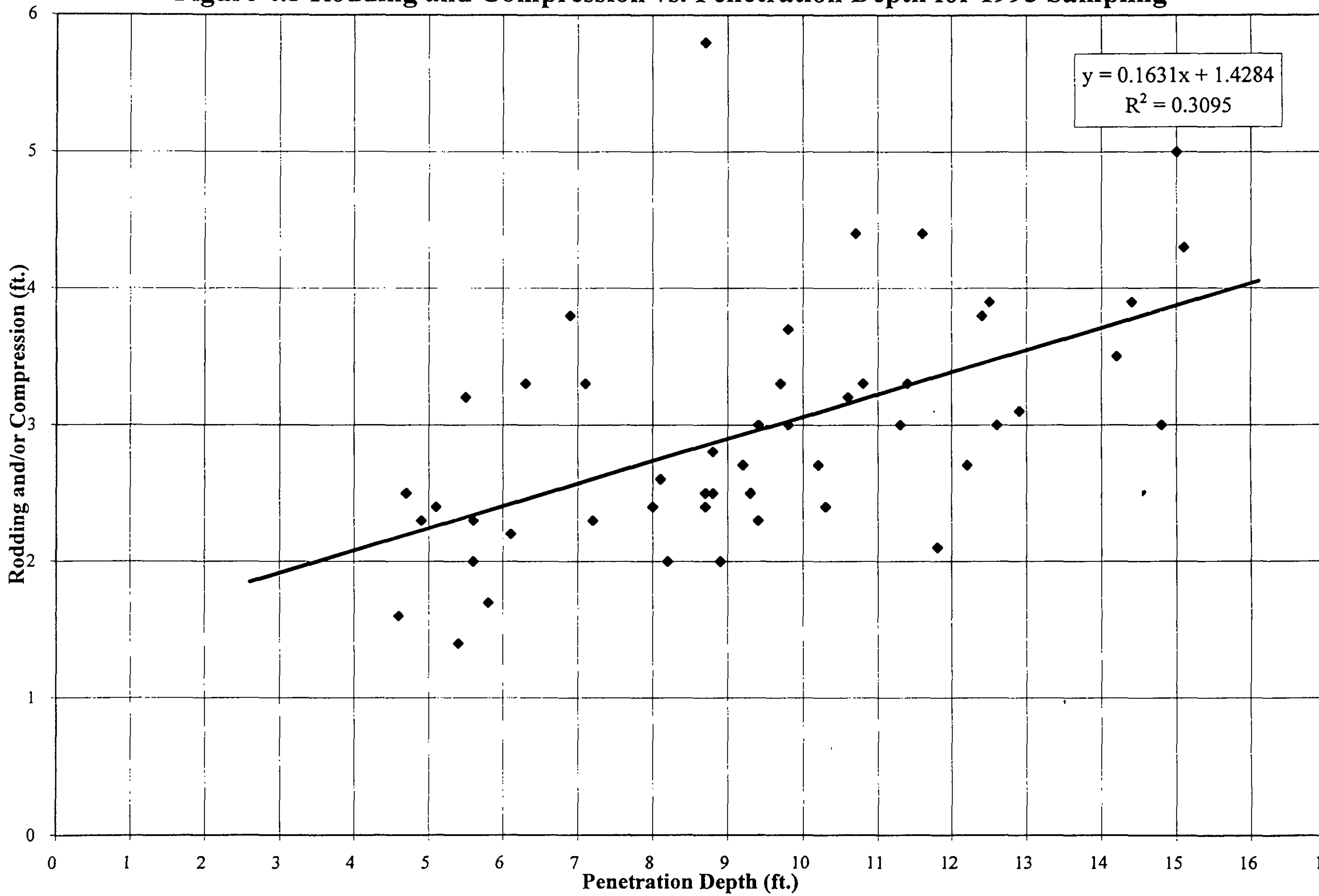


Figure 4.4 Effect of Rodding and Compression on Determining Depth of TSCA Contamination

Figure 4.5 Rodding and Compression vs. Penetration Depth for 1995 Sampling



Tab A

Detectable Levels of PCBs for 1990 and 1995 Sampling

Tab A. Detectable Levels of PCBs for 1990 and 1995 Sampling

Sample Number	Sample Date	Easting Ohio State Plane 1927	Northing Ohio State Plane 1927	Depth (ft below LWD)	Concentration (ug/kg)
203-01	1990	2463447	813366	3.0	302
203-01	1990	2463447	813366	8.0	82
203-01	1990	2463447	813366	10.0	158
203-01	1990	2463447	813366	12.0	902
202-01	1990	2463409	813455	9.0	142
202-01	1990	2463409	813455	11.0	209
201-01	1990	2463514	813560	7.0	87
201-01	1990	2463514	813560	9.0	1,057
201-01	1990	2463514	813560	11.0	1,165
201-01	1990	2463514	813560	13.0	376
200-01	1990	2463450	813661	9.0	383
200-01	1990	2463450	813661	11.0	733
200-01	1990	2463450	813661	13.0	1,298
200-01	1990	2463450	813661	15.0	239
200-01	1990	2463450	813661	16.0	659
199-01	1990	2463405	813757	6.0	88
199-01	1990	2463405	813757	8.0	254
199-01	1990	2463405	813757	8.0	323
199-01	1990	2463405	813757	9.0	5,007
198-01	1990	2463515	813868	11.0	377
198-01	1990	2463515	813868	13.0	1,703
198-01	1990	2463515	813868	15.0	1,438
198-01	1990	2463515	813868	19.0	138
197-01	1990	2463439	813959	7.0	1,078
197-01	1990	2463439	813959	9.0	3,910
197-01	1990	2463439	813959	11.0	1,242
197-01	1990	2463439	813959	13.0	972
196-01	1990	2463399	814065	8.0	1,687
196-01	1990	2463399	814065	10.0	3,785
196-01	1990	2463399	814065	10.0	3,453
196-01	1990	2463399	814065	12.0	2,876
196-01	1990	2463399	814065	13.0	1,754
195-01	1990	2463527	814165	9.0	189
195-01	1990	2463527	814165	11.0	3,008
195-01	1990	2463527	814165	13.0	2,452
194-01	1990	2463456	814252	8.0	654
194-01	1990	2463456	814252	10.0	11,205
194-01	1990	2463456	814252	12.0	5,051
194-01	1990	2463456	814252	14.0	4,082
194-01	1990	2463456	814252	15.0	674
194-01	1990	2463456	814252	15.0	675
193-02	1990	2463406	814364	9.0	911
193-02	1990	2463406	814364	11.0	141
193-02	1990	2463406	814364	13.0	1,451
193-01	1990	2463536	814358	6.0	1,551
193-01	1990	2463536	814358	8.0	2,381
193-01	1990	2463536	814358	10.0	2,041
192-B	1995	2463513	814595	10.6	550
192-B	1995	2463513	814595	11.6	1,820
192-B	1995	2463513	814595	12.8	1,440
192-B	1995	2463513	814595	12.8	1,210
192-B	1995 QA	2463513	814595	12.8	690
192-B	1995	2463513	814595	12.8	760
192-01	1990	2463499	814454	8.0	4,064
192-01	1990	2463499	814454	10.0	3,912
192-01	1990	2463499	814454	12.0	2,406
192-01	1990	2463499	814454	14.0	2,009
191-C	1995	2463234	814638	10.1	340
191-C	1995	2463234	814638	12.1	510
191-B	1995	2463187	814549	10.1	300
191-B	1995	2463187	814549	10.1	670
191-B	1995	2463187	814549	12.1	4,200
191-B	1995	2463187	814549	13.2	8,400
191-A	1995	2463447	814609	10.4	66
191-A	1995	2463447	814609	11.4	12,000

Tab A. Detectable Levels of PCBs for 1990 and 1995 Sampling

Sample Number	Sample Date	Easting Ohio State Plane 1927	Northing Ohio State Plane 1927	Depth (ft below LWD)	Concentration (ug/kg)
191-A	1995	2463447	814609	12.2	9,000
191-01	1990	2463443	814504	7.0	318
191-01	1990	2463443	814504	9.0	24,876
191-01	1990	2463443	814504	11.0	14,765
191-01	1990	2463443	814504	13.0	379
190-B	1995	2463033	814612	9.7	323
190-B	1995	2463033	814612	11.7	690
190-B	1995	2463033	814612	13.7	19,000
190-B	1995	2463033	814612	15.7	50,000
190-B	1995	2463033	814612	17.7	52,000
190-B	1995	2463033	814612	19.5	67,000
190-AFD	1995	2463384	814768	11.0	900
190-AFD	1995	2463384	814768	13.0	3,800
190-AFD	1995	2463384	814768	15.0	20,200
190-AFD	1995	2463384	814768	16.9	60,000
190-A	1995	2463401	814750	9.8	640
190-A	1995	2463401	814750	11.8	12,550
190-A	1995	2463401	814750	13.8	39,600
190-A	1995	2463401	814750	13.8	365
190-A	1995 QA	2463401	814750	13.8	40,000
190-A	1995	2463401	814750	13.8	28,300
190-A	1995	2463401	814750	15.7	24,700
190-A	1995	2463401	814750	17.1	4,600
190-07	1990	2463043	814483	7.0	1,056
190-07	1990	2463043	814483	9.0	18,000
190-07	1990	2463043	814483	11.0	77,399
190-07	1990	2463043	814483	13.0	31,609
190-07	1990	2463043	814483	15.0	17,274
190-05	1990	2462458	814226	1.0	4,593
190-04	1990	2462683	814218	12.0	745
190-04	1990	2462683	814218	15.0	1,925
190-02	1990	2463316	814592	2.0	143
190-02	1990	2463316	814592	4.0	346
190-02	1990	2463316	814592	4.0	255
190-02	1990	2463316	814592	6.0	4,623
190-02	1990	2463316	814592	8.0	24,735
190-02	1990	2463316	814592	10.0	12,281
190-02	1990	2463316	814592	11.0	6,356
190-01	1990	2463444	814659	8.0	39,735
190-01	1990	2463444	814659	10.0	26,455
190-01	1990	2463444	814659	10.0	9,720
190-01	1990	2463444	814659	12.0	10,861
190-01	1990	2463444	814659	14.0	825
189-C	1995	2462957	814742	9.1	920
189-C	1995	2462957	814742	10.1	600
189-C	1995	2462957	814742	11.7	1,720
189-B	1995	2463265	814908	10.6	1,500
189-B	1995	2463265	814908	12.6	5,600
189-B	1995	2463265	814908	14.6	61,000
189-B	1995	2463265	814908	14.6	53,000
189-B	1995	2463265	814908	16.9	47,000
189-A	1995	2463340	814971	9.4	3,600
189-A	1995	2463340	814971	9.4	4,200
189-A	1995 QA	2463340	814971	9.4	930
189-A	1995	2463340	814971	10.4	2,100
189-A	1995	2463340	814971	11.4	2,000
189-A	1995	2463340	814971	12.4	1,600
189-A	1995	2463340	814971	13.4	5,200
189-A	1995	2463340	814971	14.6	3,100
189-07	1990	2462889	814521	8.0	773
189-07	1990	2462889	814521	10.0	19,451
189-07	1990	2462889	814521	10.0	2,673
189-07	1990	2462889	814521	12.0	25,575
189-07	1990	2462889	814521	14.0	3,780
189-07	1990	2462889	814521	16.0	4,064

Tab A. Detectable Levels of PCBs for 1990 and 1995 Sampling

Sample Number	Sample Date	Easting Ohio State Plane 1927	Northing Ohio State Plane 1927	Depth (ft below LWD)	Concentration (ug/kg)
189-02	1990	2463128	814621	4.0	127
189-02	1990	2463128	814621	6.0	36,638
189-02	1990	2463128	814621	8.0	61,765
189-02	1990	2463128	814621	10.0	38,265
189-02	1990	2463128	814621	10.0	660,066
189-02	1990	2463128	814621	12.0	101,167
189-01	1990	2463336	814713	6.0	263
189-01	1990	2463336	814713	8.0	1,291
189-01	1990	2463336	814713	12.0	42,216
189-01	1990	2463336	814713	14.0	14,114
188-05	1990	2462683	814512	6.0	4,762
188-04	1990	2462968	814665	2.0	2,364
188-04	1990	2462968	814665	10.0	2,197
188-04	1990	2462968	814665	16.0	1,597
188-03	1990	2463119	814740	8.0	120,000
188-03	1990	2463119	814740	10.0	30,942
188-03	1990	2463119	814740	16.0	11,993
188-03	1990	2463119	814740	16.0	6,525
188-02	1990	2463225	814770	8.0	37,255
188-02	1990	2463225	814770	14.0	13,679
188-01	1990	2463384	814850	4.0	1,866
187-02	1990	2463053	814853	2.0	2,735
187-02	1990	2463053	814853	4.0	18,250
187-02	1990	2463053	814853	6.0	30,691
187-02	1990	2463053	814853	6.0	46,099
187-02	1990	2463053	814853	8.0	28,205
187-02	1990	2463053	814853	10.0	6,584
187-02	1990	2463053	814853	16.0	3,697
187-01	1990	2463350	814996	1.0	13,497
187-01	1990	2463350	814996	1.0	10,974
187-01	1990	2463350	814996	3.0	369,357
186-A	1995	2463254	815177	9.2	6,000
186-A	1995	2463254	815177	10.2	65,700
186-A	1995	2463254	815177	11.2	150,000
186-A	1995	2463254	815177	12.2	160,000
186-A	1995	2463254	815177	13.2	79,000
186-A	1995	2463254	815177	14.7	140,000
186-02	1990	2463211	814987	8.0	5,222
186-02	1990	2463211	814987	10.0	118,881
186-02	1990	2463211	814987	14.0	280,936
186-01	1990	2463283	815025	10.0	16,435
185-01	1990	2463234	815109	10.0	1,223
185-01	1990	2463234	815109	16.0	67,073
185-01	1990	2463234	815109	18.0	4,524
183-01	1990	2463162	815278	10.0	2,368
183-01	1990	2463162	815278	14.0	1,473
182-A	1995	2463114	815499	7.2	790
182-A	1995	2463114	815499	8.2	79
182-03	1990	2463157	815332	9.0	928
182-03	1990	2463157	815332	13.0	3,636
182-03	1990	2463157	815332	17.0	1,438
182-02	1990	2463236	815330	10.0	7,742
182-02	1990	2463236	815330	14.0	75,426
182-01	1990	2463277	815269	1.0	6,719
182-01	1990	2463277	815269	8.0	191,038
181-D	1995	2463223	815487	13.1	2,400
181-D	1995	2463223	815487	14.1	340
181-D	1995	2463223	815487	15.1	3,100
181-D	1995	2463223	815487	16.1	8,600
181-D	1995	2463223	815487	16.1	3,600
181-D	1995	2463223	815487	17.1	24,000
181-D	1995	2463223	815487	18.1	3,100
181-D	1995	2463223	815487	19.1	3,400
181-D	1995	2463223	815487	19.6	250
181-C	1995	2463279	815426	9.4	2,200

Tab A. Detectable Levels of PCBs for 1990 and 1995 Sampling

Sample Number	Sample Date	Easting Ohio State Plane 1927	Northing Ohio State Plane 1927	Depth (ft below LWD)	Concentration (ug/kg)
181-C	1995	2463279	815426	10.4	3,700
181-C	1995	2463279	815426	10.4	2,300
181-C	1995	2463279	815426	11.4	2,800
181-B	1995	2463328	815434	5.7	2,200
181-B	1995	2463328	815434	6.7	2,600
181-B	1995	2463328	815434	7.7	8,400
181-B	1995	2463328	815434	8.7	8,700
181-B	1995	2463328	815434	9.7	12,000
181-B	1995	2463328	815434	9.7	13,000
181-B	1995 QA	2463328	815434	9.7	57,000
181-B	1995	2463328	815434	9.7	10,000
181-B	1995	2463328	815434	10.7	7,600
181-B	1995	2463328	815434	11.7	16,000
181-B	1995	2463328	815434	12.7	11,000
181-B	1995	2463328	815434	13.7	22,000
181-B	1995	2463328	815434	14.4	92,000
181-A	1995	2463311	815324	5.8	740
181-A	1995	2463311	815324	6.8	1,700
181-A	1995	2463311	815324	7.8	3,600
181-A	1995	2463311	815324	8.8	9,600
181-A	1995	2463311	815324	9.8	38,000
181-A	1995	2463311	815324	10.8	25,000
181-A	1995	2463311	815324	10.8	28,000
181-A	1995 QA	2463311	815324	10.8	84,000
181-A	1995	2463311	815324	10.8	20,000
181-A	1995	2463311	815324	11.8	16,000
181-A	1995	2463311	815324	12.8	28,000
181-A	1995	2463311	815324	13.8	45,000
181-A	1995	2463311	815324	13.8	25,000
181-A	1995	2463311	815324	14.8	63,000
181-A	1995	2463311	815324	15.6	13,000
180-A	1995	2463344	815584	15.8	2,800
180-A	1995	2463344	815584	16.8	5,000
180-A	1995	2463344	815584	17.8	4,800
180-A	1995	2463344	815584	18.8	24,000
180-A	1995	2463344	815584	19.8	3,500
180-A	1995	2463344	815584	21.1	600
179-B	1995	2463415	815589	9.6	510
179-B	1995	2463415	815589	10.6	2,500
179-B	1995	2463415	815589	11.6	3,700
179-B	1995	2463415	815589	12.6	11,000
179-B	1995	2463415	815589	13.6	60,000
179-B	1995	2463415	815589	14.6	62,000
179-B	1995	2463415	815589	15.6	27,000
179-B	1995	2463415	815589	16.6	51,000
179-B	1995	2463415	815589	17.2	26,000
179-A	1995	2463440	815535	7.1	3,700
179-A	1995	2463440	815535	9.1	14,000
179-A	1995	2463440	815535	11.1	34,000
179-A	1995	2463440	815535	13.1	11,000
179-A	1995	2463440	815535	15.1	16,000
179-01	1990	2463427	815518	1.0	3,166
179-01	1990	2463427	815518	2.0	20,339
179-01	1990	2463427	815518	6.0	18,969
179-01	1990	2463427	815518	8.0	43,902
179-01	1990	2463427	815518	8.0	43,636
179-01	1990	2463427	815518	10.0	15,423
178-A	1995	2463482	815765	16.8	270
178-A	1995	2463482	815765	17.8	2,200
178-A	1995	2463482	815765	19.1	2,200
178-01	1990	2463513	815667	4.0	1,102
178-01	1990	2463513	815667	8.0	5,781
178-01	1990	2463513	815667	14.0	73,630
177-A	1995	2463584	815698	6.4	9,600
177-A	1995	2463584	815698	7.4	9,000

Tab A. Detectable Levels of PCBs for 1990 and 1995 Sampling

Sample Number	Sample Date	Easting Ohio State Plane 1927	Northing Ohio State Plane 1927	Depth (ft below LWD)	Concentration (ug/kg)
177-A	1995	2463584	815698	8.4	18,000
177-A	1995	2463584	815698	9.4	30,000
177-A	1995	2463584	815698	10.4	48,000
177-A	1995	2463584	815698	11.7	52,000
177-01	1990	2463535	815774	15.0	3,086
177-01	1990	2463535	815774	15.0	2,555
177-01	1990	2463535	815774	20.0	5,903
176-A	1995	2463622	816008	11.5	440
176-A	1995	2463622	816008	11.5	190
176-A	1995	2463622	816008	13.5	890
176-A	1995	2463622	816008	15.5	2,600
176-A	1995	2463622	816008	17.5	34,000
176-A	1995	2463622	816008	19.5	16,000
176-A	1995	2463622	816008	20.2	3,200
176-01	1990	2463647	815769	2.0	3,485
176-01	1990	2463647	815769	6.0	8,385
176-01	1990	2463647	815769	8.0	34,921
176-01	1990	2463647	815769	10.0	134,000
175-01	1990	2463665	815880	10.0	1,207
175-01	1990	2463665	815880	10.0	788
175-01	1990	2463665	815880	16.0	30,357
175-01	1990	2463665	815880	18.0	7,905
174-A	1995	2463773	816073	15.5	4,700
174-A	1995	2463773	816073	17.5	9,500
174-A	1995	2463773	816073	19.5	1,600
174-A	1995	2463773	816073	19.5	2,400
174-A	1995 QA	2463773	816073	19.5	5,500
174-A	1995	2463773	816073	19.5	4,500
173-A	1995	2463692	816199	12.9	850
173-A	1995	2463692	816199	14.9	15,000
173-A	1995	2463692	816199	16.9	67,000
173-A	1995	2463692	816199	16.9	57,000
173-A	1995 QA	2463692	816199	16.9	80,000
173-A	1995	2463692	816199	16.9	75,000
173-A	1995	2463692	816199	19.4	1,400
173-01	1990	2463788	816047	8.0	15,000
173-01	1990	2463788	816047	10.0	9,076
172-A	1995	2463824	816220	16.4	390
172-A	1995	2463824	816220	17.4	7,600
172-A	1995	2463824	816220	18.4	17,000
172-A	1995	2463824	816220	19.4	3,600
172-A	1995	2463824	816220	20.4	5,200
172-A	1995	2463824	816220	21.5	350
172-01	1990	2463774	816173	10.0	3,113
172-01	1990	2463774	816173	12.0	19,097
172-01	1990	2463774	816173	14.0	107,383
172-01	1990	2463774	816173	16.0	71,429
172-01	1990	2463774	816173	18.0	7,072
171-02	1990	2463749	816278	6.0	1,508
171-02	1990	2463749	816278	8.0	1,854
171-02	1990	2463749	816278	10.0	5,763
171-02	1990	2463749	816278	14.0	49,608
171-01	1990	2463854	816229	13.0	13,053
171-01	1990	2463854	816229	15.0	2,550
170-01	1990	2463871	816325	14.0	69,069
170-01	1990	2463871	816325	17.0	25,641
169-01	1990	2463875	816450	14.0	18,018
169-01	1990	2463875	816450	18.0	58,366
168-B	1995	2463876	816640	12.8	460
168-B	1995	2463876	816640	14.8	14,000
168-B	1995	2463876	816640	16.8	10,000
168-B	1995	2463876	816640	18.8	38,000
168-B	1995	2463876	816640	18.8	33,000
168-B	1995	2463876	816640	20.6	2,300
168-A	1995	2463883	816414	15.7	660

Tab A. Detectable Levels of PCBs for 1990 and 1995 Sampling

Sample Number	Sample Date	Easting Ohio State Plane 1927	Northing Ohio State Plane 1927	Depth (ft below LWD)	Concentration (ug/kg)
168-A	1995	2463883	816414	17.7	49,000
168-A	1995	2463883	816414	18.7	4,800
168-A	1995	2463883	816414	20.1	3,800
168-01	1990	2463856	816559	8.0	909
168-01	1990	2463856	816559	10.0	3,345
168-01	1990	2463856	816559	10.0	2,249
168-01	1990	2463856	816559	12.0	5,098
168-01	1990	2463856	816559	14.0	28,747
167-01	1990	2463991	816595	14.0	1,463
167-01	1990	2463991	816595	16.0	62,500
167-01	1990	2463991	816595	18.0	47,151
167-01	1990	2463991	816595	20.0	909
166-A	1995	2463988	816788	14.2	180
166-A	1995	2463988	816788	16.2	2,400
166-A	1995	2463988	816788	18.2	900
166-A	1995	2463988	816788	19.0	240
165-03	1990	2464007	816818	11.0	12,591
165-03	1990	2464007	816818	14.0	28,289
165-03	1990	2464007	816818	18.0	569
165-02	1990	2464068	816785	9.0	8,658
165-02	1990	2464068	816785	9.0	14,144
165-02	1990	2464068	816785	13.0	36,408
165-02	1990	2464068	816785	16.0	4,299
165-01	1990	2464118	816768	4.0	614
164-A	1995	2464093	816954	15.4	200
164-A	1995	2464093	816954	16.4	2,100
164-A	1995	2464093	816954	17.4	24,000
164-A	1995	2464093	816954	18.4	12,000
164-A	1995	2464093	816954	19.3	5,300
163-A	1995	2464177	816967	13.5	260
163-A	1995	2464177	816967	13.5	140
163-A	1995 QA	2464177	816967	13.5	1,300
163-A	1995	2464177	816967	13.5	350
163-A	1995	2464177	816967	15.5	1,700
163-A	1995	2464177	816967	17.8	8,200
163-01	1990	2464144	816977	12.0	3,061
163-01	1990	2464144	816977	14.0	37,528
163-01	1990	2464144	816977	16.0	46,667
162-01	1990	2464150	817083	10.0	1,038
162-01	1990	2464150	817083	14.0	38,363
162-01	1990	2464150	817083	17.0	268
161-02	1990	2464288	817127	10.0	3,220
161-02	1990	2464288	817127	14.0	41,801
161-01	1990	2464559	816792	8.0	1,468
161-01	1990	2464559	816792	10.0	1,421
161-01	1990	2464559	816792	12.0	210
160-A	1995	2464322	817210	13.2	260
160-A	1995	2464322	817210	15.2	1,300
160-A	1995	2464322	817210	17.2	6,600
160-A	1995	2464322	817210	18.1	2,700
160-A	1995	2464322	817210	18.1	3,000
160-A	1995 QA	2464322	817210	18.1	14,000
160-A	1995	2464322	817210	18.1	1,300
160-01	1990	2464291	817236	12.0	1,920
160-01	1990	2464291	817236	12.0	2,029
160-01	1990	2464291	817236	14.0	9,913
160-01	1990	2464291	817236	18.0	2,258
159-01	1990	2464295	817345	12.0	707
159-01	1990	2464295	817345	14.0	16,937
159-01	1990	2464295	817345	16.0	1,011
158-A	1995	2464405	817467	14.2	1,000
158-A	1995	2464405	817467	16.2	13,000
158-A	1995	2464405	817467	16.2	18,000
158-A	1995 QA	2464405	817467	16.2	14,000
158-A	1995	2464405	817467	16.2	1,300

Tab A. Detectable Levels of PCBs for 1990 and 1995 Sampling

Sample Number	Sample Date	Easting Ohio State Plane 1927	Northing Ohio State Plane 1927	Depth (ft below LWD)	Concentration (ug/kg)
158-A	1995	2464405	817467	18.2	40,000
158-A	1995	2464405	817467	19.7	8,000
158-01	1990	2464439	817385	14.0	58,824
157-A	1995	2464502	817513	9.1	230
157-A	1995	2464502	817513	10.1	350
157-A	1995	2464502	817513	11.1	1,300
157-A	1995	2464502	817513	12.2	310
157-01	1990	2464424	817507	12.0	356
157-01	1990	2464424	817507	12.0	342
157-01	1990	2464424	817507	14.0	14,523
157-01	1990	2464424	817507	16.0	25,581
157-01	1990	2464424	817507	18.0	2,576
156-A	1995	2464196	817824	8.4	290
156-02	1990	2464336	817552	6.0	591
156-02	1990	2464336	817552	8.0	3,480
156-02	1990	2464336	817552	10.0	8,703
156-02	1990	2464336	817552	12.0	28,571
156-02	1990	2464336	817552	14.0	18,042
156-02	1990	2464336	817552	16.0	39,832
156-01	1990	2464710	817460	2.0	15,128
156-01	1990	2464710	817460	4.0	2,284
156-01	1990	2464710	817460	4.0	1,595
156-01	1990	2464710	817460	8.0	108
155-A	1995	2464372	817864	8.2	1,600
155-A	1995	2464372	817864	10.2	6,200
155-A	1995	2464372	817864	10.2	9,400
155-A	1995	2464372	817864	12.2	12,000
155-A	1995	2464372	817864	14.3	2,100
155-01	1990	2464571	817646	11.0	1,055
155-01	1990	2464571	817646	13.0	4,097
155-01	1990	2464571	817646	15.0	26,531
155-01	1990	2464571	817646	17.0	12,324
154-01	1990	2464536	817785	13.0	452
154-01	1990	2464536	817785	13.0	370
154-01	1990	2464536	817785	15.0	14,971
154-01	1990	2464536	817785	17.0	5,263
153-01	1990	2464657	817938	6.0	2,321
153-01	1990	2464657	817938	8.0	3,896
153-01	1990	2464657	817938	10.0	22,449
153-01	1990	2464657	817938	12.0	13,357
153-01	1990	2464657	817938	14.0	851
152-A	1995	2464590	817886	13.3	270
152-A	1995	2464590	817886	15.3	2,100
152-A	1995	2464590	817886	17.3	10,000
152-A	1995	2464590	817886	19.2	7,100
152-01	1990	2464411	817900	7.0	705
152-01	1990	2464411	817900	7.0	918
152-01	1990	2464411	817900	9.0	3,853
152-01	1990	2464411	817900	11.0	4,771
152-01	1990	2464411	817900	13.0	19,964
152-01	1990	2464411	817900	15.0	2,044
151-03	1990	2464404	817983	3.0	12,000
151-03	1990	2464404	817983	3.0	1,035
151-03	1990	2464404	817983	7.0	15,328
151-03	1990	2464404	817983	12.0	952
151-02	1990	2464461	818058	9.0	1,061
151-02	1990	2464461	818058	12.0	2,037
151-02	1990	2464461	818058	15.0	6,600
151-01	1990	2464507	818150	8.0	13,333
150-01	1990	2464356	818038	6.0	1,410
150-01	1990	2464356	818038	8.0	1,839
150-01	1990	2464356	818038	10.0	3,608
150-01	1990	2464356	818038	12.0	24,180
150-01	1990	2464356	818038	14.0	932
150-01	1990	2464356	818038	14.0	17,349

Tab A. Detectable Levels of PCBs for 1990 and 1995 Sampling

Sample Number	Sample Date	Easting Ohio State Plane 1927	Northing Ohio State Plane 1927	Depth (ft below LWD)	Concentration (ug/kg)
150-01	1990	2464356	818038	15.0	14,371
149-B	1995	2464359	817965	11.9	890
149-B	1995	2464359	817965	12.9	2,800
149-B	1995	2464359	817965	13.8	20,000
149-A	1995	2464425	818113	15.3	110
149-A	1995	2464425	818113	17.3	4,500
149-01	1990	2464325	818211	16.0	1,277
148-03	1990	2464066	817573	8.0	2,927
148-02	1990	2464195	818044	2.0	2,559
148-02	1990	2464195	818044	4.0	41,860
148-02	1990	2464195	818044	6.0	17,606
148-02	1990	2464195	818044	8.0	2,266
148-02	1990	2464195	818044	10.0	177
148-02	1990	2464195	818044	12.0	118
148-01	1990	2464220	818147	13.0	923
148-01	1990	2464220	818147	15.0	3,154
148-01	1990	2464220	818147	17.0	23,297
148-01	1990	2464220	818147	18.0	20,788
148-01	1990	2464220	818147	18.0	12,816
147-A	1995	2464146	818271	17.5	490
146-A	1995	2464105	818172	13.0	190
146-A	1995	2464105	818172	14.3	300
146-01	1990	2464024	818187	17.0	2,532
146-01	1990	2464024	818187	17.0	2,852
146-01	1990	2464024	818187	18.0	11,191
145-01	1990	2463922	818179	16.0	419
145-01	1990	2463922	818179	16.0	461
145-01	1990	2463922	818179	18.0	594
145-01	1990	2463922	818179	19.0	1,830
144-02	1990	2463824	818134	15.0	3,257
144-01	1990	2463823	818234	17.0	517
143-01	1990	2463722	818234	17.0	1,826
143-01	1990	2463722	818234	19.0	16,226
142-01	1990	2463622	818205	16.0	643
142-01	1990	2463622	818205	18.0	1,399
142-01	1990	2463622	818205	20.0	14,898

PART II

Analysis of Extent of Contamination

Ashtabula River Contaminant Estimates

Problem Statement:

The Ashtabula River Partnership requires volume and extent estimates of PCB laden sediment in the Ashtabula River, Ashtabula, Ohio. These estimates are necessary to formulate a dredging and disposal facility plan for the removal of the appropriate sediments. The estimates should provide the volume and extent of sediments contaminated with 50 or more, 40 or more, and 30 or more parts per million (PPM) of PCBs. These estimates are to be derived from the 1990 and 1995 contractor sediment sampling and analysis. The samples were taken at various depths and locations and each consist of four values: a northing, an easting, a depth from the bathymetric surface, and a contaminant concentration. A total of 528 samples were taken over a length of the river greater than the area where contaminated sediments have been detected (see Figure 1).

Solution Strategy:

There are several requirements for producing a useful conceptualization of the contaminant plume in the Ashtabula River sediments. First, because of the four-component nature of the sampling data, a fully three-dimensional conceptualization must be utilized. Second, the conceptualization must conform to the irregular shape and bathymetry of the Ashtabula river. The Department of Defense (DoD) Groundwater Modeling System (GMS) provides the capability to create the necessary estimates from three-dimensional, unstructured, gridded data. Converting the sampled data to GMS gridded data is the key to obtaining the estimates. The GMS has tools to assist in the conversion. Initially, sample data was imported into the GMS as scatter point data, that is x, y, z locations with an attached concentration. Using the scatter point data and boundary information provided by Mr. Golyski (CENCB), a grid was created of the area of interest with the GMS. Next, the scatter point concentration values were interpolated onto the grid in the GMS. Finally, the desired estimates from the GMS gridded data were obtained and graphically reproduced.

The first step of grid creation is relatively simple. Using the boundary and making the grid spacing approximately the same as the sample spacing, a three-dimensional grid was created. Note that since contours of concentration values were to be created, it was important that the grid quality be good, i.e., that the shape of the grid cells not be distorted. For this reason, the vertices of the grid are not the sample points, but only are spaced at the same density as the sample points. An unstructured, three dimensional grid was constructed such that the lateral spacing of nodes was dictated by the clustering of the sample data (see Figure 2). The bathymetry of the Ashtabula River was used as the upper surface of the grid and the authorized dredging depths of -20 Low Water Depth (LWD) downstream of station 160 00 and -18 LWD upstream were used as the lower surface. Twenty vertical layers were used in the grid to ensure adequate spacing of nodes to capture the variability of the sample data in the vertical dimension.

The second step of interpolating the scatter point data to the grid was more complex. Within the GMS there are three interpolation schemes available, each with their own optional settings. There are also scaling issues associated with the sample data. A brief description of the interpolation schemes and the process by which the particular method used for this project was chosen follows. The goal in choosing an interpolation scheme is to remain as faithful to the original data set as possible. The GMS provides a tool called "jackknifing" to estimate how faithful an interpolation is to the original data set. Jackknifing is based on the concept that if the interpolation is faithful and the data reasonably smooth, then removing one point from the data set will not significantly change the interpolant. In jackknifing, one by one each individual data point is removed from the data set, a new interpolant is constructed, and the value of the interpolant is compared to the missing data value. Jackknife results from different interpolation option settings can also be compared to determine the relative quality of each set of interpolation options.

Three families of interpolation schemes are supported in the GMS for fully three-dimensional interpolation: Inverse Distance Weighted (IDW), Natural Neighbor, and Kriging. All three interpolation methods use a weighted average of the the scatter point data to determine the interpolated data. The differences between the methods is the selection of the weights. IDW uses some function of the inverse distance between the point being interpolated and the sample points. Natural Neighbor forms a Delauney triangulation of the sample points and the point being interpolated and calculates the weights based upon the areas of the surrounding Thiessen polygons. Kriging bases the weights upon the statistics of the sample points.

Kriging was the only scheme which was eliminated a priori. The deposition patterns of the contaminated sediments in the Ashtabula River has led to a widely dispersed plume with scattered areas of high concentration or "hot spots". These hot spots vary with depth as well as with lateral distance. In kriging, one assumes that there is a correlation of the data. The nature of the data with the isolated hot spots resulted in a poor correlation of the data. Since the data were poorly correlated, kriging was ruled out as an interpolation scheme for this project.

Since both IDW and Natural Neighbor schemes can be used effectively to approximate scattered data of the type found in the Ashtabula River samples, two sets of interpolations were performed (see Figures 3 and 4). Natural neighbor interpolation results proved to be less appropriate in this case. The nature of the natural neighbor interpolation scheme makes it occasionally susceptible to "ramping" - filling areas of the grid where no data points exist with values ramped up from the nearest areas of the grid where data points do exist. It was not immediately obvious if a set of scattered data points would cause this effect in natural neighbor interpolation but upon testing, it was generally made evident. Based on the sample data, the sediments near the area of the mesh labeled "Area A" in Figure 3 should not contain any values above the 30 ppm level. However, natural neighbor interpolation calculates that some sediments near "Area A" are above the 30 ppm level. This effect is due to ramping in the natural neighbor interpolation. The IDW interpolation did not have this problem and the 30 ppm levels predicted by IDW interpolation more closely corresponded to the sample data. For this reason, IDW interpolation was chosen.

Within the family of IDW interpolation schemes, there are several options which are available to the user involving the order of approximation. These include: linear, gradient, and quadratic models. A jackknife analysis of various IDW interpolation options was performed on the Ashtabula River sample data set. From this analysis it was determined that IDW interpolation with quadratic nodal functions using all the data points for the computation of both the nodal function coefficients and the interpolation weights was most appropriate for the Ashtabula River PCB sample data.

The remaining factor to account for in the interpolation was the scale bias of the data. The data was sampled at closer intervals in the vertical direction than in the horizontal. If interpolations were made on the raw data it is typical to expect the results to be biased too much toward a vertical dispersion of the contaminant. In this study, as with most cases, the contaminant actually was more likely to be spread in the horizontal dimension because of how it was released to or deposited in the environment. A z-scale option is included in the GMS to allow the user to exaggerate the vertical spacing of the sample data temporarily while the interpolation takes place, thus overcoming the vertical bias. From the jackknifing analysis of the IDW options, it was determined that a z-scale of 15 was most appropriate for the Ashtabula River sample data.

The conceptualization of the plume based upon an IDW interpolation with quadratic nodal functions and a z-scale of 15 was plotted on the grid shown in Figure 2. Figures 5, 6, and 7 show plan, oblique, and side views, respectively, of the 50 PPM isosurface. Figure 8 shows the plan view of the 50 PPM isosurface set against a backdrop of the United States Geological Survey (USGS) 7.5 Minute Quadrangle Map.

Results:

The specific requirements of this project were:

1. Extent estimates for the 50 PPM, 40 PPM, 30 PPM, 10 PPM, and 1 PPM contaminant levels.
2. And volume estimates for the 50 PPM, 40 PPM, 30 PPM, 10 PPM, and 1 PPM contaminant levels.

The Figures 9 - 14 provide extent estimates for the contaminant plume on horizontal cross-sections through the three dimensional grid. The cross-sections are taken at 2.5 feet intervals from -5 feet LWD to -17.5 feet LWD. This region bounds the significant plume locations as depicted in Figure 7. Five colors are used so that the concentration levels of 1-10 PPM, 10-30 PPM, 30-40 PPM, 40-50 PPM, and greater than 50 PPM can be clearly delineated. Figures 15 - 20 depict similar information in a format more useful for dredge planning purposes. In these figures, only that part of the plume above 40 PPM is depicted. Again this is shown at several depths in intervals of 2.5 feet. Figures 21 - 26 are identical except that contours show that part of the plume above 50 PPM.

In Table 1, the volume estimates of the contaminated sediments above the indicated threshold values are summarized and the percent volumes are also indicated. These estimates are based upon the gridded data and should be interpreted accordingly. Error has been introduced in three places:

1. Accuracy of the initial sample.

2. Ability of the grid to model the given plume.

3. And the error in the interpolation to the grid.

With these considerations, the volumes are calculated and presented to the nearest 1000 cubic yards.

Threshold Value (PPM)	10^3 *Cubic Yards of Contaminated Material*	*Percent of Total Volume*
50	28	2.6
40	53	4.8
30	102	9.3
10	366	33.4
1	715	65.3
0	1095	100.0

Table 1: The volume of contaminated sediment above each of the given threshold values.

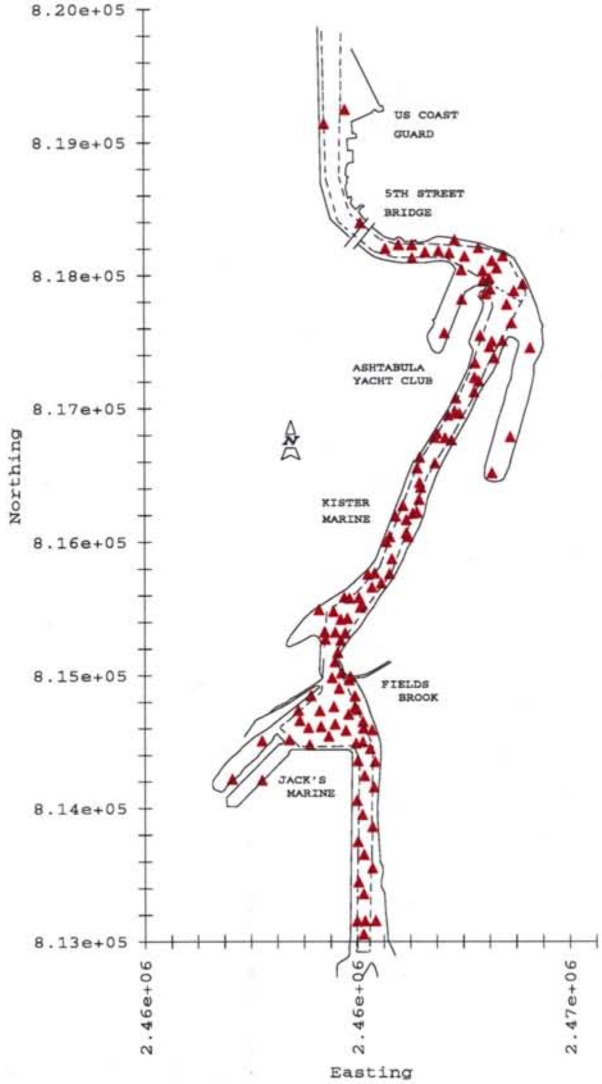


Figure 1: Ashtabula River PCB Sample Locations.

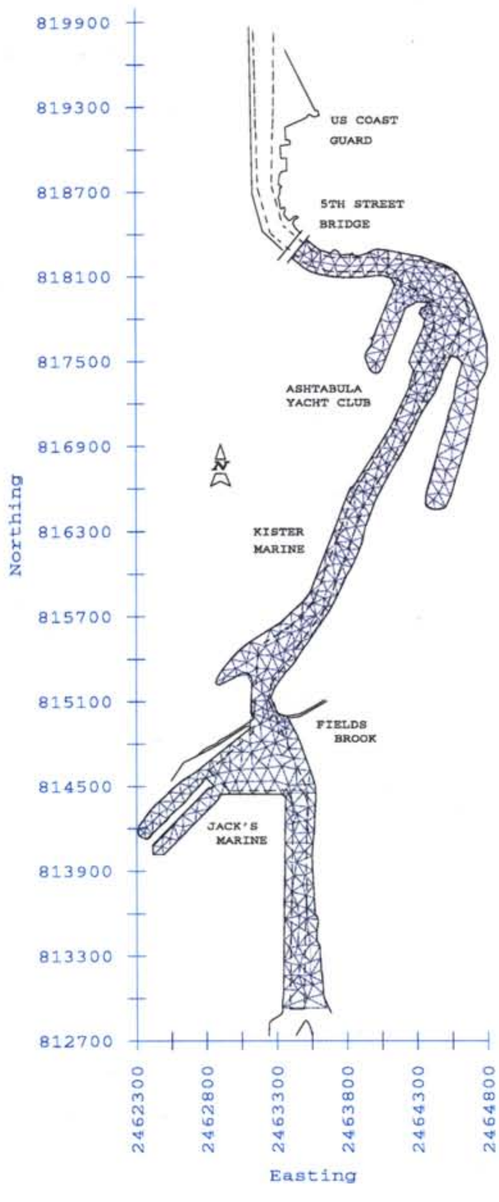


Figure 2: Sample Locations With Grid Used For Interpolation.

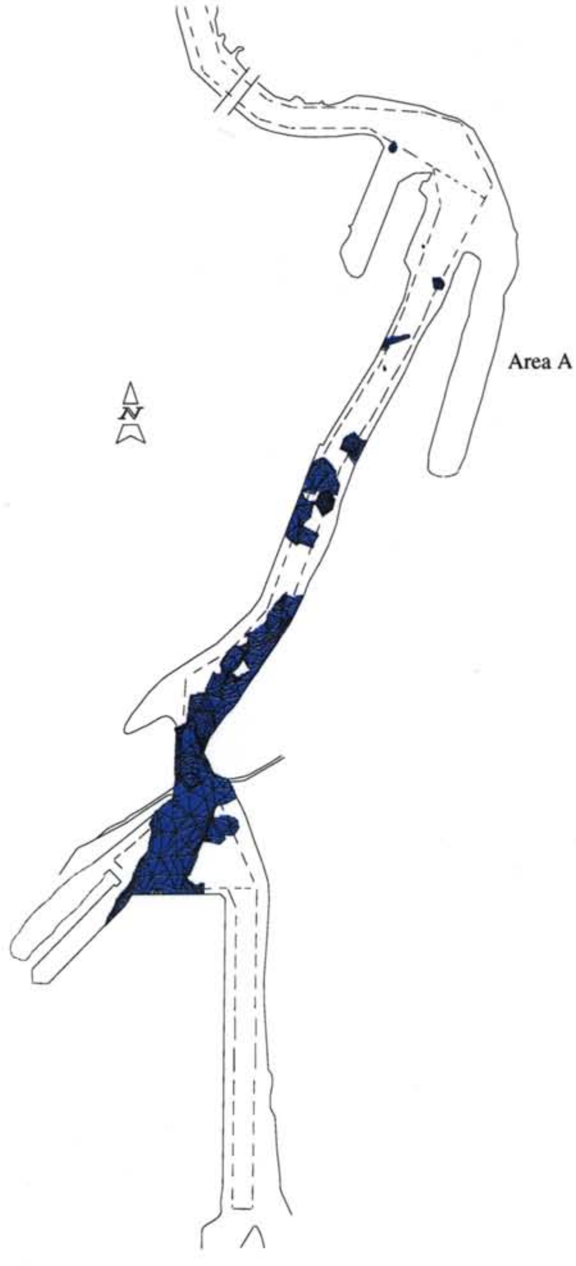


Figure 3: 30 ppm PCB Plume Generated From IDW Interpolation.

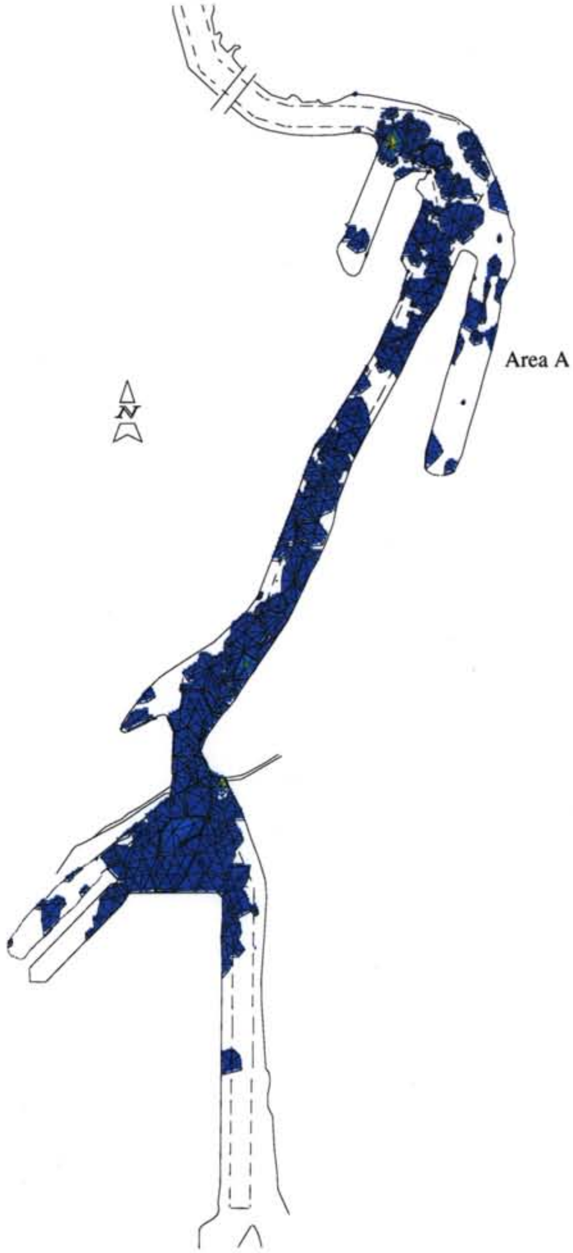


Figure 4: 30 ppm PCB Plume Generated From Natural Neighbor Interpolation.

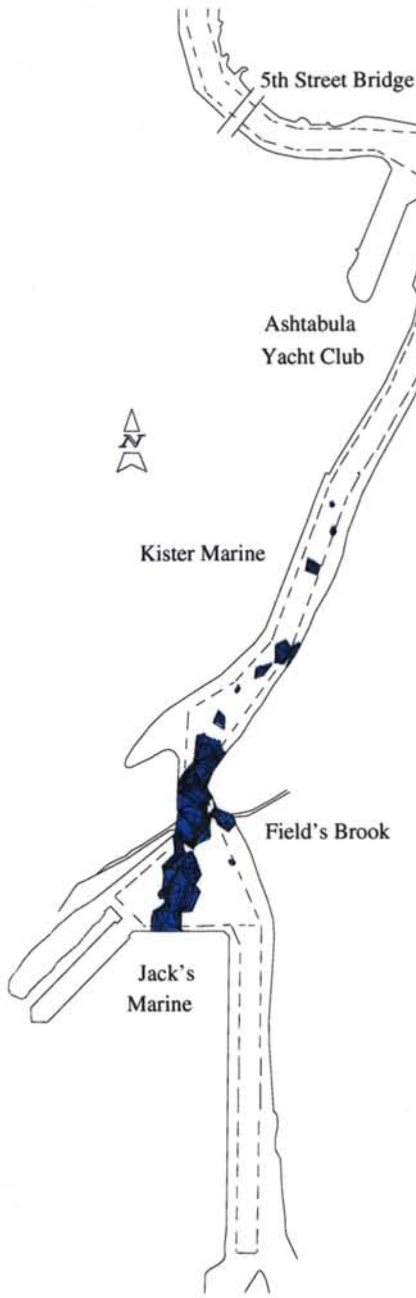


Figure 5: Plan View of 50 ppm PCB Plume Generated From IDW Interpolation With Quadratic Nodal Functions.

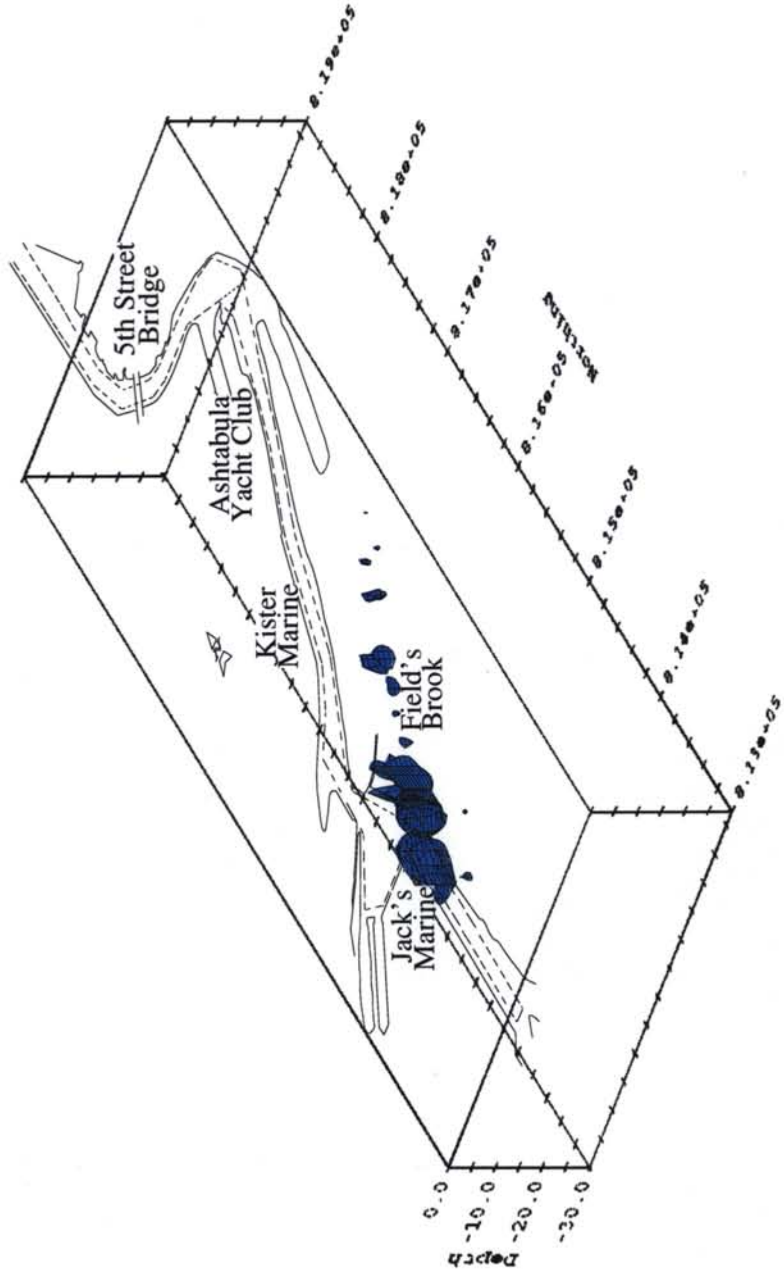


Figure 6: Oblique View of 50 ppm PCB Plume Generated From IDW Interpolation With Quadratic Nodal Functions.

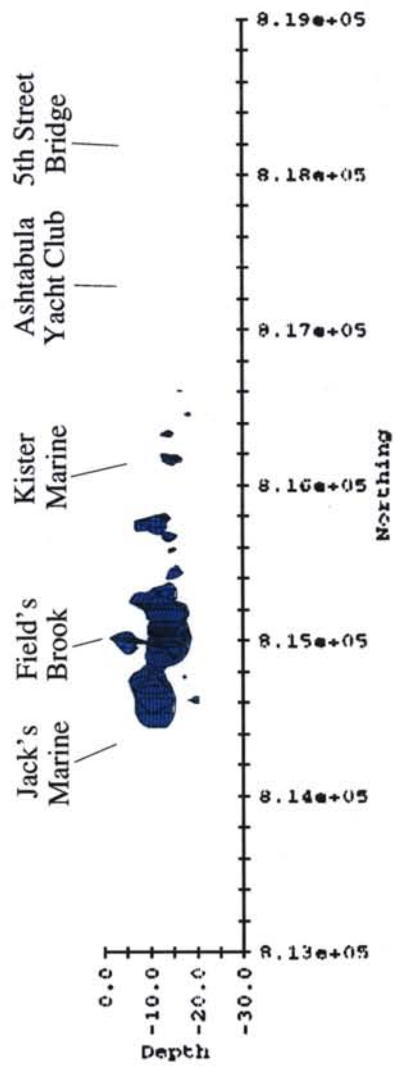


Figure 7: Side View of 50 ppm PCB Plume Generated From IDW Interpolation With Quadratic Nodal Functions.

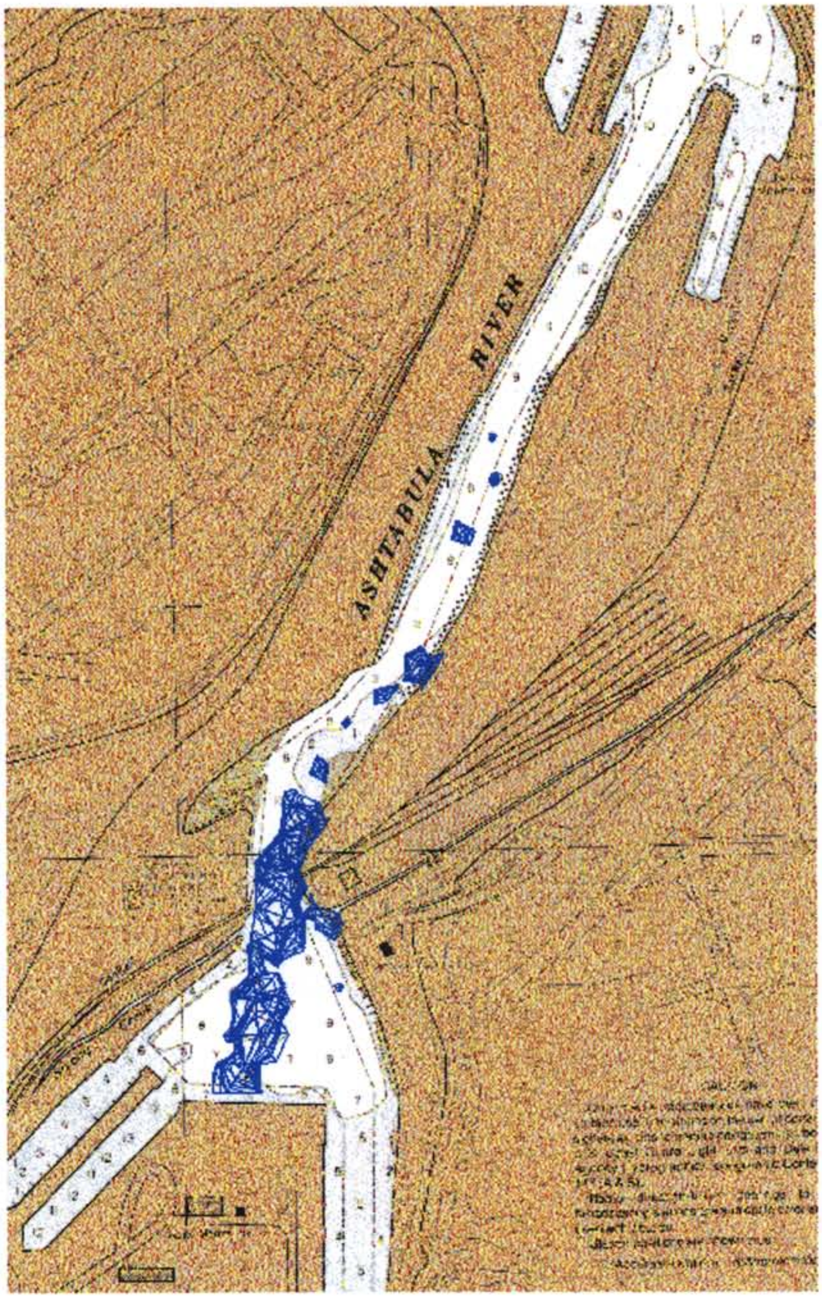


Figure 8: Plan View of 50 ppm PCB Plume Displayed With USGS 7.5 Minute Quadrangle Map.

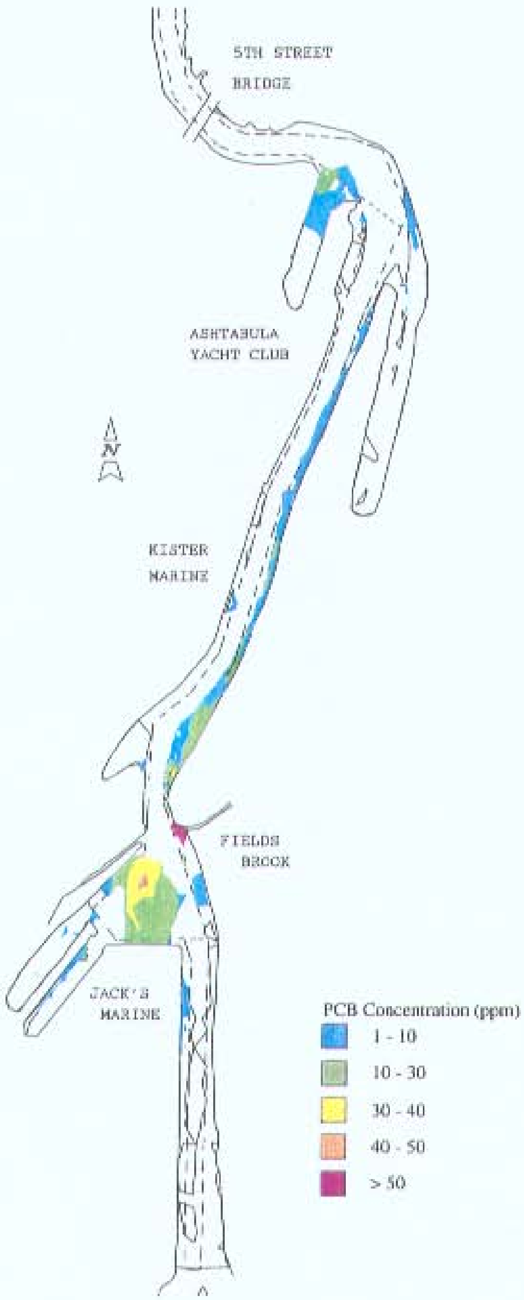


Figure 9: 2D Slice of PCB Plume At -5 feet LWD.

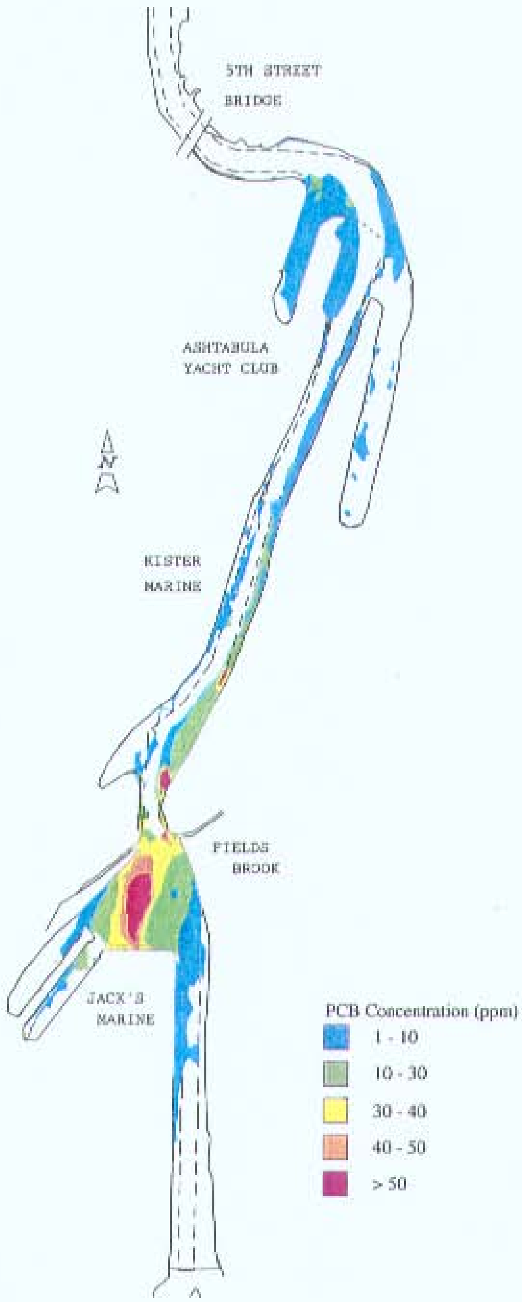


Figure 10: 2D Slice of PCB Plume At -7.5 feet LWD.

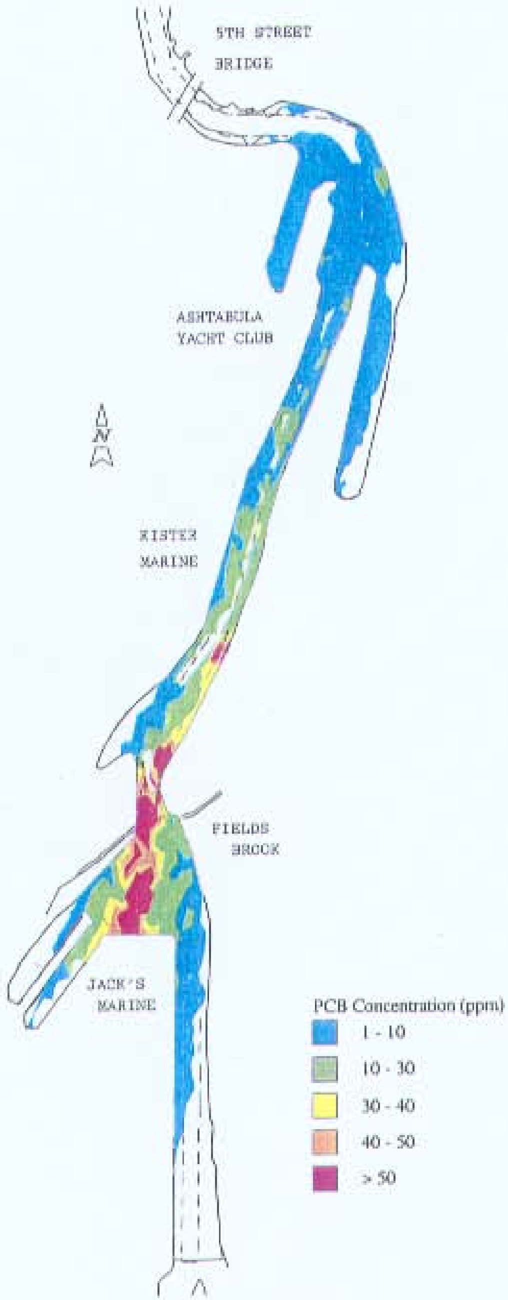


Figure 11: 2D Slice of PCB Plume At -10 feet LWD.

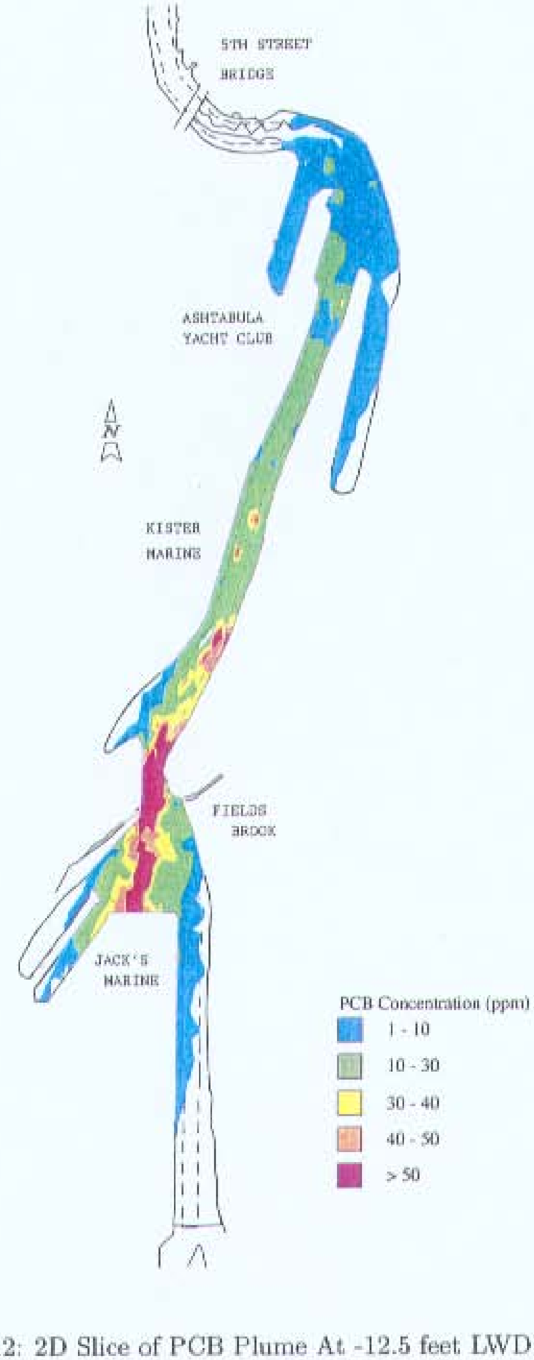


Figure 12: 2D Slice of PCB Plume At -12.5 feet LWD.

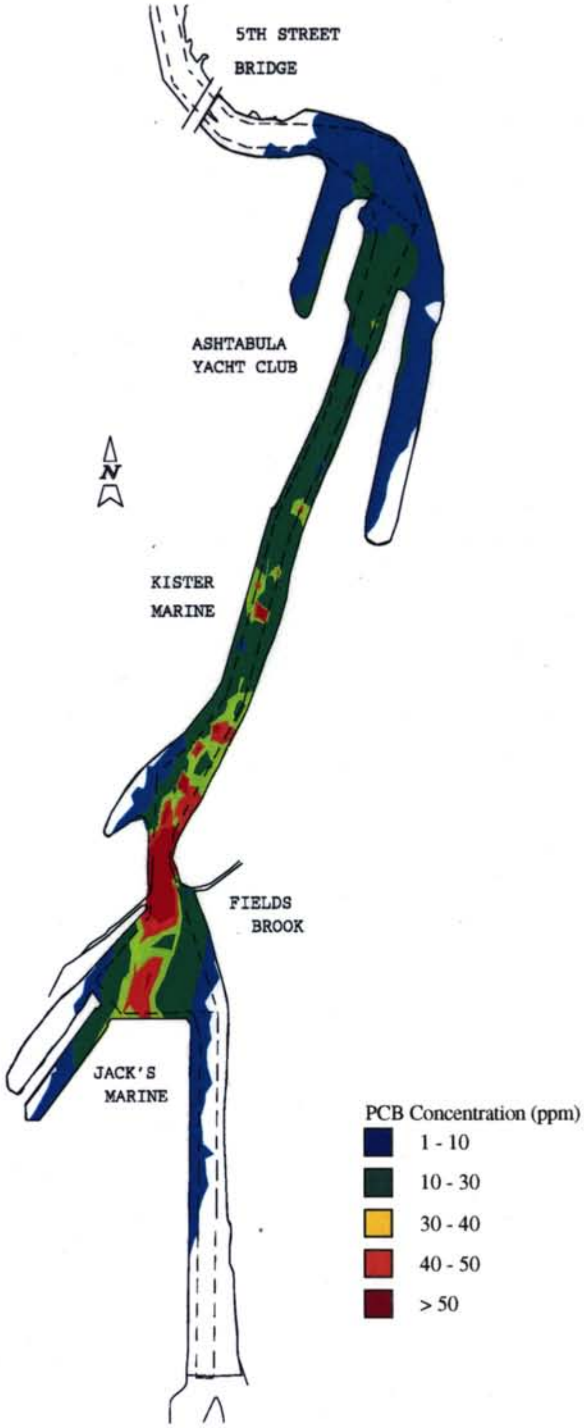


Figure 13: 2D Slice of PCB Plume At -15 feet LWD.

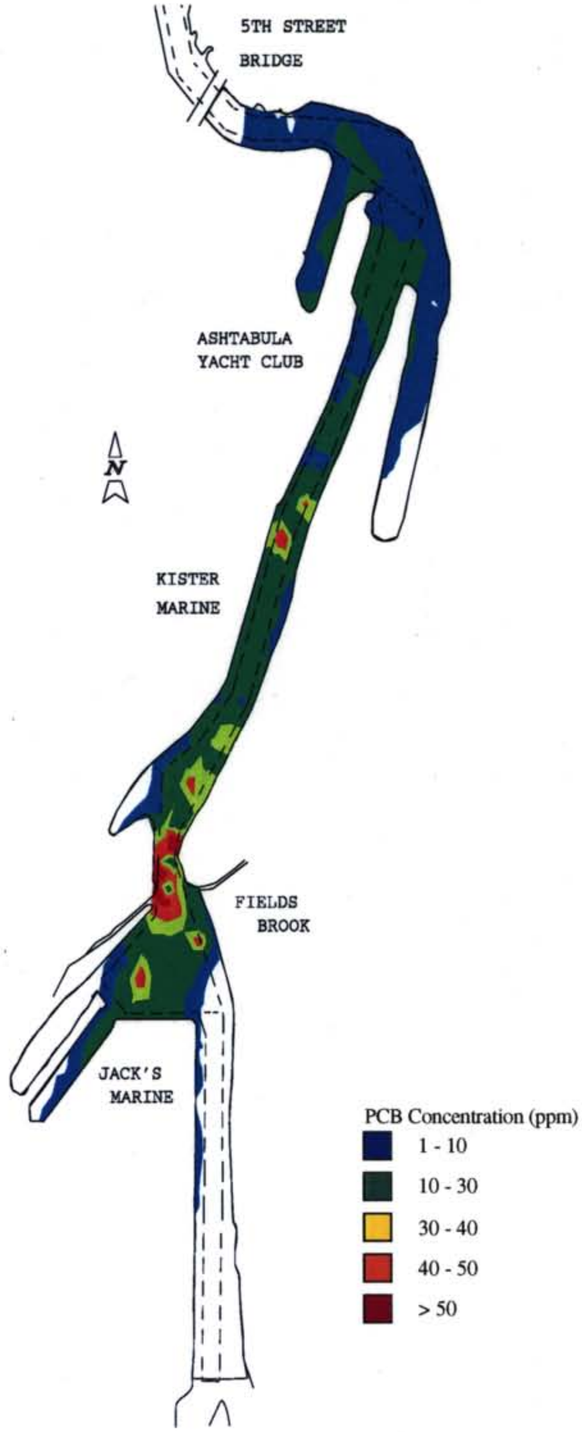


Figure 14: 2D Slice of PCB Plume At -17.5 feet LWD.

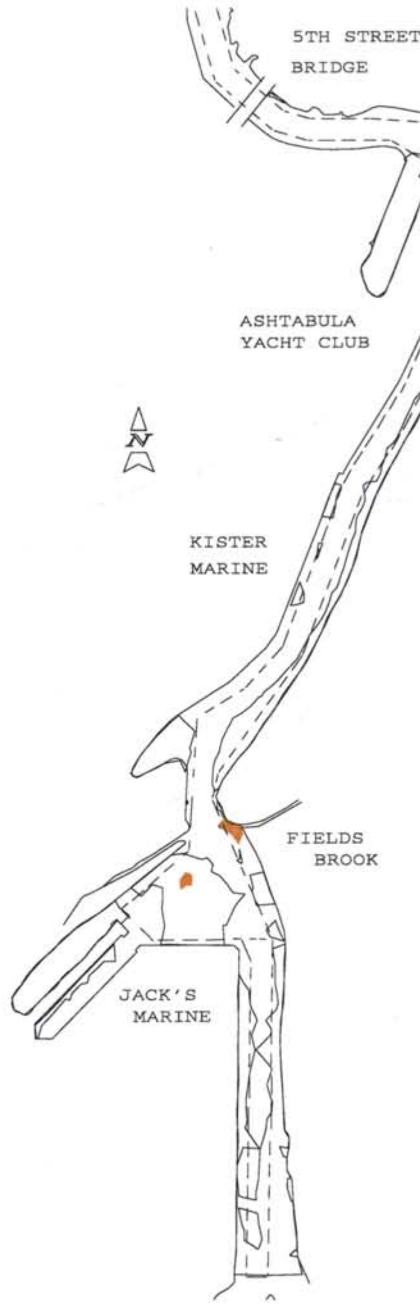


Figure 15: 2D Slice of 40 ppm PCB Plume At -5 feet LWD.

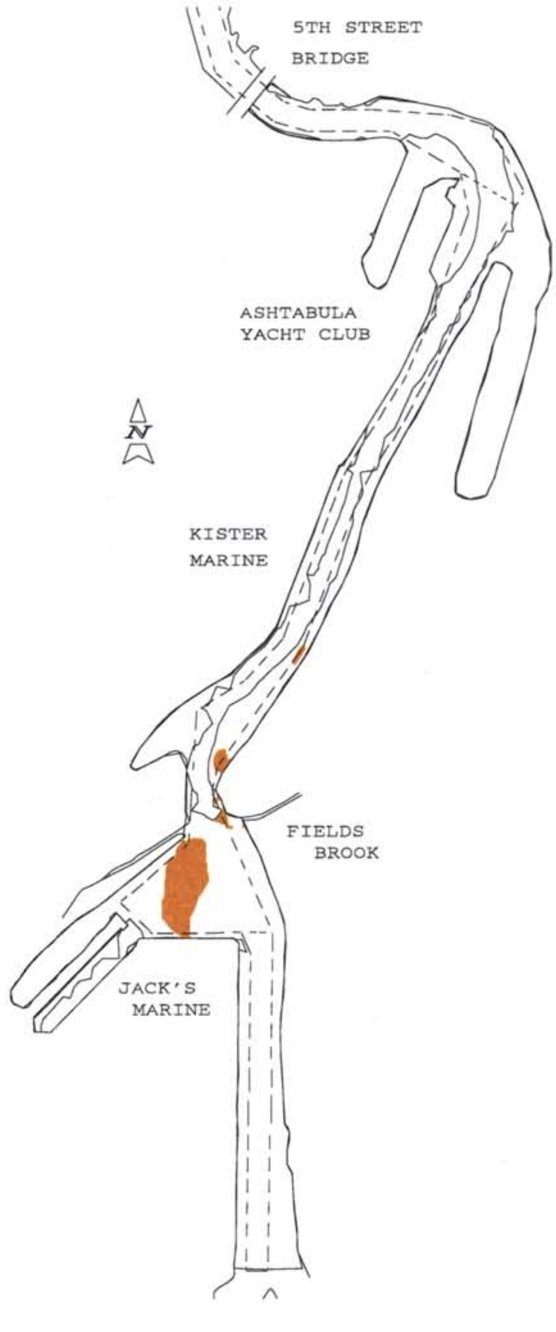


Figure 16: 2D Slice of 40 ppm PCB Plume At -7.5 feet LWD.

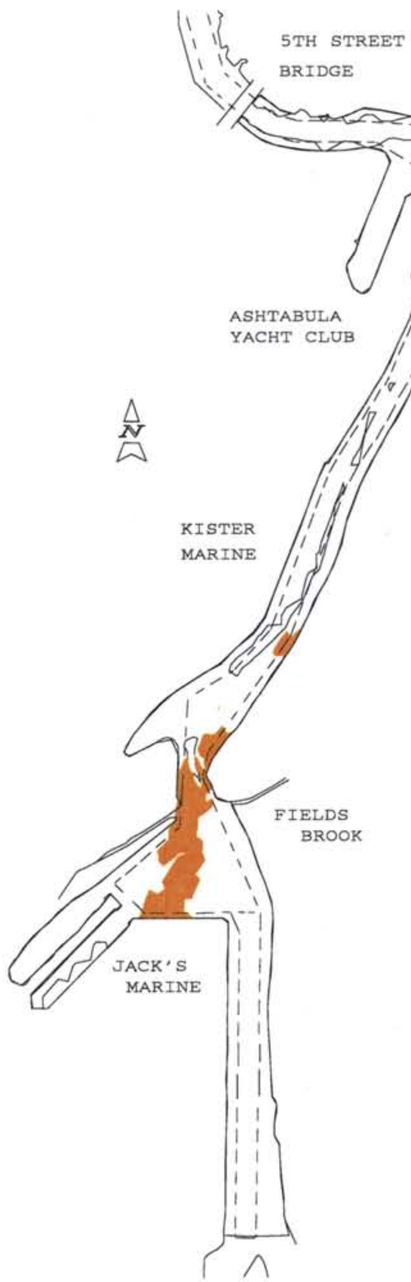


Figure 17: 2D Slice of 40 ppm PCB Plume At -10 feet LWD.

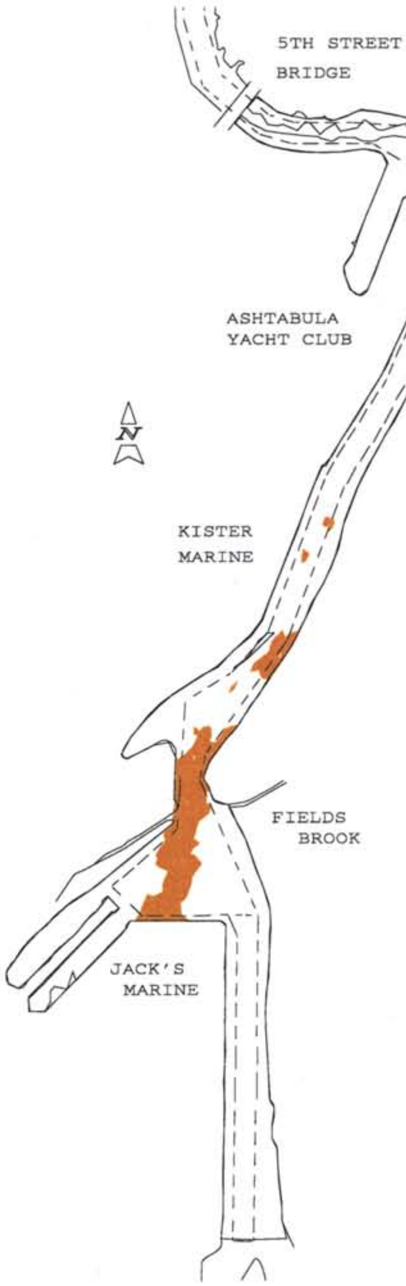


Figure 18: 2D Slice of 40 ppm PCB Plume At -12.5 feet LWD.

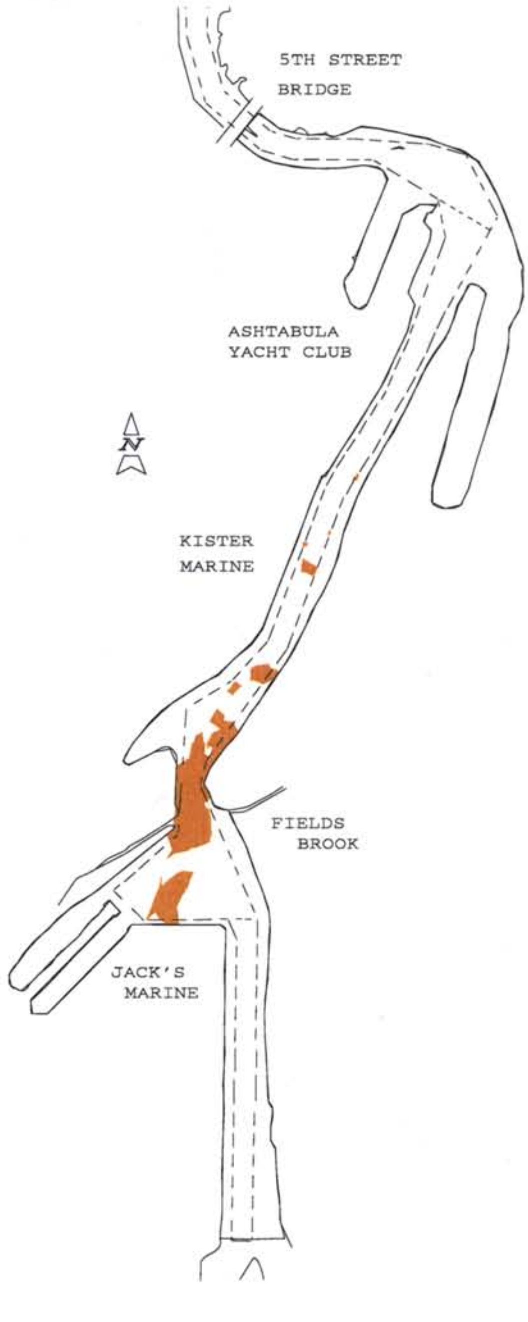


Figure 19: 2D Slice of 40 ppm PCB Plume At -15 feet LWD.

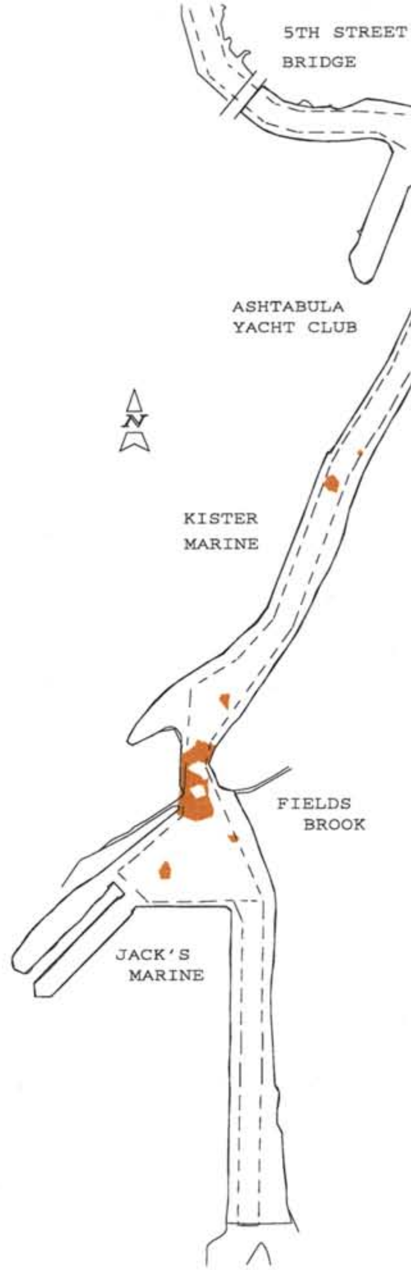


Figure 20: 2D Slice of 40 ppm PCB Plume At -17.5 feet LWD.

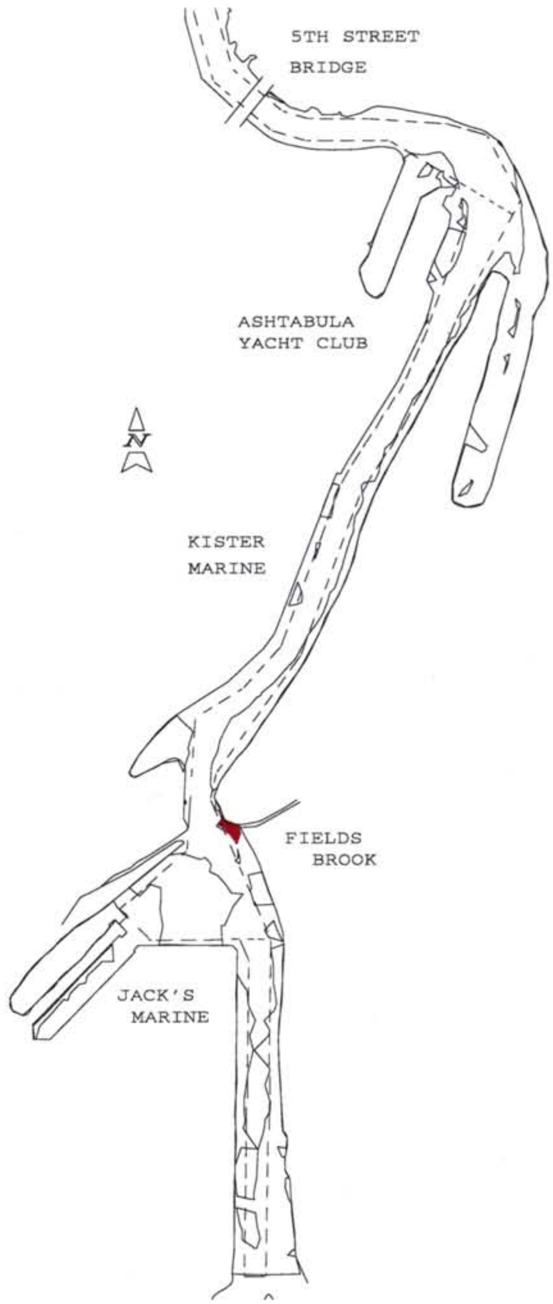


Figure 21: 2D Slice of 50 ppm PCB Plume At -5 feet LWD.

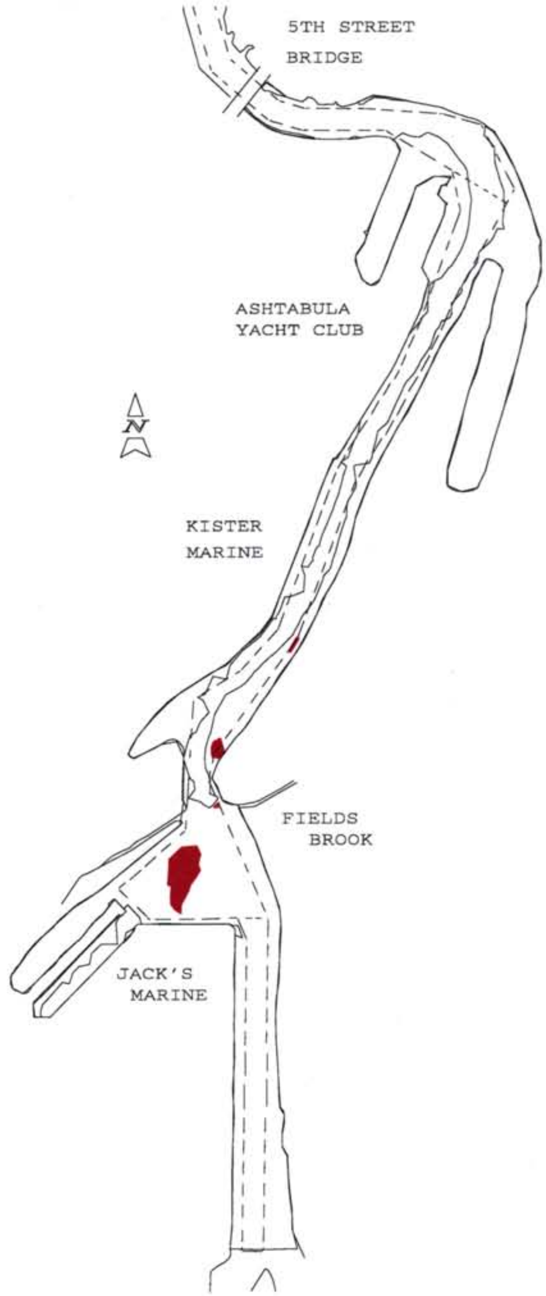


Figure 22: 2D Slice of 50 ppm PCB Plume At -7.5 feet LWD.

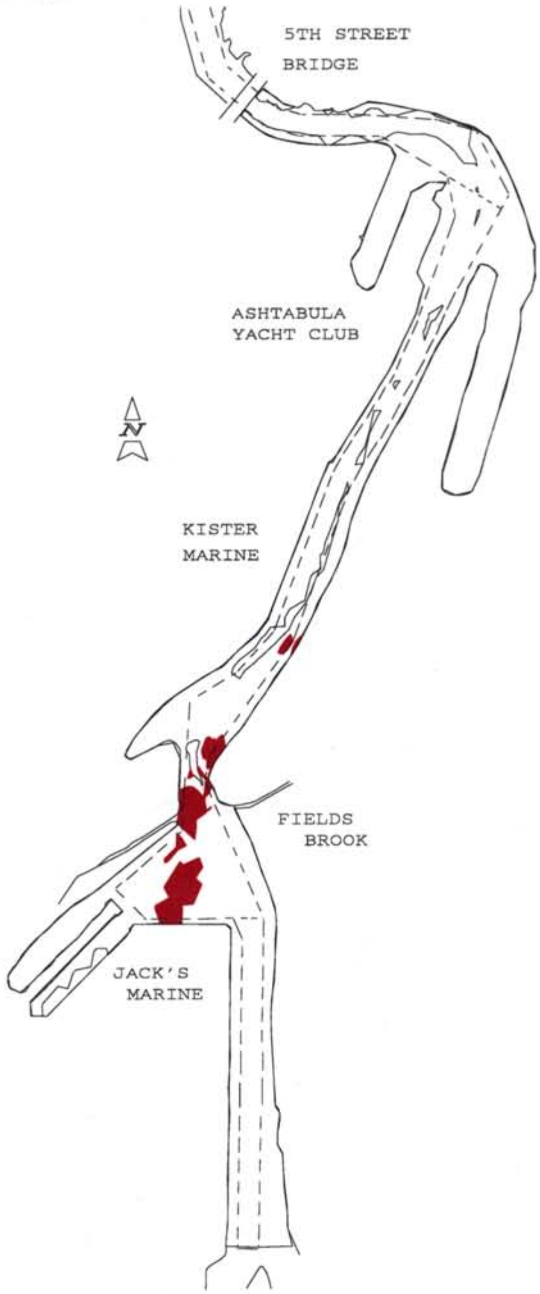


Figure 23: 2D Slice of 50 ppm PCB Plume At -10 feet LWD.

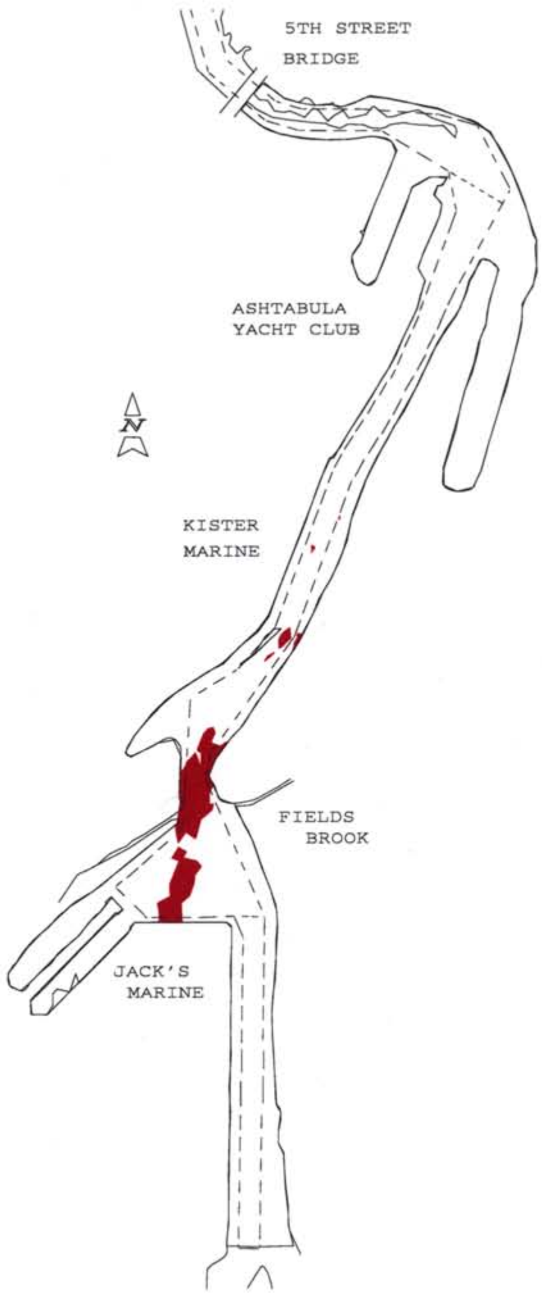


Figure 24: 2D Slice of 50 ppm PCB Plume At -12.5 feet LWD.

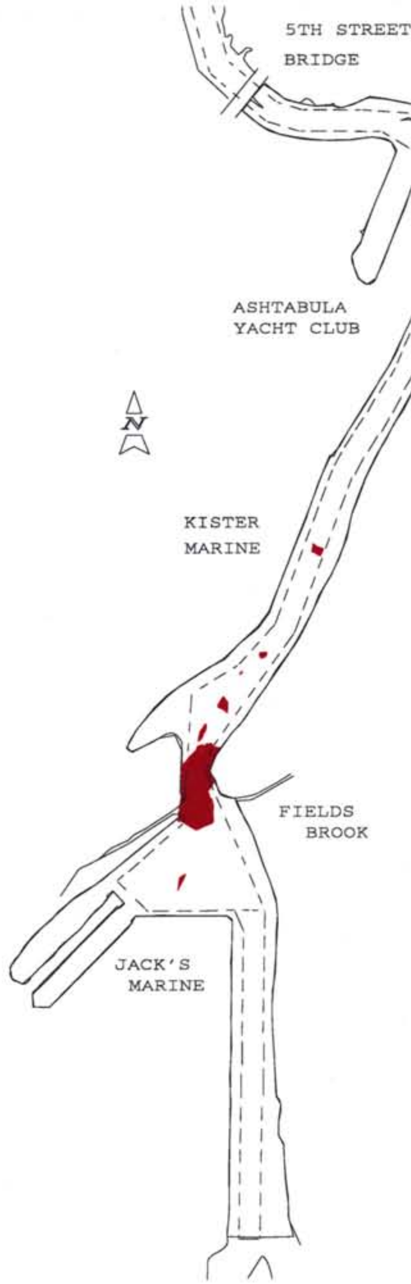


Figure 25: 2D Slice of 50 ppm PCB Plume At -15 feet LWD.

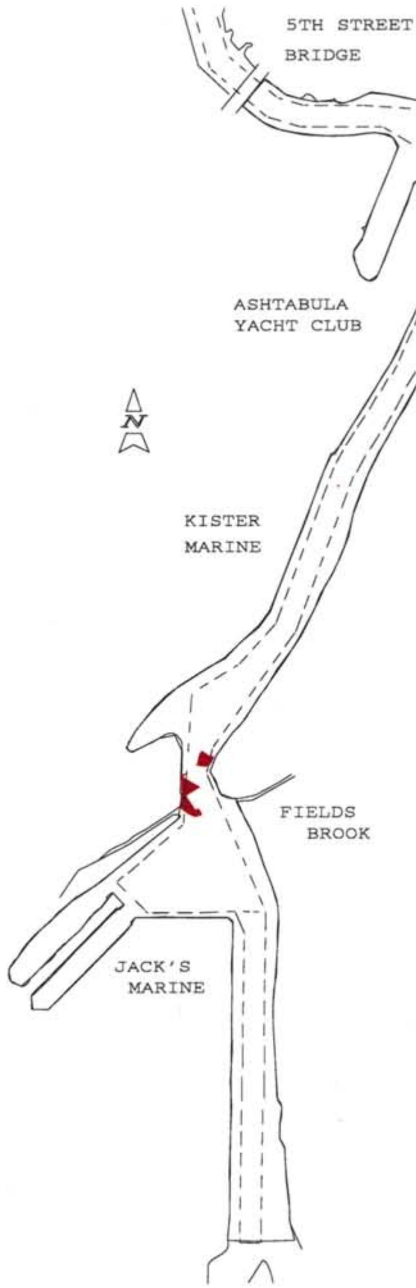


Figure 26: 2D Slice of 50 ppm PCB Plume At -17.5 feet LWD.

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX D

ASHTABULA RIVER SEDIMENT SAMPLING AND ANALYSIS OF EXTENT OF RADIONUCLIDE CONTAMINATION

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November 2000

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1.0 PROJECT DESCRIPTION

1.1 Ashtabula River Partnership

The Ashtabula River Partnership (ARP) was formed with local, State and Federal agencies and local industries to study a basinwide solution to all the polluted sediment problems in the Ashtabula River and Harbor. An ARP Charter with the goal of sediment remediation or removal has been signed and endorsed by representatives from all concerned partners who will use available resources to implement overall partnership activities. This appendix is part of the Comprehensive Management Plan and Environmental Impact Statement for the proposed work in Ashtabula.

1.2 1999 Sampling Project Objectives

The 1999 sampling of the Ashtabula River was conducted by members of the Radiation staff of the U.S. Environmental Protection Agency's Superfund Program (USEPA-SP) and personnel from the Ohio Department of Health, Bureau of Radiation Protection (ODH/BRP). This information was used to make decisions on sediment disposal options and to perform baseline risk assessments for radiological and chemical sediments. This investigation was conducted with field assistance from the U.S. Environmental Protection Agency Great Lakes National Program Office (GLNPO) and the Research Vessel (R/V) Mudpuppy.

1.3 Past Data Collection

The Ashtabula River has been the subject of several sediment surveys to determine the nature and extent of chemical and radiological contamination of river sediments. Fields Brook, and upstream tributary to the Ashtabula River is a known source of PCB and radiological contamination to the river.

Historical sediment radiological surveys were conducted in 1990 and again in 1998. These surveys were limited in nature and intended only as a screening level radiological survey. The data collected during these studies is insufficient to perform a radiological risk assessment. Data collected prior to 1999 can be summarized as follows:

	1990 Sampling
Radium-226	1.68 – 18.10 pCi/g
Radium-228*	0.92 – 3.33

Total Radium	
(Ra-226 + Ra-228)	2.61 – 20.62
Thorium-232	0.92 – 3.33
Uranium-238	1.03 – 11.00
Total Uranium	
(U-234+U-235+U-238)	2.40 – 22.30

*Th-232 being used as a surrogate for Ra-228. Ra-228 is assumed to be in secular equilibrium with it's parent due to the length of time since it's deposition.

<u>1998 Sampling</u>

Radium-226	0.17 - 16.10 pCi/g
Radium-228	0.72 - 2.13
Total Radium	
(Ra-226 + Ra-228)	1.03 - 17.34
Thorium-232	0.75 - 3.86
Uranium-238	0.75 - 27.30
Total Uranium	
(U-234+U-235+U-238)	1.58 - 64.70

1.4 Current Status

Federal, State, and Local agencies have joined together to design a navigational dredging and disposal project for the Ashtabula River and Harbor. Areas within the Ashtabula River and Harbor have been identified for sediment removal based on location in the authorized navigational channel and/or concentrations of PCBs and PAHs in the sediments.

During this investigation, all sediment was analyzed for isotopic uranium, isotopic thorium, radium-226 and radium-228.

1.5 Specific Project Objectives

(1) Delineate radionuclide identities and concentrations in Ashtabula River sediments that are projected to go into the Ashtabula River Partnership non-Toxic Substances Control Act (Non-TSCA) disposal cell;

(2) Make a statistical determination of whether the radioactivity of the Non-TSCA area sediments is distinct from the upstream background area sediments and;

(3) Collect radiological sediment data sufficient to perform baseline risk assessments for radiological and chemical sediments.

1.5.1 Work Tasks

To meet the objectives of this project, sediment cores were collected at twenty-five cross-sections within the Ashtabula River. These cross-sections had been grouped and one cross-section per group selected statistically (randomly) for sampling. The position along the cross-section (west, center, east side of channel) was also selected statistically (randomly). Core depth was set at 15 feet because of limitations on the coring equipment. Depth of samples along the core were set by reference to U.S. Army Corps of Engineers cross-sectional charts showing PCB levels and anticipated dredging depths. The cores were sectioned into predetermined numbers of sample segments, yielding approximately 118 radiological samples, 42 PCB samples, and 4 PAH samples plus an additional 10% for quality assurance purposes (12 radiological, 5 PCBs and 1 PAH), an additional 10 PCB and 2 PAH samples for matrix spikes and matrix spike duplicates. In all, there were 130 liters for radiological samples, 57 samples for PCB analysis, and 3 samples for PAH analyses. Approximate sampling locations are shown on the FIGURE 1 map. Cross-sections selected for sampling and the position along the cross-section are listed in TABLE 1. Sampling depths for each core are given in TABLES 2 and 3, background and downstream, respectively. The type of analyses to be performed and the number of core segments initially set for analysis are given in TABLE 4. The location and the core segment selected for QA/QC analysis are listed in TABLE 5.

The analytical work was performed by USEPA's National Air and Radiation Environmental Laboratory (NAREL). Results were sent to the USEPA Region V. The USEPA-SD and ODH/BRP evaluated the data in terms of the stated goals of the project.

During the course of the sampling event, several adjustments had to be made in the plan. These were in all but one case due to not being able to get a core at that location or segment depth, either because of inadequate sediments or due to refusal. Site 206a was intended to provide a background sample for USEPA's RIENL laboratory. However, when it was decided to have all analytical work done by NAREL, this sample was not needed and, therefore, it was struck from the list of cores. One additional radiological field duplicate was added when the total number of samples actually collected dropped from the original plan.

1.5.2 Project Target Parameters and Intended Data Usage

The list of target parameters for this project are included in TABLE 4. The intended uses of data collected during this investigation were to provide sufficient data to meet the specific project objectives as stated in Section 1.5.

1.6 SAMPLE NETWORK DESIGN AND RATIONALE

1.6.1 Sample Network by Task and Matrix

Sediment samples are the only matrix of concern for this investigation. Samples were collected during the week of August 23 - August 29, 1999. The field crew consisted of staff from GLNPO and its contractors, USEPA-SD, and ODH/BRP. The R/V Mudpuppy was used to collect sediment cores from the Ashtabula River. Cores for chemical and radiological analysis were collected with the vibracorer on board the Mudpuppy.

Immediately following collection of cores, the core was scanned with gamma survey instruments (thick and thin sodium iodide detectors) to, determine, primarily, the area of highest radioactivity. The intent being that the section should represent the peak exposure rate for the core. Following the gamma scan, the core tube was sectioned, and the sediment samples in each section was homogenized and placed in sample jars. Samples designated for chemical analysis (PCBs or PAHs) were placed on ice, preserved at 4°C, and were shipped by express for rapid analysis within the holding time. Samples designated for radiological analysis did not have critical nor short holding times so that they were placed in a coolers at ambient temperature, accumulated and shipped at the end of the sampling period.

1.6.2 Site Map of Sampling Locations

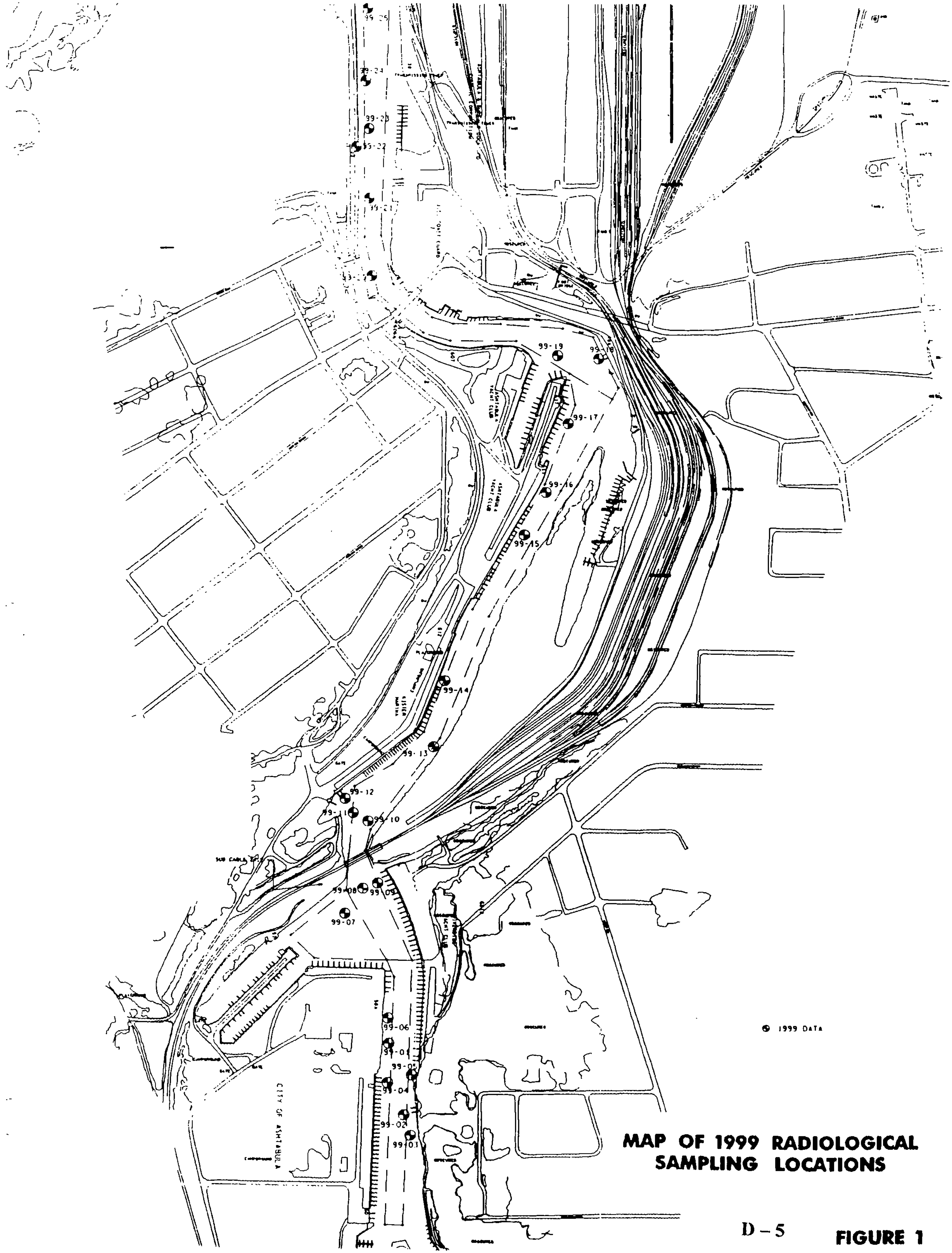
The sediment sampling locations are displayed in FIGURE 1, and designated in TABLE 1. Sediment cores were collected at each sampling location. The numbers of individual segments for each core location are provided in TABLES 2 and 3.

1.6.3 Rationale of Selected Sampling Locations

Five general sampling areas were identified within the Ashtabula River system; Background (upstream of Fields Brook), Upper Turning Basin (at the confluence of Fields Brook and the Ashtabula River), Downstream Area 1 (just downstream of the Fields Brook confluence), Downstream Area 2 (downstream of Area 1 and upstream of 5th Street Bridge) and, Downstream Area 3 (downstream of the 5th Street Bridge and upstream of the coal conveyor). Fields Brook has been identified as the source of both PCB and radiological contamination to the Ashtabula River. A coal pile north of the 5th Street Bridge is suspected to be a source of PAH's.

Data collected from each of the areas was used as follows:

Background Area - used to determine site specific, unaffected background radiological concentrations in the Ashtabula River sediments.



MAP OF 1999 RADIOLOGICAL SAMPLING LOCATIONS

FIGURE 1

Table 1: Sampling Cross-Sections and Sampling Positions Along Cross-Sections

Sample Location	Station No.	West Channel	Center Channel	East Channel		Sample Location	Station No.	West Channel	Center Channel	East Channel	
AR99-06	195		X			AR99-25	121	X			
AR99-01	196	X				AR99-24	125	X			
AR99-05	198		X			AR99-23	128	X			
AR99-04	199	X				AR99-22	129			X	
AR99-02	200			X		AR99-21	132	X			
AR99-03	202			X		AR99-20	136	X			
						AR99-19	149	X			
						AR99-18	153 + 50	X			
						AR99-17	156	X			
						AR99-16	160	X			
						AR99-15	163		X		
						AR99-14	173	X			
						AR99-13	177			X	
						AR99-11	182	X			
						AR99-12	182	X			
						AR99-10	182			X	
						AR99-07	187	X			
						AR99-08	187		X		
						AR99-09	187			X	

Table 2: Background Sampling Coring Depths by Cross-Section

Station No.	Distance from Center of Channel (feet)		Core Depths from Sediment Surface (inches)					
195	0		0 - 12	12 - 30	60 - 72	72 - 84	94 - 106	
196	80W		0 - 12	36 - 48	70 - 82			
198	0		0 - 12	12 - 24	24 - 33			
199	60W		0 - 12	12 - 24	48 - 60	68 - 80		
200	80E		0 - 12	12 - 31				
202	80E		0 - 12	12 - 24	36 - 50	50 - 62		

Table 3: Downstream Sampling Coring Depths by Cross-Section

Station No.	Distance from Center of Channel (feet)	Core Depths from Sediment Surface (inches)					
121	70W	0 - 8					
125	50W	0 - 12	12 - 30	47 - 65			
128	40E	0 - 12	12 - 24	24 - 36	36 - 58		
129	40E	0 - 12	12 - 24	49 - 61			
132	30E	0 - 12	12 - 30	30 - 42	63 - 75		
136	60W	0 - 12	12 - 24	24 - 36	58 - 71		
149	40W	0 - 12	12 - 24	24 - 36	70 - 82		
153 + 50	200W	0 - 12	12 - 30	36 - 48	63 - 75		
156	80W	0 - 12	37 - 49	94 - 106	123 - 135		
160	40W	0 - 12	12 - 24				
163	0	0 - 12	24 - 36	42 - 54	65 - 72		
173	60W	0 - 12	95 - 113	130 - 142	159 - 171		
177	40E	0 - 12	90 - 102	119 - 131	152 - 164		
182	120E	0 - 12	60 - 72	93 - 105	147 - 159		
182	20W	0 - 12	33 - 51	60 - 72	72 - 84		
182	80W	0 - 12	12 - 24	30 - 42	72 - 90		
187	160W	0 - 12	12 - 24	24 - 36	36 - 48	48 - 60	108 - 127
187	0	0 - 12	12 - 24	24 - 36	36 - 48	60 - 72	108 - 139
187	180E	0 - 12	12 - 24	24 - 36	36 - 48	48 - 60	

Upper Turning Basin and Downstream Area 1 - used to determine the maximum radiological concentrations of river sediments at various depths.

Downstream Area 2 - used to determine the extent of downstream migration of the radiological contamination, and to determine radiological concentrations.

Downstream Area 3 - used to further determine the extent of downstream migration of the radiological contamination, and to determine radiological concentrations.

Statistical methods were used to randomly select: the specific river cross section; where on the cross section (west, center, east) to core for a sample; and also which segment of the core would be used for QA/QC purposes. These sampling points were mapped by the U.S. Army Corps of Engineers in latitude and longitude so that they could be located using a Differential Global Positioning System (DGPS) that works off the U.S. Coast Guard's differential beacon. The DGPS under normal operating conditions the DGPS is accurate to less than one (<1) meter in the horizontal. A second, backup DGPS operates simultaneously. The backup DGPS is accurate to <10 meters in the horizontal.

Before sampling, the exact GPS location was be recorded at each sampling point. Core samples for chemical analysis and radiological testing were collected at each of the sampling locations.

The following sample collection and analysis protocol was used at each area of the river. Specific collection locations and types of analysis can be found in TABLES 4 and 5.

Background Area -Each core will be driven down 15 feet and samples taken (1) at the water-sediment boundary, (2) at the deepest level of the core [assumed to generally be the 14 - 15 foot segment] and at two depths in between that represent representative depths for the rest of the survey. This means that backgrounds will be taken last in this investigation. Only radiological contaminants will be analyzed in these cores. Each segment will receive isotopic uranium, isotopic thorium, radium-226, and radium-228 analysis.

Upper Turning Basin - Each core will be driven down 15 feet and samples taken (1) at the water-sediment boundary, (2) at the deepest level of the core [assumed to generally be the 14 - 15 foot segment] and (3) at 8 sections in between (sections 2, 3, 5, 6, 8, 10, 12, 14). The cores will be segmented into one-foot segments, and 10 core segments will be analyzed. Both radiological and PCB contaminants will be analyzed in these cores. Each segment will receive isotopic uranium, isotopic thorium, radium-226, radium-228, and total PCB analysis.

Downstream Area 1 - Each core will be driven down 15 feet and samples taken (1) at the water-sediment boundary, (2) at the deepest level of the core [assumed

Table 4: Contaminant Analysis and Number of Core Segments for Each Sampling Location

Sample Location		Station Number	Number of Cores	Analyses[1]
AR99-	01	196	3	Radiological[1]
AR99-	02	200	2	Radiological
AR99-	03	202	4	Radiological
AR99-	04	199	4	Radiological
AR99-	05	198	3	Radiological
AR99-	06	195	5	Radiological
AR99-	07	187,160W	10	Radiological, Total PCB
AR99-	08	187,Center	9	Radiological, Total PCB
AR99-	09	187, 180E	8	Radiological, Total PCB
AR99-	10	182, 120E	4	Radiological, Total PCB
AR99-	11	182, 20W	4	Radiological, Total PCB
AR99-	12	182, 80W	4	Radiological, Total PCB
AR99-	13	177	4	Radiological
AR99-	14	173	4	Radiological
AR99-	15	163	4	Radiological
AR99-	16	160	2	Radiological
AR99-	17	156	4	Radiological
AR99-	18	153 + 50	4	Radiological
AR99-	19	149	4	Radiological
AR99-	20	136	4	Radiological
AR99-	21	132	4	Radiological
AR99-	22	129	3	Radiological
AR99-	23	128	4	Radiological, PAH
AR99-	24	125	3	Radiological
AR99-	25	121	1	Radiological

[1] Radiological Analysis includes Isotopic Uranium, Isotopic Thorium, Radium-226 and Radium-228

Table 5: Location of QA/QC Sample Collection					
Sample		Station			
Location		Number	Core Length	Type of QA/QC Sample	
			(inches)		
AR99-	02	200	12 - 31	Radiological Field Duplicate	
AR99-	03	202	36 - 50	Radiological Field Duplicate	
AR99-	06	195	12 - 30	Radiological Field Duplicate	
AR99-	07	187,160W	12 - 24	Radiological Field Duplicate	
AR99-	07	187,160W	36 - 48	PCB MS/MSD	
AR99-	07	187,160W	36 - 48	PCB Field Duplicate	
AR99-	07	187,160W	72 - 84	PCB Field Duplicate	
AR99-	08	187,Center	108 - 139	Radiological Field Duplicate	
AR99-	09	187, 180E	12 - 24	PCB MS/MSD	
AR99-	09	187, 180E	36 - 48	Radiological Field Duplicate	
AR99-	09	187, 180E	48 - 60	Radiological Field Duplicate	
AR99-	09	187, 180E	12 - 24	PCB MS/MSD	
AR99-	09	187, 180E	48 - 60	PCB MS/MSD	
AR99-	10	182, 120E	60 - 72	PCB Field Duplicate	
AR99-	10	182, 120E	93 - 105	Radiological Field Duplicate	
AR99-	11	182, 20W	33 - 51	Radiological Field Duplicate	
AR99-	11	182, 20W	72 - 84	PCB Field Duplicate	
AR99-	12	182, 80W	72 - 90	Radiological Field Duplicate	
AR99-	14	173	95 - 113	Radiological Field Duplicate	
AR99-	18	153 + 50	12 - 30	Radiological Field Duplicate	
AR99-	21	132	12 - 30	Radiological Field Duplicate	
AR99-	23	128	12 - 24	PAH MS/MSD	
AR99-	23	128	24 - 36	PAH Field Duplicate	
AR99-	24	125	12 - 30	Radiological Field Duplicate	
AR99-	24	125	47 - 65	Radiological Field Duplicate	

to generally be the 14 - 15 foot segment], (3) at the lowest segment planned for PCB removal and (4) at a segment between the water-sediment boundary and the lowest segment planned for PCB removal. The latter segment will be based upon the highest gamma exposure rate. Both radiological and PCB contaminants will be analyzed in these cores. Each segment will receive isotopic uranium, isotopic thorium, radium-226, radium-228, and total PCB analysis.

Downstream Area 2 - Each core will be driven down 15 feet and samples taken (1) at the water-sediment boundary, (2) at the deepest level of the core [assumed to generally be the 14 - 15 foot segment], (3) at the lowest segment planned for PCB removal and (4) at a segment between the water-sediment boundary and the lowest segment planned for PCB removal. The latter segment will be based upon the highest gamma exposure rate. Only radiological contaminants will be analyzed in these cores. Each segment will receive isotopic uranium, isotopic thorium, radium-226, and radium-228 analysis.

Downstream Area 3 - Each core will be driven down 15 feet and samples taken (1) at the water-sediment boundary, (2) at the deepest level of the core [assumed to generally be the 14 - 15 foot segment], (3) at the lowest segment planned for PCB removal and (4) at a segment between the water-sediment boundary and the lowest segment planned for PCB removal. The latter segment will be based upon the highest gamma exposure rate. Both radiological and PAH contaminants will be analyzed in these cores. Each segment will receive isotopic uranium, isotopic thorium, radium-226, radium-228, and total PAH analysis.

1.7 1999 RADIOLOGICAL SAMPLING RESULTS

The radiological analytical results of the 1999 Ashtabula River sampling campaign are summarized below and can be found, as tables within this Appendix.

Table 6, maximum concentration values as identified in the Gamma Spectroscopy Results – Uranium Series, are as follows:

Th-234	12.9 pCi/g	Pa-234m	13.0 pCi/g
Ra-226	14.4 pCi/g	Pb-214	7.28 pCi/g
B-214	6.5 pCi/g		

Table 7, maximum concentration values as identified in the Gamma Spectroscopy Results – Thorium Series, are as follows:

Ra-228	8.33 pCi/g	Ra-224	7.99 pCi/g
Pb-212	9.09 pCi/g	Bi-212	8.43 pCi/g
Tl-208	2.92 pCi/g		

Table 8, maximum concentration values as identified in the Gamma Spectroscopy Results – Actinium Series, are as follows:

U-235	0.855 pCi/g	Th-227	0.612 pCi/g
Ra-223	0.706 pCi/g	Rn-219	0.589 pCi/g

Table 9, maximum concentration values as identified in the Gamma Spectroscopy Results – Miscellaneous Radionuclides, are as follows:

Cs-137	0.307 pCi/g	K-40	14.9 pCi/g
Co-56	0.0183 pCi/g		

Table 10, maximum concentration values as identified in the Isotopic Uranium Results, are as follows:

U-238	45.5 pCi/g	U-234	57.9 pCi/g
U-235	6.59 pCi/g		

Table 11, maximum concentration values as identified in the Isotopic Thorium Results, are as follows:

Th-230	20.9 pCi/g	Th-232	8.52 pCi/g
Th-228	8.64 pCi/g	Th-227	0.910 pCi/g

	ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999										
	GAMMA SPECTROSCOPY RESULTS—URANIUM SERIES (pCi/g)										
		SAMPLE I.D.				STA	Th-234	Pa-234m	Ra-226	Pb-214	Bi-214
AR99-	2-	0	12	RAD		200			1.45	0.715	0.631
AR99-	2-	12	31	RAD		200			1.14	0.640	0.593
AR99-	2-	12	31	RAD	FD	200			1.30	0.654	0.612
AR99-	3-	0	12	RAD		202			1.67	0.686	0.638
AR99-	3-	0	12	RAD	LD	202			1.23	0.679	0.616
AR99-	3-	12	24	RAD		202			1.21	0.739	0.668
AR99-	3-	36	50	RAD		202			1.35	0.764	0.675
AR99-	3-	36	50	RAD	FD	202			1.39	0.752	0.721
AR99-	3-	50	62	RAD		202			1.36	0.783	0.718
AR99-	4-	0	12	RAD		199			1.55	0.623	0.560
AR99-	4-	12	24	RAD		199	0.630		1.33	0.682	0.628
AR99-	4-	12	24	RAD	LD	199	0.494		1.42	0.689	0.644
AR99-	4-	48	60	RAD		199	0.443	1.18	1.65	0.774	0.709
AR99-	4-	68	80	RAD		199	1.02	1.20	2.16	1.11	1.00
AR99-	5-	0	12	RAD		198			1.32	0.687	0.620
AR99-	5-	12	24	RAD		198			1.24	0.722	0.634
AR99-	5-	24	33	RAD		198		1.33	1.39	0.682	0.667
AR99-	1-	0	12	RAD		196			1.62	0.830	0.796
AR99-	1-	36	48	RAD		196	2.20	2.25	3.79	1.65	1.52
AR99-	1-	70	82	RAD		196	1.69	1.75	3.42	1.21	1.09
AR99-	6-	0	12	RAD		195			1.46	0.768	0.691
AR99-	6-	12	30	RAD		195			1.41	0.732	0.666
AR99-	6-	12	30	RAD	FD	195			1.56	0.797	0.701
AR99-	6-	60	72	RAD		195			5.93	2.53	2.26
AR99-	6-	72	84	RAD		195			9.77	3.79	3.39
AR99-	6-	94	106	RAD		195		0.860	1.84	0.865	0.800
AR99-	7-	0	12	RAD		187 (160W)			1.30	0.679	0.629
AR99-	7-	12	24	RAD		187 (160W)			1.68	0.802	0.750
AR99-	7-	12	24	RAD	FD	187 (160W)	0.834		1.68	0.767	0.674
AR99-	7-	24	36	RAD		187 (160W)	1.27	1.02	1.47	0.787	0.742
AR99-	7-	36	48	RAD		187 (160W)	0.382	1.17	1.45	0.624	0.599
AR99-	7-	48	60	RAD		187 (160W)	1.12	1.96	1.90	0.891	0.819
AR99-	7-	60	72	RAD		187 (160W)	1.18	2.40	4.15	1.78	1.64
AR99-	7-	72	84	RAD		187 (160W)	4.85	4.24	5.95	3.66	3.34
AR99-	7-	84	96	RAD		187 (160W)	3.59	5.29	5.73	3.75	3.41
AR99-	7-	96	108	RAD	187 (160W)		11.3	11.1	8.68	7.28	6.51
AR99-	7-	108	127	RAD		187 (160W)	6.21	8.47	3.94	3.42	3.14
AR99-	8-	0	12	RAD		187 (0)	1.06		1.13	0.551	0.528
AR99-	8-	12	24	RAD		187 (0)	0.708		1.60	0.686	0.625
AR99-	8-	24	36	RAD		187 (0)			1.79	0.709	0.650
AR99-	8-	36	48	RAD		187 (0)	1.56		2.07	1.02	0.962
AR99-	8-	60	72	RAD		187 (0)	1.13	1.27	2.10	0.914	0.828
AR99-	8-	72	84	RAD		187 (0)	2.72	2.79	5.21	2.01	1.86
AR99-	8-	84	96	RAD	187 (0)		4.72	9.91	14.40	5.97	5.55
AR99-	8-	96	108	RAD		187 (0)	5.61	-9.48	6.50	4.12	3.66
AR99-	8-	108	139	RAD		187 (0)	3.43	8.73	6.49	4.28	3.88

AR99-	8-	108	139	RAD	FD	187 (0)	7.95	7.16	7.29	4.29	3.92
AR99-	9-	0	12	RAD		187 (180E)	6.23	4.73	5.96	2.25	2.02
AR99-	9-	12	24	RAD		187 (180E)	6.41	6.82	6.24	5.10	4.59
AR99-	9-	24	36	RAD		187 (180E)	12.0	12.1	5.05	3.22	2.91
AR99-	9-	36	48	RAD		187 (180E)	2.49	2.74	4.51	1.49	1.33
AR99-	9-	36	48	RAD	FD	187 (180E)	4.60	4.83	3.48	1.79	1.61
AR99-	9-	48	60	RAD		187 (180E)	10.6	10.5	1.49	3.17	2.82
AR99-	9-	48	60	RAD	FD	187 (180E)	1.49	2.99	3.86	1.67	1.54
AR99-	9-	60	72	RAD		187 (180E)	5.50	6.05	2.50	2.05	1.80
AR99-	9-	60	72	RAD	LD	187 (180E)			ND	2.07	1.85
AR99-	9-	72	84	RAD		187 (180E)	4.84	6.10	3.28	2.39	2.13
AR99-	9-	84	96	RAD		187 (180E)	5.63	6.08	3.62	1.90	1.59
AR99-	10-	0	12	RAD		182 (120E)		0.870	1.80	0.810	0.730
AR99-	10-	60	72	RAD		182 (120E)	1.15	1.38	2.46	1.30	1.20
AR99-	10-	93	105	RAD		182 (120E)	7.33	8.50	7.63	6.95	6.32
AR99-	10-	93	105	RAD	FD	182 (120E)	10.50	8.91	4.99	6.30	5.71
AR99-	10-	147	159	RAD		182 (120E)	5.98	5.44	5.12	4.12	3.70
AR99-	11-	0	12	RAD		182 (20W)		1.01	1.46	0.833	0.721
AR99-	11-	33	51	RAD		182 (20W)	12.9	13.0	4.93	4.90	4.06
AR99-	11-	33	51	RAD	FD	182 (20W)			9.50	4.86	4.32
AR99-	11-	60	72	RAD		182 (20W)	5.74	6.79	3.98	2.32	2.07
AR99-	11-	72	84	RAD		182 (20W)			8.16	3.10	2.78
AR99-	12-	0	12	RAD		182 (80W)	0.926		1.18	0.574	0.533
AR99-	12-	12	24	RAD		182 (80W)			1.50	0.755	0.688
AR99-	12-	30	42	RAD		182 (80W)			1.35	0.737	0.682
AR99-	12-	72	90	RAD		182 (80W)			1.48	0.652	0.603
AR99-	12-	72	90	RAD	FD	182 (80W)			1.16	0.612	0.574
AR99-	13-	0	12	RAD		177			1.16	0.584	0.550
AR99-	13-	0	12	RAD	LD	177			1.20	0.663	0.558
AR99-	13-	90	102	RAD		177			9.29	3.98	3.56
AR99-	13-	119	131	RAD		177			6.72	3.34	2.94
AR99-	13-	152	164	RAD		177			3.63	1.29	1.15
AR99-	14-	0	12	RAD		173			1.65	0.770	0.744
AR99-	14-	95	113	RAD		173	5.00	5.25	5.89	3.45	3.12
AR99-	14-	95	113	RAD	FD	173	5.07	4.26	9.71	3.69	3.28
AR99-	14-	130	142	RAD		173	10.3	9.43	3.33	3.13	2.71
AR99-	14-	159	171	RAD		173	0.903		1.87	0.760	0.650
AR99-	14-	0	12	RAD		163			1.24	0.702	0.633
AR99-	15-	24	36	RAD		163	1.33		2.78	1.31	1.19
AR99-	15-	42	54	RAD		163	3.56	4.91	8.55	3.45	3.11
AR99-	15-	65	72	RAD		163	6.84	5.40	4.47	3.84	3.39
AR99-	16-	0	12	RAD		160	0.622		1.53	0.803	0.731
AR99-	16-	12	24	RAD		160			1.87	0.787	0.758
AR99-	17-	0	12	RAD		156	0.778	0.910	1.42	0.817	0.703
AR99-	17-	37	49	RAD		156	0.749	1.61	1.74	0.833	0.776
AR99-	17-	94	106	RAD		156			5.84	2.46	2.13
AR99-	17-	123	135	RAD		156			2.09	2.93	2.61
AR99-	18-	0	12	RAD		153+50			1.34	0.752	0.694
AR99-	18-	12	30	RAD		153+50			1.44	0.785	0.741
AR99-	18-	12	30	RAD	FD	153+50			1.43	0.828	0.769
AR99-	18-	36	48	RAD		153+50	0.742		1.92	0.895	0.852

AR99-	18-	63	75	RAD		153 + 50	1.23		1.87	0.871	0.791
AR99-	19-	0	12	RAD		149			1.06	0.493	0.449
AR99-	19-	12	24	RAD		149	0.513		1.16	0.635	0.579
AR99-	19-	12	24	RAD	LD	149			1.23	0.621	0.580
AR99-	19-	24	36	RAD		149			1.24	0.499	0.440
AR99-	19-	70	82	RAD		149	0.615	1.40	1.54	0.721	0.674
AR99-	19-	70	82	RAD	LD	149		0.799	1.56	0.733	0.658
AR99-	20-	0	12	RAD		136			1.43	0.769	0.714
AR99-	20-	12	24	RAD		136			1.65	0.805	0.725
AR99-	20-	24	36	RAD		136			1.80	0.927	0.841
AR99-	20-	58	71	RAD		136			3.07	1.41	1.25
AR99-	21-	0	12	RAD		132	0.545		1.35	0.707	0.651
AR99-	21-	12	30	RAD		132	0.801	1.40	1.53	0.794	0.749
AR99-	21-	12	30	RAD	FD	132			1.47	0.821	0.742
AR99-	21-	30	42	RAD		132		1.93	1.93	0.968	0.876
AR99-	21-	63	75	RAD		132		1.99	2.31	1.09	0.994
AR99-	22-	0	12	RAD		129			1.48	0.687	0.604
AR99-	22-	12	24	RAD		129		1.16	1.53	0.710	0.657
AR99-	22-	49	61	RAD		129	0.810	2.30	2.08	1.02	0.895
AR99-	23-	0	12	RAD		128			1.46	0.717	0.641
AR99-	23-	12	24	RAD		128			1.68	0.789	0.714
AR99-	23-	24	36	RAD		128	0.717		1.51	0.863	0.755
AR99-	23-	36	58	RAD		128		0.812	1.60	0.806	0.754
AR99-	24-	0	12	RAD		125			1.33	0.722	0.665
AR99-	24-	12	30	RAD		125			1.58	0.820	0.732
AR99-	24-	12	30	RAD	FD	125			1.80	0.821	0.762
AR99-	24-	12	30	RAD	LD	125			1.71	0.836	0.756
AR99-	24-	47	65	RAD		125			1.44	0.890	0.828
AR99-	24-	47	65	RAD	FD	125	1.17		1.69	0.828	0.786
AR99-	25-	0	8	RAD		121			1.43	0.674	0.599
							Th-234	**Pa-234m**	**Ra-226**	**Pb-214**	**Bi-214**
						MAXIMUM	12.9	13.0	14.4	7.28	6.5
					(NON-						
					BACKGROUND)						
		FD		Field Duplicate							
		LD		Lab Duplicate							
		125		Priority samples, analyzed 11/99							
		125		Non-priority samples, analyzed after 11/99							
		Background sites AR99-2 to AR99-5, inclusive									

	ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999										
	GAMMA SPECTROSCOPY RESULTS—THORIUM SERIES (pCi/g)										
		SAMPLE I.D.				STA	Ra-228	Ra-224	Pb-212	Bi-212	Tl-208
AR99-	2-	0	12	RAD		200	0.773	0.801	0.805	0.696	0.261
AR99-	2-	12	31	RAD		200	0.792	0.716	0.810	0.909	0.270
AR99-	2-	12	31	RAD	FD	200	0.772	0.535	0.806	0.869	0.261
AR99-	3-	0	12	RAD		202	0.740	0.498	0.824	0.778	0.283
AR99-	3-	0	12	RAD	LD	202	0.751	0.631	0.807	0.802	0.278
AR99-	3-	12	24	RAD		202	0.860	0.531	0.930	0.805	0.274
AR99-	3-	36	50	RAD		202	0.856	0.648	0.906	0.894	0.281
AR99-	3-	36	50	RAD	FD	202	0.849	0.660	0.894	0.776	0.277
AR99-	3-	50	62	RAD		202	0.839	0.641	0.885	0.785	0.275
AR99-	4-	0	12	RAD		199	0.703	0.603	0.742	0.690	0.234
AR99-	4-	12	24	RAD		199	0.727	0.879	0.880	0.766	0.272
AR99-	4-	12	24	RAD	LD	199	0.779	0.561	0.851	0.785	0.274
AR99-	4-	48	60	RAD		199	0.793	0.732	0.906	0.872	0.282
AR99-	4-	68	80	RAD		199	0.857	0.466	0.896	0.869	0.296
AR99-	5-	0	12	RAD		198	0.746	0.634	0.836	0.823	0.275
AR99-	5-	12	24	RAD		198	0.865	0.698	0.866	0.834	0.278
AR99-	5-	24	33	RAD		198	0.805	0.656	0.899	0.849	0.290
AR99-	1-	0	12	RAD		196	0.895	0.926	0.971	0.802	0.305
AR99-	1-	36	48	RAD		196	0.887	0.591	0.985	1.02	0.300
AR99-	1-	70	82	RAD		196	0.856	0.919	0.927	0.990	0.299
AR99-	6-	0	12	RAD		195	0.829	0.583	0.889	0.805	0.266
AR99-	6-	12	30	RAD		195	0.777	0.495	0.836	0.834	0.269
AR99-	6-	12	30	RAD	FD	195	0.843	0.883	0.954	0.748	0.305
AR99-	6-	60	72	RAD		195	0.917		0.934	0.984	0.320
AR99-	6-	72	84	RAD		195	1.17	0.922	1.25	1.12	0.377
AR99-	6-	94	106	RAD		195	0.893	0.889	0.942	0.915	0.313
AR99-	7-	0	12	RAD		187 (160W)	0.806	0.895	0.919	0.820	0.294
AR99-	7-	12	24	RAD		187 (160W)	0.830	0.884	0.966	0.960	0.317
AR99-	7-	12	24	RAD	FD	187 (160W)	0.741	0.749	0.980	0.656	0.289
AR99-	7-	24	36	RAD		187 (160W)	0.896	0.740	0.971	0.885	0.320
AR99-	7-	36	48	RAD		187 (160W)	0.735	0.623	0.830	0.774	0.275
AR99-	7-	48	60	RAD		187 (160W)	0.922	0.703	1.02	0.939	0.326
AR99-	7-	60	72	RAD		187 (160W)	1.32	1.30	1.48	1.55	0.473
AR99-	7-	72	84	RAD		187 (160W)	1.52	1.27	1.84	1.67	0.558
AR99-	7-	84	96	RAD		187 (160W)	0.953		1.00	0.952	0.327
AR99-	7-	96	108	RAD		187 (160W)	1.17		1.48	1.25	0.443
AR99-	7-	108	127	RAD		187 (160W)	1.51	1.23	1.70	1.59	0.522
AR99-	8-	0	12	RAD		187 (0)	0.671	0.670	0.747	0.773	0.236
AR99-	8-	12	24	RAD		187 (0)	0.802	0.694	0.935	0.896	0.304
AR99-	8-	24	36	RAD		187 (0)	0.824	0.549	0.934	0.757	0.319
AR99-	8-	36	48	RAD		187 (0)	1.38	1.09	1.48	1.43	0.474
AR99-	8-	60	72	RAD		187 (0)	1.58	1.42	1.65	1.59	0.559
AR99-	8-	72	84	RAD		187 (0)	1.75	1.71	1.97	1.81	0.612
AR99-	8-	84	96	RAD		187 (0)	1.76	1.96	2.12	2.11	0.689
AR99-	8-	96	108	RAD		187 (0)	1.42	0.988	1.63	1.36	0.499
AR99-	8-	108	139	RAD		187 (0)	1.73	1.64	1.99	1.90	0.607

AR99-	8-	108	139	RAD	FD	187 (0)	1.14	0.807	1.32	1.26	0.405
AR99-	9-	0	12	RAD		187 (180E)	8.33	7.99	9.09	8.43	2.92
AR99-	9-	12	24	RAD		187 (180E)	1.21		1.31	1.38	0.434
AR99-	9-	24	36	RAD		187 (180E)	1.14	0.892	1.31	1.18	0.390
AR99-	9-	36	48	RAD		187 (180E)	0.869	0.719	0.983	0.926	0.314
AR99-	9-	36	48	RAD	FD	187 (180E)	0.940	1.01	1.04	0.912	0.317
AR99-	9-	48	60	RAD		187 (180E)	2.06	1.79	2.27	2.14	0.709
AR99-	9-	48	60	RAD	FD	187 (180E)	1.44	1.02	1.58	1.50	0.534
AR99-	9-	60	72	RAD		187 (180E)	1.84	1.37	1.92	1.96	0.649
AR99-	9-	60	72	RAD	LD	187 (180E)	1.90	0.848	1.97	2.07	0.629
AR99-	9-	72	84	RAD		187 (180E)	1.21	0.495	1.29	1.43	0.432
AR99-	9-	84	96	RAD		187 (180E)	1.07	0.844	1.35	1.15	0.394
AR99-	10-	0	12	RAD		182 (120E)	0.865	0.776	0.975	0.896	0.327
AR99-	10-	60	72	RAD		182 (120E)	0.853	0.533	0.881	0.858	0.296
AR99-	10-	93	105	RAD		182 (120E)	2.52	2.08	2.85	2.52	0.881
AR99-	10-	93	105	RAD	FD	182 (120E)	2.29	1.97	2.51	2.21	0.771
AR99-	10-	147	159	RAD		182 (120E)	0.761	0.989	0.875	0.684	0.252
AR99-	11-	0	12	RAD		182 (20W)	0.833	0.666	0.934	0.981	0.311
AR99-	11-	33	51	RAD		182 (20W)	1.27	1.28	1.71	1.70	0.513
AR99-	11-	33	51	RAD	FD	182 (20W)	1.38	0.569	1.56	1.60	0.462
AR99-	11-	60	72	RAD		182 (20W)	0.964	0.768	1.03	0.917	0.322
AR99-	11-	72	84	RAD		182 (20W)	1.18	0.793	1.20	1.22	0.384
AR99-	12-	0	12	RAD		182 (80W)	0.668	0.565	0.754	0.606	0.242
AR99-	12-	12	24	RAD		182 (80W)	0.977	1.05	1.02	1.01	0.321
AR99-	12-	30	42	RAD		182 (80W)	0.867	0.734	0.899	0.888	0.270
AR99-	12-	72	90	RAD		182 (80W)	0.812	0.543	0.819	0.841	0.247
AR99-	12-	72	90	RAD	FD	182 (80W)	0.758	0.621	0.754	0.842	0.246
AR99-	13-	0	12	RAD		177	0.758	0.516	0.809	0.887	0.260
AR99-	13-	0	12	RAD	LD	177	0.721	0.654	0.813	0.608	0.249
AR99-	13-	90	102	RAD		177	1.54		1.61	1.55	0.522
AR99-	13-	119	131	RAD		177	1.63		1.64	1.73	0.542
AR99-	13-	152	164	RAD		177	1.09	0.686	1.14	1.15	0.370
AR99-	14-	0	12	RAD		173	1.03	1.14	1.10	1.12	0.340
AR99-	14-	95	113	RAD		173	1.36	1.25	1.66	1.50	0.523
AR99-	14-	95	113	RAD	FD	173	1.50	1.67	1.65	1.64	0.500
AR99-	14-	130	142	RAD		173	1.21	0.793	1.50	1.33	0.458
AR99-	14-	159	171	RAD		173	0.757	0.677	0.893	0.837	0.288
AR99-	15-	0	12	RAD		163	0.795	0.738	0.902	0.931	0.302
AR99-	15-	24	36	RAD		163	0.953	0.487	1.11	1.08	0.356
AR99-	15-	42	54	RAD		163	1.73	0.310	1.88	1.79	0.618
AR99-	15-	65	72	RAD		163	1.41	1.00	1.56	1.55	0.492
AR99-	16-	0	12	RAD		160	0.866	0.710	0.959	0.783	0.319
AR99-	16-	12	24	RAD		160	0.959	0.575	1.11	0.981	0.358
AR99-	17-	0	12	RAD		156	0.819	0.580	1.01	0.908	0.314
AR99-	17-	37	49	RAD		156	1.06	0.984	1.13	1.07	0.360
AR99-	17-	94	106	RAD		156	1.48	0.760	1.50	1.43	0.488
AR99-	17-	123	135	RAD		156	1.12	0.599	1.18	0.923	0.371
AR99-	18-	0	12	RAD		153+50	0.834	0.866	1.02	0.959	0.316
AR99-	18-	12	30	RAD		153+50	1.07	0.835	1.11	1.07	0.344
AR99-	18-	12	30	RAD	FD	153+50	1.03	0.869	1.13	1.02	0.362
AR99-	18-	36	48	RAD		153+50	0.855	1.06	1.02	0.917	0.340

AR99-	18-	63	75	RAD		153+50	0.980	0.783	1.11	1.03	0.356
AR99-	19-	0	12	RAD		149	0.584	0.428	0.651	0.579	0.208
AR99-	19-	12	24	RAD		149	0.738	0.690	0.839	0.797	0.269
AR99-	19-	12	24	RAD	LD	149	0.708	0.606	0.803	0.639	0.262
AR99-	19-	24	36	RAD		149	0.616	0.624	0.718	0.702	0.226
AR99-	19-	70	82	RAD		149	0.879	0.770	0.973	0.820	0.324
AR99-	19-	70	82	RAD	LD	149	0.880	0.730	0.972	1.10	0.326
AR99-	20-	0	12	RAD		136	0.915	0.792	0.962	0.844	0.303
AR99-	20-	12	24	RAD		136	0.958	0.951	1.01	1.13	0.331
AR99-	20-	24	36	RAD		136	1.11	0.937	1.19	1.15	0.380
AR99-	20-	58	71	RAD		136	0.997	0.475	1.02	1.06	0.326
AR99-	21-	0	12	RAD		132	0.824	0.680	0.883	0.834	0.290
AR99-	21-	12	30	RAD		132	0.899	0.780	1.03	0.977	0.329
AR99-	21-	12	30	RAD	FD	132	0.909	0.718	1.00	1.03	0.331
AR99-	21-	30	42	RAD		132	1.22	1.15	1.34	1.29	0.466
AR99-	21-	63	75	RAD		132	1.11	0.819	1.22	1.29	0.395
AR99-	22-	0	12	RAD		129	0.755	0.334	0.850	0.812	0.265
AR99-	22-	12	24	RAD		129	0.788	0.535	0.916	0.879	0.301
AR99-	22-	49	61	RAD		129	0.967	0.890	1.09	0.931	0.357
AR99-	23-	0	12	RAD		128	0.871	0.614	0.968	0.862	0.292
AR99-	23-	12	24	RAD		128	0.877	0.660	0.964	0.833	0.328
AR99-	23-	24	36	RAD		128	0.956	0.776	0.993	0.998	0.333
AR99-	23-	36	58	RAD		128	0.924	0.947	1.02	0.833	0.335
AR99-	24-	0	12	RAD		125	0.784	0.790	0.899	0.833	0.279
AR99-	24-	12	30	RAD		125	1.05	0.937	1.08	1.03	0.336
AR99-	24-	12	30	RAD	FD	125	1.09	0.718	1.16	1.23	0.375
AR99-	24-	12	30	RAD	LD	125	1.12	0.711	1.19	1.20	0.359
AR99-	24-	47	65	RAD		125	1.00	0.692	1.05	1.08	0.320
AR99-	24-	47	65	RAD	FD	125	0.877	0.439	1.01	0.834	0.314
AR99-	25-	0	8	RAD		121	0.761	0.850	0.861	0.734	0.253
							Ra-228	**Ra-224**	**Pb-212**	**Bi-212**	**Tl-208**
						MAXIMUM	8.33	7.99	9.09	8.43	2.92
					(NON-						
					BACKGROUND)						
		FD		Field Duplicate							
		LD		Lab Duplicate							
		125		Priority samples, analyzed 11/99							
		125		Non-priority samples, analyzed after 11/99							
		Background sites AR99-2 to AR99-5, inclusive									

	ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999									
	GAMMA SPECTROSCOPY RESULTS—ACTINIUM SERIES (pCi/g)									
		SAMPLE I.D.				STA	U-235	Th-227	Ra-223	Rn-219
AR99-	2-	0	12	RAD		200				
AR99-	2-	12	31	RAD		200				
AR99-	2-	12	31	RAD	FD	200				
AR99-	3-	0	12	RAD		202				
AR99-	3-	0	12	RAD	LD	202				
AR99-	3-	12	24	RAD		202				
AR99-	3-	36	50	RAD		202				
AR99-	3-	36	50	RAD	FD	202				
AR99-	3-	50	62	RAD		202				
AR99-	4-	0	12	RAD		199				
AR99-	4-	12	24	RAD		199				
AR99-	4-	12	24	RAD	LD	199				
AR99-	4-	48	60	RAD		199				
AR99-	4-	68	80	RAD		199	0.131			
AR99-	5-	0	12	RAD		198				
AR99-	5-	12	24	RAD		198				
AR99-	5-	24	33	RAD		198				
AR99-	1-	0	12	RAD		196				
AR99-	1-	36	48	RAD		196	0.227			
AR99-	1-	70	82	RAD		196	0.204			
AR99-	6-	0	12	RAD		195				
AR99-	6-	12	30	RAD		195				
AR99-	6-	12	30	RAD	FD	195				
AR99-	6-	60	72	RAD		195	0.358			
AR99-	6-	72	84	RAD		195	0.594			
AR99-	6-	94	106	RAD		195				
AR99-	7-	0	12	RAD		187 (160W)	0.0802			
AR99-	7-	12	24	RAD		187 (160W)				
AR99-	7-	12	24	RAD	FD	187 (160W)	0.100		0.0994	
AR99-	7-	24	36	RAD		187 (160W)				
AR99-	7-	36	48	RAD		187 (160W)				
AR99-	7-	48	60	RAD		187 (160W)	0.116			
AR99-	7-	60	72	RAD		187 (160W)	0.247			
AR99-	7-	72	84	RAD		187 (160W)	0.185			0.319
AR99-	7-	84	96	RAD		187 (160W)	0.218		0.278	
AR99-	7-	96	108	RAD		187 (160W)	0.625	0.551	0.468	0.512
AR99-	7-	108	127	RAD		187 (160W)	0.501	0.436	0.329	0.362
AR99-	8-	0	12	RAD		187 (0)	0.0695			
AR99-	8-	12	24	RAD		187 (0)				
AR99-	8-	24	36	RAD		187 (0)				
AR99-	8-	36	48	RAD		187 (0)				
AR99-	8-	60	72	RAD		187 (0)				
AR99-	8-	72	84	RAD		187 (0)	0.302			0.113
AR99-	8-	84	96	RAD		187 (0)	0.855	0.377	0.470	
AR99-	8-	96	108	RAD		187 (0)	0.390	0.433	0.130	0.589
AR99-	8-	108	139	RAD		187 (0)	0.346	0.352	0.192	0.342

AR99-	8-	108	139	RAD	FD	187 (0)	0.240		0.211	0.405
AR99-	9-	0	12	RAD		187 (180E)	0.351			
AR99-	9-	12	24	RAD		187 (180E)	0.400			0.279
AR99-	9-	24	36	RAD		187 (180E)	0.534	0.290		0.210
AR99-	9-	36	48	RAD		187 (180E)	0.270		0.118	
AR99-	9-	36	48	RAD	FD	187 (180E)	0.171	0.163		
AR99-	9-	48	60	RAD		187 (180E)	0.665	0.459		
AR99-	9-	48	60	RAD	FD	187 (180E)	0.236			
AR99-	9-	60	72	RAD		187 (180E)	0.294		0.154	0.304
AR99-	9-	60	72	RAD	LD	187 (180E)	0.457			
AR99-	9-	72	84	RAD		187 (180E)	0.277		0.142	0.250
AR99-	9-	84	96	RAD		187 (180E)	0.206	0.271	0.286	
AR99-	10-	0	12	RAD		182 (120E)				
AR99-	10-	60	72	RAD		182 (120E)				
AR99-	10-	93	105	RAD		182 (120E)	0.507	0.481	0.331	0.268
AR99-	10-	93	105	RAD	FD	182 (120E)	0.611		0.180	0.293
AR99-	10-	147	159	RAD		182 (120E)	0.351	0.376	0.250	0.120
AR99-	11-	0	12	RAD		182 (20W)				
AR99-	11-	33	51	RAD		182 (20W)	0.788	0.612	0.706	
AR99-	11-	33	51	RAD	FD	182 (20W)	0.474		0.175	0.511
AR99-	11-	60	72	RAD		182 (20W)	0.297	0.206		
AR99-	11-	72	84	RAD		182 (20W)	0.492		0.300	
AR99-	12-	0	12	RAD		182 (80W)				
AR99-	12-	12	24	RAD		182 (80W)				
AR99-	12-	30	42	RAD		182 (80W)				
AR99-	12-	72	90	RAD		182 (80W)				
AR99-	12-	72	90	RAD	FD	182 (80W)				
AR99-	12-	0	12	RAD		177				
AR99-	13-	0	12	RAD	LD	177				
AR99-	13-	90	102	RAD		177	0.562		0.265	0.173
AR99-	13-	119	131	RAD		177	0.236		0.491	
AR99-	13-	152	164	RAD		177	0.217			
AR99-	14-	0	12	RAD		173				
AR99-	14-	95	113	RAD		173	0.199			0.166
AR99-	14-	95	113	RAD	FD	173	0.582			
AR99-	14-	130	142	RAD		173	0.573	0.436	0.291	0.403
AR99-	14-	159	171	RAD		173				
AR99-	15-	0	12	RAD		163				
AR99-	15-	24	36	RAD		163				
AR99-	15-	42	54	RAD		163	0.521		0.283	
AR99-	15-	65	72	RAD		163	0.379	0.357		0.325
AR99-	16-	0	12	RAD		160				
AR99-	16-	12	24	RAD		160				
AR99-	17-	0	12	RAD		156				
AR99-	17-	37	49	RAD		156	0.105			
AR99-	17-	94	106	RAD		156	0.350			
AR99-	17-	123	135	RAD		156	0.333			
AR99-	18-	0	12	RAD		153+50				
AR99-	18-	12	30	RAD		153+50				
AR99-	18-	12	30	RAD	FD	153+50				
AR99-	18-	36	48	RAD		153+50				

AR99-	**18-**	**63**	**75**	**RAD**		153+50				
AR99-	**19-**	**0**	**12**	**RAD**		149				
AR99-	**19-**	**12**	**24**	**RAD**		149				
AR99-	**19-**	**12**	**24**	**RAD**	LD	149				
AR99-	**19-**	**24**	**36**	**RAD**		149	0.0755			
AR99-	**19-**	**70**	**82**	**RAD**		149				
AR99-	**19-**	**70**	**82**	**RAD**	LD	149				
AR99-	**20-**	**0**	**12**	**RAD**		136				
AR99-	**20-**	**12**	**24**	**RAD**		136				
AR99-	**20-**	**24**	**36**	**RAD**		136				
AR99-	**20-**	**58**	**71**	**RAD**		136	0.186			
AR99-	**21-**	**0**	**12**	**RAD**		132	0.0826			
AR99-	**21-**	**12**	**30**	**RAD**		132	0.0940			
AR99-	**21-**	**12**	**30**	**RAD**	FD	132	0.0891			
AR99-	**21-**	**30**	**42**	**RAD**		132				
AR99-	**21-**	**63**	**75**	**RAD**		132	0.135			
AR99-	**22-**	**0**	**12**	**RAD**		129				
AR99-	**22-**	**12**	**24**	**RAD**		129				
AR99-	**22-**	**49**	**61**	**RAD**		129				
AR99-	**23-**	**0**	**12**	**RAD**		128				
AR99-	**23-**	**12**	**24**	**RAD**		128				
AR99-	**23-**	**24**	**36**	**RAD**		128				
AR99-	**23-**	**36**	**58**	**RAD**		128	0.0978			
AR99-	**24-**	**0**	**12**	**RAD**		125				
AR99-	**24-**	**12**	**30**	**RAD**		125				
AR99-	**24-**	**12**	**30**	**RAD**	FD	125				
AR99-	**24-**	**12**	**30**	**RAD**	LD	125				
AR99-	**24-**	**47**	**65**	**RAD**		125				
AR99-	**24-**	**47**	**65**	**RAD**	FD	125	0.102			
AR99-	**25-**	**0**	**8**	**RAD**		121				
							U-235	**Th-227**	**Ra-223**	**Rn-219**
						MAXIMUM	0.855	0.612	0.706	0.589
					(NON-					
					BACKGROUND)					
		FD		Field Duplicate						
		LD		Lab Duplicate						
		125		Priority samples, analyzed 11/99						
		125		Non-priority samples, analyzed after 11/99						
		Background sites AR99-2 to AR99-5, inclusive								

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999										
GAMMA SPECTROSCOPY RESULTS—MISCELLANEOUS RADIONUCLIDES										
						(pCi/g)				
		SAMPLE I.D.				STA	CS-137	K-40	Co-56	
AR99-	2-	0	12	RAD		200	0.0374	13.2		
AR99-	2-	12	31	RAD		200	0.0273	12.9		
AR99-	2-	12	31	RAD	FD	200	0.0337	12.7		
AR99-	3-	0	12	RAD		202	0.0497	12.4		
AR99-	3-	0	12	RAD	LD	202	0.0475	11.8		
AR99-	3-	12	24	RAD		202	0.0430	13.4		
AR99-	3-	36	50	RAD		202	0.119	14.2		
AR99-	3-	36	50	RAD	FD	202	0.115	14.2		
AR99-	3-	50	62	RAD		202	0.137	14.8		
AR99-	4-	0	12	RAD		199	0.0491	11.3		
AR99-	4-	12	24	RAD		199	0.0666	10.6		
AR99-	4-	12	24	RAD	LD	199	0.0652	11.3		
AR99-	4-	48	60	RAD		199	0.134	13.5		
AR99-	4-	68	80	RAD		199	0.146	13.0		
AR99-	5-	0	12	RAD		198	0.0565	12.3		
AR99-	5-	12	24	RAD		198	0.0378	13.6		
AR99-	5-	24	33	RAD		198	0.0542	12.4		
AR99-	1-	0	12	RAD		196	0.0602	13.8		
AR99-	1-	36	48	RAD		196	0.128	12.6		
AR99-	1-	70	82	RAD		196	0.211	12.1		
AR99-	6-	0	12	RAD		195	0.128	14.7		
AR99-	6-	12	30	RAD		195	0.105	12.2		
AR99-	6-	12	30	RAD	FD	195	0.126	13.8		
AR99-	6-	60	72	RAD		195	0.109	11.9		
AR99-	6-	72	84	RAD		195	0.144	9.17		
AR99-	6-	94	106	RAD		195	0.188	14.2		
AR99-	7-	0	12	RAD		187 (160W)	0.0314	11.3		
AR99-	7-	12	24	RAD		187 (160W)	0.0531	11.7		
AR99-	7-	12	24	RAD	FD	187 (160W)	0.0510	10.6		
AR99-	7-	24	36	RAD		187 (160W)	0.0466	12.8		
AR99-	7-	36	48	RAD		187 (160W)	0.0527	11.8		
AR99-	7-	48	60	RAD		187 (160W)	0.0845	12.2		
AR99-	7-	60	72	RAD		187 (160W)	0.0987	10.4		
AR99-	7-	72	84	RAD		187 (160W)	0.108	8.34		
AR99-	7-	84	96	RAD		187 (160W)	0.0995	8.74		
AR99-	7-	96	108	RAD		187 (160W)	0.0695	2.62		
AR99-	7-	108	127	RAD		187 (160W)	0.111	7.53		
AR99-	8-	0	12	RAD		187 (0)	0.0240	12.3		
AR99-	8-	12	24	RAD		187 (0)	0.0360	11.1		
AR99-	8-	24	36	RAD		187 (0)	0.0343	14.1		
AR99-	8-	36	48	RAD		187 (0)	0.0594	13.3		
AR99-	8-	60	72	RAD		187 (0)	0.0670	12.4		
AR99-	8-	72	84	RAD		187 (0)	0.0651	10.9		
AR99-	8-	84	96	RAD		187 (0)	0.0569	6.68		
AR99-	8-	96	108	RAD		187 (0)	0.0600	6.63		
AR99-	8-	108	139	RAD		187 (0)	0.116	5.11		

AR99-	8-	108	139	RAD	FD	187 (0)	0.102	5.89		
AR99-	9-	0	12	RAD		187 (180E)	0.0546	7.14		
AR99-	9-	12	24	RAD		187 (180E)	0.193	4.60		
AR99-	9-	24	36	RAD		187 (180E)	0.259	6.05		
AR99-	9-	36	48	RAD		187 (180E)	0.190	12.5		
AR99-	9-	36	48	RAD	FD	187 (180E)	0.216	11.3		
AR99-	9-	48	60	RAD		187 (180E)	0.173	6.69		
AR99-	9-	48	60	RAD	FD	187 (180E)	0.0510	11.0		
AR99-	9-	60	72	RAD		187 (180E)	0.0771	7.79		
AR99-	9-	60	72	RAD	LD	187 (180E)	0.0768	8.62		
AR99-	9-	72	84	RAD		187 (180E)	0.111	7.63		
AR99-	9-	84	96	RAD		187 (180E)	0.102	6.50		
AR99-	10-	0	12	RAD		182 (120E)	0.0256	13.2		
AR99-	10-	60	72	RAD		182 (120E)	0.0468	11.9		
AR99-	10-	93	105	RAD		182 (120E)	0.0408	3.24		
AR99-	10-	93	105	RAD	FD	182 (120E)	0.0468	3.65		
AR99-	10-	147	159	RAD		182 (120E)	0.198	5.33		
AR99-	11-	0	12	RAD		182 (20W)	0.0480	10.1		
AR99-	11-	33	51	RAD		182 (20W)	0.0603	2.35		
AR99-	11-	33	51	RAD	FD	182 (20W)	0.0651	2.51		
AR99-	11-	60	72	RAD		182 (20W)	0.180	10.6		
AR99-	11-	72	84	RAD		182 (20W)	0.307	8.61		
AR99-	12-	0	12	RAD		182 (80W)	0.0417	10.6		
AR99-	12-	12	24	RAD		182 (80W)	0.0407	13.1		
AR99-	12-	30	42	RAD		182 (80W)	ND	13.9		
AR99-	12-	72	90	RAD		182 (80W)	ND	12.5		
AR99-	12-	72	90	RAD	FD	182 (80W)	ND	11.6		
AR99-	13-	0	12	RAD		177	0.0413	12.2		
AR99-	13-	0	12	RAD	LD	177	0.0421	10.9		
AR99-	13-	90	102	RAD		177	0.0673	7.90		
AR99-	13-	119	131	RAD		177	0.0996	7.11		
AR99-	13-	152	164	RAD		177	0.137	13.2		
AR99-	14-	0	12	RAD		173	0.0389	13.3		
AR99-	14-	95	113	RAD		173	0.0871	8.24		
AR99-	14-	95	113	RAD	FD	173	0.101	7.67		
AR99-	14-	130	142	RAD		173	0.115	5.94		
AR99-	14-	159	171	RAD		173	0.129	11.6		
AR99-	15-	0	12	RAD		163	0.0237	13.2		
AR99-	15-	24	36	RAD		163	0.0723	13.2		
AR99-	15-	42	54	RAD		163	0.106	6.77		
AR99-	15-	65	72	RAD		163	0.0790	7.29		
AR99-	16-	0	12	RAD		160	0.0544	12.4		
AR99-	16-	12	24	RAD		160	0.0681	11.3		
AR99-	17-	0	12	RAD		156	0.0542	12.1		
AR99-	17-	37	49	RAD		156	0.0731	12.3		
AR99-	17-	94	106	RAD		156	0.111	11.0		
AR99-	17-	123	135	RAD		156	0.130	10.8		
AR99-	18-	0	12	RAD		153+50	0.0384	12.3		
AR99-	18-	12	30	RAD		153+50	0.0514	13.9		
AR99-	18-	12	30	RAD	FD	153+50	0.0537	14.2		
AR99-	18-	36	48	RAD		153+50	0.0578	12.7		

AR99-	18-	63	75	RAD		153 + 50	0.0943	12.8		
AR99-	19-	0	12	RAD		149	0.0314	8.68		
AR99-	19-	12	24	RAD		149	0.0480	10.0		
AR99-	19-	12	24	RAD	LD	149	0.0426	10.0		
AR99-	19-	24	36	RAD		149	0.0308	8.21		
AR99-	19-	70	82	RAD		149	0.0791	11.8		
AR99-	19-	70	82	RAD	LD	149	0.0784	11.5		
AR99-	20-	0	12	RAD		136	0.0606	14.4		
AR99-	20-	12	24	RAD		136	0.0627	13.3		
AR99-	20-	24	36	RAD		136	0.0560	14.0		
AR99-	20-	58	71	RAD		136	0.142	13.6		
AR99-	21-	0	12	RAD		132	0.0561	12.9		
AR99-	21-	12	30	RAD		132	0.0604	13.1		
AR99-	21-	12	30	RAD	FD	132	0.0665	13.4		
AR99-	21-	30	42	RAD		132	0.0600	13.5		
AR99-	21-	63	75	RAD		132	0.123	12.3		
AR99-	22-	0	12	RAD		129	0.0245	13.3		
AR99-	22-	12	24	RAD		129	0.0602	13.0		
AR99-	22-	49	61	RAD		129	0.0865	12.6		
AR99-	23-	0	12	RAD		128	0.0556	13.8		
AR99-	23-	12	24	RAD		128	0.0720	13.6		
AR99-	23-	24	36	RAD		128	0.0712	13.5		
AR99-	23-	36	58	RAD		128	0.0757	12.5		
AR99-	24-	0	12	RAD		125	0.0477	13.7		
AR99-	24-	12	30	RAD		125	0.0429	14.6		
AR99-	24-	12	30	RAD	FD	125	0.0537	14.8		
AR99-	24-	12	30	RAD	LD	125	0.0637	14.9	0.0183	
AR99-	24-	47	65	RAD		125	0.0837	14.5		
AR99-	24-	47	65	RAD	FD	125	0.0798	12.5		
AR99-	25-	0	8	RAD		121	0.0347	13.2		
							CS-137	**K-40**	**Co-56**	
						MAXIMUM	0.307	14.9	0.0183	
					(NON-					
					BACKGROUND)					
		FD		Field Duplicate						
		LD		Lab Duplicate						
		125		Priority samples, analyzed 11/99						
		125		Non-priority samples, analyzed after 11/99						
		Background sites AR99-2 to AR99-5, inclusive								

	ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999								
	ISOTOPIC URANIUM RESULTS (pCi/g)								
		SAMPLE I.D.				STA	U-238	U-234	U-235
AR99-	2-	0	12	RAD		200	1.01	1.38	0.0778
AR99-	2-	0	12	RAD	LD	200	0.998	1.22	0.0318
AR99-	2-	12	31	RAD		200	0.940	1.10	0.0841
AR99-	2-	12	31	RAD	FD	200	1.06	1.15	0.0288
AR99-	3-	0	12	RAD		202	1.03	1.14	0.0576
AR99-	3-	12	24	RAD		202	0.976	1.23	0.0739
AR99-	3-	36	50	RAD		202	1.14	0.999	0.0585
AR99-	3-	36	50	RAD	FD	202	1.05	1.09	0.0481
AR99-	3-	50	62	RAD		202	1.15	1.13	0.0784
AR99-	4-	0	12	RAD		199	1.25	1.10	0.121
AR99-	4-	12	24	RAD		199	1.20	1.29	0.0693
AR99-	4-	48	60	RAD		199	0.637	0.666	0.0547
AR99-	4-	68	80	RAD		199	0.650	0.788	0.0436
AR99-	5-	0	12	RAD		198	0.629	0.588	0.0847
AR99-	5-	12	24	RAD		198	1.22	1.19	0.0484
AR99-	5-	24	33	RAD		198	0.709	0.696	0.0623
AR99-	1-	0	12	RAD		196	0.953	1.17	0.0419
AR99-	1-	36	48	RAD		196	2.77	2.72	0.248
AR99-	1-	70	82	RAD		196	3.63	3.80	0.149
AR99-	6-	0	12	RAD		195	1.11	1.16	0.141
AR99-	6-	12	30	RAD		195	0.865	0.833	0.0318
AR99-	6-	12	30	RAD	FD	195	0.790	0.839	0.0555
AR99-	6-	60	72	RAD		195	6.88	6.52	0.277
AR99-	6-	72	84	RAD		195	13.6	14.3	0.945
AR99-	6-	94	106	RAD		195	1.11	1.07	0.0639
AR99-	7-	0	12	RAD		187 (160W)	0.568	0.759	0.110
AR99-	7-	12	24	RAD		187 (160W)	0.831	0.700	0.0529
AR99-	7-	12	24	RAD	FD	187 (160W)	0.634	0.744	0.0710
AR99-	7-	24	36	RAD		187 (160W)	0.722	0.653	0.0644
AR99-	7-	36	48	RAD		187 (160W)	0.710	0.945	0.0883
AR99-	7-	36	48	RAD	LD	187 (160W)	0.815	0.834	0.0902
AR99-	7-	48	60	RAD		187 (160W)	0.739	0.742	0.0827
AR99-	7-	60	72	RAD		187 (160W)	2.20	2.23	0.166
AR99-	7-	72	84	RAD		187 (160W)	4.05	3.83	0.284
AR99-	7-	84	96	RAD		187 (160W)	6.09	5.96	0.460
AR99-	7-	96	108	RAD		187 (160W)	7.51	8.28	0.425
AR99-	7-	108	127	RAD		187 (160W)	7.22	6.99	0.531
AR99-	8-	0	12	RAD		187 (0)	0.567	0.694	0.0812
AR99-	8-	12	24	RAD		187 (0)	0.675	0.665	0.0641
AR99-	8-	24	36	RAD		187 (0)	0.717	0.713	0.8080
AR99-	8-	36	48	RAD		187 (0)	1.12	1.06	0.0769
AR99-	8-	60	72	RAD		187 (0)	1.41	1.00	0.168
AR99-	8-	60	72	RAD	LD	187 (0)	1.53	0.997	0.107
AR99-	8-	72	84	RAD		187 (0)	2.61	2.47	0.183
AR99-	8-	84	96	RAD		187 (0)	6.74	6.85	0.694
AR99-	8-	96	108	RAD		187 (0)	7.67	7.83	0.679

AR99-	8-	108	139	RAD		187 (0)	5.48	5.67	0.414
AR99-	8-	108	139	RAD	FD	187 (0)	14.2	13.8	0.820
AR99-	9-	0	12	RAD		187 (180E)	5.83	3.79	0.521
AR99-	9-	12	24	RAD		187 (180E)	5.68	6.24	0.387
AR99-	9-	24	36	RAD		187 (180E)	4.79	4.27	0.263
AR99-	9-	36	48	RAD		187 (180E)	2.91	2.89	0.240
AR99-	9-	36	48	RAD	FD	187 (180E)	2.36	2.46	0.135
AR99-	9-	48	60	RAD		187 (180E)	7.72	8.28	0.511
AR99-	9-	48	60	RAD	FD	187 (180E)	4.37	4.66	0.293
AR99-	9-	60	72	RAD		187 (180E)	5.26	5.26	0.344
AR99-	9-	72	84	RAD		187 (180E)	5.31	4.72	0.389
AR99-	9-	84	96	RAD		187 (180E)	4.58	4.55	0.392
AR99-	10-	0	12	RAD		182 (120E)	0.752	0.837	0.0558
AR99-	10-	60	72	RAD		182 (120E)	1.02	1.01	0.141
AR99-	10-	93	105	RAD		182 (120E)	7.15	7.19	0.743
AR99-	10-	93	105	RAD	FD	182 (120E)	6.57	6.01	0.478
AR99-	10-	147	159	RAD		182 (120E)	4.89	5.85	0.389
AR99-	11-	0	12	RAD		182 (20W)	0.651	0.584	0.0887
AR99-	11-	33	51	RAD		182 (20W)	9.78	10.2	0.696
AR99-	11-	33	51	RAD	FD	182 (20W)	45.5	57.9	6.59
AR99-	11-	60	72	RAD		182 (20W)	9.50	9.91	0.540
AR99-	11-	72	84	RAD		182 (20W)	9.81	10.4	0.571
AR99-	12-	0	12	RAD		182 (80W)	0.533	0.666	0.0428
AR99-	12-	12	24	RAD		182 (80W)	0.656	0.680	0.0803
AR99-	12-	30	42	RAD		182 (80W)	0.730	0.682	0.0705
AR99-	12-	72	90	RAD		182 (80W)	0.723	0.597	0.0564
AR99-	12-	72	90	RAD	LD	182 (80W)	0.532	0.621	0.0788
AR99-	12-	72	90	RAD	FD	182 (80W)	0.607	0.713	0.0568
AR99-	13-	0	12	RAD		177	1.06	1.18	0.126
AR99-	13-	90	102	RAD		177	12.9	12.1	0.485
AR99-	13-	119	131	RAD		177	19.3	18.2	0.807
AR99-	13-	152	164	RAD		177	3.43	3.18	0.236
AR99-	14-	0	12	RAD		173	1.19	1.07	0.0498
AR99-	14-	95	113	RAD		173	8.44	8.59	0.492
AR99-	14-	95	113	RAD	FD	173	8.73	8.85	0.436
AR99-	14-	130	142	RAD		173	22.1	22.5	1.14
AR99-	14-	159	171	RAD		173	1.14	1.17	0.112
AR99-	15-	0	12	RAD		163	1.10	1.07	0.0581
AR99-	15-	24	36	RAD		163	2.15	2.31	0.0865
AR99-	15-	42	54	RAD		163	3.36	3.86	0.264
AR99-	15-	65	72	RAD		163	6.35	6.95	0.358
AR99-	16-	0	12	RAD		160	0.672	0.795	0.0819
AR99-	16-	12	24	RAD		160	0.833	0.757	0.102
AR99-	17-	0	12	RAD		156	0.666	0.682	0.0668
AR99-	17-	37	49	RAD		156	1.39	1.57	0.123
AR99-	17-	94	106	RAD		156	4.80	5.17	0.403
AR99-	17-	123	135	RAD		156	8.27	7.75	0.483
AR99-	18-	0	12	RAD		153+50	0.748	0.724	0.0660
AR99-	18-	12	30	RAD		153+50	1.14	1.27	0.132
AR99-	18-	12	30	RAD	FD	153+50	0.770	0.723	0.0397
AR99-	18-	12	30	RAD	LD	153+50	0.638	0.912	0.0863

AR99-	18-	36	48	RAD		153+50	0.746	0.812	0.0783
AR99-	18-	63	75	RAD		153+50	0.911	0.773	0.0983
AR99-	19-	0	12	RAD		149	0.546	0.557	0.0283
AR99-	19-	12	24	RAD		149	0.656	0.610	0.0383
AR99-	19-	24	36	RAD		149	0.583	0.690	0.0631
AR99-	19-	70	82	RAD		149	0.850	0.791	0.0791
AR99-	20-	0	12	RAD		136	1.02	1.23	0.153
AR99-	20-	12	24	RAD		136	0.394	0.467	0.115
AR99-	20-	24	36	RAD		136	1.29	1.27	0.129
AR99-	20-	58	71	RAD		136	0.664	0.573	0.0308
AR99-	21-	0	12	RAD		132	1.03	1.01	0.0904
AR99-	21-	0	12	RAD	LD	132	1.35	0.889	0.0503
AR99-	21-	12	30	RAD		132	1.09	1.12	0.0735
AR99-	21-	12	30	RAD	FD	132	1.23	1.24	0.0962
AR99-	21-	30	42	RAD		132	1.11	1.16	0.0498
AR99-	21-	63	75	RAD		132	1.26	1.36	0.132
AR99-	22-	0	12	RAD		129	0.774	0.653	0.0723
AR99-	22-	12	24	RAD		129	0.663	0.779	0.0669
AR99-	22-	49	61	RAD		129	0.949	0.814	0.0921
AR99-	23-	0	12	RAD		128	0.728	0.735	0.0868
AR99-	23-	12	24	RAD		128	0.669	0.875	0.0570
AR99-	23-	24	36	RAD		128	0.753	0.680	0.0374
AR99-	23-	36	58	RAD		128	0.885	0.959	0.0861
AR99-	24-	0	12	RAD		125	0.656	0.604	0.0503
AR99-	24-	12	30	RAD		125	0.798	0.732	0.0448
AR99-	24-	12	30	RAD	FD	125	0.606	0.765	0.0767
AR99-	24-	47	65	RAD		125	0.777	0.681	0.0744
AR99-	24-	47	65	RAD	FD	125	0.813	0.783	0.0905
AR99-	25-	0	8	RAD		121	0.980	1.27	0.0940
							U-238	**U-234**	**U-235**
						MAXIMUM (NON-BACKGROUND)	45.5	57.9	6.59
		FD		Field Duplicate					
		LD		Lab Duplicate					
		125		Priority samples, analyzed 11/99					
		125		Non-priority samples, analyzed after 11/99					
		Background sites AR99-2 to AR99-5, inclusive							

	ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999									
	ISOTPOIC THORIUM RESULTS (pCi/g)									
		SAMPLE I.D.				STA	Th-230	Th-232	Th-228	Th-227
AR99-	2-	0	12	RAD		200	0.664	0.728	0.819	0.0975
AR99-	2-	0	12	RAD	LD	200	0.637	0.745	0.780	0.0196
AR99-	2-	12	31	RAD		200	0.704	0.848	0.757	0.0603
AR99-	2-	12	31	RAD	FD	200	0.684	0.766	0.903	0.0253
AR99-	3-	0	12	RAD		202	0.700	0.897	0.749	0.00724
AR99-	3-	12	24	RAD		202	0.723	0.860	0.866	0.0648
AR99-	3-	36	50	RAD		202	0.669	0.861	0.889	0.0436
AR99-	3-	36	50	RAD	FD	202	0.741	0.860	0.905	0.116
AR99-	3-	50	62	RAD		202	0.714	0.871	0.807	0.115
AR99-	4-	0	12	RAD		199	0.631	0.806	0.849	0.106
AR99-	4-	12	24	RAD		199	0.647	0.832	0.790	0.0919
AR99-	4-	48	60	RAD		199	0.678	0.817	0.703	0.170
AR99-	4-	68	80	RAD		199	1.34	1.09	0.940	0.0910
AR99-	5-	0	12	RAD		198	0.531	0.781	0.778	0.0908
AR99-	5-	12	24	RAD		198	0.596	0.842	0.840	0.150
AR99-	5-	24	33	RAD		198	0.698	0.887	0.930	0.0379
AR99-	1-	0	12	RAD		196	0.715	0.763	0.769	0.0831
AR99-	1-	36	48	RAD		196	1.62	0.856	0.930	0.164
AR99-	1-	70	82	RAD		196	1.95	0.903	1.38	0.122
AR99-	6-	0	12	RAD		195	0.697	0.900	0.809	0.0882
AR99-	6-	12	30	RAD		195	0.650	0.844	0.873	0.0616
AR99-	6-	12	30	RAD	FD	195	0.832	0.783	0.873	0.0296
AR99-	6-	60	72	RAD		195	3.87	1.01	1.05	0.183
AR99-	6-	72	84	RAD		195	6.40	1.72	0.815	0.344
AR99-	6-	94	106	RAD		195	1.08	0.880	0.888	0.0398
AR99-	7-	0	12	RAD		187 (160W)	0.690	0.684	0.795	0.0575
AR99-	7-	12	24	RAD		187 (160W)	0.653	0.871	1.18	0.0656
AR99-	7-	12	24	RAD	FD	187 (160W)				
AR99-	7-	24	36	RAD		187 (160W)	0.577	0.835	0.801	0.0312
AR99-	7-	36	48	RAD		187 (160W)	0.653	0.845	0.997	0.0535
AR99-	7-	36	48	RAD	LD	187 (160W)	0.652	0.877	1.01	0.0442
AR99-	7-	48	60	RAD		187 (160W)	0.615	0.878	0.812	0.0577
AR99-	7-	60	72	RAD		187 (160W)	2.33	1.44	1.41	0.146
AR99-	7-	72	84	RAD		187 (160W)	3.52	1.38	1.08	0.182
AR99-	7-	84	96	RAD		187 (160W)	5.62	1.03	0.840	0.646
AR99-	7-	96	108	RAD		187 (160W)	7.57	1.35	1.04	0.362
AR99-	7-	108	127	RAD		187 (160W)	6.92	1.59	1.40	0.513
AR99-	8-	0	12	RAD		187 (0)	0.784	0.764	0.863	0.00451
AR99-	8-	12	24	RAD		187 (0)	0.547	0.817	0.964	0.0683
AR99-	8-	24	36	RAD		187 (0)	0.769	0.914	0.777	0.0270
AR99-	8-	36	48	RAD		187 (0)	1.02	1.22	1.28	0.0672
AR99-	8-	60	72	RAD		187 (0)	0.896	1.61	1.60	0.136
AR99-	8-	60	72	RAD	LD	187 (0)	0.949	1.59	1.44	0.0970
AR99-	8-	72	84	RAD		187 (0)	2.27	1.93	1.74	0.103
AR99-	8-	84	96	RAD		187 (0)	5.38	1.84	1.81	0.299
AR99-	8-	96	108	RAD		187 (0)	9.91	1.60	1.41	0.435

AR99-	8-	108	139	RAD		187 (0)	9.52	1.61	1.45	0.407
AR99-	8-	108	139	RAD	FD	187 (0)	7.52	1.21	1.25	0.201
AR99-	9-	0	12	RAD		187 (180E)	2.98	8.52	8.64	0.572
AR99-	9-	12	24	RAD		187 (180E)	5.81	1.20	1.08	0.274
AR99-	9-	24	36	RAD		187 (180E)	5.58	1.46	1.15	0.368
AR99-	9-	36	48	RAD		187 (180E)	1.91	0.940	0.840	0.0888
AR99-	9-	36	48	RAD	FD	187 (180E)	2.52	1.06	0.844	0.0805
AR99-	9-	48	60	RAD		187 (180E)	8.13	1.79	1.80	0.390
AR99-	9-	48	60	RAD	FD	187 (180E)	2.07	1.72	1.62	0.0773
AR99-	9-	60	72	RAD		187 (180E)	7.83	1.86	1.54	0.271
AR99-	9-	72	84	RAD		187 (180E)	5.42	1.33	0.827	0.346
AR99-	9-	84	96	RAD		187 (180E)	5.00	1.36	1.07	0.214
AR99-	10-	0	12	RAD		182 (120E)	0.738	0.680	0.923	0.0823
AR99-	10-	60	72	RAD		182 (120E)	0.845	0.988	0.910	0.0870
AR99-	10-	93	105	RAD		182 (120E)	5.77	2.26	2.27	0.325
AR99-	10-	93	105	RAD	FD	182 (120E)	5.27	1.86	1.81	0.222
AR99-	10-	147	159	RAD		182 (120E)	4.19	0.692	0.654	0.140
AR99-	11-	0	12	RAD		182 (20W)	0.529	0.596	0.689	0.0865
AR99-	11-	33	51	RAD		182 (20W)	9.10	1.24	1.14	0.272
AR99-	11-	33	51	RAD	FD	182 (20W)	8.84	1.54	2.52	0.734
AR99-	11-	60	72	RAD		182 (20W)	4.03	0.858	0.891	0.250
AR99-	11-	72	84	RAD		182 (20W)	4.80	1.11	1.07	0.247
AR99-	12-	0	12	RAD		182 (80W)	0.617	0.649	0.576	0.0504
AR99-	12-	12	24	RAD		182 (80W)	0.728	0.865	0.957	0.0626
AR99-	12-	30	42	RAD		182 (80W)	0.747	0.842	0.775	0.0486
AR99-	12-	72	90	RAD		182 (80W)	0.614	0.862	0.881	0.00690
AR99-	12-	72	90	RAD	LD	182 (80W)	0.708	0.814	0.790	0.102
AR99-	12-	72	90	RAD	FD	182 (80W)	0.648	0.836	0.853	0.0783
AR99-	13-	0	12	RAD		177	1.26	1.29	1.13	0.117
AR99-	13-	90	102	RAD		177	11.9	3.51	3.17	0.910
AR99-	13-	119	131	RAD		177	20.3	3.50	4.00	0.896
AR99-	13-	152	164	RAD		177	3.93	1.63	1.58	0.272
AR99-	14-	0	12	RAD		173	0.926	1.04	1.49	0.0787
AR99-	14-	95	113	RAD		173	8.09	2.83	2.70	0.424
AR99-	14-	95	113	RAD	FD	173	9.17	2.98	3.07	0.642
AR99-	14-	130	142	RAD		173	20.9	3.35	2.97	0.743
AR99-	14-	159	171	RAD		173	1.28	0.930	1.13	0.169
AR99-	15-	0	12	RAD		163	0.892	1.08	1.33	0.0681
AR99-	15-	24	36	RAD		163	1.88	1.39	1.52	0.0378
AR99-	15-	42	54	RAD		163	3.11	1.55	1.27	0.308
AR99-	15-	65	72	RAD		163	4.54	0.985	1.42	0.258
AR99-	16-	0	12	RAD		160	0.590	0.591	0.878	0.0821
AR99-	16-	12	24	RAD		160	0.637	0.929	0.969	0.0853
AR99-	17-	0	12	RAD		156	0.608	0.840	0.787	0.0197
AR99-	17-	37	49	RAD		156	0.874	1.47	1.40	0.184
AR99-	17-	94	106	RAD		156	4.12	2.33	2.15	0.124
AR99-	17-	123	135	RAD		156	8.40	1.97	1.92	0.411
AR99-	18-	0	12	RAD		153+50	0.708	0.793	0.969	0.0568
AR99-	18-	12	30	RAD		153+50	0.838	0.993	1.33	0.0905
AR99-	18-	12	30	RAD	FD	153+50	0.821	0.877	1.09	0.110
AR99-	18-	12	30	RAD	LD	153+50	0.675	0.996	0.952	0.0999

AR99-	18-	36	48	RAD		153+50	0.798	0.737	0.827	0.102
AR99-	18-	63	75	RAD		153+50	0.897	1.07	1.06	0.0460
AR99-	19-	0	12	RAD		149	0.485	0.669	0.554	0.0580
AR99-	19-	12	24	RAD		149	0.596	0.601	0.699	0.0373
AR99-	19-	24	36	RAD		149	0.483	0.574	0.715	0.0406
AR99-	19-	70	82	RAD		149	0.552	0.768	0.743	0.0833
AR99-	20-	0	12	RAD		136	1.33	1.32	1.46	0.122
AR99-	20-	12	24	RAD		136	0.608	0.762	1.04	0.0423
AR99-	20-	24	36	RAD		136	0.818	0.996	1.01	0.0648
AR99-	20-	58	71	RAD		136	1.36	0.913	0.830	0.0261
AR99-	21-	0	12	RAD		132	0.771	0.964	1.05	0.121
AR99-	21-	0	12	RAD	LD	132	0.897	1.06	0.919	0.0770
AR99-	21-	12	30	RAD		132	1.13	1.27	1.48	0.128
AR99-	21-	12	30	RAD	FD	132	1.31	1.22	1.46	0.0583
AR99-	21-	30	42	RAD		132	1.35	1.49	1.73	0.173
AR99-	21-	63	75	RAD		132	1.08	1.22	1.04	0.0843
AR99-	22-	0	12	RAD		129	0.613	0.690	0.642	0.0535
AR99-	22-	12	24	RAD		129	0.557	0.676	0.797	0.0613
AR99-	22-	49	61	RAD		129	0.932	0.938	0.941	0.0382
AR99-	23-	0	12	RAD		128	0.621	0.696	0.737	0.00894
AR99-	23-	12	24	RAD		128	0.663	0.746	0.678	0.0563
AR99-	23-	24	36	RAD		128	0.555	0.750	0.684	0.0340
AR99-	23-	36	58	RAD		128	0.783	0.960	1.00	0.0416
AR99-	24-	0	12	RAD		125	0.660	0.740	0.782	0.0868
AR99-	24-	12	30	RAD		125	0.878	0.958	1.02	0.0630
AR99-	24-	12	30	RAD	FD	125	0.826	1.06	1.06	0.180
AR99-	24-	47	65	RAD		125	0.703	0.785	0.888	0.0504
AR99-	24-	47	65	RAD	FD	125	0.844	1.02	1.13	0.0740
AR99-	25-	0	8	RAD		121	1.21	1.29	1.33	0.120
							Th-230	**Th-232**	**Th-228**	**Th-227**
						MAXIMUM	20.9	8.52	8.64	0.910
					(NON-					
					BACKGROUND)					
		FD		Field Duplicate						
		LD		Lab Duplicate						
		125		Priority samples, analyzed 11/99						
		125		Non-priority samples, analyzed after 11/99						
		Background sites AR99-2 to AR99-5, inclusive								

1.8 DETERMINATION OF PROJECT OBJECTIVES

Objective (1) Delineate radionuclide identities and concentrations in Ashtabula River sediments that are projected to go into the Ashtabula River Partnership non-Toxic substances Control Act (Non-TSCA) disposal cell;

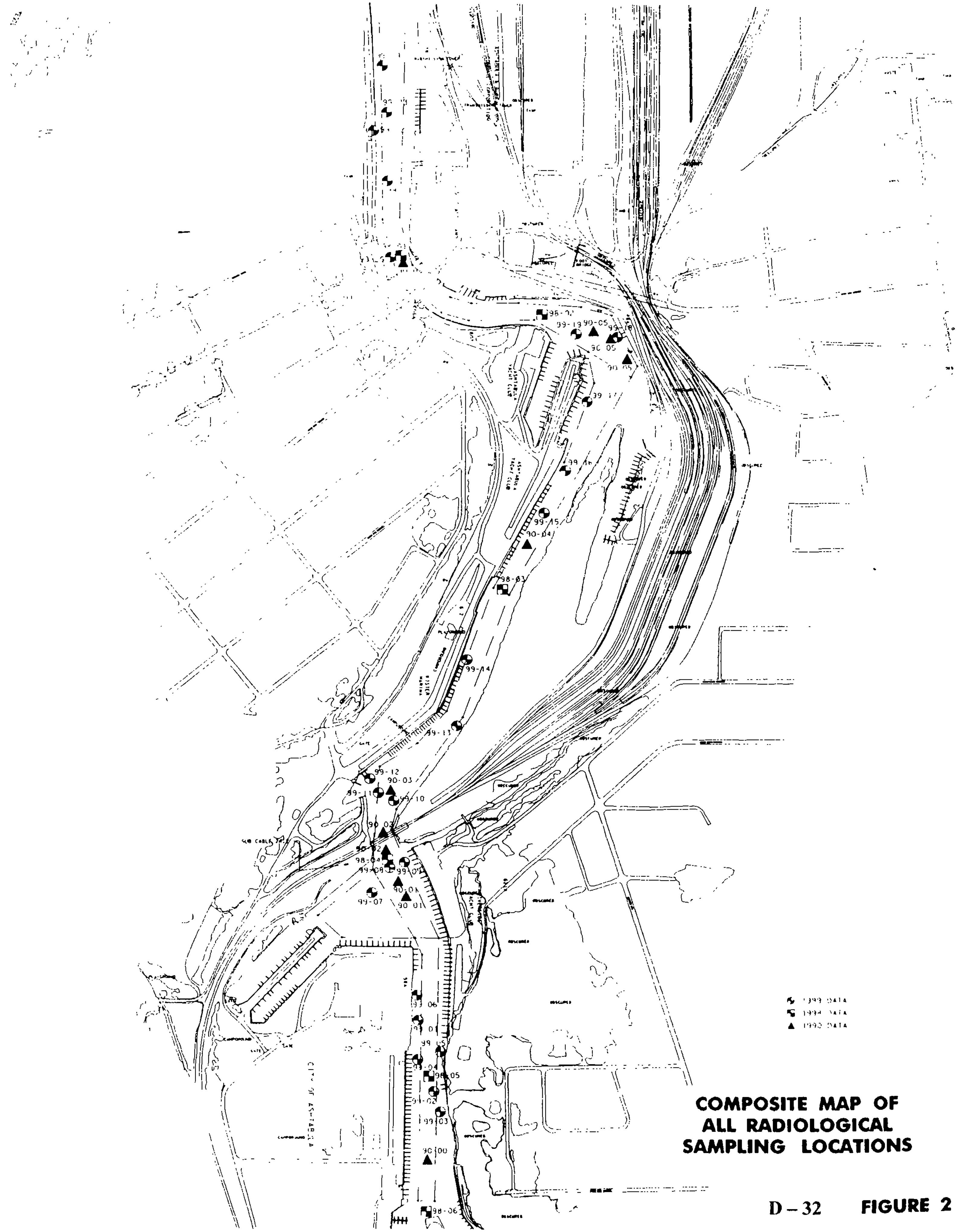
With the collection of 106 sediment samples during the 1999 sediment sampling campaign, coupled with the data from the 1998 and 1990 campaigns, the Partnership now has an adequate amount of radiological characterization data with which to assess the Ashtabula River. FIGURE 2 is a composite map of the 1990, 1998 and 1999 river sample locations.

Objective (2) Make a statistical determination of whether the radioactivity of the Non-TSCA area sediments is distinct from the upstream background area sediments;

The purpose of this objective was to determine the radioactivity of the Non-TSCA area sediments. That is, to determine if their was a statistical difference between the unaffected, upstream of the upper turning basin sediments, and sediments in the Non-TSCA areas downstream of the confluence of Fields Brook. To accomplish this, a statistical comparison between the upstream background, and therefore unaffected by the discharges of Fields Brook, sediment data and the Non-TSCA area sediment data was performed by USEPA Region 5 statisticians.

Six specific studies were performed in order to determine if radionuclides could be handled under existing PCB dredging plans, or if modifications would have to be made;

- Study #1 compared 1999 background data to 1999 Non-TSCA area data.
- Study #2 compared 1999 background data to 1999 Non-TSCA area data minus location #14,#15 and #17 (STA# 173, 163, and 156).
- Study #3 compared the combined 1999, 1998 and 1990 background data with the combined 1999, 1998 and 1990 Non-TSCA area data.
- Study #4 compared the combined 1999, 1998 and 1990 background data to the combined 1999 Non-TSCA minus locations #14,#15 and #17 (STA# 173,163, and 156), 1998 Non-TSCA minus location #3 (STA# 168), and 1990 Non-TSCA area data.
- Study #5 compared 1999 background data to 1999 Non-TSCA area data minus location #1,6,14,15,and 17, (STA# 196, 195, 173, 163, and 156).



COMPOSITE MAP OF ALL RADIOLOGICAL SAMPLING LOCATIONS

FIGURE 2

- Study #6 compared the combined 1999, 1998 and 1990 background data to the combined 1999 Non-TSCA minus locations #1,6,14,15 and 17 (STA#196,195,173,163, and 156), 1998 Non-TSCA minus location #3 (STA# 168), and 1990 Non-TSCA area data.

The results of all six studies were that there is a statistical difference between the unaffected background sediments and the sediments within the Non-TSCA areas. The full statistical analysis can be found in ATTACHMENT 1.

Objective (3) Collect radiological sediment data sufficient to perform baseline risk assessments for radiological and chemical sediments.

The details of these assessments can be found in Appendix G to the CMP/EIS. There were two radiological scenarios, Resident-Farmer and Worker-Dredger. The former scenario was based upon inadvertent use contaminated soils on residential and gardening land. The estimated risk was 1×10^{-4}, which is at the upper end of the acceptable range for lifetime cancer risk in USEPA's guiding document, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The latter scenario was based upon unprotected workers removing contaminated sediments. The risk for the period of a dredging campaign was about 5×10^{-5}, which is within the NCP acceptable risk range of 10^{-6} to 10^{-4}. Nevertheless, worker protection when dealing with contaminated sediments, even those that do not present substantial risks, should be a matter of prudent policy.

The chemical scenario was included because uranium, as a chemical, has an additional hazard over the radiological hazard. This scenario involved residential use of contaminated sediments where the pathways were dermal exposure and incidental ingestion. The total hazard index was much below the critical level of 1, indicating that the hazard was within the acceptable range.

1.9 1998 RADIOLOGICAL SAMPLING RESULTS

The highest concentrations of radionuclides were found at depths in sediment of greater than 4 feet, in the area of the upper turning basin. The data showed total uranium concentrations up to 64.7 pCi/g and total radium concentrations up to 17.3 pCi/g. The maximum total uranium concentration is about twice that being applied to a commercial cleanup on Fields Brook. The maximum total radium concentration is about 30% more than the commercial cleanup criterion and about 3 times the residential cleanup criterion for Fields Brook. The May 13, 1998 Ashtabula River sampling can be found as ATTACHMENT 2. A map of the 1998 sampling locations can be found as FIGURE 3.

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1.10 1990 RADIOLOGICAL SAMPLING RESULTS

Twelve river sites were identified as "hot spot" areas with numerous chemical contaminants, based on a comprehensive Ashtabula River sediment study completed in early 1990. That sampling was done to determine whether river sediments contained high levels of radioactive material. The highest concentrations of radionuclides were found at depths in sediment of 4 to 15 feet, in the area of the upper turning basin. The concentrations of total uranium detected in the sampling ranged from 2.4 to 22.3 pCi/g, with an average value of 10.1 pCi/g. The concentrations of total radium detected in the sampling ranged from 2.6 to 20.6 pCi/g, with an average value of 10.8 pCi/g. The 1990 River sampling results are summarized in ATTACHMENT 3.

2.0 SUMMARY AND CONCLUSIONS

The 1999 Ashtabula River sampling effectively filled in the radionuclide data gaps. Both the 1990 and 1998 sample results documented the presence of radionuclides within the sediments of the Ashtabula River. From that data, it became evident to the Partnership that radionuclides were contaminants of concern for the Ashtabula River clean up. The 1998 and 1990 data, when combined with the 1999 results, gave the Partnership, for the first time, adequate radiological characterization data to perform radiological risk assessments and to make informed decisions with regards to the impact on the project that the presence of radionuclides within river sediments will have.

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ATTACHMENT 1

Make a statistical determination of whether the radioactivity of the Non-TSCA area sediments is distinct from the upstream background area sediments.

The purpose of this objective was to determine the radioactivity of the Non-TSCA area sediments. That is, to determine if their was a statistical difference between the unaffected, upstream of the upper turning basin sediments, and sediments in the Non-TSCA areas downstream of the confluence of Fields Brook. To accomplish this, a statistical comparison between the upstream background, and therefore unaffected by the discharges of Fields Brook, sediment data and the Non-TSCA area sediment data was performed by USEPA Region 5 statisticians.

Six specific studies were performed in order to determine if radionuclides could be handled under existing PCB dredging plans, or if modifications would have to be made. The results of all six studies were that there is a significant statistical difference between the unaffected background sediments and the sediments within the Non-TSCA areas.

The statistical procedures used to compare background to sediment sample site concentrations were the parametric two sample T test, the non-parametric Mann-Whitney U and the Wilcoxon Rank Sum tests. Both parametric and non-parametric procedures were used because environmental data rarely adheres to normal data distribution. Thus, a comparison was only deemed to be statistically significant if and only if <u>both</u> the parametric and non-parametric tests demonstrated statistical significance. The chance for false positive results (alpha) was set at 5%. This is, if statistical significance is claimed, the likelihood of a false positive error less than or equal to 5%.

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STATISTICAL STUDY NUMBER ONE							
STATISTICAL COMPARISON OF 1999 BACKGROUNDS (AR99-2, 3, 4, 5) TO 1999 NON-TSCA SITES DATA (AR99-1, 6, 14 - 25)							
5% CHANCE OF FALSE POSITIVE							
			Uranium Decay Series				
	U-238	U-234	TH-230	RA-226	PB-214	BI-214	
Significant	1.37	1.36	1.28	1.01	0.50	0.43	
Not Significant							
			Thorium Decay Series				
	TH-232	TH-228	RA-228	RA-224	PB-212	BI-212	TL-208
Significant	0.29	0.34	0.18	0.14	0.21	0.20	0.07
Not Significant							
			Actinium Decay Series				
	U-235	TH-227					
Significant	0.09	0.05					
Not Significant							
Where numerical values appear, the data is statistically significant when compared to background.							
Numerical values correspond to the difference between the mean of data values and the background mean.							

STATISTICAL STUDY NUMBER TWO

STATISTICAL COMPARISON OF 1999 BACKGROUNDS (AR99-2, 3, 4, 5) TO 1999 NON-TSCA SITES DATA, EXCEPT SITES AR99- 14, 15 AND 17 (NAMELY AR99-1, 6, 18 - 25)

5% CHANCE OF FALSE POSITIVE

			Uranium Decay Series				
	U-238	U-234	TH-230	RA-226	PB-214	BI-214	
Significant			0.37	0.47	0.21	0.19	
Not Significant	X	X					
			Thorium Decay Series				
	TH-232	TH-228	RA-228	RA-224	PB-212	BI-212	TL-208
Significant	0.09	0.15	0.11	0.11	0.14	0.13	0.04
Not Significant							
			Actinium Decay Series				
	U-235	TH-227					
Significant							
Not Significant	X	X					

Where numerical values appear, the data is statistically significant when compared to background.

Numerical values correspond to the difference between the mean of data values . and the background mean.

STATISTICAL STUDY NUMBER THREE

STATISTICAL COMPARISON OF 1990 BACKGROUND DATA + 1998 BACKGROUND DATA + 1999 BACKGROUND DATA TO 1990 NON-TSCA AREA SEDIMENT DATA + 1998 NON-TSCA AREA SEDIMENT DATA + 1999 NON-TSCA SITES DATA (AR99-1, 6, 14 - 25)

5% CHANCE OF FALSE POSITIVE

			Uranium Decay Series				
	U-238	U-234	TH-230	RA-226	PB-214	BI-214	
Significant			1.32	1.23			
Not Significant	X	X					
			Thorium Decay Series				
	TH-232	TH-228	RA-228	RA-224	PB-212	BI-212	TL-208
Significant	0.27	0.30	0.18				
Not Significant							
			Actinium Decay Series				
	U-235	TH-227					
Significant	0.11						
Not Significant		X					

Where numerical values appear, the data is statistically significant when compared to background.
Numerical values correspond to the difference between the mean of data values and the background mean.

STATISTICAL STUDY NUMBER FOUR

STATISTICAL COMPARISON OF 1990 BACKGROUND DATA + 1998 BACKGROUND DATA
+ 1999 BACKGROUND DATA TO 1990 NON-TSCA AREA SEDIMENT DATA
+ 1998 NON-TSCA AREA SEDIMENT DATA (MINUS 98-3) + 1999 NON-TSCA
DATA MINUS AR99-14, 15, AND 17 (NAMELY AR99-1, 6, 18 - 25)

5% CHANCE OF FALSE POSITIVE

			Uranium Decay Series				
	U-238	U-234	TH-230	RA-226	PB-214	BI-214	
Significant			0.13	0.97			
Not Significant	X	X					
			Thorium Decay Series				
	TH-232	TH-228	RA-228	RA-224	PB-212	BI-212	TL-208
Significant			0.11				
Not Significant	X	X					
			Actinium Decay Series				
	U-235	TH-227					
Significant	0.07						
Not Significant		X					

Where numerical values appear, the data is statistically significant when compared to background.
Numerical values correspond to the difference between the mean of data values and the background mean.

STATISTICAL STUDY NUMBER FIVE

STATISTICAL COMPARISON OF 1999 BACKGROUNDS (AR99-2, 3, 4, 5) TO 1999 NON-TSCA SITES DATA EXCEPT SITES AR99- 1, 6, 14, 15 AND 17 (NAMELY AR99-18 - 25)

5% CHANCE OF FALSE POSITIVE

			Uranium Decay Series				
	U-238	U-234	TH-230	RA-226	PB-214	BI-214	
Significant				0.18			
Not Significant	X	X	X		X	X	
			Thorium Decay Series				
	TH-232	TH-228	RA-228	RA-224	PB-212	BI-212	TL-208
Significant		0.16	0.12	0.11	0.15	0.14	
Not Significant	X						X
			Actinium Decay Series				
	U-235	TH-227					
Significant							
Not Significant	X	X					

Where numerical values appear, the data is statistically significant when compared . to background.

Numerical values correspond to the difference between the mean of data values and the background mean.

STATISTICAL STUDY NUMBER SIX

STATISTICAL COMPARISON OF 1990 BACKGROUND DATA + 1998 BACKGROUND DATA + 1999 BACKGROUND DATA TO 1990 NON-TSCA AREA SEDIMENT DATA + 1998 NON-TSCA AREA SEDIMENT DATA (MINUS 98-3) + 1999 NON-TSCA SITES DATA MINUS AR99-1, 6, 14, 15, AND 17 (NAMELY AR99-18 - 25)

5% CHANCE OF FALSE POSITIVE

			Uranium Decay Series				
	U-238	U-234	TH-230	RA-226	PB-214	BI-214	
Significant				0.26			
Not Significant	X	X	X				
			Thorium Decay Series				
	TH-232	TH-228	RA-228	RA-224	PB-212	BI-212	TL-208
Significant			0.11				
Not Significant	X	X					
			Actinium Decay Series				
	U-235	TH-227					
Significant							
Not Significant	X	X					

Where numerical values appear, the data is statistically significant when compared to background.

Numerical values correspond to the difference between the mean of data values and the background mean.

ATTACHMENT 2

Summary

The highest concentrations of radionuclides were found at depths in sediment of greater than 4 feet, in the area of the upper turning basin. The data showed total uranium concentrations up to 64.7 pCi/g and total radium concentrations up to 17.3 pCi/g. The maximum total uranium concentration is about twice that being applied to a commercial cleanup on Fields Brook. The maximum combined radium concentration is about 30% more than the commercial cleanup criterion and about 3 times the residential cleanup criterion for Fields Brook.

Sampling Information

Sampling Site

Ashtabula River, Ashtabula Ohio
May 13, 1998

Sampling Design and Rationale

Six (6) sediment samples were collected from depositional areas within the Ashtabula River.

1. Two (2) samples were collected in the Ashtabula River upstream from the mouth of Fields Brook, where it enters the Ashtabula River, approximately 300 meters and 600 meters upstream from the mouth of Fields Brook, respectively. These samples were collected to serve as background reference sites, because Fields Brook is suspected of being the source of the contamination.

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2. One (1) sample was collected near the mouth of Fields Brook to determine the maximum level of contamination since it is expected that this location is located closest to the source of contamination.

3. The final three (3) samples were collected approximately one-third of the way between the mouth of Fields Brook and the 5th Street lift bridge, two-thirds of the way between the mouth of Fields Brook and the 5th Street lift bridge, and at the 5th Street lift bridge, respectively. These samples were collected to determine the spatial extent and level of any radiation contamination existing in the Ashtabula River.

Sampling Procedures

The sampling process proceeded as follows:

1. Approximate sampling locations were determined by best professional judgement and the boat was anchored over the sampling location.
2. Sampling latitude/longitude information was recorded in the field log book from the onboard differential GPS.
3. Water depth was measured and recorded to the nearest one inch (1").
4. Sediment cores were collected using a vibracore unit that accepted a plastic core tube fitted with a plastic nose cone.
5. The vibracoring unit was allowed to penetrate the sediment surface until refusal (i.e., the tube would penetrate no further into the sediment surface).
6. The sediment core was then brought on-board the boat and immediately screened with a geiger counter
7. The length of the collected core was measure to the nearest one inch (1") and recorded.
8. If the length of core was less than forty-eight inches (48") a single sediment sample was processed. If the core was greater than forty-eight inches (48"), the sediment core was sectioned into two sub-samples, the first consisting of the top forty-eight inches (48"), and the second consisting of the remaining length of the sediment core. [For example a sediment core of ninety-nine inches (99") was sub-sectioned into two sub-samples, the first forty-eight inches (48") in length, representing sediment depth of 0" to 48"; and the second fifty-one inches (51") in length, representing the depth interval from 48" to 99"].
9. Each sub-section was then placed into a stainless steel bowl and homogenized using a stainless steel spoon.
10. The homogenized samples were screened with a geiger counter and the results were recorded as either "negative" (referring to a reading equal to or below background) or "positive" (referring to a reading above background).
11. After screening, the sediment samples were placed into plastic sample bottles and labeled with the sampling station number, date, and time.

Sample Preservation and Storage

After labeling, the sample bottles were stored in a cooler onboard the sampling vessel. No ice or preservation solutions were added to the samples or cooler. The cooler was filled with shipping material to prevent damage during shipping, stored overnight, and shipped on May 14, 1998 to USEPA-NAREL via overnight delivery.

Analysis Methods

All samples were analyzed first by gamma spectrometry and then several by radiospecific methods.

Gamma spectrometry would identify all the gamma emitters. This is a standard and well accepted method of screening samples. It relies upon the unique gamma energies of the radionuclides. If the gamma energy is determined, then the radionuclide can be identified because the gamma energy is unique to the radionuclide (likes fingerprints are unique to people). It will miss a few radionuclides that are not gamma emitters or have gamma emissions that interfere with each other. Results for Ra-228, Cs-137 and K-40 were obtained this way.

Specific analyses were done for radium-226, uranium, thorium, and plutonium.

Radium-226--This was done by emanation, a method that relies upon measuring the alpha level of emissions of radionuclides produced by radon-222 (which was produced by radium-226). A sample of soil is sealed in a glass tube for 30 days. Radium-226 produces radon-222 which produces several alpha emitters. Measuring the level of these alpha emitters gives the radium-226 level.

Uranium/Thorium---Chemical lab methods were used to purify the sample to uranium only or thorium only. Then the samples were analyzed by alpha spectrometry. All the uranium alpha emitters and all the thorium alpha emitters can be identified this way, uniquely, much like gamma spectrometry.

Plutonium---Chemical lab methods were used to purify the sample to plutonium only. Then the samples were anlayzed by alpha spectromety. This parallels the methods used for uranium and thorium.

1998 SAMPLING DATA SUMMARY pCi/g

(STATION 136.5) 1998 AR98-01 (Nth. of 5th St. Bridge) 0-4ft in sediment

U-238	0.835	Th-232	1.16	Cs-137	0.0471	U-235	0.147
U-234	0.767	Ra-228	0.864	K-40	11.55	Th-227	0.118
Th-230	0.858	Th-228	1.19	Pu-238	0.0387		
Ra-226	0.17			Pu-239	0.0065		

(STATION 147) 1998 AR98-02 (Sth. of 5th St. Bridge) 0-4ft.

U-238	1.23	Th-232	1.05	Cs-137	0.0733	U-235	0.415
U-234	1.25	Ra-228	0.914	K-40	10.3	Th-227	0.0419
Th-230	1.41	Th-228	0.951	Pu-238	0.0519		
Ra-226	1.29			Pu-239	0.0148		

(STATION 168) 1998 AR98-03 (Nth. of Confluence - Shallow) 0-4ft.

U-238	3.11	Th-232	1.48	Cs-137	0.0702	U-235	0.276
U-234	3.06	Ra-228	1.24	K-40	8.56	Th-227	0.207
Th-230	3.27	Th-228	1.49	Pu-238	0.00		
Ra-226	1.00			Pu-239	0.0177		

(STATION 168) 1998 AR98-03B (Nth. of Confluence - Deep) 4ft. +

U-238	6.23	Th-232	1.42	Cs-137	0.166	U-235	0.509
U-234	6.03	Ra-228	1.02	K-40	8.8	Th-227	0.208
Th-230	5.72	Th-228	1.17	Pu-238	0.0057		
Ra-226	2.52			Pu-239	0.0311		

(STATION 186.5) 1998 AR98-04 (Confluence - Shallow) 0-4ft.

U-238	1.62	Th-232	1.45	Cs-137	0.0419	U-235	0.224
U-234	1.4	Ra-228	2.13	K-40	10.3	Th-227	0.216
Th-230	0.935	Th-228	1.53	Pu-238	0.0232		
Ra-226	1.0			Pu-239	0.0026		

(STATION 186.5) 1998 AR98-04B (Confluence - Deep) 4ft. +

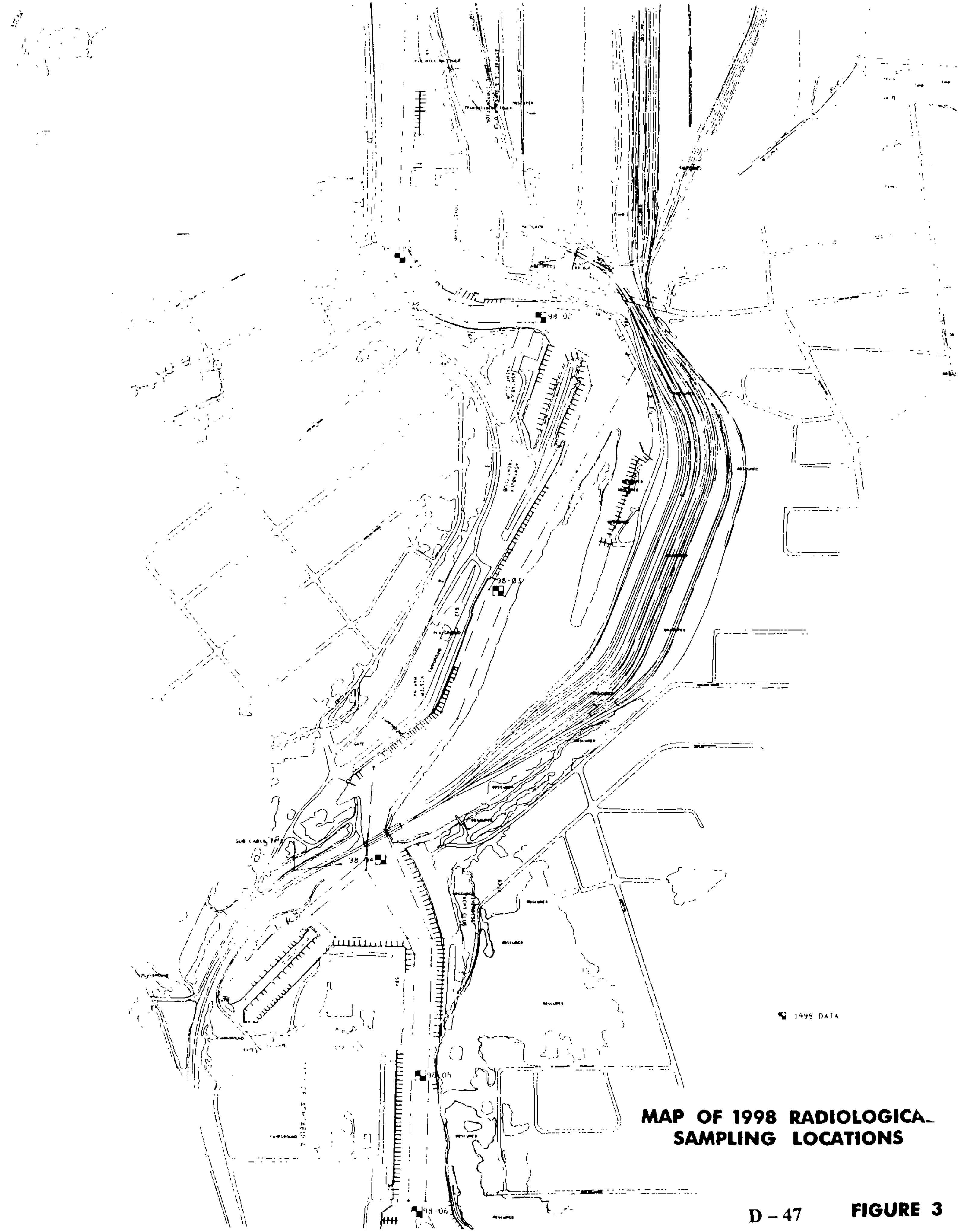
U-238	27.3	Th-232	3.86	Cs-137	0.0591	U-235	3.03
U-234	34.4	Ra-228	1.24	K-40	1.87	Th-227	0.834
Th-230	2.0	Th-228	0.00	Pu-238	0.834		
Ra-226	16.1			Pu-239	0.208		

(STATION 200) 1998 AR98-05 (Near Upstream Background) 0-4ft.

U-238	0.75	Th-232	0.747	Cs-137	0.0784	U-235	0.0685
U-234	0.811	Ra-228	0.723	K-40	10.9	Th-227	0.638
Th-230	0.832	Th-228	0.741	Pu-238	0.00		
Ra-226	0.665			Pu-239	0.0108		

(STATION 208) 1998 AR98-06 (Far Upstream Background) 0-4ft.

U-238	0.906	Th-232	0.94	Cs-137	0.0304	U-235	0.1108
U-234	0.9765	Ra-228	0.736	K-40	11.7	Th-227	0.766
Th-230	0.74	Th-228	1.0	Pu-238	0.667		
Ra-226	0.868			Pu-239	0.0118		



MAP OF 1998 RADIOLOGICAL SAMPLING LOCATIONS

FIGURE 3

ATTACHMENT 3

1990 RADIOLOGICAL SAMPLING RESULTS

Twelve river sites were identified as "hot spot" areas with numerous chemical contaminants, based on a comprehensive Ashtabula River sediment study completed in early 1990. That sampling was done to determine whether river sediments contained high levels of radioactive material. The highest concentrations of radionuclides were found at depths in sediment of 4 to 15 feet, in the area of the upper turning basin. The concentrations of total uranium detected in the sampling ranged from 2.4 to 22.3 pCi/g, with an average value of 10.1 pCi/g. The concentrations of total radium detected in the sampling ranged from 2.6 to 20.6 pCi/g, with an average value of 10.8 pCi/g.

1990 SAMPLING DATA SUMMARY pCi/g

(STATION 139) 1990 ARSD-06 (Nth. of 5th St. Bridge) 0 - 10.7 ft in sediment

U-238	2.415	Th-232	1.288	Cs-137	0.250	U-235	0.191
U-234	2.79	Ra-228*	1.288	Pu-238	0.059		
Ra-226	5.151			Pu-239	0.008		

(STATION 150,151 & 152) 1990 ARSD-05 (Sth. of 5th St. Bridge) 0 - 8 ft

U-238	2.31	Th-232	1.47	Cs-137	0.160	U-235	0.092
U-234	2.39	Ra-228*	1.47	Pu-238	0.025		
Ra-226	4.553			Pu-239	0.012		

(STATION 150,151 & 152) 1990 ARSD-05 (Sth. of 5th St. Bridge) 3 - 10.6 ft

U-238	2.38	Th-232	1.38	Cs-137	0.317	U-235	0.095
U-234	2.44	Ra-228*	1.38	Pu-238	0.020		
Ra-226	4.225			Pu-239	0.010		

(STATION 165) 1990 ARSD-04 (Just Sth. of Lower Turning Basin) 0 - 3.6 ft

U-238	3.07	Th-232	nd	Cs-137	0.164	U-235	0.104
U-234	3.08	Ra-228*	nd	Pu-238	0.026		
Ra-226	nd			Pu-239	0.006		

(STATION 165) 1990 ARSD-04 (Just Sth. of Lower Turning Basin) 0 - 7.6 ft

U-238	6.34	Th-232	2.022	Cs-137	0.191	U-235	0.183
U-234	6.55	Ra-228*	2.022	Pu-238	0.015		
Ra-226	9.778			Pu-239	0.019		

(STATION 182) 1990 ARSD-03 (Nth. of Confluence) 0.3 – 7.5 ft

U-238	4.32	Th-232	2.872	Cs-137	0.128	U-235	0.144
U-234	4.48	Ra-228*	2.872	Pu-238	0.005		
Ra-226	8.712			Pu-239	0.003		

(STATION 182) 1990 ARSD-03 (Nth. of Confluence) 4.3 – 15.5 ft

U-238	11.00	Th-232	2.514	Cs-137	0.128	U-235	0.292
U-234	11.04	Ra-228*	2.514	Pu-238	0.018		
Ra-226	18.11			Pu-239	0.010		

(STATION 185 & 186) 1990 ARSD-02 (Just Nth. of Confluence) 0 – 4.9 ft

U-238	6.61	Th-232	3.33	Cs-137	nd	U-235	0.212
U-234	7.25	Ra-228*	3.33	Pu-238	0.019		
Ra-226	10.40			Pu-239	0.003		

(STATION 185 & 186) 1990 ARSD-02 (Just Nth. of Confluence) 3.7 – 14.9 ft

U-238	8.60	Th-232	2.56	Cs-137	1.015	U-235	0.353
U-234	9.87	Ra-228*	2.56	Pu-238	0.013		
Ra-226	15.71			Pu-239	0.008		

(STATION 188 & 189) 1990 ARSD-01 (Confluence of Fields Brook) 0 – 8.6 ft.

U-238	4.34	Th-232	1.964	Cs-137	0.185	U-235	0.197
U-234	3.72	Ra-228*	1.964	Pu-238	0.001		
Ra-226	7.345			Pu-239	0.008		

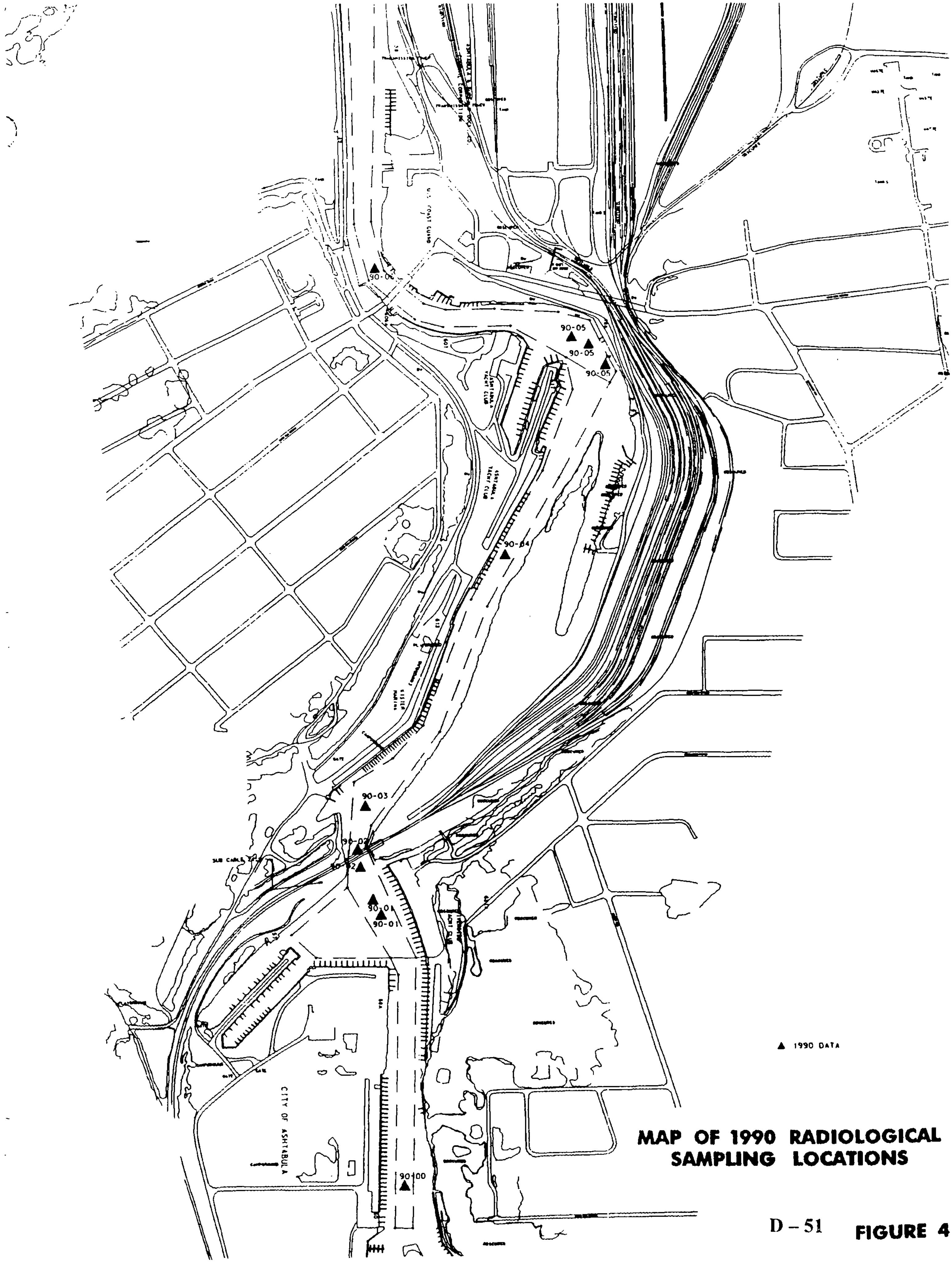
(STATION 188 & 189) 1990 ARSD-01 (Confluence of Fields Brook) 8.6 ft. +

U-238	5.96	Th-232	1.663	Cs-137	0.484	U-235	0.134
U-234	6.32	Ra-228*	1.663	Pu-238	0.042		
Ra-226	11.66			Pu-239	0.019		

(STATION 205) 1990 ARSD-00 (Far Upstream Background) 0 – 3.4 ft

U-238	1.03	Th-232	0.925	Cs-137	0.070	U-235	0.057
U-234	1.33	Ra-228*	0.925	Pu-238	0.016		
Ra-226	1.683			Pu-239	nd		

nd = Not Detected
* = Th-232 being used as a surrogate for Ra-228. Ra-228 is assumed to be in secular equilibrium with it's parent due to the length of time since it's deposition.



MAP OF 1990 RADIOLOGICAL SAMPLING LOCATIONS

FIGURE 4

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX E

DREDGING SCENARIOS AND SEDIMENT VOLUME ESTIMATES

PREPARED BY:

Environmental Engineering Section
U.S. Army Corps of Engineers, Buffalo District
August 1997

1.0 BACKGROUND

In an effort to develop other dredging scenarios in addition to the bank to bank to bedrock option, Buffalo District conducted additional analysis of the Ashtabula River sediments using GMS. This additional analysis was conducted to comply with NEPA which requires that several alternatives be evaluated for a given project. The following methodology, which is detailed in subsequent sections, was used:

<u>**Development of Dredging Scenarios**</u>

- Develop Cross Sections of the River Every 100 Feet
- Interpolate PCB Sampling Data to Cross Section
- Plot Isoconcentration Lines
- Evaluate Cross Sections and Develop Dredging Alternatives
- Develop Post-Dredging Surfaces in GMS based on Dredging Cut Lines

<u>**Evaluation of Dredging Scenarios**</u>

- Determine Post Dredging Surface Area Weighted PCB Concentrations for Each Scenario
- Determine Sediment Volume Removed for Each Scenario
- Determine PCB Mass Removed for Each Scenario
- Determine Linear Feet of Bank Effected for Each Scenario

2.0 DEVELOPMENT OF DREDGING SCENARIOS

2.1 Develop Cross Sections Every 100 Feet

The three - dimensional finite element mesh created by WES to represent Ashtabula River sediments was used as the starting point for this analysis. The mesh surface represents the existing bathymetry based on the 1995 survey and the bottom of the mesh is -20 feet LWD, which is roughly the depth of bedrock. Using the Cross Section tool within GMS, vertical cross sections of the mesh were made every 100 feet. Additional cross sections were made of other areas, such as Jack's Marine Slip and the Conrail Slip. A total of 80 cross-sections were completed from River Station 207+00 to 139+80. Examples of the cross-sections are shown in Figures 1 through 5.

2.2 Interpolate Data to Cross Section and Plot Isoconcentration Lines

After creating the cross sections, the interpolated data was plotted on each of the cross sections. Contour lines showing the areas of the cross section where PCB levels were <1 mg/kg, 1 - 5 mg/kg, 5 - 10 mg/kg. 10 - 40 mg/kg and > 40 mg/kg were plotted. A Buffalo District Team then met to interpret the data and develop additi ,nal dredging scenarios by drawing cutlines on each cross section.

2.3 Evaluate Cross Sections and Develop Dredging Alternatives

The intent initially was to draw cutlines based on removing all sediment with PCB concentrations greater than 1 mg/kg. It quickly became evident that this method would not create a dredging scenario significantly different than the bank to bank to bedrock option. This is because, based on the sampling data, the model calculates very few areas with PCB concentration less than 1 mg/kg and most of these areas are near the surface and would have to be removed to dredge more contaminated sediments.

After discussions with the OEPA and USEPA it was decided to use a PCB level of 10 mg/kg as a starting point for developing the dredging scenarios. This level was selected because it would allow the development of dredging alternatives that were sufficiently different from the bank to bank to bedrock to allow comparison and analysis.

Based on this agreement, the Buffalo District Team evaluated each of the cross sections. Other criteria that were used included maintaining at least -6 feet LWD in the federal channel to allow for recreational boating and the effect of the scour analysis of the river sediments that was completed by WES. Ultimately, two scenarios, in addition to bank to bank to bedrock were developed as defined below:

The **Deep Dredging Option** included the following:

- Removal of all sediment with PCB concentrations greater than 10 mg/kg, and
- Maintaining a federal channel depth of at least -6 LWD.

The **Shallow Dredging Option** included the following:

- Removal of sediment with PCB concentrations greater than 10 mg/kg that is currently exposed to the surface or would be exposed to the surface after a 100 year flood event, and
- Maintaining a federal channel depth of at least -6 LWD.

Example cross sections with dredging cutlines are shown in Figure 1 through 5. These figures also show the general impact of scour on cross sections where the shallow dredging option was considered. It can be seen in Figure 4 that there are areas of the river where sediment PCB concentration exceed 10 mg/kg, even after dredging to -19.5 LWD, the estimated limit of clamshell dredging with bedrock at -20 LWD. This is discussed further in Section 3.1.

2.4 Develop a Dredging Surface in GMS based on Dredging Cut Lines

After drawing cutlines on each cross section, the data was brought back into GMS so additional evaluation could be completed. The starting point for this effort was the hydrographic survey that was completed in 1995. The survey determined the depth of river sediments, every 100 feet at the same location as the cross sections were made. First, the survey data was brought into GMS as individual x,y,z data points. The cross sections for each dredging scenario were then compared against the existing conditions. Where dredging cut lines were drawn, the z (depth) value was changed to represent the post dredging scenario. Where no dredging was planned, the existing conditions were left unchanged.

The end result of this effort was a file containing x, y and z data that represented the post dredging conditions for each scenario. From this data, Triangulated Irregular Networks (TINs) representing the post dredging bathymetry were developed. A post dredging surface throughout the river at -19.5 LWD was created for the bank to bank to bedrock option. This depth, roughly 0.5 foot above the estimated bedrock depth, was selected as the reasonable maximum dredging depth that could be achieved using a closed clamshell dredge.

3.0 EVALUATION OF DREDGING SCENARIOS

In order to evaluate each of the three (bank to bank to bedrock, deep dredging and shallow dredging) dredging scenarios, computer modeling in GMS of the post dredging conditions was conducted. For each scenario, the post dredging surface area weighted PCB concentration, sediment volume removed and PCB mass removed were calculated. The details of this modeling effort is presented below.

3.1 Surface Area Weighted PCB Concentration

Post dredging surface area weighted sediment PCB concentrations were calculated for each dredging scenario. The first step in accomplishing this was interpolating the PCB sample data to the post dredging surface. Contour intervals were created for various concentrations intervals as shown in Table 1. The representation of the river, with contour intervals was then exported from GMS into Mapinfo. The map was registered so that distances on the map were representative of actual distances on the ground. Figures 6, 7 and 8 show the post dredging bathymetry and PCB concentrations for the bank to bank to bedrock, deep dredging and shallow dredging options, respectively. Figure 9 shows the existing bathymetry and PCB concentrations.

Mapinfo was then used to calculate the area within each contour interval. The contribution of each contour interval to the overall surface area weighted concentration was calculated by multiplying the average PCB concentration for the range, by the fraction of the total surface area in the range. The results of these calculations are shown in Table 1.

As can be seen in Figures 6,7 and 8 there are areas of the river where the model is calculating that PCB concentrations are in excess of 10 mg/kg. This is in locations where sediment is dredged as deep as practical with a clamshell dredge (-19.5 feet LWD), but levels less than 10 mg/kg are not reached. One option is to redredge these locations with a specialty hydraulic dredge that would dredge more completely. Based on other dredging projects it was estimated that this process would result in a final post dredging concentration of roughly 5 mg/kg in the areas redredged. Table 1 shows the results of the surface area weighted PCB concentrations with and without specialty dredging.

3.2 Sediment Volume Removed

For each scenario, a three dimensional finite element mesh was created using GMS. This was done by using the post dredging surface as the upper boundary and -20 LWD as the lower boundary. Twenty vertical layers were used in each grid to ensure adequate spacing of nodes to capture the variability of the sample data. After creation of the mesh, the volume of the mesh, which represents the volume of sediment remaining in the river, was determined. Subtracting this amount from the initial conditions results in the volume of sediment removed in each scenario. Table 2 summarizes this information.

3.3 PCB Mass Removed

GMS also calculates the volume of sediment within a given concentration range. This information, along with the density of the sediment and the average concentration in the range allows calculation of PCB mass within a certain range. Summing this information for all the ranges of concentrations results in the total PCB mass in the sediment for each scenario. This information is summarized in Table 1. The additional specialty dredging does not result in a significant increase in PCB mass removed for any of the scenarios.

3.4 Linear Feet of Bank Effected

One of the potential impacts of dredging is the failure of the sheet pile walls lining portions of the Ashtabula River. Additionally, even in areas that currently do not have sheet piling, some protection may be necessary to prevent unwanted sloughing of the shoreline after dredging. For the purposes of this estimate it was determined that removal of more than 4 feet of the bank would result in a failure situation. Each cross-section developed for the deep and shallow dredging options was reviewed based on the stated criteria. For the bank to bank to bedrock option Mapinfo was used to determine the distance around the entire perimeter of the area to be dredged. Table 3 shows the results of this analysis.

4.0 SEDIMENT VOLUME DREDGED AND DISPOSED

In order to ensure consistency in the various parts of the CMP and EIS, Table 4 was developed to show the rounded values of sediment dredged and disposed to be used. Dewatering and settling of the dredged sediment were factored in to determine the required capacity of the disposal facility. This information was also used to determine the size and capacity of the dewatering facility. The fact that sediments may be dredged both mechanically and hydraulically will have a significant impact on the volumes because of the differing solids concentrations of the dredged material.

5.0 SUMMARY

The purpose of this section was to explain how the different dredging scenarios were developed and present the results of analyses conducted on the alternatives. The volumes of sediment throughout the dredging and disposal process can be used to size facilities and develop cost estimates for each scenario. The information on linear feet of sheet piling effected for each scenario can also be used to refine the costs.

Data on post dredging surface area weighted concentration, PCB mass removal and sediment volume removal can be used by USEPA and OEPA to develop risk assessments to determine which dredging scenarios are acceptable. The agencies and the partnership should also take a close look at the necessity of specialty dredging given the cost involved and the fact that PCB mass removal is not appreciably affected. Ultimately, the partnership will have to weigh the cost for each scenario against the risk assessment and other factors to determine which is the most acceptable alternative. Based on available information, the partnership has selected the deep dredging option as the preferred alternative.

Table 1. Post-Dredging Surface Area Weighted Sediment Concentrations for Ashtabula River Dredging Scenarios

Initial Conditions

Concentration Range (ppm)	Average Concentration (ppm)	Surface Area in Range (sf)	Percent of Total Surface Area	Surface Area Weighted Concentration (ppm)
>50	75	5,019	0%	0.18
40-50	45	12,983	1%	0.28
30-40	35	60,075	3%	1.00
20-30	25	125,701	6%	1.50
10-20	15	204,444	10%	1.46
5-10	7.5	286,404	14%	1.02
1-5	3	434,456	21%	0.62
0-1	0.5	969,437	46%	0.23
Total		**2,098,519**	**100%**	**6.29**

Calculations on left hand side assume that sediments >10 ppm at bedrock interface are redredged with a specialty dredge.

Calculations on right hand side assume that sediments >10 ppm at bedrock interface are left in place.

Bank to Bank to Bedrock Dredging

Concentration Range (ppm)	Average Concentration (ppm)	Surface Area in Range (sf)	Percent of Total Surface Area	Surface Area Weighted Concentration (ppm)
5-10	7.5	601,654	29%	2.15
5	5	633,045	30%	1.51
1 - 5	3	214,392	10%	0.31
0.5 - 1.0	0.75	40,937	2%	0.01
0 - 0.5	0.25	608,491	29%	0.07
Total		**2,098,519**	**100%**	**4.05**

Concentration Range (ppm)	Average Concentration (ppm)	Surface Area in Range (sf)	Percent of Total Surface Area	Surface Area Weighted Concentration (ppm)
5-10	7.5	601,654	29%	2.15
>10	20	633,045	30%	6.03
1 - 5	3	214,392	10%	0.31
0.5 - 1.0	0.75	40,937	2%	0.01
0 - 0.5	0.25	608,491	29%	0.07
Total		**2,098,519**	**100%**	**8.58**

Deep Dredging

Concentration Range (ppm)	Average Concentration (ppm)	Surface Area in Range (sf)	Percent of Total Surface Area	Surface Area Weighted Concentration (ppm)
5-10	7.5	526,580	25%	1.88
5	5	542,260	26%	1.29
1 - 5	3	218,476	10%	0.31
0.5 - 1.0	0.75	49,106	2%	0.02
0 - 0.5	0.25	762,097	36%	0.09
Total		**2,098,519**	**100%**	**3.59**

Concentration Range (ppm)	Average Concentration (ppm)	Surface Area in Range (sf)	Percent of Total Surface Area	Surface Area Weighted Concentration (ppm)
5-10	7.5	526,580	25%	1.88
>10	20	542,260	26%	5.17
1 - 5	3	218,476	10%	0.31
0.5 - 1.0	0.75	49,106	2%	0.02
0 - 0.5	0.25	762,097	36%	0.09
Total		**2,098,519**	**100%**	**7.47**

Shallow Dredging

Concentration Range (ppm)	Average Concentration (ppm)	Surface Area in Range (sf)	Percent of Total Surface Area	Surface Area Weighted Concentration (ppm)
5-10	7.5	436,364	21%	1.56
5	5	432,642	21%	1.03
1 - 5	3	321,960	15%	0.46
0.5 - 1.0	0.75	71,944	3%	0.03
0 - 0.5	0.25	835,609	40%	0.10
Total		**2,098,519**	**100%**	**3.18**

Concentration Range (ppm)	Average Concentration (ppm)	Surface Area in Range (sf)	Percent of Total Surface Area	Surface Area Weighted Concentration (ppm)
5-10	7.5	436,364	21%	1.56
>10	20	432,642	21%	4.12
1 - 5	3	321,960	15%	0.46
0.5 - 1.0	0.75	71,944	3%	0.03
0 - 0.5	0.25	835,609	40%	0.10
Total		**2,098,519**	**100%**	**6.27**

Table 2. Comparison of Sediment Volume and PCB Mass Removal for Ashtabula River Dredging Scenarios

Initial Conditions					
Threshold Value	Cubic Feet Between Threshold Values	Cubic Yards Between Threshold Values	Cumulative Volume (CY)	Mass Between Threshold Values (kg)	Cumulative Mass (kg)
50 ppm	775,980	28,740	28,740	1735	1735
40 ppm	557,150	20,635	49,375	801	2,537
30 ppm	1,346,300	49,863	99,238	1505	4,042
20 ppm	2,788,900	103,293	202,531	2228	6,270
10 ppm	4,838,500	179,204	381,734	2320	8,589
5 ppm	4,922,400	182,311	564,046	1180	9,769
1 ppm	4,987,100	184,707	748,753	1196	10,964
0.5 ppm	1,144,200	42,378	791,131	27	10,992
0.1 ppm	1,259,800	46,659	837,790	12	11,004
0	8,223,300	304,567	1,142,357	14	11,018

Bank to Bank to Bedrock					
Threshold Value	Cubic Feet Between Threshold Values	Cubic Yards Between Threshold Values	Cumulative Volume Removed (CY)	Mass Between Threshold Values (kg)	Cumulative Mass Removed (kg)
50 ppm	775,848	28,735	28,735.11	1735	1735
40 ppm	555,638	20,579	49,314	799	2,534
30 ppm	1,337,337	49,531	98,845	1495	4,029
20 ppm	2,723,117	100,856	199,701	2175	6,205
10 ppm	4,595,420	170,201	369,902	2203	8,408
5 ppm	4,687,910	173,626	543,529	1124	9,531
1 ppm	4,858,800	179,956	723,484	1165	10,696
0.5 ppm	1,130,614	41,875	765,359	27	10,723
0.1 ppm	1,243,234	46,046	811,404	12	10,735
0	5,247,400	194,348	1,005,753	9	10,744
			PCB Mass Removal =		98%

Deep Dredging					
Threshold Value	Cubic Feet Between Threshold Values	Cubic Yards Between Threshold Values	Cumulative Volume Removed (CY)	Mass Between Threshold Values (kg)	Cumulative Mass (kg)
50 ppm	775,836	28,735	28,734.67	1735	1735
40 ppm	554,569	20,540	49,274	797	2,532
30 ppm	1,334,065	49,410	98,684	1492	4,024
20 ppm	2,723,697	100,878	199,562	2176	6,200
10 ppm	4,025,860	149,106	348,668	1930	8,130
5 ppm	2,229,700	82,581	431,249	534	8,664
1 ppm	1,627,100	60,263	491,512	390	9,054
0.5 ppm	370,390	13,718	505,230	9	9,063
0.1 ppm	130,500	4,833	510,064	1	9,064
0	1,119,300	41,456	551,519	2	9,066
			PCB Mass Removal =		82%

Shallow Dredging					
Threshold Value	Cubic Feet Between Threshold Values	Cubic Yards Between Threshold Values	Cumulative Volume Removed (CY)	Mass Between Threshold Values (kg)	Cumulative Mass (kg)
50 ppm	771,751	28,583	28,583	1726	1726
40 ppm	524,962	19,443	48,026	755	2,481
30 ppm	1,297,562	48,058	96,084	1451	3,932
20 ppm	2,698,220	99,934	196,018	2155	6,087
10 ppm	3,290,500	121,870	317,889	1577	7,664
5 ppm	1,201,300	44,493	362,381	288	7,952
1 ppm	1,081,400	40,052	402,433	259	8,212
0.5 ppm	318,350	11,791	414,224	8	8,219
0.1 ppm	15,100	559	414,783	0	8,219
0	1,173,800	43,474	458,257	2	8,221
			PCB Mass Removal =		75%

Table 3. Linear Feet Of Sheet Piling Effected for Ashtabula River Dredging Scenarios

Shallow Dredging Option					Deep Dredging Option					Bank to Bank to Bedrock
Left Bank Station No.	Feet Impacted	Right Bank Station No.	Feet Impacted	Total Feet Impacted	Left Bank Station No.	Feet Impacted	Right Bank Station No.	Feet Impacted	Total Feet Impacted	Total Feet Impacted
192	100	189	100	200	194	100	189	100	200	
191	100	188	100	200	193	100	188	100	200	
190	100	187	100	200	192	100	187	100	200	
189	100	186	100	200	191	100	186	100	200	
187	100	185	100	200	190	100	185	100	200	
186	100	184	100	200	189	100	184	100	200	
185	100	183	100	200	187	100	183	100	200	
184	100	182	100	200	186	100	182	100	200	
183	100	181	100	200	185	100	181	100	200	
179	100	180	100	200	184	100	180	100	200	
178	100	179	100	200	183	100	179	100	200	
177	100	178	100	200	179	100	178	100	200	
176	100	177	100	200	178	100	177	100	200	
175	100	176	100	200	177	100	176	100	200	
174	100	175	100	200	176	100	175	100	200	
173	100	174	100	200	175	100	174	100	200	
172	100	173	100	200	174	100	173	100	200	
171	100	172	100	200	173	100	172	100	200	
170	100	171	100	200	172	100	171	100	200	
169	100	170	100	200	171	100	170	100	200	
168	100	169	100	200	170	100	169	100	200	
167	100	168	100	200	169	100	168	100	200	
166	100	167	100	200	168	100	167	100	200	
165	100	166	100	200	167	100	166	100	200	
164	100	165	100	200	166	100	165	100	200	
163	100	164	100	200	165	100	164	100	200	
162	100	163	100	200	164	100	163	100	200	
161	100	162	100	200	163	100	162	100	200	
		161	100	100	162	100	161	100	200	
					161	100	159	100	200	
					159	100	158	100	200	
					158	100	157	100	200	
					157	100	156	100	200	
					156	100	152	100	200	
					155	100			100	
					154	100			100	
					153	100			100	
					152	100			100	
					150	100			100	
					149	100			100	
					148	100			100	
	2800		2900	**5,700**		4100		3400	**7,500**	**21,000**

Table shows cross section where dredging causes removal of at least 4 feet of the bank
100 feet is used as the impact at each cross section because this is the approximate distance between cross sections
Impact of sheet piling for the bank to bank to bedrock scenario was determined using Mapinfo

Table 4. Rounded Values for Volume of Sediment Dredged and Capacity of Landfill for Use in Ashtabula Reports

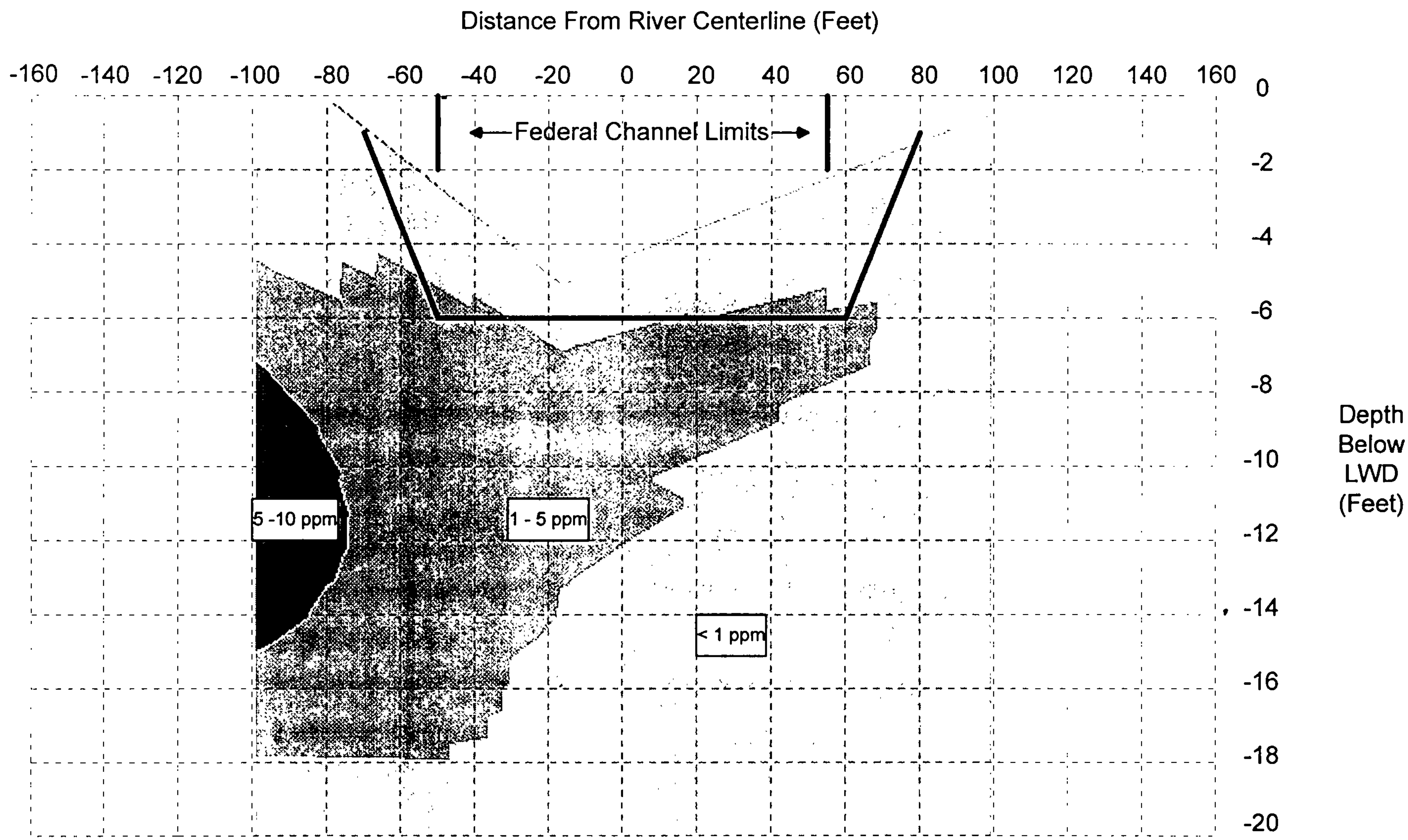
Dredging Volumes (cy)

	TSCA	Non-TSCA			TOTAL	
		GMS	to St 120+00	Total non-TSCA		Overdredging (If used)
BBB	150,000	860,000	115,000	975,000	1,125,000	25,000
Deep	150,000	410,000	115,000	525,000	675,000	21,000
Shallow	150,000	310,000	115,000	425,000	575,000	17,000

When bulking, dewatering and settling are considered, along with disposal of 70,000 cubic yards from the interim disposal facility, the required capacity of the landfill is as follows

Capacity of Disposal Facility (cy)

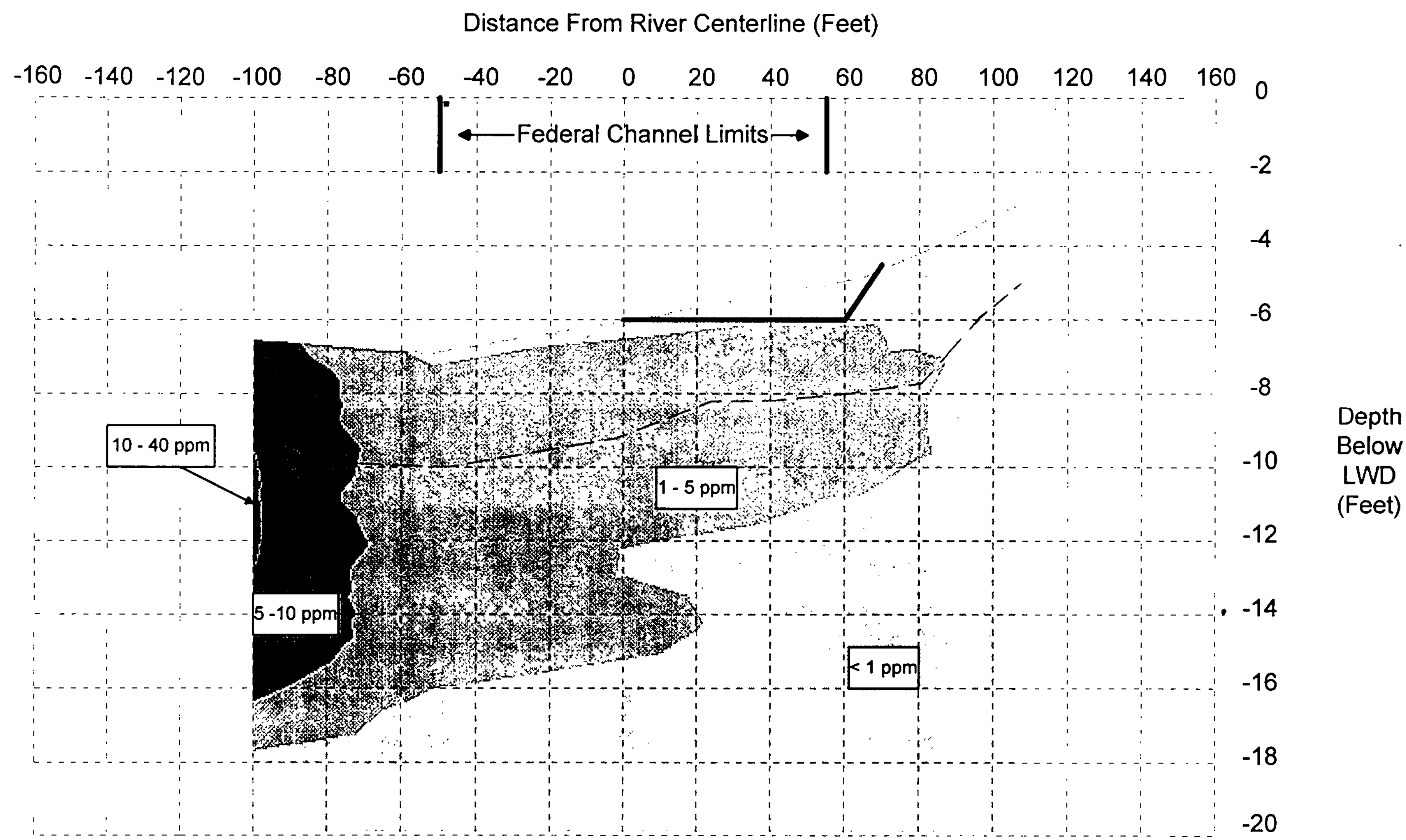
	TSCA	non-TSCA
BBB	100,000	700,000
Deep	100,000	400,000
Shallow	100,000	350,000



Dredge Lines

Figure 1
Ashtabula River Cross Section 197+00

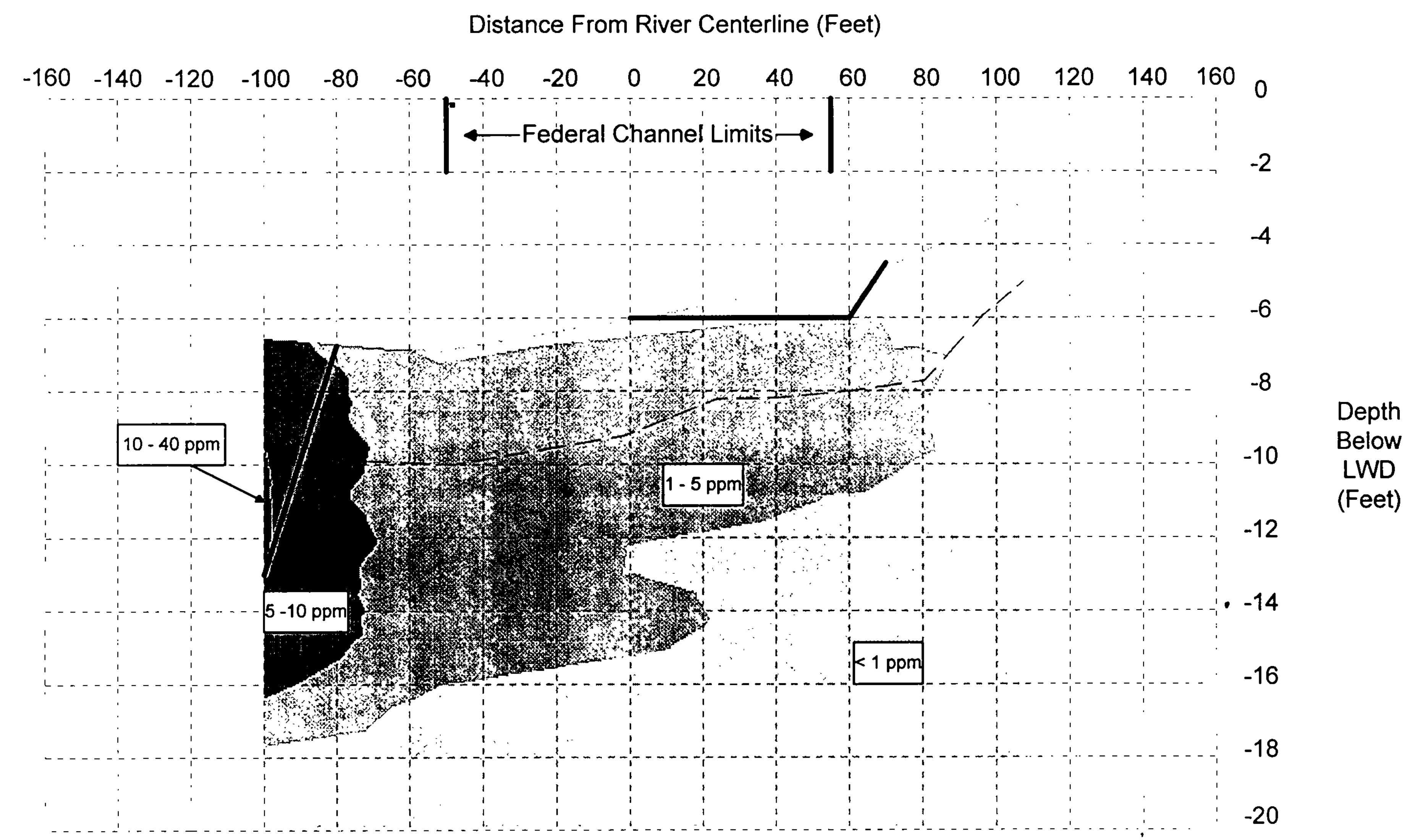
Depth measurement is shown exaggerated by a factor of 10.



Scour Impact
Dredge Lines

Depth measurement is shown exaggerated by a factor of 10.

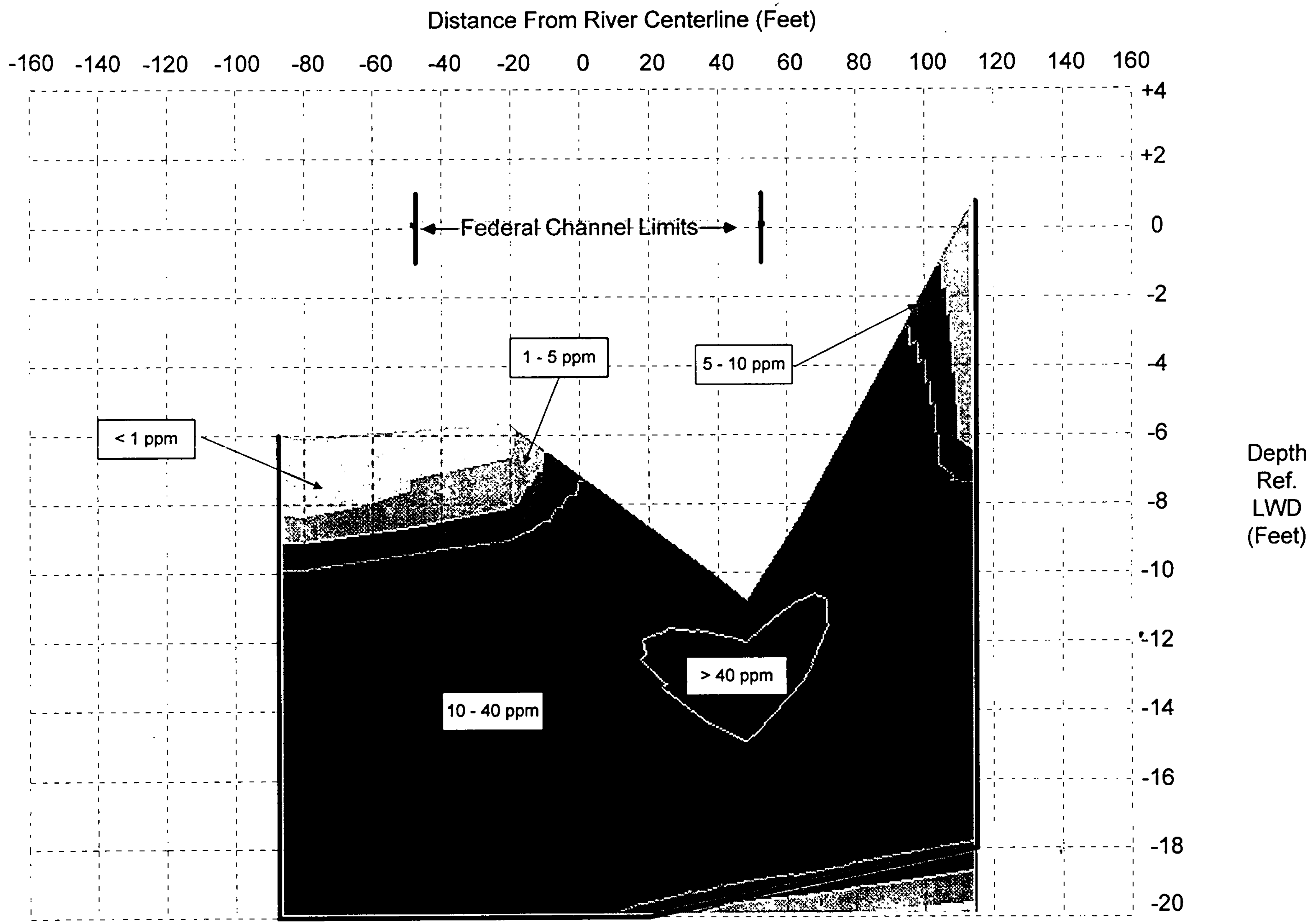
Figure 2
Ashtabula River Cross Section 193+00
Shallow Dredging Option



Scour Impact
Dredge Lines

Figure 3
Ashtabula River Cross Section 193+00
Deep Dredging Option

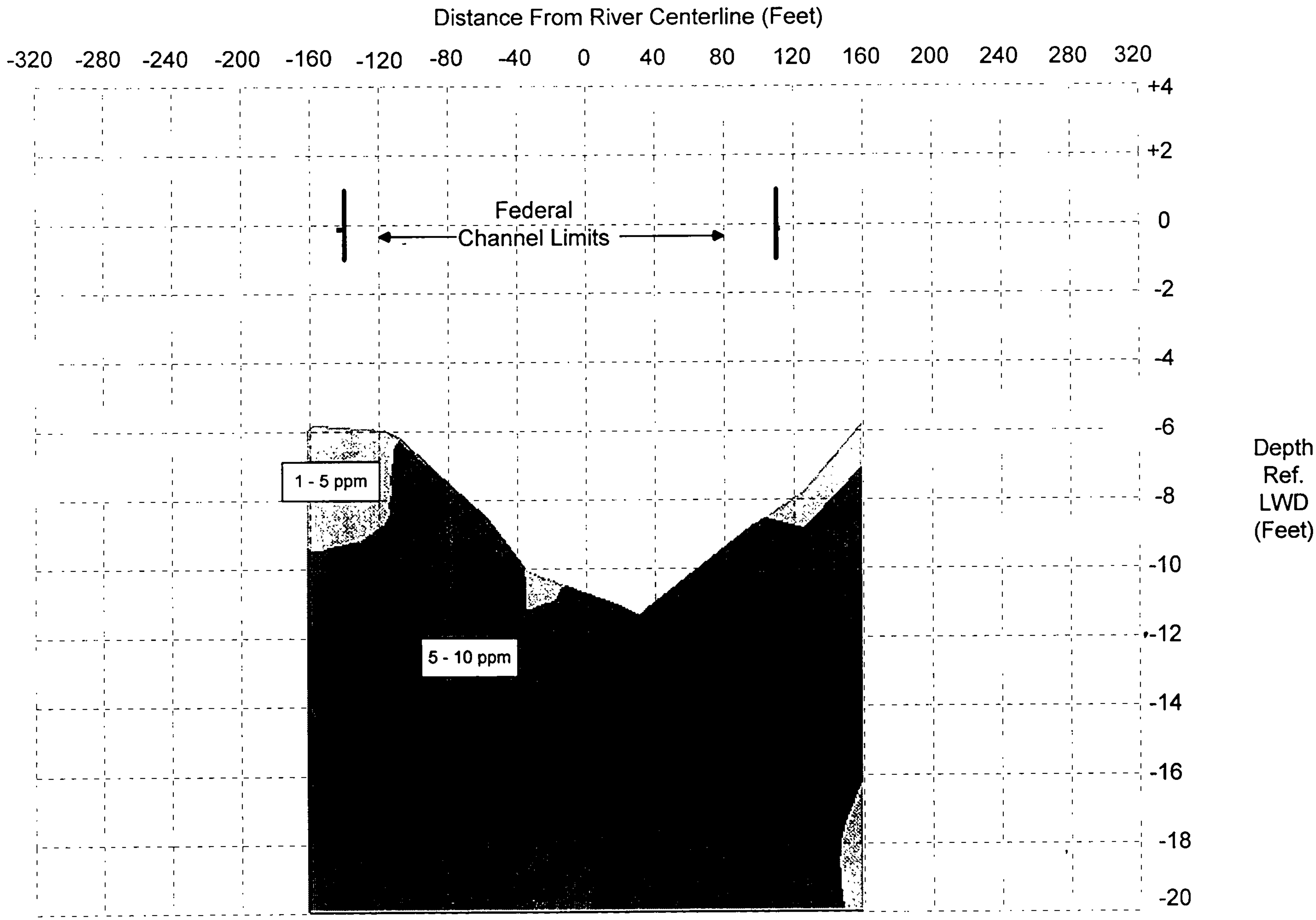
Depth measurement is shown exaggerated by a factor of 10.



Dredge Lines

Figure 4
Ashtabula River Cross Section 170+00

Depth measurement is shown exaggerated by a factor of 10.



Dredge Lines (no dredging)

Figure 5
Ashtabula River Cross Section 151a+00

Depth measurement is shown exaggerated by a factor of 20.

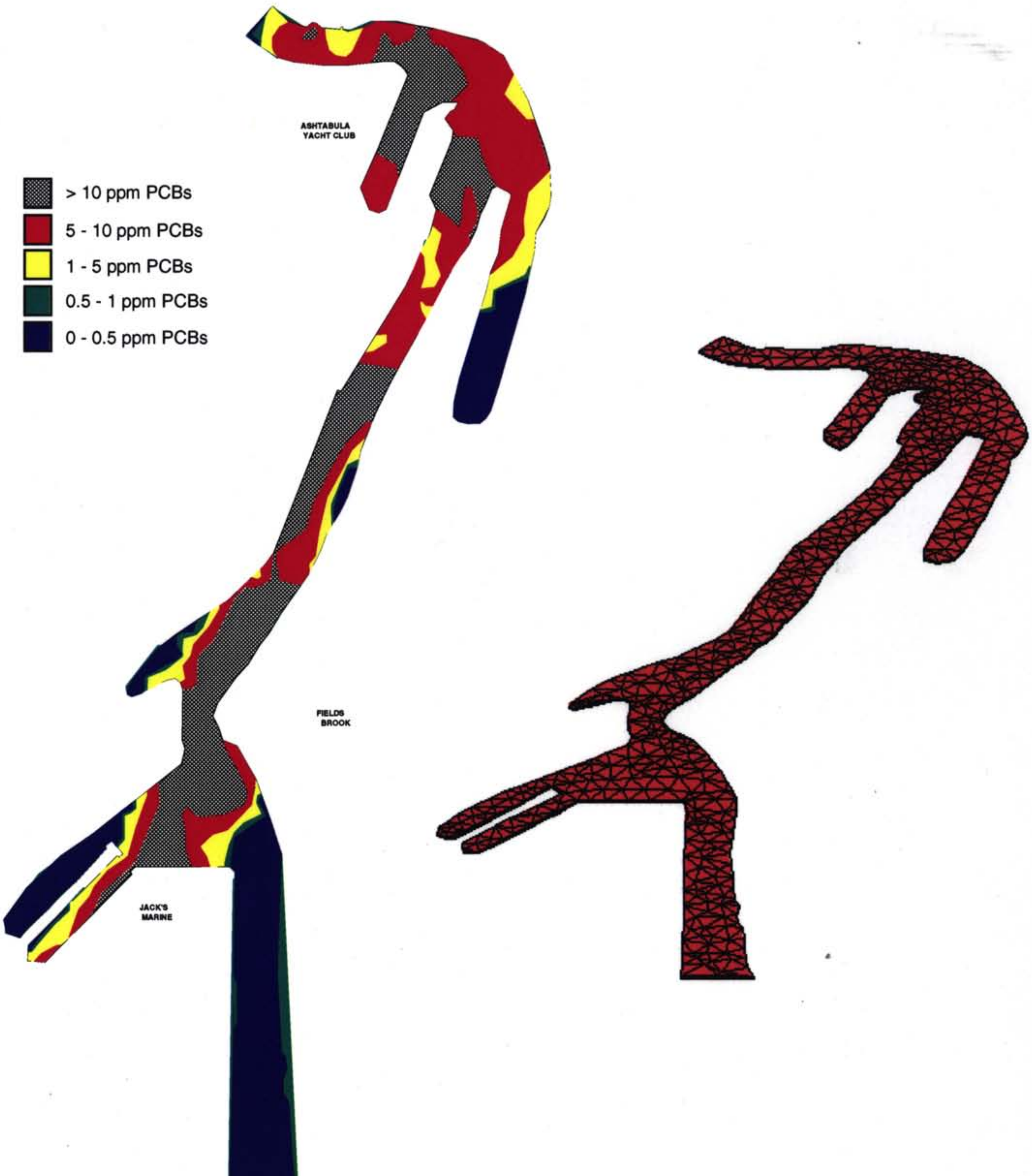


Figure 6. Post Dredging Sediment PCB Concentrations in the Ashtabula River
Bank to Bank to Bedrock Dredging Option

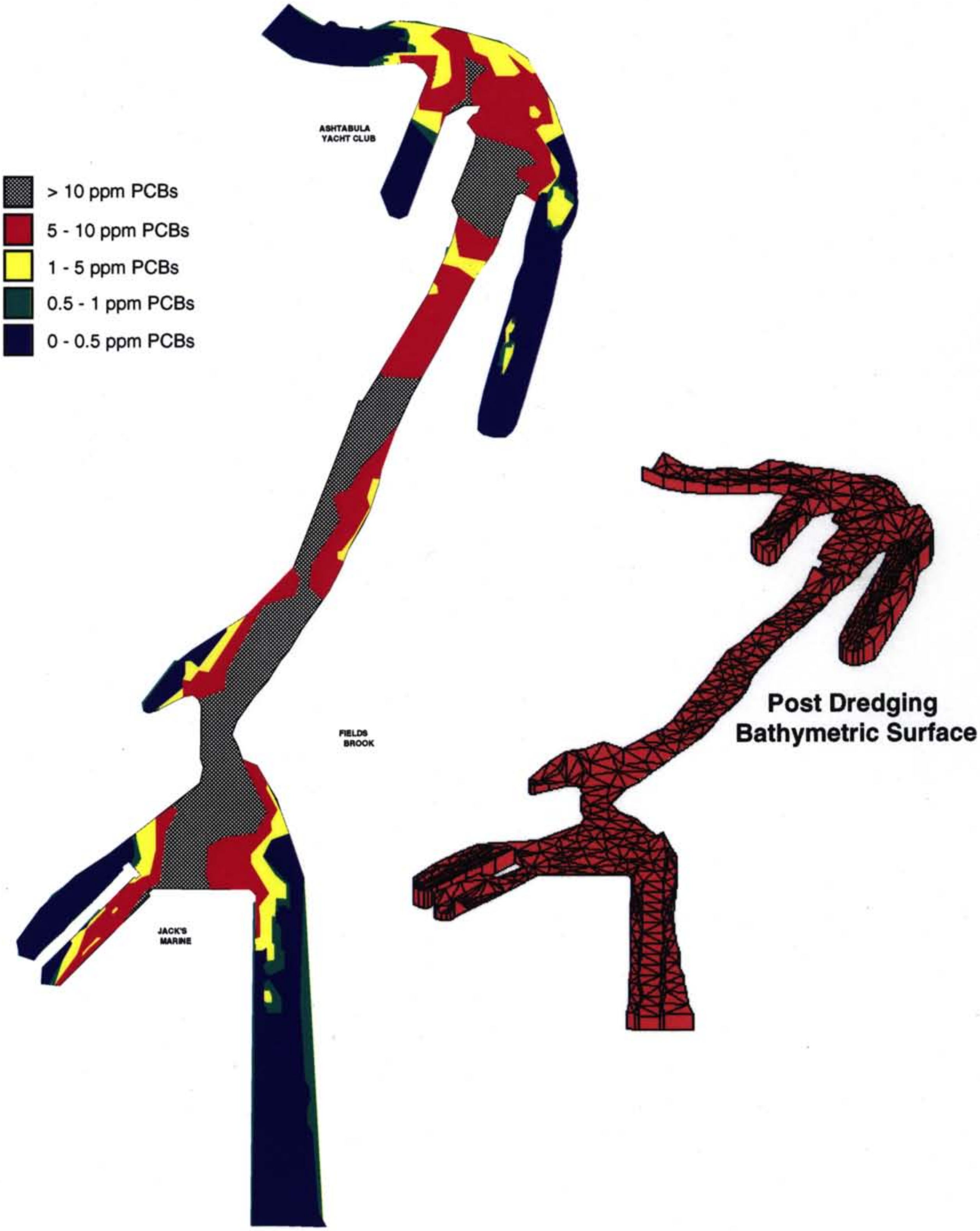


Figure 7. Post Dredging Sediment PCB Concentrations in the Ashtabula River
Deep Dredging Option

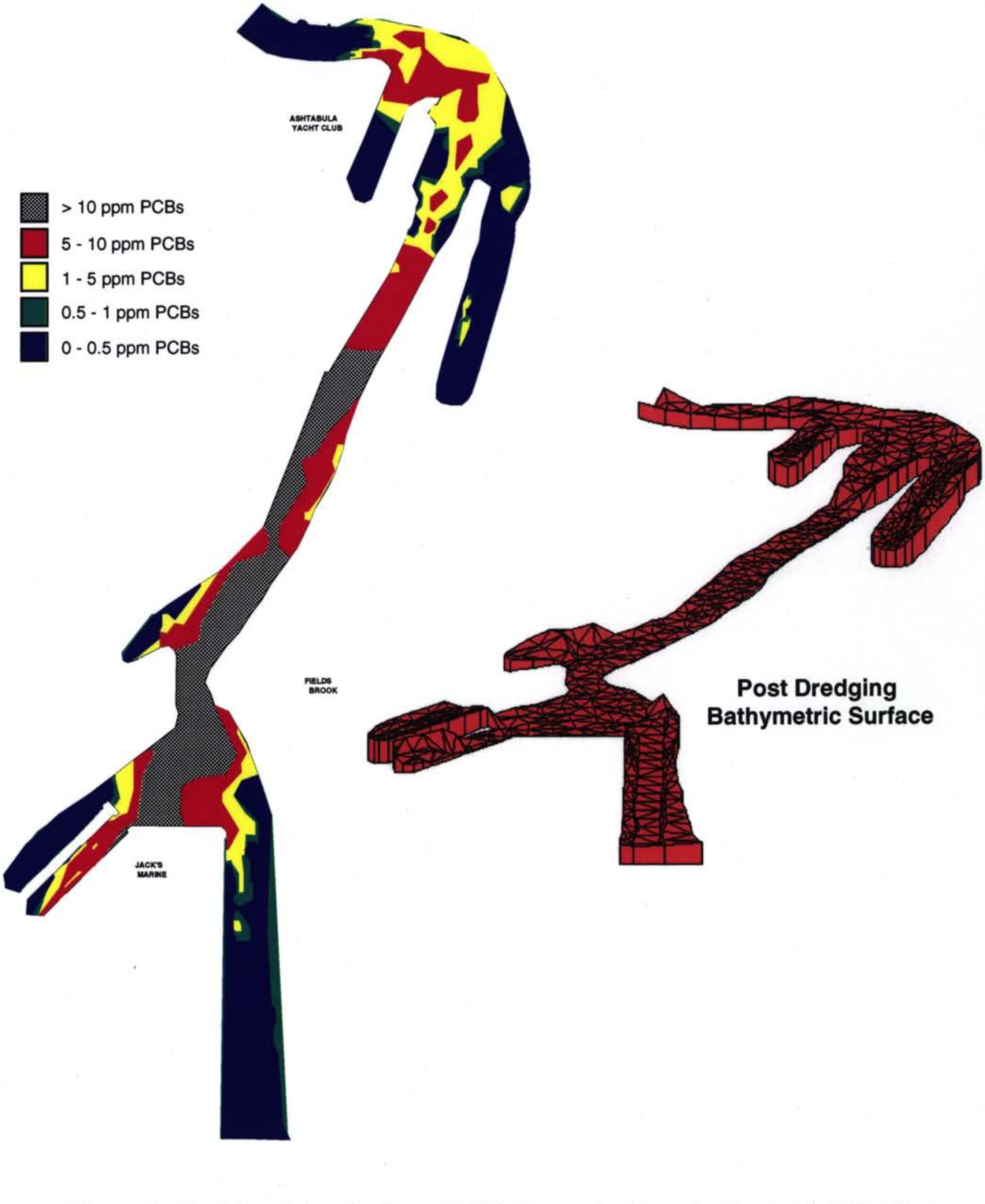


Figure 8. Post Dredging Sediment PCB Concentrations in the Ashtabula River
Shallow Dredging Option

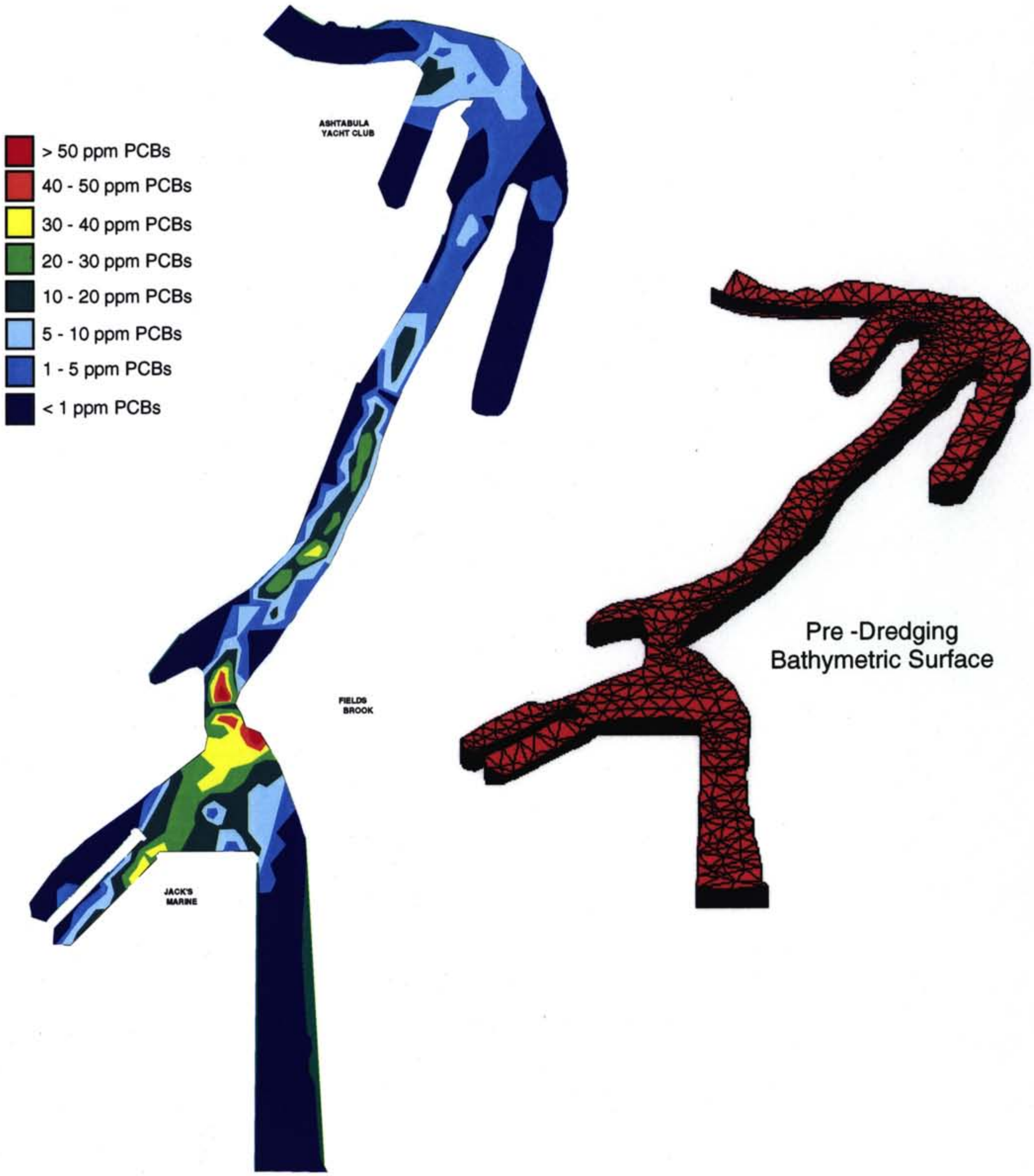


Figure 9. Pre-Dredging Sediment Bathymetry and PCB Concentrations in the Ashtabula River

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX F

ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT CONSIDERATIONS FOR DREDGING THE ASHTABULA RIVER AND HARBOR

ASHTABULA RIVER PARTNERSHIP
EIS AND COMPREHENSIVE MANAGEMENT PLAN

APPENDIX F

Environmental Risk Assessment and Management Considerations for Dredging the Ashtabula River and Harbor

Purpose

The purpose of this appendix is to discuss environmental issues involved in remediating the contaminated sediment in the Ashtabula River and Harbor. Generally, a risk assessment consists of a qualitative and/or quantitative evaluation of the actual or potential impacts of contaminants on humans, animals, and plants. A qualitative risk assessment approach is deemed most appropriate for this project because of the project specific issues which include the following: 1) the three dredging alternatives being evaluated in the EIS result in similar post-remedial surface area weighted concentrations for PCBs (i.e. all within a few ppm PCBs) and therefore would not result in much different quantitative risk estimates; 2) because the most highly contaminated sediments are at deeper depths, dredging must continue below navigable depths (i.e. 6-8 feet), otherwise the most highly contaminated sediments would be left at the surface and available for uptake by biota; and 3) an important goal of the partnership is to ensure that sediment dredged in the future can be open-water disposed, which cannot be predicted using standard risk assessment techniques. Therefore, the scope of this appendix is to provide a qualitative analysis of the human health and ecological risk considerations, in support of the EIS' goal of developing and evaluating alternatives for the project.

Background

Contamination in the sediment has transferred to fish, affected habitat quality, and has restricted lower Ashtabula River commercial and recreational use. Due to natural sedimentation and shoaling, the Ashtabula River and Harbor need to be dredged on a regular basis to maintain adequate navigation depths. However, because of the levels of contaminants in the sediment, these sediments are not suitable for unrestricted open-lake disposal and, instead require confined disposal. Currently, there is no confined disposal facility (CDF) available to contain dredged Ashtabula River sediment. As a result, navigable channel maintenance cannot be conducted. In addition, the total mass of PCBs in the River is such that future events could reasonably result in continued downstream migration of PCBs and other contaminants of concern into Lake Erie resulting in sediment and fish contamination well into the future. Removal of the bulk of this mass will dramatically reduce potential ecological and human health risk from the site, not only in the present, but also significantly reduce the potential for release in the future.

The Ashtabula River Partnership has been described earlier in this document, however, the goals of the Partnership's sediment remediation project bear repeating:

- Full recreational and commercial use of the River, including recreational boating and fishing;

- Future dredged sediments will be suitable for open-lake disposal once remediation has been completed;

- Long-term risk reduction to human health and the environment, including complete removal of the fish advisory;

- Preventing recontamination of the River and loadings to Lake Erie by addressing those sediments that could be released and redistributed via scouring and storm events;

- Remove as much PCB mass, and other contaminants of concern, as feasible (e.g. technical, economic); and,

- Restoration of fish and benthic communities, wildlife populations (e.g. fish-eating birds and mammals), and ecological habitat.

All of the above goals help in evaluating and selecting remedial alternatives. However, when actually selecting an appropriate alternative, the issues of project feasibility and cost are also important.

Contaminants of Concern

The sediment has been well characterized in the Ashtabula River and Harbor, and has been discussed extensively in this document. This appendix will focus on the main contaminants of concern in the Ashtabula River Area of Concern (AOC) due to their level and extent of contamination. Specifically, the focus will be on PCBs and to a somewhat lesser degree, PAHs. There are other contaminants in the AOC, specifically metals (e.g., chromium, cadmium, mercury, arsenic) and organics (e.g., hexachlorobenzene, octochlorostyrene) which while not discussed explicitly are also of concern. It is assumed in this analysis that by focusing on PCBs and PAHs, the other contaminants of concern will be addressed due to the co-localization of contaminants. The contaminants that have been detected in Ashtabula River sediment, surface water and fish are summarized in Table 2 (Ohio EPA, Stage 1 Report, 1991).

Risk

Generally, a risk assessment consists of a qualitative and/or quantitative evaluation of the actual or potential impacts of contaminants on humans, animals, and plants. The human health risk assessment evaluates the potential for unacceptable risk to humans through exposure to contaminants from an area of concern or site. The ecological risk assessment evaluates the potential impacts of contaminants from an AOC or another site on animals and plants. As discussed above, a qualitative rather than a quantitative risk assessment approach is deemed most appropriate for this project for a number of reasons. As discussed in Appendix _E_, the sediment post-remedial surface area weighted PCB concentrations for the three dredging alternatives being evaluated in the EIS are all within a few ppm of each other and therefore, would result in similar risk estimates.

PCBs are a mixture of many different compounds or aroclors which can vary in terms of their toxicity, degree of chlorination, and log K_{ow} (degree to which compound is hydrophobic). In general, the more highly chlorinated the aroclor, the more stable and lipid soluble, less degradable, and more strongly adsorbed by sediment it becomes. PCBs can biomagnify in aquatic and terrestrial food chains which means they increase in concentration at each step of the food chain. They remain in aquatic food chains for a long time due to their persistence. Some of the higher chlorinated aroclors are found in the Ashtabula River sediment and fish tissue, specifically aroclors 1248 and 1260.

PCBs build up in the environment and cause a number of harmful effects, including both cancer and noncancer adverse effects. Non-carcinogenic health effects such as reproductive impairment, neurotoxicity, developmental toxicity, endocrine disruption, and immunosuppression have also been associated with exposure to PCBs. Some PAHs have been found to cause cancer in both humans and animals. PAHs have also been found to cause noncancer adverse health effects including difficulties in reproduction, decreased body weight, immunosuppression, and harmful effects to the skin.

Human Health

There are several potential ways that contaminated sediment in the Ashtabula River and Harbor could potentially impact human health. The contaminants in the sediment can be taken up by fish and cause adverse health effects to those who consume the contaminated fish. This is specifically an issue for PCBs because the higher chlorinated aroclors, many of which are found in Ashtabula, are persistent and bioaccumulative compounds. In addition, people swimming and recreating in the River could come into contact with the surface water and sediments.

The Assessment and Remediation of Contaminated Sediments (ARCS) program of the Great Lakes National Program Office (GLNPO) developed a risk assessment of the Ashtabula River and Harbor (Crane, 1992) . This document dated December, 1992, presented a screening level risk assessment of human health only for the AOC. This risk assessment found that out of all exposure pathways investigated, consumption of contaminated fish was the most significant exposure (over ingestion of contaminated surface water, and dermal exposure to sediment). Further, it found that the PCB-contaminated fish in the River were posing a level of carcinogenic risk to various types of anglers in the range of 10^{-3} (i.e. the probability of one excess cancer in 1000 people) to 10^{-9} (i.e. the probability of one excess cancer in one billion people). This risk range is due to different assumptions on how much and what type of fish people may consume from the Ashtabula River.

The risk assessment used the average levels of contamination found in large mouth bass, small mouth bass, bluegill, and carp caught in the Ashtabula River. The concentrations of PCBs in bass, blue gill, and whole carp used in the risk assessment were: non-detect, non-detect, and 0.81 respectively (1990, Woodward-Clyde). The cancer risk estimated for fish with non-detect levels of PCBs were from other contaminants, such as 1,1,2,2-tetrachloroethane. The 10^{-3} risk correlates with the assumption that people eat 130 grams a day of whole carp from the Ashtabula River 350 days a year whereas the 10^{-9} risk is for people who eat 19 grams a day of bass fillets, on average, 350 days a year. In addition to carcinogenic risks, fish contaminated with PCBs have been implicated in non-carcinogenic health effects such as neurotoxicity, developmental toxicity, endocrine disruption, and immunosuppression.

More recent fish data are now available. Ohio EPA collected several species of fish in 1994 (large mouth bass, small mouth bass, carp, rock bass, catfish, redhorse, walleye and drum). On average, PCB concentrations in fish increased by approximately 0.5 parts per million over the concentrations reported in 1990. Although this is not considered to be a statistically significant increase, it does indicate that fish in the Ashtabula River continue to be contaminated with PCBs. The levels of PCBs have not declined to completely safe levels and those consuming a larger number of fattier fish such as carp have the greatest risk.

This is consistent with the Ohio Department of Health's (ODH) fish advisory. In 1983, ODH issued a fish consumption advisory on all species in the Ashtabula River based on significantly elevated levels of PCBs in fish tissue samples. In 1997, the fish consumption advisory was revised based on decreased levels of PCBs more recently measured in fish. The current fish consumption advisory is less stringent. It places specific limits on the amounts of smallmouth bass, largemouth bass, walleye, channel catfish, and common carp that can be safely consumed. Because common carp and channel catfish contain the highest levels of PCBs, the amount of these species that can be safely consumed is much less than for other species. The amounts of fish that can be safely consumed were determined by ODH using the Great Lakes Sport Fish Advisory Task Force September 1993 protocol titled "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory." This protocol is used consistently by ODH to issue fish advisories in Ohio.

The less stringent 1997 fish consumption advisory is due, in part, to the more highly contaminated sediments being buried by cleaner sediments, which are therefore less available for uptake by biota. The lower river has not been dredged since 1962, due to the contaminated sediments which require confined disposal. So, sedimentation in the watershed over the long-term has yielded some benefit to the fish community. It has also resulted in the need for substantial dredging to maintain navigable depths for both commercial and recreational purposes.

If either bank-to-bank-to-bedrock or deep dredging is implemented and the majority of PCB mass is removed, long-term protection is expected to be achieved. Ongoing sedimentation in the Ashtabula River, while historically low on an annual basis, will gradually cover any low level residual contaminants left behind. Since 1983, significant reductions in the concentration of

PCBs in fish have occurred due in part to cleaner sediments burying contaminated sediments, and also due to discharger compliance. After cleanup, it is expected the fish consumption advisory will be lifted and long-term protection will be achieved, because the majority of the PCB mass will be removed. In order to maintain navigable depths for recreational purposes, future dredging in the lower river will likely be conducted to no more than -8 feet depth. Therefore, an adequate buffer will exist between any residual contamination and clean sediment that will eventually cover it, ensuring long-term protection of human health.

Ecological

PCBs are a particular concern to aquatic food chains because of the process known as biomagnification where contaminant concentrations increase at each step of the food chain. For instance, microscopic floating aquatic plants known as phytoplankton containing very low levels of PCBs are eaten by zooplankton, primarily microscopic floating aquatic animals. Zooplankton are eaten by small fish, which are then eaten by larger fish. Fish-eating birds, such as herons and kingfishers, and fish-eating mammals, such as mink, then eat the fish, resulting in significantly elevated PCB levels compared to those measured in animals lower in the food chain. Highly elevated levels of PCBs have been measured in bird eggs as well. Because of the concentrations of PCBs detected in fish and the ability of PCBs to biomagnify up into the food web, fish-eating birds and mammals have the highest potential to experience any associated toxicological effects.

Direct exposure pathways to PCBs in aquatic systems include the ingestion of surface water and sediment as well as dietary exposure through the food chain. Exposure of aquatic organisms to PCBs has been documented to result in a number of sublethal effects including reduced growth, reduced reproduction, and biochemical perturbations. The most significant route of PCB exposure in birds is through dietary exposures which have been documented to adversely effect growth, reproduction, behavior, metabolism, and hepatic metabolism (e.g. affects liver function). The interspecies sensitivities to PCBs varies widely even between species that are taxonomically closely related. For instance, mink have been found to be extremely sensitive to PCBs which cause adverse effects on reproduction even at very low levels. In aquatic plants, PCBs have been found to cause reduced growth through a reduction in photosynthetic activity as a result of diminished chlorophyll content.

Sediment screening values, also commonly referred to as sediment quality criteria or ecologically-based benchmarks, can be defined as contaminant concentrations above which there is sufficient concern regarding adverse ecological effects to warrant further site investigation (USEPA, 1996). In USEPA (1996) *Ecotox Thresholds,* the ecotox threshold for total PCBs is 0.023 mg/kg which is based on the Long et al. (1995) effects range- low (ERL) value. The ERL is defined by Long et al. (1995) as the lower 10th percentile of the data analyzed from a variety of marine and freshwater environments and indicates the low end of the range of concentrations in which adverse effects have been observed or predicted in various studies. Similarly, the ERL reported in USEPA (1996) from Long et al. (1995) is 4.0 mg/kg for PAHs. These screening values are considered to be conservative and are not clean up goals. They are values below which further study is generally not warranted.

The statistical analysis of 1990 and 1995 Ashtabula River sediment sampling data reported a maximum PCB concentration of 660 mg/kg and 160 mg/kg, respectively and an average concentration of detected samples of 18.2 mg/kg and 15.7 mg/kg, respectively. The sampling locations closest to Fields Brook contain the highest concentrations as expected and decrease with distance down the river (refer to Table 7 of Draft 1997 Feasibility and Planning Report). Therefore, exposure to the areas nearest to Fields Brook have the highest potential for adverse effects to ecological receptors. Because of the concentrations of PCBs detected in fish and the ability of PCBs to biomagnify up into the terrestrial food web, fish-eating birds and mammals have the highest potential to experience any associated toxicological effects.

If either bank-to-bank-to-bedrock or deep dredging is implemented and the majority of PCB mass is removed, long-term protection is expected to be achieved. Ongoing sedimentation in the Ashtabula River, while historically low on an annual basis, will gradually cover any low level residual contaminants left behind. Since 1983, significant reductions in the concentration of PCBs in fish have occurred due in part to cleaner sediments burying contaminated sediments, and also due to discharger compliance. After cleanup, it is expected the fish consumption advisory will be lifted and long-term protection will be achieved because the majority of the PCB mass will be removed. In order to maintain navigable depths for recreational purposes, future dredging in the lower river will likely be conducted to no more than -8 feet depth. Therefore, an adequate buffer will exist between the residual contamination left behind and the amount of clean sediment that will eventually cover it to help ensure long-term protection of the environment.

Assessing Future Open-Lake Disposal Suitability

In 1993, USACE-Buffalo analyzed sediment in the lower river and harbor for suitability for open-water disposal, in accordance with the revised Clean Water Act Section 404 Great Lakes Dredge Material Testing and Evaluation Guidance (1997). This guidance utilizes the results of bioassays to determine environmental quality of sediments, instead of relying solely upon sediment chemistry. Twelve management units, or sediment areas, were defined for this testing (6 in the lower River and 6 in the Harbor--see Figure 4.2 CMP). The results of the bioassays from these test areas were then compared to results obtained from sediments at a lake reference site to determine any significant difference. This comparison was the primary criterion used to determine the suitability of the harbor sediments for open-lake disposal. Based on the contamination information known about the sediments, the following bioassays were done:

- Toxicity tests using *Chironomus tentans* (midge larvae) and *Hyallela azteca* (amphipod); assessing toxicity of PAHs and metals, and,

- Quantitation of the bioaccumulation of total PCBs using *Lumbriculus variegatus* (aquatic earthworm).

Based on the results of these assays, all of the Harbor management units and the two most downstream River management units were considered suitable for open water-disposal (management units H1-6, and R1 and R2). However, three upstream River management units (R3, R5a and R5b) did not pass one or more of the assays. The main contaminants considered to be responsible for the toxicity observed in these tests are PCBs for the bioaccumulation, and PAHs plus other contaminants for the toxicity tests. Note: Due to the presence of multiple contaminants, the toxicity cannot be attributed solely to a particular contaminant or group of contaminants for the toxicity tests.

The highest level to pass this bioaccumulation test (a "pass" indicates that the bioaccumulation of PCBs was not significantly elevated when compared to the reference exposures) was 0.95 ppm PCBs dry weight in the sediment. The lowest levels found to cause significant bioaccumulation using *Lumbriculus variegatus* was 2.6 ppm PCBs dry weight in the sediment. River management units R3, R5a and R5b had significantly higher PCB tissue concentrations compared to the reference sites. It is important to note that a limitation of this test is that it does not address biomagnification for animals higher in the food chain. Therefore, the results from this test cannot be used to determine whether these concentrations are protective of fish-eating birds and mammals. However, in the preliminary Draft 1997 report titled "Development of Polychlorinated Biphenyl (PCB) Sediment Cleanup Guidelines for Ashtabula Harbor (Upper River), Ohio" (Pickard 1997), it was determined that total PCB concentrations of 0.32 and 0.40 ppm are concentrations near which Ashtabula River sediments would not cause bioaccumulation to levels greater than those present in Lake Erie environs and would therefore be suitable for open-water disposal.

For PAHs, the most relevant sediment chemistry data for the lower river is from 1992. (Bioassays were done in 1993.) Because these analyses were done at different times, the location of the samples taken do not exactly match the management units chosen in 1993, but there is significant overlap (see Figure 4-8, CMP). The highest level found to pass the *Chironomus tentans* toxicity test (a "pass" indicates that the results from the test sites are not significantly different when compared to the reference site results) was 11.6 ppm total PAHs. The lowest level found to cause significant adverse effects in this organism is 27.7 ppm total PAHs. Therefore, a range of 10-20 ppm total PAHs may be an appropriate target. In addition, it needs to be noted that there is a high level of uncertainty regarding the impacts from PAHs versus other contaminants because of the multiple contaminants present. However, due to the co-localization of contaminants in the sediment, addressing the removal of PAHs and PCBs in sediment should help address the other contaminants present.

PCB Mass

The Ashtabula River AOC currently contains approximately 11,000 kg of PCBs, of which 1700 kg is TSCA-regulated material (≥50 ppm PCBs). To ensure removal of all TSCA material, the ARP has agreed to use 40 ppm as the cutoff for TSCA-regulated material. Therefore, this mass will be greater than 1700 kg. The PCB mass contributes to risk in two main ways. First, the exposed sediment has transferred into ongoing fish contamination. Secondly, the mass of PCBs can be released and redistributed during storm events, scouring, etc. allowing for recontamination of the river and a continued loading of available PCBs and other contaminants in the future to the river and potentially the Great Lakes Basin.

It is important to realize that the Ashtabula River is a dynamic system. Sediment from cleaner upstream areas continues to cover the contaminants. However, it is clear that river sediments are mobile, and that contaminated sediment currently buried may become exposed and bioavailable during a future storm or scouring event, and thereby contribute to risk in the future. And, unfortunately, as sedimentation slowly continues without dredging being conducted, the minimum depth needed for recreational and commercial activities will not exist. The contaminated sediment cannot be open-water disposed. Therefore, the overall best long-term approach is removal of the PCB mass, which will ensure long-term protection and open-water disposal in the future.

Choosing and Evaluating Dredging Alternatives

As discussed in the draft EIS (See Dredging Scenarios Appendix), there are currently three dredging alternatives under consideration: bank-to-bank-to-bedrock, shallow and deep. The bank-to-bank-to-bedrock alternative seeks to remove all of the sediment in the river, to the maximum extent possible. The deep alternative removes all of the sediment starting from the upper turning basin down to station 158 (near the lower turning basin), and then, downstream of that point, removes all sediments greater than 10 ppm (from roughly the lower turning basin to the Harbor). This alternative does not dredge sediment in river sideslips nor the upstream areas of the AOC (roughly station 207 to station 193). The shallow dredging option is similar to the deep in that it also removes all sediment from the upper turning basin and continues downstream, removing all sediments greater than 10 ppm PCBs, except for river sideslips and upstream of station 193. The shallow option differs from deep dredging in that it does not dredge the most downstream TSCA-regulated (>50 ppm PCBs) area, near station 158. The deep dredging option removes this TSCA-regulated mass, which is estimated to be 489 cubic yards.

To meet the goals of the partnership remediation, sediments need to be dredged to maintain navigable depths and to ensure that future dredged sediments will be eligible for open-water disposal. However, dredging will reveal significantly higher levels of contamination at a depth for recreational navigation (-8 feet), and therefore dredging will need to continue beyond this depth. Although a quantitative risk assessment is often used to develop cleanup goals that help drive the selection and evaluation of remedial alternatives, a full quantitative risk assessment is not sufficient in this case to select remedial alternatives, given the following project issues:

-most of the highly contaminated sediment lies at considerable depth, therefore once dredging begins it is critical to continue dredging in many areas down to bedrock to remove highly contaminated material;

-given where the mass of contaminants are and the goal of open-water disposal for future dredged sediments, the range of possible alternatives is limited, and requires that any alternative be fairly comprehensive (i.e. high amount of removal is necessary); and

-the current alternatives under consideration are reasonable and appropriate, and a quantitative cleanup goal analysis would in all likelihood generate similar alternatives.

Therefore, to best evaluate the proposed dredging alternatives, a weight of evidence approach that considers several factors, not just risk, is employed. A matrix with the three dredging alternatives was developed, and considers the following factors: 1) PCB mass removed; 2) surficial PCB sediment concentration after dredging; 3) beneficial uses addressed; and 4) scour/release potential (see Table 1). Note: In addition to these factors, both cost and feasibility need to be considered when weighing the dredging alternatives.

The post-remedial surface area weighted sediment concentrations of the Ashtabula River were estimated by USACE-Buffalo, using the Groundwater Modeling System (GMS) computer simulation program. The amount of PCB mass removed was also calculated by USACE-Buffalo and utilized the same model of the River to estimate PCB mass before and after the different remedial dredging alternatives (Table 1). All sediment sampling data including location, volume, and contaminant level were entered into the GMS to create a three dimensional "mesh" of the River. The model uses this 3-D mesh to calculate the contours of sediment at the surface in terms of width, depth, and PCB concentration, as well as the volume of sediment and mass of PCBs that will be removed. To compare the dredging alternatives, post-remedial conditions were modeled using the GMS, whereupon the model graphically shows the river bottom where sediment is dredged under each scenario. Dredging efficiencies are taken into account to calculate the PCB concentrations and volumes of sediment left at the river bottom after dredging.

It may seem surprising that this analysis shows that the *less* that is dredged, the *lower* the resulting surface concentration (Table 1). This is due to the PCB contaminant distribution associated with the sediment. In general, the bank-to-bank-to-bedrock and deep dredging scenarios require more river bottom to be dredged, thus exposing more contaminated material which results in higher overall post-dredging concentrations. In addition, dredging is not a 100% efficient technology, and accordingly may leave behind a small residue. As a result, dredging high volumes of the most contaminated areas of the river bottom will leave behind the most contaminated residue. Although post-dredging PCB surface concentrations are somewhat elevated, it is expected that they will gradually decrease in their overall concentration, as natural mixing with cleaner sediment occurs during post-cleanup years.

The matrix in Table 1 clearly shows that taking no action will not reduce long-term risk and future potential release into the lake, nor address beneficial use impairments. In addition, the shallow dredging option leaves behind TSCA-regulated sediments, which is generally unacceptable to the TSCA program and increases the uncertainty of whether dredged river sediments will be eligible for open-water disposal in the future. In all three dredging scenarios, relative current risk reduction is not significantly different. The reason for this is that post-remedial surface area weighted PCB sediment concentration for each dredging scenario varies by only a few parts per million, which will not generate measurable differences in risk.

If either bank-to-bank-to-bedrock or deep dredging is implemented and the majority of PCB mass is removed, long-term protection is expected to be achieved. The GMS model indicates that after dredging, surface area weighted PCB sediment concentrations will approximate current surficial concentrations. Ongoing sedimentation in the Ashtabula River, while historically low on an annual basis, will gradually cover any low level residual contaminants left behind. Since 1983, significant reductions in the concentration of PCBs in fish have occurred due in part to cleaner sediments burying contaminated sediments, and also due to discharger compliance. After cleanup, it is expected the fish consumption advisory will be lifted and long-term protection will be achieved because the majority of the PCB mass will be removed. In order to maintain navigable depths for recreational purposes, future dredging in the lower river will likely be conducted to no more than -8 feet depth. Therefore, an adequate buffer will exist between the residual contamination left behind and the amount of clean sediment that will gradually cover it to help ensure long-term protection of human health and the environment.

The bank-to-bank to-bedrock alternative is the most protective and conservative in terms of PCB mass reduction, addressing most use impairments, and reducing scour potential. It attempts to remove practically all of the PCBs in this system. However, the bank-to-bank to-bedrock alternative also has extremely high implementation costs and concerns regarding river bank stability. The deep dredging alternative provides a similar degree of protectiveness and accomplishes much of what the bank to bank to bedrock does at a significantly lower cost. Deep dredging removes all TSCA material and a significant PCB mass (82%), substantially reducing any future scouring and potential release of elevated levels of contaminants. In addition, this large PCB mass removal gives greater assurance of open-water disposal for future dredging. In addition, deep dredging will likely facilitate river bank stability, help sustain habitat diversity, and perhaps, generate the least impact to ecological communities along the channel edges, compared to bank-to-bank to-bedrock dredging. Given the high costs and logistical issues inherent with bank-to-bank to-bedrock, and the positive anticipated results of the deep dredging alternative, the deep dredging alternative is the recommended starting point.

The dredging alternatives discussed are primarily based on PCB contamination. As noted previously, there are other contaminants of concern in this system, notably PAHs. Most of the PAH contamination is in the downstream portion of the River, starting at station 138. Currently, the draft EIS calls for dredging 120,000 yds^3 of the lower river and Harbor sediments, in areas where PAH contamination is of greatest concern. Utilizing the approach discussed in the

Assessing Open-Lake Disposal Suitability section above, it is recommended to dredge those areas with the greatest likelihood of being unsuitable for open-water disposal (i.e., >10 ppm total PAHs) as the highest priority areas for the 120,000 ^{yds}. In addition, post-remedial design should include habitat restoration to further address impaired beneficial uses. It is anticipated that a habitat restoration plan will be developed at a later date with appropriate parties.

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Table 1. Alternatives Matrix

Dredging Scenarios	**PCB Mass Removed[1]**	**PCB Sediment Concentration Left Behind in ppm[1,2] (Surface Area Weighted)**	**Beneficial Uses Addressed (Including Open-Lake Disposal and Risk)**	**Scour/Release Potential (Future risk and loading to the Lake)**
No Action	none	6.3	none	High
Bank to Bank to Bedrock	98%	4 8.6	open-lake disposal ++ recreational and commercial shipping ++ fish advisory lifted ++ long-term risk reduction ++ habitat quality +	Low
Deep	82%	3.6 7.5	open-lake disposal + recreational and commercial shipping ++ fish advisory lifted + long-term risk reduction + habitat quality ++	Low
Shallow	75% (one TSCA regulated mass remains)	3 6.3	open-lake disposal +/- recreational and commercial shipping + fish advisory lifted +/- long-term risk reduction +/- habitat quality +	Medium

[1]*Surface concentrations and percent mass removal estimates are from Dave Conboy, USACE-Buffalo*

[2]*The two concentrations shown refer to whether dredging will be one pass (second number) or two passes to increase efficiency (first number)*

Where:

- -	-	+/-	+	++
poor	low	no difference	good	excellent

Table 2: Pollutants identified in the Ashtabula River Area of Concern. This table was compiled from the results of a number of studies conducted in the area since 1975. This table documents only positive identification of pollutants.

PARAMETER	PRIORITY POLLUTANT	CARCINOGEN	PERSISTANT TOXIC*	WATER				SEDIMENT				FISH
				OUTER HARBOR	ASHTABULA RIVER	FIELDS BROOK	LAKE ERIE	OUTER HARBOR	ASHTABULA RIVER	FIELDS BROOK	LAKE ERIE	
Inorganics												
Aluminum	N	N	N	X	X	X	-	X	X	X	-	-
Arsenic	Y	Y	Y	-	-	-	X	X	X	X	X	X
Barium	N	N	N	X	X	X	X	X	X	X	X	-
Beryllium	Y	Y	-	-	-	-	-	-	X	X	-	X
Cadmium	Y	N	Y	X	X	X	X	X	X	X	X	-
Chromium	Y	N	Y	X	X	X	X	X	X	X	X	-
Copper	Y	N	Y	X	X	X	X	X	X	X	X	X
Cyanide	Y	N	N	-	X	-	-	X	X	X	-	-
Iron	N	N	Y	X	X	X	X	X	X	X	X	-
Lead	Y	N	Y	X	X	X	X	X	X	X	X	X
Manganese	N	N	N	X	X	X	-	X	X	X	X	-
Mercury	Y	N	Y	X	X	X	X	X	X	X	X	X
Nickel	Y	N	Y	X	-	-	X	X	X	X	X	-
Nitrogen (Ammonia)	N	N	N	X	X	X	X	X	-	-	X	-
Nitrate + Nitrite	N	N	N	X	X	X	X	X	-	-	X	-
Phosphorus	N	N	N	X	X	X	X	X	-	-	X	-
Oil and Grease	N	N	N	-	-	-	-	X	X	-	X	-
Silver	Y	N	-	-	-	-	-	-	X	X	-	X
Zinc	Y	N	Y	X	X	X	X	X	X	X	X	X
Total Dissolved Solids	N	N	Y	X	X	X	X	-	-	-	-	-
Phenols	Y	N	-	-	-	-	-	X	X	-	X	-
Organics												
Aldrin + Dieldrin	Y	Y	Y	X	X	-	X	-	X	-	-	-
PCBs	Y	Y	Y	-	-	-	X	X	X	X	X	X

Table 2: Pollutants identified in the Ashtabula River Area of Concern. (Continued)

PARAMETER	PRIORITY POLLUTANT	CARCINOGEN	PERSISTANT TOXIC*	WATER: OUTER HARBOR	WATER: ASHTABULA RIVER	WATER: FIELDS BROOK	WATER: LAKE ERIE	SEDIMENT: OUTER HARBOR	SEDIMENT: ASHTABULA RIVER	SEDIMENT: FIELDS BROOK	SEDIMENT: LAKE ERIE	FISH
PAHs												
Acenaphthene	Y	Y	-	-	-	-	-	X	-	-	-	-
Anthracene	Y	Y	-	-	-	-	-	X	X	-	-	-
Benzo(a)anthracene	Y	Y	-	-	-	-	-	X	X	-	X	-
Benzo(a)pyrene	Y	Y	-	-	-	-	-	X	X	X	X	-
Benzo(b)fluoroanthene	Y	Y	-	-	-	-	-	X	X	-	X	-
Chrysene	Y	Y	-	-	-	-	-	X	X	-	X	-
Fluoranthene	Y	Y	-	-	-	-	-	X	X	X	X	X
Fluorene	Y	Y	-	-	-	-	-	X	X	-	-	-
Naphthalene	Y	Y	-	-	-	X	-	X	X	-	-	-
Phenanthrene	Y	Y	-	-	-	-	-	X	X	X	X	-
Pyrene	Y	Y	-	-	-	-	-	X	X	-	-	-
2-chloronaphthalene	-	-	-	-	-	-	-	-	X	-	-	-
Benzo(k)fluoranthene	Y	Y	-	-	-	-	-	-	X	-	-	-
Other Organics												
Acetone	N	N	-	-	-	-	-	-	X	X	-	-
Benzene	Y	Y	-	-	-	-	-	-	-	X	-	-
Bis(2-ethylhexyl) phthalate	Y	N	Y	-	-	-	-	X	X	X	X	-
2-butanone	N	N	-	-	-	-	-	-	X	X	-	-
Butylbenzyl phthalate	Y	N	Y	-	-	-	-	-	X	X	-	-
Chlorobenzene	Y	N	-	-	-	-	X	-	X	-	-	-
Chloroform	Y	Y	-	-	-	X	-	-	-	X	-	-
1,1-dichloroethene	Y	Y	-	-	-	-	-	-	-	X	-	-
Diethyl phthalate	Y	N	Y	-	-	X	-	-	-	X	-	-
Dimethyl phthalate	Y	N	Y	-	-	-	-	-	-	X	-	-
Di-n-butyl phthalate	Y	N	Y	-	-	-	-	-	X	X	-	-
Ethylbenzene	Y	N	-	-	-	-	-	-	X	X	-	-

Table 2: Pollutants identified in the Ashtabula River Area of Concern. (Continued)

PARAMETER	PRIORITY POLLUTANT	CARCINOGEN	PERSISTANT TOXIC*	WATER OUTER HARBOR	WATER ASHTABULA RIVER	WATER FIELDS BROOK	WATER LAKE ERIE	SEDIMENT OUTER HARBOR	SEDIMENT ASHTABULA RIVER	SEDIMENT FIELDS BROOK	SEDIMENT LAKE ERIE	FISH
Other Organics (Continued)												
Fluorotrichloromethane	N	N	-	-	-	-	-	-	-	X	-	-
Hexachlorobenzene	Y	Y	-	-	-	X	X	-	X	X	-	X
Hexachlorobutadiene	Y	Y	-	-	-	X	-	-	X	X	-	X
Hexachloroethane	Y	Y	-	-	-	-	-	-	X	X	-	-
Methylene chloride	Y	Y	-	-	X	X	-	X	X	X	X	-
1,2-Dichlorobenzene	Y	N	-	-	-	X	X	-	-	-	-	-
1,3-Dichlorobenzene	Y	N	-	-	-	X	X	-	X	-	-	-
1,4-Dichlorobenzene	Y	N	-	-	-	X	X	-	X	-	-	-
n-nitrosodiphenylamine	Y	Y	-	-	-	X	-	-	-	-	-	-
Carbon tetrachloride	Y	Y	-	-	-	X	X	-	-	-	-	-
Octachlorostyrene	N	N	-	-	-	-	-	-	X	-	-	X
Xylene	N	N	-	-	-	-	-	-	X	X	-	-
Pentachlorobenzene	N	N	-	-	-	-	X	-	-	-	-	X
1,1,1,2-tetrachloro-ethane	N	N	-	-	-	-	-	-	X	-	-	-
1,1,2,2-tetrachlor-ethane	Y	Y	-	X	X	X	-	-	-	X	-	-
Tetrachloroethene	Y	Y	-	X	X	X	-	-	X	X	-	X
1,2-transdichloroethene	N	N	-	-	-	X	-	-	-	X	-	-
1,1,2-trichloroethane	Y	Y	-	-	-	X	-	-	-	X	-	-
1,1,1-trichlorethane	Y	N	-	-	-	-	-	-	-	X	-	-
Trichloroethene	Y	N	-	X	X	X	-	-	X	X	-	X
Toluene	Y	N	-	-	-	-	-	-	X	X	-	-
Vinyl chloride	Y	Y	-	-	-	-	-	-	-	X	-	-
1,2,4-trichlorobenzene	N	N	-	-	-	-	X	-	X	-	-	-
1,2-dichloroethane	Y	Y	-	-	-	X	-	-	-	-	-	-
1,3,5-trichlorobenzene	N	Y	-	-	-	-	X	-	-	-	-	-
1,2,3,4-tetrachlorobenzene	N	Y	-	-	-	-	X	-	-	-	-	-

* As identified in the Great Lakes Water Quality Agreement

Y - Yes X - Pollutant detected in medium
N - No "-" - Pollutant not present or not tested

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX G

RADIOLOGICAL RISK ASSESSMENT FOR ASHTABULA RIVER, ASHTABULA, OHIO

Resident – Farmer

And

Worker, Dredger

PREPARED BY:

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U.S. Environmental Protection Agency
November 2000

Overview

In May 1998 and August 1999 measurements were made by the U.S. Environmental Protection Agency (USEPA) and the Ohio Department of Health, Bureau of Radiation Protection (ODH/BRP), of radionuclide concentrations in sediments of the Ashtabula River, northeast of Cleveland Ohio. Radiological constituents were believed to have entered the river from Fields Brook on which a titanium ore processing plant is operating and a uranium extrusion plant once operated. Titanium ores at the processing plant contain Naturally Occurring Radioactive Materials (uranium, thorium and actinium decay series radionuclides). Uranium at the extrusion plant was purified radioactive metal containing uranium-238, uranium-234 and uranium-235. These sediment measurements were intended to enhance the database on the contamination already known to include hazardous chemicals, including polychlorinated biphenyls (PCBs). See Map 1, 1998 sampling sites, and Map 2, 1999 sampling sites in Attachment A.

Plans are already being drawn up to remove chemically contaminated sediments above a depth known as the cutline. At the least, radiological constituents could be removed along with the chemical constituents. It is also possible that the remedy action will have to be enhanced to remove additional radiological constituents at greater depths.

In order to assess this situation, radiological risk assessments under two scenarios are performed in this document. This follows in the section labeled Radiological Risk Assessment. A risk assessment for uranium as a chemical contaminant of concern was also performed and is found further below in the section labeled Chemical Risk Assessment.

The first radiological scenario is of a resident-farmer. The assumption is that after overlying contaminated sediments were dredged from the Ashtabula River the underlying sediments, containing some degree of residual radioactivity, are later dredged up and inadvertently spread on residential land where foodstuffs are grown. This scenario is designated the **Resident-Farmer Scenario.** It is intended to answer the question of whether more sediments, below the cutline, will have to be removed.

The resulting radiological exposure is taken to be from birth to 30 years of age with six subdivisions for exposure periods of

- a baby (1 year),
- an older baby (1 year),
- a young child (3 years),
- an older child (7 years),

- a teenager (7 years) and
- an adult (11 years).

Exposure pathways for the baby and the older baby, indoors and outdoors, were

- external exposure,
- radon decay product inhalation.

Exposure pathways for the young child, the older child, the teenager and the adult, indoors and outdoors, were

- external exposure
- plant ingestion
- soil ingestion and
- dust inhalation (including radon decay product inhalation).

Risks were computed as excess risk (over background radiation risks).

The second radiological scenario, where workers were assumed to be exposed while dredging sediments from the Ashtabula River, focuses on the peak values found in the sediments above the cutline. This is the risk with no remedial action and no protective action for the workers. This scenario was designated the **Worker-Dredger Scenario.** It is intended to answer the question of whether protective measures will have to be instituted for workers involved in dredging operations. All risks are excess risks due to over background radiological concentrations.

Exposure pathways were

- external exposure and
- soil ingestion.

The period of exposure was for the two-year plus 4 month period estimated for dredging the river.

Chemical risks from uranium were also computed since soluble uranium is a chemical hazard as well. Only the residential scenario was used. Pathways were dermal exposure and incidental ingestion of soil. Estimates were made for a full lifetime of exposure, with 0-18 year olds estimated separately from 18-70 year olds. This was done to specifically ensure that childhood and adolescent exposures were estimated accurately, because they can differ from exposure patterns in adults. Concentrations were based upon the 95% Upper Confidence Limit and the maximum level. Risks were expressed as a Hazard Index where the estimated exposure is compared to a safe threshold or level of no effects.

RADIOLOGICAL RISK ASSESSMENTS

Resident-Farmer Scenario

Scenario overview: Under this scenario, it is assumed that chemical and radiological contaminants have been dredged from the upper layer of Ashtabula River sediments, the cutline depth set by chemical criteria. The issue addressed by this assessment is, "What risk do the radiological constituents found below the cutline pose?" Alternatively, "Under the plans proposed for the chemical cleanup, will the risk from underlying radiological constituents require further dredging or will the proposed dredging be sufficient?"

Under this scenario, the dredged materials are spread over the residential property where home farming is done. The resident is exposed outdoors and indoors to these radionuclides and their decay products for a period of 30 years, from birth until 30 years of age. Thirty years is a span USEPA associates with an average residence time at one property. This span was subdivided into 6 age ranges in order to assess risk for both younger and older individuals.

Under this scenario, the dredged materials are spread over the residential property where home farming is done. The resident is exposed outdoors and indoors to these radionuclides and their decay products. No exposure occurs when the person leaves the residential property. The exposure occurs in 6 age groups **Baby** (0 - 1 year), **Older Baby** (1 - 2 years), **Young Child** (3 - 5 years), **Older Child** (6 - 12 years), **Teenager** (13 - 19 years) and **Adult** (20 - 30 years). Daily activities were defined for each age group and time allotted to each so that the time fractions indoors, outdoors and away from home could be computed.

Measurement Sites: Background sites for this assessment were selected upstream of the Turning Basin, based upon 1999 sampling sites. The designations correspond to sites shown in Map 2. Data for this assessment came from 1999 data, although both 1998 and 1999 data were consulted. Both 1998 and 1999 data comprise the total database for this assessment (see Attachment C).

Contaminants of Concern: The contaminants of concern are the complete Uranium (U-238) Decay Series, the complete Thorium (Th-232) Decay Series, and the complete Actinium (U-235) Decay Series. See Attachment B.

Within each series, radionuclides were grouped individually and also by parent with immediate decay products of less than one year half-life (+ D). These groups are

URANIUM DECAY SERIES

- Uranium-238 + D [U-238 + D]
- Uranium-234 [U-234]
- Thorium-230 [Th-230]
- Radium-226 [Ra-226]
- Radon-222 + D [Rn-220 + D]
- Lead-210 + D [Pb-210 + D]

THORIUM DECAY SERIES

- Thorium-232 [Th-232]
- Radium-228 [Ra-228]
- Actinium-228 [Ac-228]
- Thorium-228 [Th-228]
- Radium-224 [Ra-224]
- Radon-220 + D [Rn-220 + D]

ACTINIUM DECAY SERIES

- Uranium-235 + D [U-235 + D]
- Protactinium-231 [Pa-231]
- Actinium-227 + D [Ac-227 + D]

These groupings correspond to slope factor groups (risk coefficients) in the U.S. Environmental Protection Agency's (USEPA) 1995 Health Effects Assessment Summary Tables (HEAST).

Contaminant Concentrations: Gross sediment concentrations by isotope were measured below the depth intended for dredging of chemicals. These are listed in Attachment C for both 1998 and 1999 data sets. Background levels were measured upstream of the Turning Basin. These are listed in Attachment C as well. For this scenario, the average background levels were subtracted from peak sediment concentrations, giving net concentrations for the risk calculations.

Exposure periods/pathways: A 30-year residence was assumed, based upon USEPA default exposure factors. This was further broken down into 6 age groups because of the differences in exposure pathways and exposure factors over time. These age groups, with the exposure pathways, were

- **Baby (0 - 1 years)**—External exposure, radon/thoron decay product inhalation
- **Older Baby (1 - 2 years)**—External exposure, radon/thoron decay product inhalation
- **Young Child (3 - 5 years)**—External exposure, plant ingestion, soil ingestion, dust inhalation (including radon/thoron decay product inhalation)
- **Older Child (6 - 12 years)**—External exposure, plant ingestion, soil ingestion, dust inhalation (including radon/thoron decay product inhalation)
- **Teenager (13 - 19 years)**—External exposure, plant ingestion, soil ingestion, dust inhalation (including radon/thoron decay product inhalation)
- **Adult (20 - 30 years)**—External exposure, plant ingestion, soil ingestion, dust inhalation (including radon/thoron decay product inhalation)

Risk equations: Risk calculations were made for each age group, for each pathway and for each radionuclide group. Risk equations for external exposure, plant ingestion, soil ingestion and dust inhalation are based on USEPA's Review Draft of the Technical Support Document for the Development of Radionuclide Cleanup Levels for Soil. Radon-220 + decay product and radon-222 + decay product equations were developed specifically for this assessment (see Attachment D). The risk equations and all the parameters by symbol, name and numerical value are listed in Attachment D.

Slope factors: Slope factors for external exposure, ingestion and inhalation are from the FY-1995 HEAST Supplement.

Other parameters: Exposure factors were taken from USEPA's Exposure Factors Handbook (1989). Additional factors were taken from USEPA'S Draft Technical Support Document for the Development of Radionuclide Cleanup Standards for Soil (soil-to-plant transfer factors);

Indoor/outdoor exposure times: Exposures are affected by whether the exposed individual is inside the home, outside the home or away from home. (e.g., radon decay product exposure is greatest inside the home; gamma ray exposure rates are diminished within a home, when there is an outdoor source, because of shielding by the walls; no exposure occurs when the individual is off the property).

- Radon refers to radon-222, a radioactive gas produced in the Uranium Decay Series, and thoron refers to radon-220, a radioactive gas produced in the Thorium Decay Series.

Annual time percentages for inside and outside the home and for away from home were computed by estimating time usage over each hour of the day, over weekdays and weekends, and over seasons specifically for this project. There are no USEPA default values for these times. See Attachment E.

Worker, Dredger Scenario

Scenario overview: Under this scenario, workers dredging the Ashtabula River are not aware that it is radiologically contaminated and, thus, they have taken no personal protection. The levels to which they are exposed are the maximum levels seen in 1998 and 1999 data (see Attachment C). The pathways of exposure are external exposure and soil ingestion. The period of exposure is the total time needed to dredge the river, two years and four months.

Contaminants of Concern: The contaminants of concern are the complete Uranium (U-238) Decay Series, the complete Thorium (Th-232) Decay Series, and the complete Actinium (U-235) Decay Series. See Attachment B.

Within each series, radionuclides were grouped individually and also by parent with immediate decay products of less than one year half-life (+ D). These groups are

URANIUM DECAY SERIES

- Uranium-238 + D [U-238 + D]
- Uranium-234 [U-234]
- Thorium-230 [Th-230]
- Radium-226 [Ra-226]
- Radon-222 + D [Rn-220 + D]
- Lead-210 + D [Pb-210 + D]

THORIUM DECAY SERIES

- Thorium-232 [Th-232]
- Radium-228 [Ra-228]
- Actinium-228 [Ac-228]
- Thorium-228 [Th-228]
- Radium-224 [Ra-224]
- Radon-220 + D [Rn-220 + D]

ACTINIUM DECAY SERIES

- Uranium-235 + D [U-235 + D]
- Protactinium-231 [Pa-231]

- Actinium-227 + D [Ac-227 + D]

These groupings correspond to slope factor groups (risk coefficients) in the USEPA HEAST FY-1995 supplementary tables.

Contaminant Concentrations: Gross sediment concentrations by isotope were measured in the Ashtabula River sediments in 1998 and 1999 (see Attachment C). The maximum measured was used in this scenario. Background levels were measured upstream of the Turning Basin in 1998 and 1999. The 1999 concentrations were used for this risk assessment because they were taken at several sites and were taken in a formal way specifically to investigate the extent and degree of contamination seen in previous investigations. Net concentrations for the computation of excess risk were taken as gross concentrations minus background concentrations. See Attachment C.

Exposure periods: A two year plus four month exposure period was assumed based upon a U.S. Army Corps of Engineers estimate of the time needed to dredge the river.

Risk equations: Risk equations are based on USEPA's Review Draft of the Technical Support Document for the Development of Radionuclide Cleanup Levels for Soil. These were external exposure and soil ingestion (see Attachment D). The risk equations and all the parameters by symbol, name and numerical value are listed in Attachment D.

Risk Evaluation

Risks can be evaluated against the acceptable exposure levels for lifetime cancer risk to an individual of 10^{-6} to 10^{-4} found in Title 40, Part 300.430 (e)(2)(I)(A)(2) of the Code of Federal Regulations, also known as the National Oil and Hazardous Substances Pollution Contingency Plan. 10^{-6} is the point of departure for establishing acceptable risk. Risks beyond this require justification.

Radiological Results for the Resident-Farmer Scenario

Risks for this scenario are summarized in Attachment F, Tables 1 - 6.

For maximum concentrations, the leading contributors are evident in Table 2.

- For external exposure, an adult (ages 20 - 30 years)is most at risk from Thorium Decay Series radionuclides [9.35E-6].
- For plant ingestion, an adult is most at risk from Uranium Decay Series radionuclides [9.69E-6].

- For soil ingestion, an older child (ages 6 - 12 years) is most at risk from Uranium Decay Series radionuclides [5.79E-8].

- For dust inhalation with radon decay product inhalation included, the adult is most at risk from Uranium Decay Series radionuclides [1.08E-5].

- For total, all pathway, risk the adult is most at risk due to dust inhalation with radon + decay products from Uranium Decay Series radionuclides [1.08E-5].

The cause for these maximums is shown in Table 3.

- External exposure risk is due, about equally, radon-222 + decay products and radon-220 + decay products in all age groups.

- Plant ingestion risk is due to radium-226 and radium-228 with radium-226 slightly higher.

- Soil ingestion risk is due to lead-210 + decay products.

- Dust inhalation risk is due to radon-222 + decay products.

- The highest overall risk for all age groups and all pathways is dust inhalation radon-222 + decay products. The adult risk is the dominant risk.

When 95% Upper Confidence Level (95%UCL) concentrations are used changes occur

- Plant ingestion uranium and thorium decay series risks are about equal for an adult,

- Total, all pathway, risk where uranium and thorium risks are about equal with Thorium Decay Series risks slightly higher, and

- Numerical risk drops.

The cause for these maximums is shown in Tables 2 and 4. The only difference in conclusions, as compared to that for maximum concentrations, is

- Plant ingestion risk is more strongly caused by radium-226.

Overall, risk is dominated by radon-222 + decay product inhalation. Significant secondary risks are caused by external exposure to radon-222 + decay products and radon-220 + decay products, plant ingestion of radium-226 and radium-228, and dust inhalation of radon-220 + decay products.

Comparisons to Criteria

The risk from this scenario is about 1 x 10^{-4} (1.38 x 10^{-4} using maximum concentrations, 8.66 x 10^{-5} using 95%UCL concentrations). The "excess upper bound lifetime cancer risk to an individual," under the National Oil and Hazardous Substances Pollution Contingency Plan (known as the NCP) is 10^{-6} to 10^{-4} where 10^{-4} is not specifically or rigidly quantified. Thus, under this comparison the 10^{-6} point of departure is exceeded. Acceptance of criteria with risks at 10^{-4} must, thus, be justified.

Commonly used cleanup criteria in Region 5 are 5 pCi/g combined radium (Ra-226 + Ra-228) from U.S. Environmental Protection Agency standards for uranium and thorium mill tailings (found in Title 40, Part 192 of the Code of Federal Regulations, 40 CFR 192) and 30 pCi/g combined for enriched uranium (U-238 +U-234 + U-235) set out in the Nuclear Regulatory Commission's Branch Technical Position (found in Vol. 46, No. 205, p 52061-52063, of the Federal Register, October 23, 1981). 5 pCi/g combined radium was the criterion set for residential area cleanups on Fields Brook, the stream that feeds into Ashtabula River. 30 pCi/g combined uranium was the criterion set for Fields Brook as well.

Radiological Conclusions for the Resident-Farmer Scenario

The total risk from all radionuclides and all pathways is about 1 x 10^{-4}. This is at the upper end of the NCP risk range. Risk is about equally apportioned between external exposure, plant ingestion and inhalation of radon + decay products and has the greatest impact on older age groups (older child, teenager, adult) where the exposure period is longer.

The measured excess sediment concentrations are considerably under 5 pCi/g combined radium and 30 pCi/g combined for enriched uranium.

Radiological Results for the Worker- Dredger Scenario

Risks for this scenario are summarized in Attachment F, Tables 7 - 11.

For maximum concentrations, the leading contributors are evident in Table 8.

- For external exposure, thorium contributes the highest risk [4.60E-5].
- For soil ingestion, uranium contributes the highest risk [4.12E-7].
- For total risk from both pathways, thorium contributes the most risk [4.61E-5].

The causes for maximums are shown in Table 10.

- External exposure risk is primarily due to radon decay products with radon-222 + decay products about equal to radon-220 + decay products[2.81 - 2.97E-5].

- Soil ingestion risk is due to lead-210 + decay products [1.85E-7]
- Total risk is due primarily to radon + decay products with radon-222 + decay products about equal to radon-220 + decay products [2.81 -2.98E-5].

- The maximum risk is due to radon-220 + decay products [2.97E-5].

When 95%UCL concentrations are used (Table 7)

- External exposure risk, total exposure risk and maximum risk are due primarily to uranium (radon-222 + decay products).

- Soil ingestion risk is still due to uranium (lead-210 + decay products).

- The maximum risk is due to external exposure from radon-222 + decay products.

- All numerical risks drop.

Radiological Conclusions for the Worker-Dredger Scenario

The conclusion is that the predominance of risk is due to external exposure caused by radon + decay products in the Uranium Decay Series and the Thorium Decay Series. The risk is about equal for both decay series, about 3×10^{-5}.

CHEMICAL RISK ASSESSMENT

Chemical Risks from Uranium - Ashtabula River, Ohio

(accompanying data and spreadsheets: Attachment G)

In addition to assessing the risk from uranium as a radionuclide, uranium can also be assessed for it's affects as a chemical - from exposures such as ingestion or dermal contact. To assess the toxicity of a chemical, EPA utilizes IRIS (Integrated Risk Information System) as its toxicity database (www.epa.gov/iris). IRIS contains toxicity information on uranium only (for chemical risks). Therefore, only uranium chemical risks were assessed in this section. Uranium as soluble salts has toxicity information to assess non-cancer risks only - specifically body weight loss and moderate nephrotoxicity. Therefore this assessment provides estimates of non-cancer risks of uranium as a chemical. For all other risks from uranium and the other radionuclides found in the Ashtabula River sediment, please see Radiological Risk Assessments above.

Uranium data were used from the August, 1999 sampling of the Ashtabula River. The data used to drive this analysis were those sample results below the cutline, or what would potentially be left behind after dredging (see Attachment G). Therefore the risks are for exposures to the residual, or remaining, sediment. In order to be conservative and be sure to estimate the worst-case scenario risks, the sediment was assumed to be applied to residential land, where people could be exposed in their everyday lives. Therefore, they could become exposed both via dermal contact as well as through incidental ingestion. Both the dermal and incidental ingestion routes were estimated. Estimates were made for a full lifetime of exposure, with the 0-18 year olds estimated separately from 18-70 year olds. This was done to specifically ensure that childhood and adolescent exposures were estimated accurately, because they can differ from exposure patterns in adults. For the mass concentration term (what levels people would be exposed to), two estimates were used. It is EPA Superfund policy to use the 95% upper confidence limit (UCL) on the mean (a more conservative measure of the mean) and this term was therefore estimated and used. To ensure again that a conservative and protective estimate was done, the maximum concentration of uranium was also used. Therefore, in the risk estimates provided below, a range is given to indicate the 95%UCL and maximum terms used.

As a result, conversion of the different type of data was needed to assess chemical-based risks. The data needed to be converted to a mass/mass basis (e.g. ug/g) instead of on a picocurie/gram basis. Conversion was made using this formula.

$$G = A * T_{1/2} * C_1 * C_2 * C_3 / [C_4 * C_5]$$

where: G = mass concentration, parts per million (ppm)/micrograms per gram (ug/g)
A = activity concentration in picocuries per gram (pCi/g)
$T_{1/2}$ = half-life in seconds (s) of specific radionuclide
C_1 = constant, 10^6 micrograms per gram (ug/g)
C_2 = constant, 3.7×10^{-2} disintegrations per second per picocurie [(d/s)/pCi]
C_3 = constant, atomic mass of specific radionuclide per mole (g/mole)
C_4 = constant, natural logarithm of 2 (unitless)
C_5 = constant, 6.023×10^{23} atoms per mole (atoms/mole)

For details on parameters used in the risk estimates, see Attachment G.

Because we are assessing non-cancer risks, we are assuming there is a safe level of exposure, or a threshold of effect. Risk is described as a ratio or hazard index comparing the estimated exposure to a safe threshold or level that no effects are expected:

$$\frac{\text{Estimate of site-specific exposure}}{\text{Safe level of exposure or RfD (Reference Dose)}}$$

Therefore, to interpret non-cancer risk estimates, a ratio of 1 or lower is considered acceptable because the estimate of exposure is less than or equal to a safe level.

In no case did the non-cancer risk estimate reach 1 or greater, meaning all were acceptable risks because all estimates were well below a level where effects would be seen (below 1). Note that the range is due to using both maximum contaminant level and an estimate of the mean (95% upper confidence limit). Results were as follows:

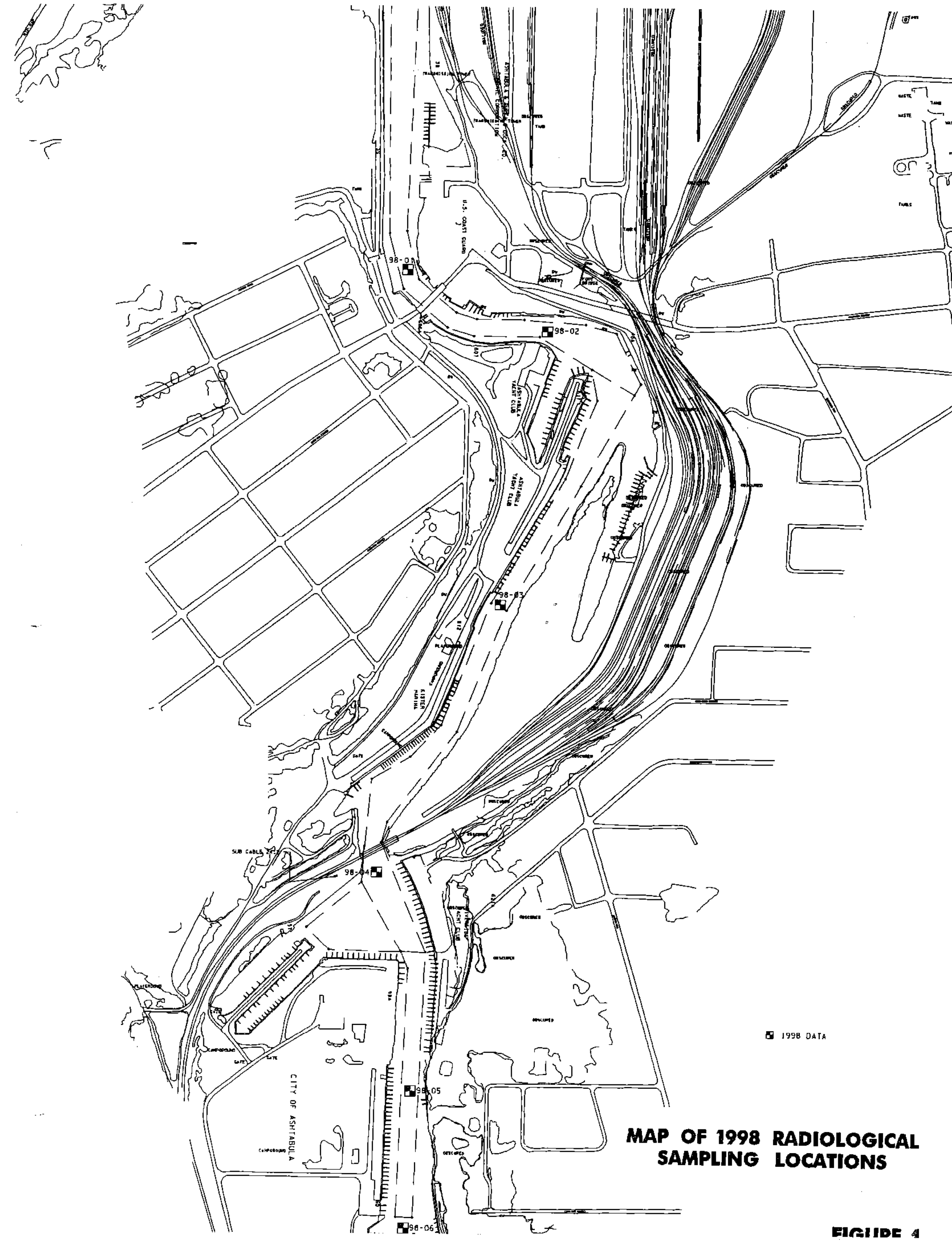
PATHWAY AND TOTAL, LIFETIME, URANIUM CHEMICAL RISK (HAZARD INDEX)

Pathway	Range (95%UCL to Maximum)
Dermal	9.4E-5 – 1.4E-4
Incidental ingestion	3.1E-3 – 4.6E-3
Total	3.2E-3 – 4.7E-3

ATTACHMENT A

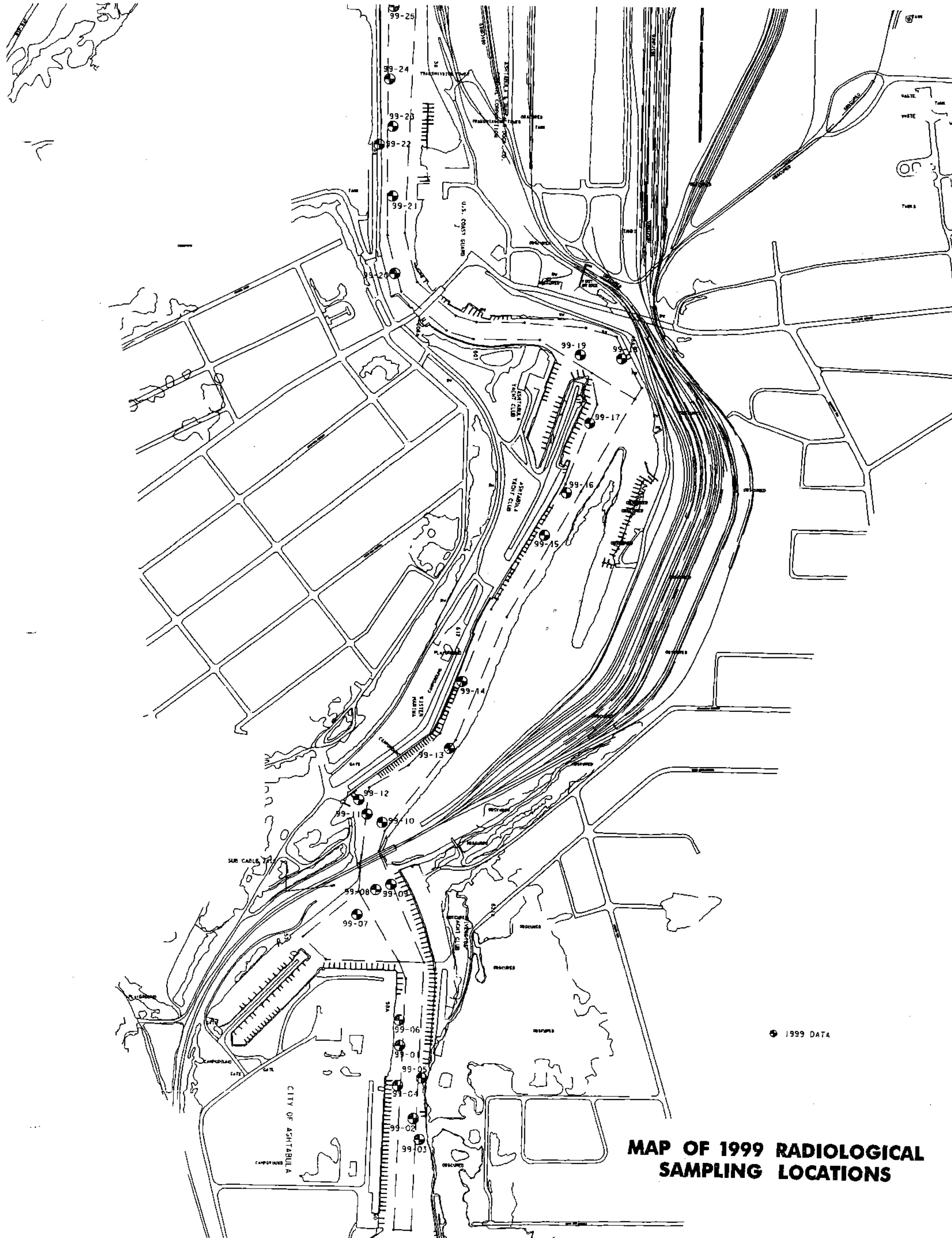
Attachment A

Table of Contents



MAP OF 1998 RADIOLOGICAL SAMPLING LOCATIONS

FIGURE 4



MAP OF 1999 RADIOLOGICAL SAMPLING LOCATIONS

FIGURE 9

ATTACHMENT B

Attachment B

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Attachment B – Figure 1

URANIUM DECAY SERIES	
	Half-Life
Uranium-238	4.51 million years
alpha	
Thorium-234	24.1 days
beta	
Protactinium-234m	1.17 minutes
beta	
Uranium-234	247,000 years
alpha	
Thorium-230	80,000 years
alpha	
Radium-226	1602 years
alpha, gamma	
Radon-222	3.823 days
alpha	
Polonium-218	3.05 minutes
alpha	
Lead-214	26.8 minutes
beta, gamma	
Bismuth-214	19.7 minutes
beta, gamma	
Polonium-214	164 micro seconds
alpha	
Lead-210	22.3 years
beta, gamma	
Bismuth-210	5.01 days
beta	
Polonium-210	138.4 days
alpha	
Lead-206	Stable

Attachment B – Figure 2

	THORIUM DECAY SERIES		
			Half-Life
	Thorium-232		14 Billion years
	alpha		
	Radium-228		5.75 years
	beta		
	Actinium-228		6.13 hours
	beta, gamma		
	Thorium-228		1.91 years
	alpha		
	Radium-224		3.64 days
	alpha		
	Radon-220		55 seconds
	alpha		
	Polonium-216		0.15 seconds
	alpha		
	Lead-212		10.64 hours
	beta, gamma		
	Bismuth-212		60.6 minutes
beta		alpha	
Polonium-212		**Thallium-208**	0.304 microseconds
alpha		beta, gamma	
	Lead-208		Stable

Attachment B – Figure 3

ACTINIUM DECAY SERIES	
	Half-Life
Uranium-235	710 million years
alpha, gamma	
Thorium-231	25.5 hours
beta, gamma	
Protactinium-231	32,500 years
alpha, gamma	
Actinium-227	21.6 years
beta	
Thorium-227	18.2 days
alpha, gamma	
Radium-233	11.43 days
alpha, gamma	
Radon-219	4.0 seconds
alpha, gamma	
Polonium-215	1.78 milli seconds
alpha	
Lead-211	36.1 minutes
beta, gamma	
Bismuth-211	2.15 minutes
alpha, gamma	
Thallium-207	4.79 minutes
beta	
Lead-207	Stable

ATTACHMENT C

Attachment C

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Attachment C – Table 1

SUMMARY OF MODIFIED NET MAXIMUM, AND 95UCL					
	BELOW CUTLINE AND ABOVE CUTLINE				
	Mean Background (pCi/g)	Modified Net @ Below Cutline Maximum (pCi/g)	Modified Net @ Below Cutline 95UCL (pCi/g)	Modified Net @ Above Cutline Maximum (pCi/g)	Modified Net @ Above Cutline 95UCL (pCi/g)
U-238 + D	0.965	0.440	0.353	44.5	4.05
U-234	1.02	0.338	0.136	56.9	4.32
Th-230	0.716	0.644	0.290	20.2	3.14
Ra-226	0.929	0.311	0.164	6.40	3.86
Rn-222 + D	0.929	0.311	0.164	6.40	3.86
Pb-210 + D	0.929	0.311	0.164	6.40	3.86
Th-232	0.853	0.367	0.190	7.67	0.647
Ra-228	0.798	0.312	0.231	7.53	0.522
Ac-228	0.798	0.312	0.231	7.53	0.522
Th-228	0.829	0.301	0.216	7.81	0.671
Ra-224	0.640	0.311	0.237	7.35	0.470
Rn-220 + D	0.640	0.311	0.237	7.35	0.470
U-235 + D	0.0660	0.0660	0.0660	6.52	0.372
Pa-231	0.0756	0.0660	0.0660	6.52	0.372
Ac-227 + D	0.0851	0.0002	0.0001	0.825	0.140

@ Modified net means the mean background was subtracted from each data point to get net data. Each data point less than zero was defined to be zero. From this the maximum was selected and the 95% Upper Confidence Limit (UCL) was computed

Attachment C – Table 2

ASHTABULA RIVER SEDIMENT SAMPLING, MAY 1998										
SAMPLE I.D.		U-238 (pCi/g)	U-234 (pCi/g)	Th-230 (pCi/g)	Ra-226 (pCi/g)	Th-232 (pCi/g)	Ra-228 (pCi/g)	Th-228 (pCi/g)	U-235 (pCi/g)	Th-227 (pCi/g)
AR98-01	North of 5th Street Bridge	0.835	0.767	0.858	0.170	1.16	0.862	1.19	0.147	0.118
AR98-01	North of 5th Street Bridge DUPLICATE						0.865			
AR98-02	South of 5th Street Bridge	1.23	1.25	1.41	1.29	1.05	0.914	0.951	0.145	0.0419
AR98-03	North of Fields Brook---deep	6.23	6.03	5.72	2.52	1.42	1.02	1.17	0.509	0.208
AR98-03	North of Fields Brook--shallow	3.11	3.06	3.27	1.00	1.48	1.24	1.49	0.276	0.207
AR98-04	Confluence of Fields Brook—deep	27.3	34.4	2.00	5.77	3.86	1.24	3.33	3.03	0.834
AR98-04	Confluence of Fields Brook--shallow	1.62	1.40	0.935	1.12	1.45	2.13	1.53	0.224	0.216
AR98-04	Confluence of Fields Brook--shallow DUPLICATE				0.884					
AR98-05	Near upstream background	0.750	0.811	0.832	0.665	0.747	0.723	0.741	0.0685	0.638
AR98-06	Far upstream background	0.944	1.10	0.813	0.868	1.01	0.736	1.10	0.129	0.931
06	DUPLICATE	0.868	0.853	0.667		0.870		0.917	0.0926	0.601

Attachment C - Table 3

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999														
BACKGROUND														
URANIUM DECAY SERIES	MEAN * (pCi/g)		THORIUM DECAY SERIES	MEAN * (pCi/g)		ACTINIUM DECAY SERIES	MEAN * (pCi/g)		* Sites					
									AR99	2	-	0	-	12
										2		0		12 LD
U-238	0.965		**Th-232**	0.853		**U-235**	0.0660			2		12		31
Th-234	0.675		**Ra-228**	0.798		Th-231				2		12		31 FD
Pa-234m			Ac-228			**Pa-231**				3		0		12
U-234	1.02		**Th-228**	0.829		**Ac-227**				3		12		24
Th-230	0.716		Ra-224	0.640		Th-227	0.0851			3		36		50
Ra-226	0.929		Rn-220			Ra-223				3		36		50 FD
Rn-222			Po-216			Rn-219				3		50		62
Po-218			Pb-212	0.358		Po-215				4		0		12
Pb-214	0.739		Bi-212	0.809		Pb-211				4		12		24
Bi-214	0.675		Po-212			Bi-211				4		48		60
Po-214			Tl-208	0.274		Tl-207				4		68		80
Pb-210										5		0		12
Bi-210										5		12		24
Po-210										5		24		33

Attachment C – Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

ISOTOPIC URANIUM RESULTS (pCi/g)

SAMPLE I.D.	STATION	U-238	MEAN U-238	U-234	MEAN U-234	U-235	MEAN U-235
AR99 2 - 0 - 12 RAD	200	1.01	1.00	1.38	1.30	0.0778	0.0548
AR99 2 - 0 - 12 RAD LD	200	0.998		1.22		0.0318	
AR99 2 - 12 - 31 RAD	200	0.940	1.00	1.10	1.13	0.0841	0.0565
AR99 2 - 12 - 31 RAD FD	200	1.06		1.15		0.0288	
AR99 3 - 0 - 12 RAD	202	1.03	1.03	1.14	1.14	0.0576	0.0576
AR99 3 - 12 - 24 RAD	202	0.976	0.976	1.23	1.23	0.0739	0.0739
AR99 3 - 36 - 50 RAD	202	1.14	1.10	0.999	1.04	0.0585	0.0533
AR99 3 - 36 - 50 RAD FD	202	1.05		1.09		0.0481	
AR99 3 - 50 - 62 RAD	202	1.15	1.15	1.130	1.13	0.0784	0.0784
AR99 4 - 0 - 12 RAD	199	1.25	1.25	1.10	1.10	0.121	0.121
AR99 4 - 12 - 24 RAD	199	1.20	1.20	1.29	1.29	0.0693	0.0693
AR99 4 48 60 RAD	199	0.637	0.637	0.666	0.666	0.0547	0.0547
AR99 4 68 80 RAD	199	0.650	0.650	0.788	0.788	0.0436	0.0436
AR99 5 0 12 RAD	198	0.629	0.629	0.588	0.588	0.0847	0.0847
AR99 5 12 24 RAD	198	1.22	1.22	1.19	1.19	0.0484	0.0484
AR99 5 24 33 RAD	198	0.709	0.709	0.696	0.696	0.0623	0.0623
	AVERAGE		0.965		1.02		0.0660

FD = Field Duplicate
LD = Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, anlayzed after 11/99

Attachment C – Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

ISOTOPIC RADIUM RESULTS (pCi/g)

SAMPLE I.D.						STATION	GROSS Ra-226	MEAN Ra-226	NET Ra-226	MODIFIED NET Ra-226
AR99	2 -	0 -	12	RAD		200				
AR99	2 -	0 -	12	RAD	LD	200				
AR99	2 -	12 -	31	RAD		200				
AR99	2 -	12 -	31	RAD	FD	200				
AR99	3 -	0 -	12	RAD		202				
AR99	3 -	12 -	24	RAD		202				
AR99	3 -	36 -	50	RAD		202				
AR99	3 -	36 -	50	RAD	FD	202				
AR99	3 -	50 -	62	RAD		202				
AR99	4 -	0 -	12	RAD		199				
AR99	4 -	12 -	24	RAD		199	0.638			
AR99	4	48	60	RAD		199	0.73			
AR99	4	68	80	RAD		199	1.42			
AR99	5	0	12	RAD		198				
AR99	5	12	24	RAD		198				
AR99	5	24	33	RAD		198				
						AVERAG	0.929			

FD = Field Duplicate

LD = Lab Duplicate

125 = Priority samples, analyzed 11/99

125 = Non-priority samples, anlayzed after 11/99

Attachment C – Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

GAMMA SPECTROSCOPY RESULTS--URANIUM SERIES (pCi/g)

SAMPLE I.D.	STATION	GROSS Th-234	MEAN Th-234	Pb-214	MEAN Pb-214	Bi-214	MEAN Bi-214
AR99 2 - 0 - 12 RAD	200			0.715	0.715	0.631	0.631
AR99 2 - 0 - 12 RAD LD	200			0.640		0.593	
AR99 2 - 12 - 31 RAD	200			0.654	0.647	0.612	0.603
AR99 2 - 12 - 31 RAD FD	200			0.686		0.638	
AR99 3 - 0 - 12 RAD	202			0.679	0.683	0.616	0.627
AR99 3 - 12 - 24 RAD	202			0.739	0.739	0.668	0.668
AR99 3 - 36 - 50 RAD	202			0.764		0.675	
AR99 3 - 36 - 50 RAD FD	202			0.752	0.758	0.721	0.698
AR99 3 - 50 - 62 RAD	202			0.783	0.783	0.718	0.718
AR99 4 - 0 - 12 RAD	199			0.623	0.623	0.560	0.560
AR99 4 - 12 - 24 RAD	199	0.630		0.682		0.628	
AR99 4 - 12 - 24 RAD LD	199	0.494	0.562	0.689	0.686	0.644	0.636
AR99 4 48 60 RAD	199	0.443	0.443	0.774	0.774	0.709	0.709
AR99 4 68 80 RAD	199	1.02	1.02	1.11	1.11	1.00	1.00
AR99 5 0 12 RAD	198			0.687	0.687	0.620	0.620
AR99 5 12 24 RAD	198			0.722	0.722	0.634	0.634
AR99 5 24 33 RAD	198			0.682	0.682	0.667	0.667
	AVERAGE		0.675		0.739		0.675

FD = Field Duplicate
LD = Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, anlayzed after 11/99

Attachment C – Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

ISOTOPIC THORIUM RESULTS (pCi/g))

SAMPLE I.D.							STATION	Th-230	MEAN Th-230	Th-232	MEAN Th-232	Th-228	MEAN Th-228
AR99	2	- 0	- 12	RAD			200	0.664		0.728		0.819	
AR99	2	- 0	- 12	RAD	LD		200	0.637	0.651	0.745	0.737	0.780	0.800
AR99	2	- 12	- 31	RAD			200	0.704		0.848		0.757	
AR99	2	- 12	- 31	RAD	FD		200	0.684	0.694	0.766	0.807	0.903	0.830
AR99	3	- 0	- 12	RAD			202	0.700	0.700	0.897	0.897	0.749	0.749
AR99	3	- 12	- 24	RAD			202	0.723	0.723	0.860	0.860	0.866	0.866
AR99	3	- 36	- 50	RAD			202	0.669		0.861		0.889	
AR99	3	- 36	- 50	RAD	FD		202	0.741	0.705	0.860	0.861	0.905	0.897
AR99	3	- 50	- 62	RAD			202	0.714	0.714	0.871	0.871	0.807	0.807
AR99	4	- 0	- 12	RAD			199	0.631	0.631	0.806	0.806	0.849	0.849
AR99	4	- 12	- 24	RAD		199		0.647	0.647	0.832	0.832	0.790	0.790
AR99	4	48	60	RAD		199		0.678	0.678	0.817	0.817	0.703	0.703
AR99	4	68	80	RAD		199		1.34	1.34	1.09	1.09	0.940	0.940
AR99	5	0	12	RAD			198	0.531	0.531	0.781	0.781	0.778	0.778
AR99	5	12	24	RAD			198	0.596	0.596	0.842	0.842	0.840	0.840
AR99	5	24	33	RAD			198	0.698	0.698	0.887	0.887	0.930	0.930
						AVERAGE			0.716		0.853		0.829

FD = Field Duplicate
LD = Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, anlayzed after 11/99

Attachment C – Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999														
GAMMA SPECTROSCOPY RESULTS---THORIUM SERIES (pCi/g)														
SAMPLE I.D.							STATION	Pb-212	MEAN Pb-212	Bi-212	MEAN Bi-212	Tl-208	MEAN Tl-208
AR99	2	-	0	-	12	RAD		200	0.805	0.805	0.696	0.696	0.261	0.261
AR99	2	-	0	-	12	RAD	LD	200	0.810		0.909		0.27	
AR99	2	-	12	-	31	RAD		200	0.806	0.808	0.869	0.889	0.261	0.266
AR99	2	-	12	-	31	RAD	FD	200	0.824		0.778		0.283	
AR99	3	-	0	-	12	RAD		202	0.807	0.816	0.802	0.790	0.278	0.281
AR99	3	-	12	-	24	RAD		202	0.930	0.930	0.805	0.805	0.274	0.274
AR99	3	-	36	-	50	RAD		202	0.906		0.894		0.281	
AR99	3	-	36	-	50	RAD	FD	202	0.894	0.900	0.776	0.835	0.277	0.279
AR99	3	-	50	-	62	RAD		202	0.885	0.885	0.785	0.785	0.275	0.275
AR99	4	-	0	-	12	RAD		199	0.742	0.742	0.690	0.690	0.23	0.234
AR99	4	-	12	-	24	RAD		199	0.8[illegible]0		0.766		0.272	
AR99	4	-	12	-	24	RAD	LD	199	0.851	0.866	0.785	0.776	0.274	0.273
AR99	4		48		60	RAD		199	0.906	0.906	0.872	0.872	0.282	0.282
AR99	4		68		80	RAD		199	0.896	0.896	0.869	0.869	0.296	0.296
AR99	5		0		12	RAD		198	0.836	0.836	0.823	0.823	0.275	0.275
AR99	5		12		24	RAD		198	0.866	0.866	0.834	0.834	0.278	0.278
AR99	5		24		33	RAD		198	0.899	0.899	0.849	0.849	0.29	0.290
								AVERAGE		0.858		0.809		0.274
FD	=	Field Duplicate												
LD	=	Lab Duplicate												
125	=	Priority samples, analyzed 11/99												
125	=	Non-priority samples, anlayzed after 11/99												

Attachment C – Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

GAMMA SPECTROSCOPY RESULTS---THORIUM SERIES (pCi/g)

SAMPLE I.D.	STATION	Ra-228	MEAN Ra-228	Ra-224	MEAN Ra-224
AR99 2 - 0 - 12 RAD	200	0.773	0.773	0.801	0.801
AR99 2 - 0 - 12 RAD LD	200	0.792		0.716	
AR99 2 - 12 - 31 RAD	200	0.772	0.782	0.535	0.626
AR99 2 - 12 - 31 RAD FD	200	0.740		0.498	
AR99 3 - 0 - 12 RAD	202	0.751	0.746	0.631	0.565
AR99 3 - 12 - 24 RAD	202	0.860	0.860	0.531	0.531
AR99 3 - 36 - 50 RAD	202	0.856		0.648	
AR99 3 - 36 - 50 RAD FD	202	0.849	0.853	0.660	0.654
AR99 3 - 50 - 62 RAD	202	0.839	0.839	0.641	0.641
AR99 4 - 0 - 12 RAD	199	0.703	0.703	0.603	0.603
AR99 4 - 12 - 24 RAD	199	0.727		0.879	
AR99 4 - 12 - 24 RAD LD	199	0.779	0.753	0.561	0.720
AR99 4 48 60 RAD	199	0.793	0.793	0.732	0.732
AR99 4 68 80 RAD	199	0.857	0.857	0.466	0.466
AR99 5 0 12 RAD	198	0.746	0.746	0.634	0.634
AR99 5 12 24 RAD	198	0.865	0.865	0.698	0.698
AR99 5 24 33 RAD	198	0.805	0.805	0.656	0.656
	AVERAGE		0.780		0.640

FD = Field Duplicate
LD = Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, anlayzed after 11/99

Attachment C – Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

GAMMA SPECTROSCOPY RESULTS---ACTINIUM SERIES (pCi/g)

SAMPLE I.D.							STATION	U-235	MEAN U-235
AR99	2	- 0	- 12	RAD			200		
AR99	2	- 0	- 12	RAD	LD		200		
AR99	2	- 12	- 31	RAD			200		
AR99	2	- 12	- 31	RAD	FD		200		
AR99	3	- 0	- 12	RAD			202		
AR99	3	- 12	- 24	RAD			202		
AR99	3	- 36	- 50	RAD			202		
AR99	3	- 36	- 50	RAD	FD		202		
AR99	3	- 50	- 62	RAD			202		
AR99	4	- 0	- 12	RAD			199		
AR99	4	- 12	- 24	RAD		199			
AR99	4	- 12	- 24	RAD	LD	199			
AR99	4	48	60	RAD		199			
AR99	4	68	80	RAD		199		0.131	0.131
AR99	5	0	12	RAD			198		
AR99	5	12	24	RAD			198		
AR99	5	24	33	RAD			198		
							AVERAGE		0.131

FD = Field Duplicate
LD -= Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, anlayzed after 11/99

Attachment C - Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

ISOTOPIC URANIUM RESULTS (pCi/g)

SAMPLE I.D.	STATION	GROSS U-238	MEAN U-238	NET U-238	MODIFIED NET U-238	GROSS U-234	MEAN U-234	NET U-234	MODIFIED NET U-234	GROSS U-235	MEAN U-235	NET U-235	MODIFIED NET U-235
AR99 16 - 0 - 12 RAD	160	0.672		-0.293	0	0.795		-0.227	0	0.0819		0.016	0.016
AR99 16 - 12 - 24 RAD	160	0.833		-0.132	0	0.757		-0.265	0	0.102		0.036	0.036
AR99 18 - 63 - 75 RAD	153+50	0.911		-0.054	0	0.773		-0.249	0	0.0983		0.032	0.032
AR99 20 - 12 - 24 RAD	136	0.394		-0.571	0	0.467		-0.555	0	0.115		0.049	0.049
AR99 20 - 24 - 36 RAD	136	1.29		0.325	0.325	1.27		0.248	0.248	0.129		0.063	0.063
AR99 20 - 58 - 71 RAD	136	0.664		-0.301	0	0.53		-0.449	0	0.0308		-0.035	0
AR99 21 - 63 - 75 RAD	132	126		0.295	0.295	1.36		0.338	0.338	0.132		0.066	0.066
AR99 22 - 49 - 61 RAD	129	0.949		-0.016	0	0.814		-0.208	0	0.0921		0.026	0.026
AR99 23 - 36 - 58 RAD	128	0.885		-0.080	0	0.959		-0.063	0	0.0861		0.020	0.020
AR99 24 - 47 - 65 RAD	125	0.777		-0.188	0	0.681		-0.341	0	0.0744		0.008	0.008
AR99 24 - 47 - 65 RAD FD	125	0.813	0.795			0.783	0.732			0.0905	0.0825		
					0.325	MAXIMUM			0.338				0.0660
					0.0619	AVERAGE			0.0586				0.0316
					0.131	STANDARD DEVIATION			0.125				0.0220
					0.081	CONFIDENCE LEVEL			0.0777				0.0138
					0.143	95% UPPER CONFIDENCE LE			0.136				0.0454

FD = Field Duplicate
LD = Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, anlayzed after 11/99

Attachment C - Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

ISOTOPIC RADIUM RESULTS (pCi/g)

SAMPLE I.D.						STATION	GROSS Ra-226	MEAN Ra-226	NET Ra-226	MODIFIED NET Ra-226
AR99	16 -	0 -	12	RAD		160	0.751		-0.178	0
AR99	16 -	12 -	24	RAD		160	0.844		-0.085	0
AR99	18 -	63 -	75	RAD		153+50	0.789		-0.140	0
AR99	20 -	12 -	24	RAD		136	0.798		-0.131	0
AR99	20 -	24 -	36	RAD		136	0.912		-0.017	0
AR99	20 -	58 -	71	RAD		136	1.24		0.311	0.311
AR99	21 -	63 -	75	RAD		132	1.24		0.311	0.311
AR99	22 -	49 -	61	RAD		129	1.01			
AR99	22 -	49 -	61	RAD	LD	129	0.701	0.856	-0.074	0
AR99	23 -	36 -	58	RAD		128	0.863		-0.066	0
AR99	24 -	47 -	65	RAD		125	0.762		-0.167	0
AR99	24 -	47 -	65	RAD	FD	125	1.60	1.181	0.252	0.252

FD = Field Duplicate
LD = Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, anlayzed after 11/99

0.311	MAXIMUM
0.0795	AVERAGE
0.137	STANDARD DEVIATION
0.0849	CONFIDENCE LEVEL
0.164	95% UPPER CONFIDENCE LEVEL

Attachment C - Table 3

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

GAMMA SPECTROSCOPY RESULTS—URANIUM SERIES (pCi/g)

SAMPLE I.D.	STATION	GROSS Th-234	MEAN Th-234	NET Th-234	MODIFIED NET Th-234	GROSS Pb-214	MEAN Pb-214	NET Pb-214	MODIFIED NET Pb-214	GROSS Bi-214	MEAN Bi-214	NET Bi-214	MODIFIED NET Bi-214
AR99 16 - 0 - 12 RAD	160	0.622		-0.053	0	0.803		0.064	0.064	0.731		0.056	0.056
AR99 16 - 12 - 24 RAD	160					0.787		0.048	0.048	0.758		0.083	0.083
AR99 18 - 63 - 75 RAD	153+50	1.23		0.555	0.555	0.871		0.132	0.132	0.791		0.116	0.116
AR99 20 - 12 - 24 RAD	136					0.805		0.066	0.066	0.725		0.050	0.050
AR99 20 - 24 - 36 RAD	136					0.927		0.188	0.188	0.841		0.166	0.166
AR99 20 - 58 - 71 RAD	136					1.41		0.671	0.671	1.25		0.575	0.575
AR99 21 - 63 - 75 RAD	132					1.09		0.351	0.351	0.994		0.319	0.319
AR99 22 - 49 - 61 RAD	129	0.810		0.135	0.135	1.02		0.281	0.281	0.895		0.220	0.220
AR99 23 - 36 - 58 RAD	128					0.806		0.067	0.067	0.754		0.079	0.079
AR99 24 - 47 - 65 RAD	125					0.890				0.828			
AR99 24 - 47 - 65 RAD FD	125	1.17	1.17	0.495	0.495	0.828	0.859	0.089	0.089	0.786	0.807	0.111	0.111
					0.555	MAXIMUM			0.671				0.575
					0.296	AVERAGE			0.196				0.178
					0.271	STANDARD DEVIATION			0.196				0.163
					0.266	CONFIDENCE LEVEL			0.121				0.101
					0.562	95% UPPER CONFIDENCE LE			0.317				0.278

FD = Field Duplicate
LD = Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, anlayzed after 11/99

Attachment C - Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

ISOTOPIC THORIUM RESULTS (pCi/g))

SAMPLE I.D.	STATION	GROSS Th-230	MEAN Th-230	NET Th-230	MODIFIED NET Th-230	GROSS Th-232	MEAN Th-232	NET Th-232	MODIFIED NET Th-232	GROSS Th-228	MEAN Th-228	NET Th-228	MODIFIED NET Th-228
AR99 16 - 0 - 12 RAD	160	0.590		-0.126	0	0.591		-0.262	0	0.878		0.049	0.049
AR99 16 - 12 - 24 RAD	160	0.637		-0.079	0	0.929		0.076	0.076	0.969		0.140	0.140
AR99 18 - 63 - 75 RAD	153+50	0.897		0.181	0.181	1.07		0.217	0.217	1.06		0.231	0.231
AR99 20 - 12 - 24 RAD	136	0.608		-0.108	0	0.762		-0.091	0	1.04		0.211	0.211
AR99 20 - 24 - 36 RAD	136	0.818		0.102	0.102	0.996		0.143	0.143	1.01		0.181	0.181
AR99 20 - 58 - 71 RAD	136	1.36		0.644	0.644	0.913		0.060	0.06	0.830		0.001	0.001
AR99 21 - 63 - 75 RAD	132	1.08		0.364	0.364	1.22		0.367	0.367	1.04		0.211	0.211
AR99 22 - 49 - 61 RAD	129	0.932		0.216	0.216	0.938		0.085	0.085	0.941		0.122	0.112
AR99 23 - 36 - 58 RAD	128	0.783		0.067	0.067	0.960		0.107	0.107	1.00		0.171	0.171
AR99 24 - 47 - 65 RAD	125	0.703				0.785				0.888			
AR99 24 - 47 - 65 RAD FD	125	0.844	0.774	0.058	0.058	1.02	0.9025	0.167	0.167	1.13	1.009	0.301	0.301
					0.644	MAXIMUM			0.367				0.301
					0.163	AVERAGE			0.122				0.162
					0.205	STANDARD DEVIATION			0.110				0.088
					0.127	CONFIDENCE LEVEL			0.0682				0.055
					0.290	95% UPPER CONFIDENCE LE			0.190				0.216

FD = Field Duplicate
LD = Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, anlayzed after 11/99

Attachment C - Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

GAMMA SPECTROSCOPY RESULTS—THORIUM SERIES (pCi/g)

SAMPLE I.D.	STATION	GROSS Pb-212	MEAN Pb-212	NET Pb-212	MODIFIED NET Pb-212		GROSS Bi-212	MEAN Bi-212	NET Bi-212	MODIFIED NET Bi-212	GROSS Tl-208	MEAN Tl-208	NET Tl-208	MODIFIED NET Tl-208
AR99 16 - 0 - 12 RAD	160	0.959		0.101	0.101		0.783		-0.026	0	0.319		0.045	0.045
AR99 16 - 12 - 24 RAD	160	1.11		0.252	0.252		0.981		0.172	0.048	0.358		0.084	0.084
AR99 18 - 63 - 75 RAD	153+50	1.11		0.252	0.252		1.03		0.221	0.132	0.356		0.082	0.082
AR99 20 - 12 - 24 RAD	136	1.01		0.152	0.152		1.13		0.321	0.066	0.331		0.057	0.057
AR99 20 - 24 - 36 RAD	136	1.19		0.332	0.332		1.15		0.341	0.188	0.380		0.106	0.106
AR99 20 - 58 - 71 RAD	136	1.02		0.162	0.162		1.06		0.251	0.671	0.326		0.052	0.052
AR99 21 - 63 - 75 RAD	132	1.22		0.362	0.362		1.29		0.481	0.351	0.395		0.121	0.121
AR99 22 - 49 - 61 RAD	129	1.09		0.232	0.232		0.931		0.122	0.281	0.357		0.083	0.083
AR99 23 - 36 - 58 RAD	128	1.02		0.162	0.162		0.833		0.024	0.067	0.335		0.061	0.061
AR99 24 - 47 - 65 RAD	125	1.05					1.08				0.320			
AR99 24 - 47 - 65 RAD FD	125	1.01	1.03	0.152	0.152		0.834	0.957	0.025	0.089	0.314	0.317	0.040	0.040
					0.362	MAXIMUM				0.671				0.121
					0.216	AVERAGE				0.189				0.073
					0.085	STANDARD DEVIATION				0.202				0.027
					0.053	CONFIDENCE LEVEL				0.125				0.017
					0.269	95% UPPER CONFIDENCE LE				0.314				0.090

FD = Field Duplicate
LD = Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, anlayzed after 11/99

Attachment C - Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999										
GAMMA SPECTROSCOPY RESULTS---THORIUM SERIES (pCi/g)										
SAMPLE I.D.		STATION	GROSS Ra-228	MEAN Ra-228	NET Ra-228	MODIFIED NET Ra-228	GROSS Ra-224	MEAN Ra-224	NET Ra-224	MODIFIED NET Ra-224
AR99 16 - 0 - 12 RAD		160	0.866		0.068	0.068	0.710		0.070	0.070
AR99 16 - 12 - 24 RAD		160	0.959		0.161	0.161	0.575		-0.065	0
AR99 18 - 63 - 75 RAD		153+50	0.980		0.182	0.182	0.783		0.143	0.143
AR99 20 - 12 - 24 RAD		136	0.958		0.160	0.160	0.951		0.311	0.311
AR99 20 - 24 - 36 RAD		136	1.11		0.312	0.312	0.937		0.297	0.297
AR99 20 - 58 - 71 RAD		136	0.997		0.199	0.199	0.475		-0.165	0
AR99 21 - 63 - 75 RAD		132	1.11		0.312	0.312	0.819		0.179	0.179
AR99 22 - 49 - 61 RAD		129	0.967		0.169	0.169	0.890		0.250	0.250
AR99 23 - 36 - 58 RAD		128	0.924		0.126	0.126	0.947		0.307	0.307
AR99 24 - 47 - 65 RAD		125	1.00				0.692			
AR99 24 - 47 - 65 RAD	FD	125	0.877	0.939	0.141	0.141	0.439	0.566	-0.201	0
						0.312	MAXIMUM			0.311
						0.183	AVERAGE			0.156
						0.077	STANDARD DEVIATION			0.132
						0.048	CONFIDENCE LEVEL			0.082
						0.231	95% UPPER CONFIDENCE LE			0.237

FD = Field Duplicate
LD -= Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, anlayzed after 11/99

Attachment C – Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

GAMMA SPECTROSCOPY RESULTS—ACTINIUM SERIES (pCi/g)

SAMPLE I.D.									STATION	GROSS U-235	MEAN U-235	NET U-235	MODIFIED NET U-235
AR99	16	-	0	-	12	RAD			160				
AR99	16	-	12	-	24	RAD			160				
AR99	18	-	63	-	75	RAD			153+50				
AR99	20	-	12	-	24	RAD			136				
AR99	20	-	24	-	36	RAD			136				
AR99	20	-	58	-	71	RAD			136	0.186		0.055	0.055
AR99	21	-	63	-	75	RAD			132	0.135		0.004	0.004
AR99	22	-	49	-	61	RAD			129				
AR99	23	-	36	-	58	RAD			128	0.0978		-0.033	0
AR99	24	-	47	-	65	RAD			125				
AR99	24	-	47	-	65	RAD	FD		125	0.102		-0.029	0

FD	=	Field Duplicate
LD	-=	Lab Duplicate
125	=	Priority samples, analyzed 11/99
125	=	Non-priority samples, anlayzed after 11/99

0.055	MAXIMUM
0.015	AVERAGE
0.027	STANDARD DEVIATION
0.026	CONFIDENCE LEVEL
0.041	95% UPPER CONFIDENCE LEVEL

Attachment C – Table 3 Cont'd

	ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999										
	ISOTOPIC URANIUM RESULTS (pCi/g)										
			SAMPLE I.D.					STATION	U-238	U-234	U-235
AR99-	1	-	0	-	12	RAD		196	0.953	1.17	0.0419
AR99-	1	-	36	-	48	RAD		196	2.77	2.72	0.248
AR99-	1	-	70	-	82	RAD		196	3.63	3.80	0.149
AR99-	6	-	0	-	12	RAD		195	1.11	1.16	0.141
AR99-	6	-	12	-	30	RAD		195	0.865	0.833	0.0318
AR99-	6	-	12	-	30	RAD	FD	195	0.790	0.839	0.0555
AR99-	6	-	60	-	72	RAD		195	6.88	6.52	0.277
AR99-	6	-	72	-	84	RAD		195	13.6	14.3	0.945
AR99-	6	-	94	-	106	RAD		195	1.11	1.07	0.0639
AR99-	7	-	0	-	12	RAD		187 (160W)	0.568	0.759	0.110
AR99-	7	-	12	-	24	RAD		187 (160W)	0.831	0.700	0.0529
AR99-	7	-	12	-	24	RAD	FD	187 (160W)	0.634	0.744	0.0710
AR99-	7	-	24	-	36	RAD		187 (160W)	0.722	0.653	0.0644
AR99-	7	-	36	-	48	RAD		187 (160W)	0.710	0.945	0.0883
AR99-	7	-	36	-	48	RAD	LD	187 (160W)	0.815	0.834	0.0902
AR99-	7	-	48	-	60	RAD		187 (160W)	0.739	0.742	0.0827
AR99-	7	-	60	-	72	RAD		187 (160W)	2.20	2.23	0.166
AR99-	7	-	72	-	84	RAD		187 (160W)	4.05	3.83	0.284
AR99-	7	-	84	-	96	RAD		187 (160W)	6.09	5.96	0.460
AR99-	7	-	96	-	108	RAD		**187 (160W)**	7.51	8.28	0.425
AR99-	7	-	108	-	127	RAD		187 (160W)	7.22	6.99	0.531
AR99-	8	-	0	-	12	RAD		187 (0)	0.567	0.694	0.0812
AR99-	8	-	12	-	24	RAD		187 (0)	0.675	0.665	0.0641
AR99-	8	-	24	-	36	RAD		187 (0)	0.717	0.713	0.8080
AR99-	8	-	36	-	48	RAD		187 (0)	1.12	1.06	0.0769
AR99-	8	-	60	-	72	RAD		187 (0)	1.41	1.00	0.168
AR99-	8	-	60	-	72	RAD	LD	187 (0)	1.53	0.997	0.107
AR99-	8	-	72	-	84	RAD		187 (0)	2.61	2.47	0.183
AR99-	8	-	84	-	96	RAD		**187 (0)**	6.74	6.85	0.694
AR99-	8	-	96	-	108	RAD		187 (0)	7.67	7.83	0.679
AR99-	8	-	108	-	139	RAD		187 (0)	5.48	5.67	0.414
AR99-	8	-	108	-	139	RAD	FD	187 (0)	14.2	13.8	0.820
AR99-	9	-	0	-	12	RAD		**187 (180E)**	5.83	3.79	0.521
AR99-	9	-	12	-	24	RAD		187 (180E)	5.68	6.24	0.387
AR99-	9	-	24	-	36	RAD		187 (180E)	4.79	4.27	0.263
AR99-	9	-	36	-	48	RAD		187 (180E)	2.91	2.89	0.240
AR99-	9	-	36	-	48	RAD	FD	187 (180E)	2.36	2.46	0.135
AR99-	9	-	48	-	60	RAD		187 (180E)	7.72	8.28	0.511
AR99-	9	-	48	-	60	RAD	FD	187 (180E)	4.37	4.66	0.293
AR99-	9	-	60	-	72	RAD		187 (180E)	5.26	5.26	0.344
AR99-	9	-	72	-	84	RAD		187 (180E)	5.31	4.72	0.389
AR99-	9	-	84	-	96	RAD		187 (180E)	4.58	4.55	0.392

Attachment C – Table 3 Cont'd

	ISOTOPIC URANIUM RESULTS (pCi/g)										
			SAMPLE I.D.					STATION	U-238	U-234	U-235
AR99-	10	-	0	-	12	RAD		182 (120E)	0.752	0.837	0.0558
AR99-	10	-	60	-	72	RAD		182 (120E)	1.02	1.01	0.141
AR99-	10	-	93	-	105	RAD		182 (120E)	7.15	7.19	0.743
AR99-	10	-	93	-	105	RAD	FD	182 (120E)	6.57	6.01	0.478
AR99-	10	-	147	-	159	RAD		182 (120E)	4.89	5.85	0.389
AR99-	11	-	0	-	12	RAD		182 (20W)	0.651	0.584	0.0887
AR99-	11	-	33	-	51	RAD		182 (20W)	9.78	10.2	0.696
AR99-	11	-	33	-	51	RAD	FD	182 (20W)	45.5	57.9	6.59
AR99-	11	-	60	-	72	RAD		182 (20W)	9.50	9.91	0.540
AR99-	11	-	72	-	84	RAD		182 (20W)	9.81	10.4	0.571
AR99-	12	-	0	-	12	RAD		182 (80W)	0.533	0.666	0.0428
AR99-	12	-	12	-	24	RAD		182 (80W)	0.656	0.680	0.0803
AR99-	12	-	30	-	42	RAD		182 (80W)	0.730	0.682	0.0705
AR99-	12	-	72	-	90	RAD		182 (80W)	0.723	0.597	0.0564
AR99-	12	-	72	-	90	RAD	LD	182 (80W)	0.532	0.621	0.0788
AR99-	12	-	72	-	90	RAD	FD	182 (80W)	0.607	0.713	0.0568
AR99-	13	-	0	-	12	RAD		177	1.06	1.18	0.126
AR99-	13	-	90	-	102	RAD		177	12.9	12.1	0.485
AR99-	13	-	119	-	131	RAD		177	19.3	18.2	0.807
AR99-	13	-	152	-	164	RAD		177	3.43	3.18	0.236
AR99-	14	-	0	-	12	RAD		173	1.19	1.07	0.0498
AR99-	14	-	95	-	113	RAD		173	8.44	8.59	0.492
AR99-	14	-	95	-	113	RAD	FD	173	8.73	8.85	0.436
AR99-	14	-	130	-	142	RAD		173	22.1	22.5	1.14
AR99-	14	-	159	-	171	RAD		173	1.14	1.17	0.112
AR99-	15	-	0	-	12	RAD		163	1.10	1.07	0.0581
AR99-	15	-	24	-	36	RAD		163	2.15	2.31	0.0865
AR99-	15	-	42	-	54	RAD		163	3.36	3.86	0.264
AR99-	15	-	65	-	72	RAD		163	6.35	6.95	0.358
AR99-	17	-	0	-	12	RAD		156	0.666	0.682	0.0668
AR99-	17	-	37	-	49	RAD		156	1.39	1.57	0.123
AR99-	17	-	94	-	106	RAD		156	4.80	5.17	0.403
AR99-	17	-	123	-	135	RAD		156	8.27	7.75	0.483
AR99-	18	-	0	-	12	RAD		153+50	0.748	0.724	0.0660
AR99-	18	-	12	-	30	RAD		153+50	1.14	1.27	0.132
AR99-	18	-	12	-	30	RAD	FD	153+50	0.770	0.723	0.0397
AR99-	18	-	12	-	30	RAD	LD	153+50	0.638	0.912	0.0863
AR99-	18	-	36	-	48	RAD		153+50	0.746	0.812	0.0783
AR99-	19	-	0	-	12	RAD		149	0.546	0.557	0.0283
AR99-	19	-	12	-	24	RAD		149	0.656	0.610	0.0383
AR99-	19	-	24	-	36	RAD		149	0.583	0.690	0.0631
AR99-	19	-	70	-	82	RAD		149	0.850	0.791	0.0791
AR99-	20	-	0	-	12	RAD		136	1.02	1.23	0.153

Attachment C – Table 3 Cont'd

	ISOTOPIC URANIUM RESULTS (pCi/g)				
	SAMPLE I.D.	STATION	U-238	U-234	U-235
AR99-21 - 0 - 12 RAD		132	1.03	1.01	0.0904
AR99-21 - 0 - 12 RAD LD		132	1.35	0.889	0.0503
AR99-21 - 12 - 30 RAD		132	1.09	1.12	0.0735
AR99-21 - 12 - 30 RAD FD		132	1.23	1.24	0.0962
AR99-21 - 30 - 42 RAD		132	1.11	1.16	0.0498
AR99-22 - 0 - 12 RAD		129	0.774	0.653	0.0723
AR99-22 - 12 - 24 RAD		129	0.663	0.779	0.0669
AR99-23 - 0 - 12 RAD		128	0.728	0.735	0.0868
AR99-23 - 12 - 24 RAD		128	0.669	0.875	0.0570
AR99-23 - 24 - 36 RAD		128	0.753	0.680	0.0374
AR99-24 - 0 - 12 RAD		125	0.656	0.604	0.0503
AR99-24 - 12 - 30 RAD		125	0.798	0.732	0.0448
AR99-24 - 12 - 30 RAD FD		125	0.606	0.765	0.0767
AR99-25 - 0 8 RAD		121	0.980	1.27	0.0940
	MAX		45.5	57.9	6.59
	AVERAGE		3.85	3.99	0.304
	STANDARD DEVIATION		5.89	6.84	0.682
	CONFIDENCE LEVEL		1.16	1.35	0.134
	95% UPPER CONFIDENCE LEVEL		5.01	5.34	0.438
	FD = Field Duplicate				
	LD = Lab Duplicate				
	125 = Priority samples, analyzed 11/99				
	125 = Non-priority samples, analyzed after 11/99				
	Background sites AR99-2 to AR99-5, inclusive				

Attachment C – Table 3 Cont'd

										EMAN	GAMMA	GAM/EM
	ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999											
	ISOTOPIC RADIUM RESULTS (pCi/g)											
			SAMPLE I.D.						STATION	Ra-226	Ra-226	FACTOR
AR99-	1	-	0	-	12	RAD			196			
AR99-	1	-	36	-	48	RAD			196			
AR99-	1	-	70	-	82	RAD			196			
AR99-	6	-	0	-	12	RAD			195			
AR99-	6	-	12	-	30	RAD			195			
AR99-	6	-	12	-	30	RAD	FD		195			
AR99-	6	-	60	-	72	RAD			195			
AR99-	6	-	72	-	84	RAD			195			
AR99-	6	-	94	-	106	RAD			195			
AR99-	7	-	0	-	12	RAD			187 (160W)			
AR99-	7	-	12	-	24	RAD			187 (160W)			
AR99-	7	-	12	-	24	RAD	FD		187 (160W)			
AR99-	7	-	24	-	36	RAD			187 (160W)			
AR99-	7	-	36	-	48	RAD			187 (160W)			
AR99-	7	-	36	-	48	RAD	LD		187 (160W)			
AR99-	7	-	48	-	60	RAD			187 (160W)			
AR99-	7	-	60	-	72	RAD			187 (160W)			
AR99-	7	-	72	-	84	RAD			187 (160W)			
AR99-	7	-	84	-	96	RAD			187 (160W)			
AR99-	7	-	96	-	108	RAD			187 (160W)	7.33	8.68	1.2
AR99-	7	-	108	-	127	RAD			187 (160W)			
AR99-	8	-	0	-	12	RAD			187 (0)			
AR99-	8	-	12	-	24	RAD			187 (0)			
AR99-	8	-	24	-	36	RAD			187 (0)			
AR99-	8	-	36	-	48	RAD			187 (0)			
AR99-	8	-	60	-	72	RAD			187 (0)			
AR99-	8	-	60	-	72	RAD	LD		187 (0)			
AR99-	8	-	72	-	84	RAD			187 (0)			
AR99-	8	-	84	-	96	RAD			187 (0)	6.59	14.40	2.2
AR99-	8	-	96	-	108	RAD			187 (0)			
AR99-	8	-	108	-	139	RAD			187 (0)			
AR99-	8	-	108	-	139	RAD	FD		187 (0)			
AR99-	9	-	0	-	12	RAD			187 (180E)	2.56	5.96	2.3
AR99-	9	-	12	-	24	RAD			187 (180E)			
AR99-	9	-	24	-	36	RAD			187 (180E)			
AR99-	9	-	36	-	48	RAD			187 (180E)			
AR99-	9	-	36	-	48	RAD	FD		187 (180E)			
AR99-	9	-	48	-	60	RAD			187 (180E)			
AR99-	9	-	48	-	60	RAD	FD		187 (180E)			
AR99-	9	-	60	-	72	RAD			187 (180E)			
AR99-	9	-	72	-	84	RAD			187 (180E)			
AR99-	9	-	84	-	96	RAD			187 (180E)			

Attachment C – Table 3 Cont'd

ISOTOPIC RADIUM RESULTS (pCi/g)				
		EMAN	GAMMA	GAM/EM
SAMPLE I.D.	STATION	Ra-226	Ra-226	FACTOR
AR99-10 - 0 - 12 RAD	182 (120E)			
AR99-10 - 60 - 72 RAD	182 (120E)			
AR99-10 - 93 - 105 RAD	**182 (120E)**	7.04	7.63	1.1
AR99-10 - 93 - 105 RAD FD	182 (120E)			
AR99-10 - 147 - 159 RAD	182 (120E)			
AR99-11 - 0 - 12 RAD	182 (20W)			
AR99-11 - 33 - 51 RAD	**182 (20W)**	4.50	4.93	1.1
AR99-11 - 33 - 51 RAD FD	182 (20W)			
AR99-11 - 60 - 72 RAD	182 (20W)			
AR99-11 - 72 - 84 RAD	182 (20W)			
AR99-12 - 0 - 12 RAD	182 (80W)			
AR99-12 - 12 - 24 RAD	182 (80W)			
AR99-12 - 30 - 42 RAD	182 (80W)			
AR99-12 - 72 - 90 RAD	**182 (80W)**	0.755	1.48	2.0
AR99-12 - 72 - 90 RAD LD	**182 (80W)**			
AR99-12 - 72 - 90 RAD FD	**182 (80W)**	0.784	1.16	1.5
AR99-13 - 0 - 12 RAD	177			
AR99-13 - 90 - 102 RAD	177			
AR99-13 - 119 - 131 RAD	177			
AR99-13 - 152 - 164 RAD	177			
AR99-14 - 0 - 12 RAD	173			
AR99-14 - 95 - 113 RAD	173			
AR99-14 - 95 - 113 RAD FD	173			
AR99-14 - 130 - 142 RAD	173			
AR99-14 - 159 - 171 RAD	173			
AR99-15 - 0 - 12 RAD	163			
AR99-15 - 24 - 36 RAD	163			
AR99-15 - 42 - 54 RAD	163			
AR99-15 - 65 - 72 RAD	163			
AR99-17 - 0 - 12 RAD	156			
AR99-17 - 37 - 49 RAD	156			
AR99-17 - 94 - 106 RAD	156			
AR99-17 - 123 - 135 RAD	156			
AR99-18 - 0 - 12 RAD	153+50			
AR99-18 - 12 - 30 RAD	153+50			
AR99-18 - 12 - 30 RAD FD	153+50			
AR99-18 - 12 - 30 RAD LD	153+50			
AR99-18 - 36 - 48 RAD	153+50			
AR99-19 - 0 - 12 RAD	149			
MAX		7.33	14.4	2.33
AVERAGE		4.22	6.32	1.62
STANDARD DEVIATION		2.88	4.56	0.534
CONFIDENCE LEVEL		0.568	0.898	0.105
95% UPPER CONFIDENCE LEVEL		4.79	7.22	1.72

FD = Field Duplicate
LD = Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, analyzed after 11/99

Background sites AR99-2 to AR99-5, inclusive

Attachment C – Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999						
GAMMA SPECTROSCOPY RESULTS---URANIUM SERIES (pCi/g)						
SAMPLE I.D.	STATION	Th-234	Pa-234m	Ra-226	Pb-214	Bi-214
AR99- 1 - 0 - 12 RAD	196			1.62	0.830	0.796
AR99- 1 - 36 - 48 RAD	196	2.20	2.25	3.79	1.65	1.52
AR99- 1 - 70 - 82 RAD	196	1.69	1.75	3.42	1.21	1.09
AR99- 6 - 0 - 12 RAD	195			1.46	0.768	0.691
AR99- 6 - 12 - 30 RAD	195			1.41	0.732	0.666
AR99- 6 - 12 - 30 RAD FD	195			1.56	0.797	0.701
AR99- 6 - 60 - 72 RAD	195			5.93	2.53	2.26
AR99- 6 - 72 - 84 RAD	195			9.77	3.79	3.39
AR99- 6 - 94 - 106 RAD	195		0.860	1.84	0.865	0.800
AR99- 7 - 0 - 12 RAD	187 (160W)			1.30	0.679	0.629
AR99- 7 - 12 - 24 RAD	187 (160W)			1.68	0.802	0.750
AR99- 7 - 12 - 24 RAD FD	187 (160W)	0.834		1.68	0.767	0.674
AR99- 7 - 24 - 36 RAD	187 (160W)	1.27	1.02	1.47	0.787	0.742
AR99- 7 - 36 - 48 RAD	187 (160W)	0.382	1.17	1.45	0.624	0.599
AR99- 7 - 48 - 60 RAD	187 (160W)	1.12	1.96	1.90	0.891	0.819
AR99- 7 - 60 - 72 RAD	187 (160W)	1.18	2.40	4.15	1.78	1.64
AR99- 7 - 72 - 84 RAD	187 (160W)	4.85	4.24	5.95	3.66	3.34
AR99- 7 - 84 - 96 RAD	187 (160W)	3.59	5.29	5.73	3.75	3.41
AR99- 7 - 96 - 108 RAD	**187 (160W)**	11.3	11.1	8.68	7.28	6.51
AR99- 7 - 108 - 127 RAD	187 (160W)	6.21	8.47	3.94	3.42	3.14
AR99- 8 - 0 - 12 RAD	187 (0)	1.06		1.13	0.551	0.528
AR99- 8 - 12 - 24 RAD	187 (0)	0.708		1.60	0.686	0.625
AR99- 8 - 24 - 36 RAD	187 (0)			1.79	0.709	0.650
AR99- 8 - 36 - 48 RAD	187 (0)	1.56		2.07	1.02	0.962
AR99- 8 - 60 - 72 RAD	187 (0)	1.13	1.27	2.10	0.914	0.828
AR99- 8 - 72 - 84 RAD	187 (0)	2.72	2.79	5.21	2.01	1.86
AR99- 8 - 84 - 96 RAD	**187 (0)**	4.72	9.91	14.40	5.97	5.55
AR99- 8 - 96 - 108 RAD	187 (0)	5.61	9.48	6.50	4.12	3.66
AR99- 8 - 108 - 139 RAD	187 (0)	3.43	8.73	6.49	4.28	3.88
AR99- 8 - 108 - 139 RAD FD	187 (0)	7.95	7.16	7.29	4.29	3.92
AR99- 9 - 0 - 12 RAD	**187 (180E)**	6.23	4.73	5.96	2.25	2.02
AR99- 9 - 12 - 24 RAD	187 (180E)	6.41	6.82	6.24	5.10	4.59
AR99- 9 - 24 - 36 RAD	187 (180E)	12.0	12.1	5.05	3.22	2.91
AR99- 9 - 36 - 48 RAD	187 (180E)	2.49	2.74	4.51	1.49	1.33
AR99- 9 - 36 - 48 RAD FD	187 (180E)	4.60	4.83	3.48	1.79	1.61
AR99- 9 - 48 - 60 RAD	187 (180E)	10.6	10.5	1.49	3.17	2.82
AR99- 9 - 48 - 60 RAD FD	187 (180E)	1.49	2.99	3.86	1.67	1.54
AR99- 9 - 60 - 72 RAD	187 (180E)	5.50	6.05	2.50	2.05	1.80
AR99- 9 - 60 - 72 RAD LD	187 (180E)			ND	2.07	1.85
AR99- 9 - 72 - 84 RAD	187 (180E)	4.84	6.10	3.28	2.39	2.13
AR99- 9 - 84 - 96 RAD	187 (180E)	5.63	6.08	3.62	1.90	1.59

Attachment C – Table 3 Cont'd

	GAMMA SPECTROSCOPY RESULTS---URANIUM SERIES (pCi/g)					
SAMPLE I.D.	STATION	Th-234	Pa-234m	Ra-226	Pb-214	Bi-214
AR99-10 - 0 - 12 RAD	182 (120E)		0.870	1.80	0.810	0.730
AR99-10 - 60 - 72 RAD	182 (120E)	1.15	1.38	2.46	1.30	1.20
AR99-10 - 93 - 105 RAD	**182 (120E)**	7.33	8.50	7.63	6.95	6.32
AR99-10 - 93 - 105 RAD FD	182 (120E)	10.50	8.91	4.99	6.30	5.71
AR99-10 - 147 - 159 RAD	182 (120E)	5.98	5.44	5.12	4.12	3.70
AR99-11 - 0 - 12 RAD	182 (20W)		1.01	1.46	0.833	0.721
AR99-11 - 33 - 51 RAD	**182 (20W)**	12.9	13.0	4.93	4.90	4.06
AR99-11 - 33 - 51 RAD FD	182 (20W)			9.50	4.86	4.32
AR99-11 - 60 - 72 RAD	182 (20W)	5.74	6.79	3.98	2.32	2.07
AR99-11 - 72 - 84 RAD	182 (20W)			8.16	3.10	2.78
AR99-12 - 0 - 12 RAD	182 (80W)	0.926		1.18	0.574	0.533
AR99-12 - 12 - 24 RAD	182 (80W)			1.50	0.755	0.688
AR99-12 - 30 - 42 RAD	182 (80W)			1.35	0.737	0.682
AR99-12 - 72 - 90 RAD	**182 (80W)**			1.48	0.652	0.603
AR99-12 - 72 - 90 RAD FD	**182 (80W)**			1.16	0.612	0.574
AR99-13 - 0 - 12 RAD	177			1.16	0.584	0.550
AR99-13 - 0 - 12 RAD LD	177			1.20	0.663	0.558
AR99-13 - 90 - 102 RAD	177			9.29	3.98	3.56
AR99-13 - 119 - 131 RAD	177			6.72	3.34	2.94
AR99-13 - 152 - 164 RAD	177			3.63	1.29	1.15
AR99-14 - 0 - 12 RAD	173			1.65	0.770	0.744
AR99-14 - 95 - 113 RAD	173	5.00	5.25	5.89	3.45	3.12
AR99-14 - 95 - 113 RAD FD	173	5.07	4.26	9.71	3.69	3.28
AR99-14 - 130 - 142 RAD	173	10.3	9.43	3.33	3.13	2.71
AR99-14 - 159 - 171 RAD	173	0.903		1.87	0.760	0.650
AR99-15 - 0 - 12 RAD	163			1.24	0.702	0.633
AR99-15 - 24 - 36 RAD	163	1.33		2.78	1.31	1.19
AR99-15 - 42 - 54 RAD	163	3.56	4.91	8.55	3.45	3.11
AR99-15 - 65 - 72 RAD	163	6.84	5.40	4.47	3.84	3.39
AR99-17 - 0 - 12 RAD	156	0.778	0.910	1.42	0.817	0.703
AR99-17 - 37 - 49 RAD	156	0.749	1.61	1.74	0.833	0.776
AR99-17 - 94 - 106 RAD	156			5.84	2.46	2.13
AR99-17 - 123 - 135 RAD	156			2.09	2.93	2.61
AR99-18 - 0 - 12 RAD	153+50			1.34	0.752	0.694
AR99-18 - 12 - 30 RAD	153+50			1.44	0.785	0.741
AR99-18 - 12 - 30 RAD FD	153+50			1.43	0.828	0.769
AR99-18 - 36 - 48 RAD	153+50	0.742		1.92	0.895	0.852
AR99-19 - 0 - 12 RAD	149			1.06	0.493	0.449
AR99-19 - 12 - 24 RAD	149	0.513		1.16	0.635	0.579
AR99-19 - 12 - 24 RAD LD	149			1.23	0.621	0.580
AR99-19 - 24 - 36 RAD	149			1.24	0.499	0.440
AR99-19 - 70 - 82 RAD	149	0.615	1.40	1.54	0.721	0.674
AR99-19 - 70 - 82 RAD LD	149		0.799	1.56	0.733	0.658
AR99-20 - 0 - 12 RAD	136			1.43	0.769	0.714

Attachment C – Table 3 Cont'd

	GAMMA SPECTROSCOPY RESULTS—URANIUM SERIES (pCi/g)							
	SAMPLE I.D.		STATION	Th-234	Pa-234m	Ra-226	Pb-214	Bi-214
AR99-21	0 - 12 RAD		132	0.545		1.35	0.707	0.651
AR99-21	12 - 30 RAD		132	0.801	1.40	1.53	0.794	0.749
AR99-21	12 - 30 RAD	FD	132			1.47	0.821	0.742
AR99-21	30 - 42 RAD		132		1.93	1.93	0.968	0.876
AR99-22	0 - 12 RAD		129			1.48	0.687	0.604
AR99-22	12 - 24 RAD		129		1.16	1.53	0.710	0.657
AR99-23	0 - 12 RAD		128			1.46	0.717	0.641
AR99-23	12 - 24 RAD		128			1.68	0.789	0.714
AR99-23	24 - 36 RAD		128	0.717		1.51	0.863	0.755
AR99-24	0 - 12 RAD		125			1.33	0.722	0.665
AR99-24	12 - 30 RAD		125			1.58	0.820	0.732
AR99-24	12 - 30 RAD	FD	125			1.80	0.821	0.762
AR99-24	12 - 30 RAD	LD	125			1.71	0.836	0.756
AR99-25	0 8 RAD		121			1.43	0.674	0.599
	MAX			12.9	13.0	14.4	7.28	6.51
	AVERAGE			3.97	4.83	3.30	1.87	1.68
	STANDARD DEVIATION			3.47	3.51	2.65	1.61	1.44
	CONFIDENCE LEVEL			0.683	0.691	0.522	0.317	0.284
	95% UPPER CONFIDENCE LEVEL			4.65	5.52	3.83	2.18	1.96

FD = Field Duplicate

LD = Lab Duplicate

125 = Priority samples, analyzed 11/99

125 = Non-priority samples, analyzed after 11/99

Background sites AR99-2 to AR99-5, inclusive

Attachment C – Table 3 Cont'd

	ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999											
	ISOTOPIC THORIUM RESULTS (pCi/g)											
			SAMPLE I.D.					STATION	Th-230	Th-232	Th-228	Th-227
AR99-	1	-	0	-	12	RAD		196	0.715	0.763	0.769	0.0831
AR99-	1	-	36	-	48	RAD		196	1.62	0.856	0.930	0.164
AR99-	1	-	70	-	82	RAD		196	1.95	0.903	1.38	0.122
AR99-	6	-	0	-	12	RAD		195	0.697	0.900	0.809	0.0882
AR99-	6	-	12	-	30	RAD		195	0.650	0.844	0.873	0.0616
AR99-	6	-	12	-	30	RAD	FD	195	0.832	0.783	0.873	0.0296
AR99-	6	-	60	-	72	RAD		195	3.87	1.01	1.05	0.183
AR99-	6	-	72	-	84	RAD		195	6.40	1.72	0.815	0.344
AR99-	6	-	94	-	106	RAD		195	1.08	0.880	0.888	0.0398
AR99-	7	-	0	-	12	RAD		187 (160W)	0.690	0.684	0.795	0.0575
AR99-	7	-	12	-	24	RAD		187 (160W)	0.653	0.871	1.18	0.0656
AR99-	7	-	12	-	24	RAD	FD	187 (160W)				
AR99-	7	-	24	-	36	RAD		187 (160W)	0.577	0.835	0.801	0.0312
AR99-	7	-	36	-	48	RAD		187 (160W)	0.653	0.845	0.997	0.0535
AR99-	7	-	36	-	48	RAD	LD	187 (160W)	0.652	0.877	1.01	0.0442
AR99-	7	-	48	-	60	RAD		187 (160W)	0.615	0.878	0.812	0.0577
AR99-	7	-	60	-	72	RAD		187 (160W)	2.33	1.44	1.41	0.146
AR99-	7	-	72	-	84	RAD		187 (160W)	3.52	1.38	1.08	0.182
AR99-	7	-	84	-	96	RAD		187 (160W)	5.62	1.03	0.840	0.646
AR99-	7	-	96	-	108	RAD		**187 (160W)**	7.57	1.35	1.04	0.362
AR99-	7	-	108	-	127	RAD		187 (160W)	6.92	1.59	1.40	0.513
AR99-	8	-	0	-	12	RAD		187 (0)	0.784	0.764	0.863	0.00451
AR99-	8	-	12	-	24	RAD		187 (0)	0.547	0.817	0.964	0.0683
AR99-	8	-	24	-	36	RAD		187 (0)	0.769	0.914	0.777	0.0270
AR99-	8	-	36	-	48	RAD		187 (0)	1.02	1.22	1.28	0.0672
AR99-	8	-	60	-	72	RAD		187 (0)	0.896	1.61	1.60	0.136
AR99-	8	-	60	-	72	RAD	LD	187 (0)	0.949	1.59	1.44	0.0970
AR99-	8	-	72	-	84	RAD		187 (0)	2.27	1.93	1.74	0.103
AR99-	8	-	84	-	96	RAD		**187 (0)**	5.38	1.84	1.81	0.299
AR99-	8		96	-	108	RAD		187 (0)	9.91	1.60	1.41	0.435
AR99-	8	-	108	-	139	RAD		187 (0)	9.52	1.61	1.45	0.407
AR99-	8	-	108	-	139	RAD	FD	187 (0)	7.52	1.21	1.25	0.201
AR99-	9	-	0	-	12	RAD		**187 (180E)**	2.98	8.52	8.64	0.572
AR99-	9	-	12	-	24	RAD		187 (180E)	5.81	1.20	1.08	0.274
AR99-	9	-	24	-	36	RAD		187 (180E)	5.58	1.46	1.15	0.368
AR99-	9	-	36	-	48	RAD		187 (180E)	1.91	0.940	0.840	0.0888
AR99-	9	-	36	-	48	RAD	FD	187 (180E)	2.52	1.06	0.844	0.0805
AR99-	9	-	48	-	60	RAD		187 (180E)	8.13	1.79	1.80	0.390
AR99-	9	-	48	-	60	RAD	FD	187 (180E)	2.07	1.72	1.62	0.0773
AR99-	9	-	60	-	72	RAD		187 (180E)	7.83	1.86	1.54	0.271
AR99-	9	-	72	-	84	RAD		187 (180E)	5.42	1.33	0.827	0.346
AR99-	9	-	84	-	96	RAD		187 (180E)	5.00	1.36	1.07	0.214

Attachment C – Table 3 Cont'd

ISOTOPIC THORIUM RESULTS (pCi/g)						
SAMPLE I.D.		STATION	Th-230	Th-232	Th-228	Th-227
AR99-10 - 0 - 12 RAD		182 (120E)	0.738	0.680	0.923	0.0823
AR99-10 - 60 - 72 RAD		182 (120E)	0.845	0.988	0.910	0.0870
AR99-10 - 93 - 105 RAD		182 (120E)	5.77	2.26	2.27	0.325
AR99-10 - 93 - 105 RAD	FD	182 (120E)	5.27	1.86	1.81	0.222
AR99-10 - 147 - 159 RAD		182 (120E)	4.19	0.692	0.654	0.140
AR99-11 - 0 - 12 RAD		182 (20W)	0.529	0.596	0.689	0.0865
AR99-11 - 33 - 51 RAD		182 (20W)	9.10	1.24	1.14	0.272
AR99-11 - 33 - 51 RAD	FD	182 (20W)	8.84	1.54	2.52	0.734
AR99-11 - 60 - 72 RAD		182 (20W)	4.03	0.858	0.891	0.250
AR99-11 - 72 - 84 RAD		182 (20W)	4.80	1.11	1.07	0.247
AR99-12 - 0 - 12 RAD		182 (80W)	0.617	0.649	0.576	0.0504
AR99-12 - 12 - 24 RAD		182 (80W)	0.728	0.865	0.957	0.0626
AR99-12 - 30 - 42 RAD		182 (80W)	0.747	0.842	0.775	0.0486
AR99-12 - 72 - 90 RAD		182 (80W)	0.614	0.862	0.881	0.00690
AR99-12 - 72 - 90 RAD	LD	182 (80W)	0.708	0.814	0.790	0.102
AR99-12 - 72 - 90 RAD	FD	182 (80W)	0.648	0.836	0.853	0.0783
AR99-13 - 0 - 12 RAD		177	1.26	1.29	1.13	0.117
AR99-13 - 90 - 102 RAD		177	11.9	3.51	3.17	0.910
AR99-13 - 119 - 131 RAD		177	20.3	3.50	4.00	0.896
AR99-13 - 152 - 164 RAD		177	3.93	1.63	1.58	0.272
AR99-14 - 0 - 12 RAD		173	0.926	1.04	1.49	0.0787
AR99-14 - 95 - 113 RAD		173	8.09	2.83	2.70	0.424
AR99-14 - 95 - 113 RAD	FD	173	9.17	2.98	3.07	0.642
AR99-14 - 130 - 142 RAD		173	20.9	3.35	2.97	0.743
AR99-14 - 159 - 171 RAD		173	1.28	0.930	1.13	0.169
AR99-15 - 0 - 12 RAD		163	0.892	1.08	1.33	0.0681
AR99-15 - 24 - 36 RAD		163	1.88	1.39	1.52	0.0378
AR99-15 - 42 - 54 RAD		163	3.11	1.55	1.27	0.308
AR99-15 - 65 - 72 RAD		163	4.54	0.985	1.42	0.258
AR99-17 - 0 - 12 RAD		156	0.608	0.840	0.787	0.0197
AR99-17 - 37 - 49 RAD		156	0.874	1.47	1.40	0.184
AR99-17 - 94 - 106 RAD		156	4.12	2.33	2.15	0.124
AR99-17 - 123 - 135 RAD		156	8.40	1.97	1.92	0.411
AR99-18 - 0 - 12 RAD		153+50	0.708	0.793	0.969	0.0568
AR99-18 - 12 - 30 RAD		153+50	0.838	0.993	1.33	0.0905
AR99-18 - 12 - 30 RAD	FD	153+50	0.821	0.877	1.09	0.110
AR99-18 - 12 - 30 RAD	LD	153+50	0.675	0.996	0.952	0.0999
AR99-18 - 36 - 48 RAD		153+50	0.798	0.737	0.827	0.102
AR99-19 - 0 - 12 RAD		149	0.485	0.669	0.554	0.0580
AR99-19 - 12 - 24 RAD		149	0.596	0.601	0.699	0.0373
AR99-19 - 24 - 36 RAD		149	0.483	0.574	0.715	0.0406
AR99-19 - 70 - 82 RAD		149	0.552	0.768	0.743	0.0833
AR99-20 - 0 - 12 RAD		136	1.33	1.32	1.46	0.122

Attachment C – Table 3 Cont'd

ISOTOPIC THORIUM RESULTS (pCi/g)						
SAMPLE I.D.		STATION	Th-230	Th-232	Th-228	Th-227
AR99-21 - 0 - 12 RAD		132	0.771	0.964	1.05	0.121
AR99-21 - 0 - 12 RAD	LD	132	0.897	1.06	0.919	0.0770
AR99-21 - 12 - 30 RAD		132	1.13	1.27	1.48	0.128
AR99-21 - 12 - 30 RAD	FD	132	1.31	1.22	1.46	0.0583
AR99-21 - 30 - 42 RAD		132	1.35	1.49	1.73	0.173
AR99-22 - 0 - 12 RAD		129	0.613	0.690	0.642	0.0535
AR99-22 - 12 - 24 RAD		129	0.557	0.676	0.797	0.0613
AR99-23 - 0 - 12 RAD		128	0.621	0.696	0.737	0.00894
AR99-23 - 12 - 24 RAD		128	0.663	0.746	0.678	0.0563
AR99-23 - 24 - 36 RAD		128	0.555	0.750	0.684	0.0340
AR99-24 - 0 - 12 RAD		125	0.660	0.740	0.782	0.0868
AR99-24 - 12 - 30 RAD		125	0.878	0.958	1.02	0.0630
AR99-24 - 12 - 30 RAD	FD	125	0.826	1.06	1.06	0.180
AR99-25 - 0 8 RAD		121	1.21	1.29	1.33	0.120
MAX			20.9	8.52	8.64	0.91
AVERAGE			3.10	1.31	1.31	0.19
STANDARD DEVIATION			3.82	0.957	0.961	0.193
CONFIDENCE LEVEL			0.753	0.189	0.189	0.0381
95% UPPER CONFIDENCE LEVEL			3.86	1.50	1.50	0.225

FD = Field Duplicate

LD = Lab Duplicate

125 = Priority samples, analyzed 11/99

125 = Non-priority samples, analyzed after 11/99

Background sites AR99-2 to AR99-5, inclusive

Attachment C – Table 3 Cont'd

ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

GAMMA SPECTROSCOPY RESULTS---THORIUM SERIES (pCi/g)

SAMPLE I.D.								STATION	Ra-228	Ra-224	Pb-212	Bi-212	Tl-208
AR99-	1	-	0	-	12	RAD		196	0.895	0.926	0.971	0.802	0.305
AR99-	1	-	36	-	48	RAD		196	0.887	0.591	0.985	1.02	0.300
AR99-	1	-	70	-	82	RAD		196	0.856	0.919	0.927	0.990	0.299
AR99-	6	-	0	-	12	RAD		195	0.829	0.583	0.889	0.805	0.266
AR99-	6	-	12	-	30	RAD		195	0.777	0.495	0.836	0.834	0.269
AR99-	6	-	12	-	30	RAD	FD	195	0.843	0.883	0.954	0.748	0.305
AR99-	6	-	60	-	72	RAD		195	0.917		0.934	0.984	0.320
AR99-	6	-	72	-	84	RAD		195	1.17	0.922	1.25	1.12	0.377
AR99-	6	-	94	-	106	RAD		195	0.893	0.889	0.942	0.915	0.313
AR99-	7	-	0	-	12	RAD		187 (160W)	0.806	0.895	0.919	0.820	0.294
AR99-	7	-	12	-	24	RAD		187 (160W)	0.830	0.884	0.966	0.960	0.317
AR99-	7	-	12	-	24	RAD	FD	187 (160W)	0.741	0.749	0.980	0.656	0.289
AR99-	7	-	24	-	36	RAD		187 (160W)	0.896	0.740	0.971	0.885	0.320
AR99-	7	-	36	-	48	RAD		187 (160W)	0.735	0.623	0.830	0.774	0.275
AR99-	7	-	48	-	60	RAD		187 (160W)	0.922	0.703	1.02	0.939	0.326
AR99-	7	-	60	-	72	RAD		187 (160W)	1.32	1.30	1.48	1.55	0.473
AR99-	7	-	72	-	84	RAD		187 (160W)	1.52	1.27	1.84	1.67	0.558
AR99-	7	-	84	-	96	RAD		187 (160W)	0.953		1.00	0.952	0.327
AR99-	7	-	96	-	108	RAD		**187 (160W)**	1.17		1.48	1.25	0.443
AR99-	7	-	108	-	127	RAD		187 (160W)	1.51	1.23	1.70	1.59	0.522
AR99-	8	-	0	-	12	RAD		187 (0)	0.671	0.670	0.747	0.773	0.236
AR99-	8	-	12	-	24	RAD		187 (0)	0.802	0.694	0.935	0.896	0.304
AR99-	8	-	24	-	36	RAD		187 (0)	0.824	0.549	0.934	0.757	0.319
AR99-	8	-	36	-	48	RAD		187 (0)	1.38	1.09	1.48	1.43	0.474
AR99-	8	-	60	-	72	RAD		187 (0)	1.58	1.42	1.65	1.59	0.559
AR99-	8	-	72	-	84	RAD		187 (0)	1.75	1.71	1.97	1.81	0.612
AR99-	8	-	84	-	96	RAD		**187 (0)**	1.76	1.96	2.12	2.11	0.689
AR99-	8	-	96	-	108	RAD		187 (0)	1.42	0.988	1.63	1.36	0.499
AR99-	8	-	108	-	139	RAD		187 (0)	1.73	1.64	1.99	1.90	0.607
AR99-	8	-	108	-	139	RAD	FD	187 (0)	1.14	0.807	1.32	1.26	0.405
AR99-	9	-	0	-	12	RAD		**187 (180E)**	8.33	7.99	9.09	8.43	2.92
AR99-	9	-	12	-	24	RAD		187 (180E)	1.21		1.31	1.38	0.434
AR99-	9	-	24	-	36	RAD		187 (180E)	1.14	0.892	1.31	1.18	0.390
AR99-	9	-	36	-	48	RAD		187 (180E)	0.869	0.719	0.983	0.926	0.314
AR99-	9	-	36	-	48	RAD	FD	187 (180E)	0.940	1.01	1.04	0.912	0.317
AR99-	9	-	48	-	60	RAD		187 (180E)	2.06	1.79	2.27	2.14	0.709
AR99-	9	-	48	-	60	RAD	FD	187 (180E)	1.44	1.02	1.58	1.50	0.534
AR99-	9	-	60	-	72	RAD		187 (180E)	1.84	1.37	1.92	1.96	0.649
AR99-	9	-	60	-	72	RAD	LD	187 (180E)	1.90	0.848	1.97	2.07	0.629
AR99-	9	-	72	-	84	RAD		187 (180E)	1.21	0.495	1.29	1.43	0.432
AR99-	9	-	84	-	96	RAD		187 (180E)	1.07	0.844	1.35	1.15	0.394

Attachment C – Table 3 Cont'd

		GAMMA SPECTROSCOPY RESULTS---THORIUM SERIES (pCi/g)					
SAMPLE I.D.		STATION	Ra-228	Ra-224	Pb-212	Bi-212	Tl-208
AR99-10 - 0 - 12 RAD		182 (120E)	0.865	0.776	0.975	0.896	0.327
AR99-10 - 60 - 72 RAD		182 (120E)	0.853	0.533	0.881	0.858	0.296
AR99-10 - 93 - 105 RAD		182 (120E)	2.52	2.08	2.85	2.52	0.881
AR99-10 - 93 - 105 RAD	FD	182 (120E)	2.29	1.97	2.51	2.21	0.771
AR99-10 - 147 - 159 RAD		182 (120E)	0.761	0.989	0.875	0.684	0.252
AR99-11 - 0 - 12 RAD		182 (20W)	0.833	0.666	0.934	0.981	0.311
AR99-11 - 33 - 51 RAD		182 (20W)	1.27	1.28	1.71	1.70	0.513
AR99-11 - 33 - 51 RAD	FD	182 (20W)	1.38	0.569	1.56	1.60	0.462
AR99-11 - 60 - 72 RAD		182 (20W)	0.964	0.768	1.03	0.917	0.322
AR99-11 - 72 - 84 RAD		182 (20W)	1.18	0.793	1.20	1.22	0.384
AR99-12 - 0 - 12 RAD		182 (80W)	0.668	0.565	0.754	0.606	0.242
AR99-12 - 12 - 24 RAD		182 (80W)	0.977	1.05	1.02	1.01	0.321
AR99-12 - 30 - 42 RAD		182 (80W)	0.867	0.734	0.899	0.888	0.270
AR99-12 - 72 - 90 RAD		182 (80W)	0.812	0.543	0.819	0.841	0.247
AR99-12 - 72 - 90 RAD	FD	182 (80W)	0.758	0.621	0.754	0.842	0.246
AR99-13 - 0 - 12 RAD		177	0.758	0.516	0.809	0.887	0.260
AR99-13 - 0 - 12 RAD	LD	177	0.721	0.654	0.813	0.608	0.249
AR99-13 - 90 - 102 RAD		177	1.54		1.61	1.55	0.522
AR99-13 - 119 - 131 RAD		177	1.63		1.64	1.73	0.542
AR99-13 - 152 - 164 RAD		177	1.09	0.686	1.14	1.15	0.370
AR99-14 - 0 - 12 RAD		173	1.03	1.14	1.10	1.12	0.340
AR99-14 - 95 - 113 RAD		173	1.36	1.25	1.66	1.50	0.523
AR99-14 - 95 - 113 RAD	FD	173	1.50	1.67	1.65	1.64	0.500
AR99-14 - 130 - 142 RAD		173	1.21	0.793	1.50	1.33	0.458
AR99-14 - 159 - 171 RAD		173	0.757	0.677	0.893	0.837	0.288
AR99-15 - 0 - 12 RAD		163	0.795	0.738	0.902	0.931	0.302
AR99-15 - 24 - 36 RAD		163	0.953	0.487	1.11	1.08	0.356
AR99-15 - 42 - 54 RAD		163	1.73	0.310	1.88	1.79	0.618
AR99-15 - 65 - 72 RAD		163	1.41	1.00	1.56	1.55	0.492
AR99-17 - 0 - 12 RAD		156	0.819	0.580	1.01	0.908	0.314
AR99-17 - 37 - 49 RAD		156	1.06	0.984	1.13	1.07	0.360
AR99-17 - 94 - 106 RAD		156	1.48	0.760	1.50	1.43	0.488
AR99-17 - 123 - 135 RAD		156	1.12	0.599	1.18	0.923	0.371
AR99-18 - 0 - 12 RAD		153+50	0.834	0.866	1.02	0.959	0.316
AR99-18 - 12 - 30 RAD		153+50	1.07	0.835	1.11	1.07	0.344
AR99-18 - 12 - 30 RAD	FD	153+50	1.03	0.869	1.13	1.02	0.362
AR99-18 - 36 - 48 RAD		153+50	0.855	1.06	1.02	0.917	0.340
AR99-19 - 0 - 12 RAD		149	0.584	0.428	0.651	0.579	0.208
AR99-19 - 12 - 24 RAD		149	0.738	0.690	0.839	0.797	0.269
AR99-19 - 12 - 24 RAD	LD	149	0.708	0.606	0.803	0.639	0.262
AR99-19 - 24 - 36 RAD		149	0.616	0.624	0.718	0.702	0.226
AR99-19 - 70 - 82 RAD		149	0.879	0.770	0.973	0.820	0.324
AR99-19 - 70 - 82 RAD	LD	149	0.880	0.730	0.972	1.10	0.326
AR99-20 - 0 - 12 RAD		136	0.915	0.792	0.962	0.844	0.303

Attachment C – Table 3 Cont'd

SAMPLE I.D.		STATION	Ra-228	Ra-224	Pb-212	Bi-212	Tl-208
GAMMA SPECTROSCOPY RESULTS—THORIUM SERIES (pCi/g)							
AR99-21 - 0 - 12 RAD		132	0.824	0.680	0.883	0.834	0.290
AR99-21 - 12 - 30 RAD		132	0.899	0.780	1.03	0.977	0.329
AR99-21 - 12 - 30 RAD	FD	132	0.909	0.718	1.00	1.03	0.331
AR99-21 - 30 - 42 RAD		132	1.22	1.15	1.34	1.29	0.466
AR99-22 - 0 - 12 RAD		129	0.755	0.334	0.850	0.812	0.265
AR99-22 - 12 - 24 RAD		129	0.788	0.535	0.916	0.879	0.301
AR99-23 - 0 - 12 RAD		128	0.871	0.614	0.968	0.862	0.292
AR99-23 - 12 - 24 RAD		128	0.877	0.660	0.964	0.833	0.328
AR99-23 - 24 - 36 RAD		128	0.956	0.776	0.993	0.998	0.333
AR99-24 - 0 - 12 RAD		125	0.784	0.790	0.899	0.833	0.279
AR99-24 - 12 - 30 RAD		125	1.05	0.937	1.08	1.03	0.336
AR99-24 - 12 - 30 RAD	FD	125	1.09	0.718	1.16	1.23	0.375
AR99-24 - 12 - 30 RAD	LD	125	1.12	0.711	1.19	1.20	0.359
AR99-25 - 0 8 RAD		121	0.761	0.850	0.861	0.734	0.253
MAX			8.33	7.99	9.09	8.43	2.92
AVERAGE			1.16	0.951	1.28	1.21	0.407
STANDARD DEVIATION			0.819	0.819	0.896	0.838	0.286
CONFIDENCE LEVEL			0.161	0.161	0.176	0.165	0.0564
95% UPPER CONFIDENCE LEVEL			1.32	1.11	1.46	1.38	0.464

FD = Field Duplicate

LD = Lab Duplicate

125 = Priority samples, analyzed 11/99

125 = Non-priority samples, analyzed after 11/99

Background sites AR99-2 to AR99-5, inclusive

Attachment C – Table 3 Cont'd

SAMPLE I.D.		STATION	U-235	Th-227	Ra-223	Rn-219
ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999						
GAMMA SPECTROSCOPY RESULTS—ACTINIUM SERIES (pCi/g)						
AR99- 1 - 0 - 12 RAD		196				
AR99- 1 - 36 - 48 RAD		196	0.227			
AR99- 1 - 70 - 82 RAD		196	0.204			
AR99- 6 - 0 - 12 RAD		195				
AR99- 6 - 12 - 30 RAD		195				
AR99- 6 - 12 - 30 RAD	FD	195				
AR99- 6 - 60 - 72 RAD		195	0.358			
AR99- 6 - 72 - 84 RAD		195	0.594			
AR99- 6 - 94 - 106 RAD		195				
AR99- 7 - 0 - 12 RAD		187 (160W)	0.0802			
AR99- 7 - 12 - 24 RAD		187 (160W)				
AR99- 7 - 12 - 24 RAD	FD	187 (160W)	0.100		0.0994	
AR99- 7 - 24 - 36 RAD		187 (160W)				
AR99- 7 - 36 - 48 RAD		187 (160W)				
AR99- 7 - 48 - 60 RAD		187 (160W)	0.116			
AR99- 7 - 60 - 72 RAD		187 (160W)	0.247			
AR99- 7 - 72 - 84 RAD		187 (160W)	0.185			0.319
AR99- 7 - 84 - 96 RAD		187 (160W)	0.218		0.278	
AR99- 7 - 96 - 108 RAD		187 (160W)	0.625	0.551	0.468	0.512
AR99- 7 - 108 - 127 RAD		187 (160W)	0.501	0.436	0.329	0.362
AR99- 8 - 0 - 12 RAD		187 (0)	0.0695			
AR99- 8 - 12 - 24 RAD		187 (0)				
AR99- 8 - 24 - 36 RAD		187 (0)				
AR99- 8 - 36 - 48 RAD		187 (0)				
AR99- 8 - 60 - 72 RAD		187 (0)				
AR99- 8 - 72 - 84 RAD		187 (0)	0.302			0.113
AR99- 8 - 84 - 96 RAD		187 (0)	0.855	0.377	0.470	
AR99- 8 - 96 - 108 RAD		187 (0)	0.390	0.433	0.130	0.589
AR99- 8 - 108 - 139 RAD		187 (0)	0.346	0.352	0.192	0.342
AR99- 8 - 108 - 139 RAD	FD	187 (0)	0.240		0.211	0.405
AR99- 9 - 0 - 12 RAD		187 (180E)	0.351			
AR99- 9 - 12 - 24 RAD		187 (180E)	0.400			0.279
AR99- 9 - 24 - 36 RAD		187 (180E)	0.534	0.290		0.210
AR99- 9 - 36 - 48 RAD		187 (180E)	0.270		0.118	
AR99- 9 - 36 - 48 RAD	FD	187 (180E)	0.171	0.163		
AR99- 9 - 48 - 60 RAD		187 (180E)	0.665	0.459		
AR99- 9 - 48 - 60 RAD	FD	187 (180E)	0.236			
AR99- 9 - 60 - 72 RAD		187 (180E)	0.294		0.154	0.304
AR99- 9 - 60 - 72 RAD	LD	187 (180E)	0.457			
AR99- 9 - 72 - 84 RAD		187 (180E)	0.277		0.142	0.250
AR99- 9 - 84 - 96 RAD		187 (180E)	0.206	0.271	0.286	

Attachment C – Table 3 Cont'd

	GAMMA SPECTROSCOPY RESULTS—ACTINIUM SERIES (pCi/g)					
SAMPLE I.D.		STATION	U-235	Th-227	Ra-223	Rn-219
AR99-10 - 0 - 12 RAD		182 (120E)				
AR99-10 - 60 - 72 RAD		182 (120E)				
AR99-10 - 93 - 105 RAD		**182 (120E)**	0.507	0.481	0.331	0.268
AR99-10 - 93 - 105 RAD	FD	182 (120E)	0.611		0.180	0.293
AR99-10 - 147 - 159 RAD		182 (120E)	0.351	0.376	0.250	0.120
AR99-11 - 0 - 12 RAD		182 (20W)				
AR99-11 - 33 - 51 RAD		**182 (20W)**	0.788	0.612	0.706	
AR99-11 - 33 - 51 RAD	FD	182 (20W)	0.474		0.175	0.511
AR99-11 - 60 - 72 RAD		182 (20W)	0.297	0.206		
AR99-11 - 72 - 84 RAD		182 (20W)	0.492		0.300	
AR99-12 - 0 - 12 RAD		182 (80W)				
AR99-12 - 12 - 24 RAD		182 (80W)				
AR99-12 - 30 - 42 RAD		182 (80W)				
AR99-12 - 72 - 90 RAD		**182 (80W)**				
AR99-12 - 72 - 90 RAD	FD	**182 (80W)**				
AR99-13 - 0 - 12 RAD		177				
AR99-13 - 0 - 12 RAD	LD	177				
AR99-13 - 90 - 102 RAD		177	0.562		0.265	0.173
AR99-13 - 119 - 131 RAD		177	0.236		0.491	
AR99-13 - 152 - 164 RAD		177	0.217			
AR99-14 - 0 - 12 RAD		173				
AR99-14 - 95 - 113 RAD		173	0.199			0.166
AR99-14 - 95 - 113 RAD	FD	173	0.582			
AR99-14 - 130 - 142 RAD		173	0.573	0.436	0.291	0.403
AR99-14 - 159 - 171 RAD		173				
AR99-15 - 0 - 12 RAD		163				
AR99-15 - 24 - 36 RAD		163				
AR99-15 - 42 - 54 RAD		163	0.521		0.283	
AR99-15 - 65 - 72 RAD		163	0.379	0.357		0.325
AR99-17 - 0 - 12 RAD		156				
AR99-17 - 37 - 49 RAD		156	0.105			
AR99-17 - 94 - 106 RAD		156	0.350			
AR99-17 - 123 - 135 RAD		156	0.333			
AR99-18 - 0 - 12 RAD		153+50				
AR99-18 - 12 - 30 RAD		153+50				
AR99-18 - 12 - 30 RAD	FD	153+50				
AR99-18 - 36 - 48 RAD		153+50				
AR99-19 - 0 - 12 RAD		149				
AR99-19 - 12 - 24 RAD		149				
AR99-19 - 12 - 24 RAD	LD	149				
AR99-19 - 24 - 36 RAD		149	0.0755			
AR99-19 - 70 - 82 RAD		149				
AR99-19 - 70 - 82 RAD	LD	149				
AR99-20 - 0 - 12 RAD		136				

Attachment C – Table 3 Cont'd

	GAMMA SPECTROSCOPY RESULTS—ACTINIUM SERIES (pCi/g)				
SAMPLE I.D.	STATION	U-235	Th-227	Ra-223	Rn-219
AR99-21 - 0 - 12 RAD	132	0.0826			
AR99-21 - 12 - 30 RAD	132	0.0940			
AR99-21 - 12 - 30 RAD FD	132	0.0891			
AR99-21 - 30 - 42 RAD	132				
AR99-22 - 0 - 12 RAD	129				
AR99-22 - 12 - 24 RAD	129				
AR99-23 - 0 - 12 RAD	128				
AR99-23 - 12 - 24 RAD	128				
AR99-23 - 24 - 36 RAD	128				
AR99-24 - 0 - 12 RAD	125				
AR99-24 - 12 - 30 RAD	125				
AR99-24 - 12 - 30 RAD FD	125				
AR99-24 - 12 - 30 RAD LD	125				
AR99-25 - 0 8 RAD	121				
MAX		0.855	0.612	0.706	0.589
AVERAGE		0.342	0.387	0.280	0.313
STANDARD DEVIATION		0.195	0.121	0.147	0.132
CONFIDENCE LEVEL		0.0385	0.0239	0.0290	0.0259
95% UPPER CONFIDENCE LEVEL		0.380	0.411	0.308	0.339

FD = Field Duplicate
LD = Lab Duplicate
125 = Priority samples, analyzed 11/99
125 = Non-priority samples, analyzed after 11/99

Background sites AR99-2 to AR99-5, inclusive

Attachment C – Table 4

BELOW CUT LINE---NET VALUES				
URANIUM DECAY SERIES	MAXIMIUM # (pCi/g)	MAXIMIUM ## (pCi/g)	95% UCL # (pCi/g)	95% UCL ## (pCi/g)
U-238	0.325	**0.440**	0.143	**0.353**
Th-234	0.555		0.562	
Pa-234m				
U-234	0.338	**0.338**	0.136	**0.136**
Th-230	0.644	**0.644**	0.290	**0.290**
Ra-226	0.311	**0.311**	0.164	**0.164**
Rn-222				
Po-218				
Pb-214	0.671		0.317	
Bi-214	0.575		0.278	
Po-214				
Pb-210		**0.311**		**0.164**
Bi-210				
Po-210				

# Sites						
AR99-	16	-	0	-	12	
AR99-	16	-	12	-	24	
AR99-	18	-	63	-	75	
AR99-	20	-	12	-	24	
AR99-	20	-	24	-	36	
AR99-	20	-	58	-	71	
AR99-	21	-	63	-	75	
AR99-	22	-	49	-	61	
AR99-	23	-	36	-	58	
AR99-	24	-	47	-	65	
AR99-	24	-	47	-	65	FD

U-238 = (U-238 + Th-234)/2
Pb-210 = Ra-226

BELOW CUT LINE---NET VALUES				
THORIUM DECAY SERIES (pCi/g)	MAXIMIUM # (pCi/g)	MAXIMIUM ## (pCi/g)	95% UCL # (pCi/g)	95% UCL ## (pCi/g)
Th-232	0.367	**0.367**	0.190	**0.190**
Ra-228	0.312	**0.312**	0.231	**0.231**
Ac-228				
Th-228	0.301	**0.353**	0.216	**0.225**
Ra-224	0.311		0.237	
Rn-220				
Po-216				
Pb-212	0.362		0.269	
Bi-212	0.671		0.314	
Po-212				
Tl-208	0.121		0.090	

# Sites						
AR99-	16	-	0	-	12	
AR99-	16	-	12	-	24	
AR99-	18	-	63	-	75	
AR99-	20	-	12	-	24	
AR99-	20	-	24	-	36	
AR99-	20	-	58	-	71	
AR99-	21	-	63	-	75	
AR99-	22	-	49	-	61	
AR99-	23	-	36	-	58	
AR99-	24	-	47	-	65	
AR99-	24	-	47	-	65	FD

Th-228 = (Th-228 + Ra-224 + Pb-212 + Bi-212 + Tl-208)/5

Attachment C – Table 4 Cont'd

BELOW CUT LINE—NET VALUES															
ACTINIUM															
DECAY		MAXIMIUM	MAXIMIUM	95%	95%		# Sites		AR99-	16	-	0	-	12	
SERIES		#	##	UCL #	UCL ##				AR99-	16	-	12	-	24	
(pCi/g)		(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)				AR99-	18	-	63	-	75	
									AR99-	20	-	12	-	24	
U-235		0.0660	0.0660	0.0660	0.0660				AR99-	20	-	24	-	36	
Th-231									AR99-	20	-	58	-	71	
Pa-231			0.0660		0.0660				AR99-	21	-	63	-	75	
Ac-227			0.0002		0.0001				AR99-	22	-	49	-	61	
Th-227		0.0002		0.0001					AR99-	23	-	36	-	58	
Ra-223									AR99-	24	-	47	-	65	
Rn-219									AR99-	24	-	47	-	65	FD
Po-215															
Pb-211							##	Pa-231 = U-235							
Bi-211								Ac-227 = Th-227							
Tl-207															

Attachment C - Table 5

ABOVE CUT LINE—NET VALUES										
URANIUM										
DECAY	BACKGROUND	MAXIMIUM	NET	DESIGNATED	95%	NET	DESIGNATED	# Sites	AR99-	1
SERIES		#		NET ##	UCL #		NET ##		AR99-	6
	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)		AR99-	7 - 25
U-238	0.965	45.5	44.5	44.5	5.01	4.05	4.05	## U-238 = U-238		
Th-234	0.675	12.9	12.2		4.65			Th-234, too low, dropped		
Pa-234m		13.0			5.52			Pa-234m, no background, dropped		
U-234	1.02	57.9	56.9	56.9	5.34	4.32	4.32	Rn-222 = Ra-226		
Th-230	0.716	20.9	20.2	20.2	3.86	3.14	3.14	Pb-210 = Ra-226		
Ra-226	0.929	7.33	6.4	6.40	4.79	3.86	3.86			
Rn-222				6.40			3.86			
Po-218										
Pb-214	0.739	7.28	6.54		2.18					
Bi-214	0.675	6.51	5.84		1.96					
Po-214										
Pb-210				6.40			3.86			
Bi-210										
Po-210										

Attachment C - Table 5 Cont'd

ABOVE CUTLINE---NET VALUES											
										AR99-	1
THORIUM										AR99-	6
DECAY	BACKGROUND	MAXIMIUM	NET	DESIGNATED	95%	NET	DESIGNATED	# Sites		AR99-	7 - 25
SERIES		#		NET	UCL #		NET				
(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)				
Th-232	0.853	8.52	7.67	7.67				## Rn-220 = Ra-224			
Ra-228	0.798	8.33	7.53	7.53	1.50	0.647	0.647				
Ac-228				7.53	1.32	0.522	0.522				
Th-228	0.829	8.64	7.81	7.81			0.522				
Ra-224	0.640	7.99	7.35	7.35	1.50	0.671	0.671				
Rn-220				7.35	1.11	0.470	0.470				
Po-216							0.470				
Pb-212	0.858	9.09	8.23								
Bi-212	0.809	8.43	7.62		1.46	0.602					
Po-212					1.38	0.571					
Tl-208	0.274	2.92	2.65		0.464	0.190					

ABOVE CUTLINE---NET VALUES											
										AR99-	1
ACTINIUM										AR99-	6
DECAY	BACKGROUND	MAXIMIUM	NET	DESIGNATED	95%	NET	DESIGNATED	# Sites		AR99-	7'- 25
SERIES		#		NET ##	UCL #		NET ##				
(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)				
U-235	0.0660	6.59	6.52	6.52	0.438	0.372	0.372	## Pa-231 = U-235			
Th-231								Ac-227 = Th-227			
Pa-231				3.67			0.372				
Ac-227				0.825			0.140				
Th-227	0.0851	0.91	0.825		0.225	0.140					
Ra-223		0.706	0.706		0.308						
Rn-219		0.589	0.589		0.339						
Po-215											
Pb-211											
[illegible]-211											
[illegible]-207											

ATTACHMENT D

Attachment D

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Attachment D – Table 1

EXTERNAL EXPOSURE	
RISK =	[RS * SF * (EF/365) * ED] * [(ETo * GSFo) + (ETi * GSFi)]
RS	Radionuclide sediment concentration (pCi/g)
SF	External exposure slope factor (risk/yr per pCi/g)
EF	Exposure frequency (d/yr)
ED	Exposure duration (yr)
ETo	Exposure time fraction, outdoors (unitless)
GSFo	Gamma shielding factor outdoors (unitless)
ETi	Exposure time fraction, indoors (unitless)
GSFi	Gamma shielding factor indoors (unitless)
PLANT INGESTION	
RISK =	RS * SF * IRfv * CFp * TFp * ED
RS	Radionuclide sediment concentration (pCi/g)
SF	Ingestion slope factor (risk/pCi)
IRfv	Ingestion rate - fruit and vegetables(kg/yr)
	fruit (g/kg-day)
	vegetables (g/kg-day)
	total (g/kg-day)
	body weight (Male/Female Mean)
	(50th percentile) (kg)
	total fruit + vegetable ingestion (g/day)
	(kg/yr)
CFp	Conversion factor - plant (g/kg)
TFp	Soil-to-plant transfer factor (pCi/g plant per pCi/g soil)
ED	Exposure duration (yr)

Attachment D – Table 1 Cont'd

SOIL INGESTION	
Risk =	RS * SF * IR * CF * EF * ED / CFs
RS	Radionuclide soil concentration (pCi/g)
SF	Ingestion slope factor (risk/pCi)
IR	Soil ingestion rate (mg/d)
EF	Exposure frequency (d/yr)
ED	Exposure duration (yr)
CFs	Conversion factor (mg/g)
DUST INHALATION	
Risk =	RS * SF * BR * PEF * EF * ED * CFm * [ETo + (ETi * DF)]
RS	Radionuclide soil concentration (pCi/g)
SF	Inhalation slope factor (risk/pCi)
BR	Breathing rate (m3/d)
PEF	Particulate Emission Factor (ug/m3)
EF	Exposure frequency (d/yr)
ED	Exposure duration (yr)
CFm	Conversion factor, mass (g/ug)
ETo	Exposure time fraction, outdoors (unitless)
ETi	Exposure time fraction, indoors (unitless)
DF	Dilution factor for indoor inhalation (unitless)

Attachment D – Table 1 Cont'd

Radon-222 (Radon) + Decay Products Inhalation					
	At	25	Bq/kg, Radium- 226, Radon-222 =	4	Bq/m3
	At	0.676	pCi/g Radium- 226, Radon-222 =	0.108	pCi/L
	At	(data)	pCi/g Radium- 226, Radon-222 =	(ratio)	pCi/L
RC	Radon-222 concentration (pCi/L)		(ratio)		
EF	Exposure Frequency (days/yr)				
	(hr/yr)				
EGFo	Radon equilibrium factor, outdoors (unitless)				
ETo	Exposure time fraction, outdoors (unitless)				
DFo	Outdoor to indoor air concentration dilution factor, outdoors (unitless)				
EQFi	Radon equilibrium factor, indoors (unitless)				
ETi	Exposure time fraction, indoors (unitless)				
DFi	Outdoor to indoor air concentration dilution factor, indoors (unitless)				
ED	Exposure Duration (yr)				
RF	Radon risk factor (risk/Working Level Month, WLM)				
CF1	Conversion factor (pCi/WL)				
CF2	Conversion factor (WL-hr/WLM)				
Rn-222 + D (Radon)					
Risk =	RC * EF * (EQFo * ETo * DFo + EQFi * ETi * DFi) * ED * RF / (CF1 * CF2)				
This method is based upon ratioing the radium-226 soil concentration to the outdoor air radon-222 concentration.					

Attachment D – Table 1 Cont'd

Radon-220 (Thoron) + Decay Products Inhalation					
	At	25	Bq/kg, Radium- 228, Radon-220 =	0.001	WL
	At	0.676	pCi/g, Radium- 228, Radon-220 =	0.001	WL
	At	(data)	pCi/g, Radium- 228, Radon-220 =	(ratio)	WL
RC	Radon-220 decay product concentration (WL)			(ratio)	
EF	Exposure frequency (days/yr				
CF1	Conversion factor #1 (hr/day)				
ETo	Exposure time fraction, outdoors (unitless)				
DFo	Outdoor to indoor air concentration dilution factor, outdoors (unitless)				
ETi	Exposure time fraction, indoors (unitless)				
DFi	Outdoor to indoor air concentration dilution factor, indoors (unitless)				
ED	Exposure duration (yr)				
RF	Thoron risk factor = 1/3 * radon risk factor (risk/Working Level Month, WLM)				
CF2	Conversion factor #2 (WL-hr/WLM)				
Radon-220 + D (Thoron)					
Risk =	RC * EF * CF1 * (ETo * DFo + ETi * DFi) * ED * RF / CF2				
This method is based upon ratioing the radium-228 soil concentration to the outdoor air radon-220 decay product concentration.					

ATTACHMENT E

Attachment E

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Attachment E – Table 1

SUMMARY OF TIME USAGE	Total Inside of Home (Sleeping + Inside of Home)	Total Outside of Home	Total Away From Home
Baby's Time Usage (0 - 1yrs)	85%	5%	10%
Older Baby's Time Usage (1 - 2 yrs)	75%	10%	15%
Young Child's Time Usage (3 - 5 yrs)	70%	5%	25%
Older Child's Time Usage (6 - 12)	60%	10%	30%
Teenager's Time Usage (13 - 19 yrs)	55%	10%	35%
Adult's Time Usage (20 - 30 yrs)	50%	10%	40%

Attachment E - Table 1 Cont'd

Baby's Time Usage (0 - 1yrs)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1.5	2	0.5	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1.5	2	0.5	1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	13	8	1	2

Baby's Time Usage (0 - 1yrs)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1.5	2	0.5	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1.5	2	0.5	1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	13	8	1	2

Baby's Time Usage (0 - 1yrs)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Winter				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1.5	2.5		1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1.5	2.5		1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	13	9	0	2

Baby's Time Usage (0 - 1yrs)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Winter				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1.5	2.5		1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1.5	2.5		1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	13	9	0	2

Attachment E - Table 1 Cont'd

Baby's Time Usage (0 - 1yrs)		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Spring				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1.5	2	0.5	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1.5	2	0.5	1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	13	8	1	2

Baby's Time Usage (0 - 1yrs)		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Spring				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1.5	2	0.5	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1.5	2	0.5	1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	13	8	1	2

		5 Weekdays @ 11 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Summer				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1.5	1.5	1	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1.5	1.5	1	1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	13	7	2	2

Baby's Time Usage (0 - 1yrs)		2 Weekend Days @ 11 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Summer				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1.5	1.5	1	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1.5	1.5	1	1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	13	7	2	2

Attachment E - Table 1 Cont'd

	Baby's Time Usage (0 - 1yrs)			
		5 Weekdays		
Weeks	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall (13 weeks)	13	8	1	2
Winter (13 weeks)	13	9	0	2
Spring (13 weeks)	13	8	1	2
Summer (11 week	13	7	2	2

	Baby's Time Usage (0 - 1yrs)			
		2 Weekend Days		
Weeks	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall (13 weeks)	13	8	1	2
Winter (13 weeks)	13	9	0	2
Spring (13 weeks)	13	8	1	2
Summer (11 weeks)	13	7	2	2

	Baby's Time Usage (0 - 1yrs)			
		5 Weekdays		
	Sleeping	Inside of Home	Outside of Home (hr/season)	Away from Home
Fall (13 weeks)	845	520	65	130
Winter (13 weeks)	845	585	0	130
Spring (13 weeks)	845	520	65	130
Summer (11 week	715	385	110	110
Total	3250	2010	240	500

	Baby's Time Usage (0 - 1yrs)			
		2 Weekend Days		
	Sleeping	Inside of Home	Outside of Home (hr/season)	Away from Home
Fall (13 weeks)	338	208	26	52
Winter (13 weeks)	338	234	0	52
Spring (13 weeks)	338	208	26	52
Summer (11 weeks)	286	154	44	44
Total	1300	804	96	200

	Baby's Time Usage (0 - 1yrs)		
	Totals		
Sleeping	Inside of Home	Outside of Home	Away from Home
		(hr/350 day year)	
4550	2814	336	700

	Baby's Time Usage (0 - 1yrs)	
Total Inside of Home (Sleeping + Inside of Home)	Total Outside of Home	Total Away From Home
	(hr/350 day year)	
7364	336	700
87.7%	4.0%	8.3%
Round to		
85%	5%	10%

Attachment E - Table 1 Cont'd

Older Baby's Time Usage (1 - 2 yrs)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1	1	1	2
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1	1	1	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	12	6	2	4

Older Baby's Time Usage (1 - 2 yrs)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1	1	1	2
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1	1	1	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	12	6	2	4

Older Baby's Time Usage (1 - 2 yrs)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Winter				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1	2		2
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1	2		2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	12	8	0	4

Older Baby's Time Usage (1 - 2 yrs)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Winter				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1	2		2
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1	2		2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	12	8	0	4

Attachment E - Table 1 Cont'd

Older Baby's Time Usage (1 - 2 yrs)

		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Spring				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1	1	1	2
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1	1	1	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	12	6	2	4

Older Baby's Time Usage (1 - 2 yrs)

		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Spring				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1	1	1	2
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1	1	1	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	12	6	2	4

Older Baby's Time Usage (1 - 2 yrs)

		5 Weekdays @ 11 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Summer				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1	1	1	2
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1	1	1	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	12	6	2	4

Older Baby's Time Usage (1 - 2 yrs)

		2 Weekend Days @ 11 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Summer				
12:00am - 6:00 am	6			
6:00 am - 7:00 am		1		
7:00am -12:00 pm	1	1	1	2
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm	1	1	1	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	4	1		
Total	12	6	2	4

Attachment E - Table 1 Cont'd

		Older Baby's Time Usage (1 - 2 yrs) 5 Weekdays		
Weeks	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall (13 weeks)	12	6	2	4
Winter (13 weeks)	12	8	0	4
Spring (13 weeks)	12	6	2	4
Summer (11 weeks)	12	6	2	4

		Older Baby's Time Usage (1 - 2 yrs) 5 Weekdays		
	Sleeping	Inside of Home	Outside of Home (hr/season)	Away from Home
Fall (13 weeks)	780	390	130	260
Winter (13 weeks)	780	520	0	260
Spring (13 weeks)	780	390	130	260
Summer (11 weeks)	660	330	110	220
Total	3000	1630	370	1000

	Older Baby's Time Usage (1 - 2 yrs) Totals		
Sleeping	Inside of Home	Outside of Home (hr/350 day year)	Away from Home
4200	2282	518	1400

		Older Baby's Time Usage (1 - 2 y 2 Weekend Days		
Weeks	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall (13 weeks)	12	6	2	4
Winter (13 weeks)	12	8	0	4
Spring (13 weeks)	12	6	2	4
Summer (11 weeks)	12	6	2	4

		Older Baby's Time Usage (1 - 2 y 2 Weekend Days		
	Sleeping	Inside of Home	Outside of Home (hr/season)	Away from Home
Fall (13 weeks)	312	156	52	104
Winter (13 weeks,	312	208	0	104
Spring (13 weeks)	312	156	52	104
Summer (11 weeks)	264	132	44	88
Total	1200	652	148	400

	Older Baby's Time Usage (1 - 2 yrs)	
Total Inside of Home (Sleeping + Inside of Home)	Total Outside of Home	Total Away From Home
(hr/350 day year)		
6482	518	1400
77.2%	6.2%	16.7%
Round to		
75%	10%	15%

Attachment E - Table 1 Cont'd

Younger Child's Time Usage (3 - 5 yrs)		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall				
12:00am - 7:00 am	7			
7:00 am - 8:00 am		1		
8:00am -12:00 pm				4
12:00 pm - 1:00 pm				1
1:00 pm - 4:00 pm				3
4:00 pm - 6:00 pm		1	1	
6:00 pm - 12:00 am	4	2		
Total	11	4	1	8

Younger Child's Time Usage (3 - 5 yrs)		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall				
12:00am - 7:00 am	7			
7:00 am - 8:00 am		1		
8:00am -12:00 pm		1	2	1
12:00 pm - 1:00 pm		1		
1:00 pm - 4:00 pm		1	1	1
4:00 pm - 6:00 pm		1	1	
6:00 pm - 12:00 am	4	2		
Total	11	7	4	2

Younger Child's Time Usage (3 - 5 yrs)		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Winter				
12:00am - 7:00 am	7			
7:00 am - 8:00 am		1		
8:00am -12:00 pm				4
12:00 pm - 1:00 pm				1
1:00 pm - 4:00 pm				3
4:00 pm - 6:00 pm		1	1	
6:00 pm - 12:00 am	4	2		
Total	11	4	1	8

Younger Child's Time Usage (3 - 5 yrs)		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Winter				
12:00am - 7:00 am	7			
7:00 am - 8:00 am		1		
8:00am -12:00 pm		2	1	1
12:00 pm - 1:00 pm		1		
1:00 pm - 4:00 pm		1	1	1
4:00 pm - 6:00 pm		2		
6:00 pm - 12:00 am	4	2		
Total	11	9	2	2

Attachment E - Table 1 Cont'd

Younger Child's Time Usage (3 - 5 yrs)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Spring				
12:00am - 7:00 am	7			
7:00 am - 8:00 am		1		
8:00am -12:00 pm				4
12:00 pm - 1:00 pm				1
1:00 pm - 4:00 pm				3
4:00 pm - 6:00 pm		1	1	
6:00 pm - 12:00 am	4	2		
Total	11	4	1	8

Younger Child's Time Usage (3 - 5 yrs)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Spring				
12:00am - 7:00 am	7			
7:00 am - 8:00 am		1		
8:00am -12:00 pm		1	2	1
12:00 pm - 1:00 pm		1		
1:00 pm - 4:00 pm		1	1	1
4:00 pm - 6:00 pm		1	1	
6:00 pm - 12:00 am	4	2		
Total	11	7	4	2

Younger Child's Time Usage (3 - 5 yrs)				
		5 Weekdays @ 11 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Summer				
12:00am - 7:00 am	7			
7:00 am - 8:00 am		1		
8:00am -12:00 pm				4
12:00 pm - 1:00 pm				1
1:00 pm - 4:00 pm				3
4:00 pm - 6:00 pm		1	1	
6:00 pm - 12:00 am	4	2		
Total	11	4	1	8

Younger Child's Time Usage (3 - 5 yrs)				
		2 Weekend Days @ 11 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Summer				
12:00am - 7:00 am	7			
7:00 am - 8:00 am		1		
8:00am -12:00 pm		1	2	1
12:00 pm - 1:00 pm		1		
1:00 pm - 4:00 pm		1	1	1
4:00 pm - 6:00 pm		1	1	
6:00 pm - 12:00 am	4	2		
Total	11	7	4	2

Attachment E - Table 1 Cont'd

Weeks	Younger Child's Time Usage (3 - 5 yrs) Sleeping	5 Weekdays Inside of Home	Outside of Home (hr/day)	Away from Home
Fall (13 weeks)	11	4	1	8
Winter (13 weeks)	11	4	1	8
Spring (13 weeks)	11	4	1	8
Summer (11 weeks)	11	4	1	8

Weeks	Younger Child's Time Usage (3 - 5 yrs) Sleeping	2 Weekend Days Inside of Home	Outside of Home (hr/day)	Away from Home
Fall (13 weeks)	11	7	4	2
Winter (13 weeks)	11	9	2	2
Spring (13 weeks)	11	7	4	2
Summer (11 weeks)	11	7	4	2

	Younger Child's Time Usage (3 - 5 yrs) Sleeping	5 Weekdays Inside of Home	Outside of Home (hr/season)	Away from Home
Fall (13 weeks)	715	260	65	520
Winter (13 weeks)	715	260	65	520
Spring (13 weeks)	715	260	65	520
Summer (11 weeks)	605	220	55	440
Total	2750	1000	250	2000

	Younger Child's Time Usage (3 - 5 yrs) Sleeping	2 Weekend Days Inside of Home	Outside of Home (hr/season)	Away from Home
Fall (13 weeks)	286	182	104	52
Winter (13 weeks)	286	234	52	52
Spring (13 weeks)	286	182	104	52
Summer (11 weeks)	242	154	88	44
Total	1100	752	348	200

Younger Child's Time Usage (3 - 5 yrs) Totals Sleeping	Inside of Home	Outside of Home (hr/350 day year)	Away from Home
3850	1752	598	2200

Total Inside of Home (Sleeping + Inside of Home)	Younger Child's Time Usage (3 - 5 yrs) Total Outside of Home (hr/350 day year)	Total Away From Home
5602	598	2200
66.7%	7.1%	26.2%
Round to		
70%	5%	25%

Attachment E - Table 1 Cont'd

Older Child's Time Usage (6 - 12)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall				
12:00am - 6:30 am	6.5			
6:30 am - 7:30 am		1		
7:30am -8:00 pm				.5 (busing)
8:00 pm - 3:00 pm				7 (school)
3:00 pm - 3:30 pm				.5 (busing)
3:30 pm - 6:00 pm		0.5	1	1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	2.5	1	0.5	1
Total	9	3.5	1.5	10

Older Child's Time Usage (6 - 12)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall				
12:00am - 7:30 am	7.5			
7:30 am - 8:30 am		1		
8:30am -12:00 pm		2	1.5	
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		1	2	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	2.5	1	
Total	9	8.5	4.5	2

Older Child's Time Usage (6 - 12)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Winter				
12:00am - 6:30 am	6.5			
6:30 am - 7:30 am		1		
7:30am -8:00 pm				.5 (busing)
8:00 pm - 3:00 pm				7 (school)
3:00 pm - 3:30 pm				.5 (busing)
3:30 pm - 6:00 pm		0.5	1	1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	2.5	1	0.5	1
Total	9	3.5	1.5	10

Older Child's Time Usage (6 - 12)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Winter				
12:00am - 7:30 am	7.5			
7:30 am - 8:30 am		1		
8:30am -12:00 pm		2	1.5	
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		2	1	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	2.5		1
Total	9	9.5	2.5	3

Attachment E - Table 1 Cont'd

Older Child's Time Usage (6 - 12)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Spring				
12:00am - 6:30 am	6.5			
6:30 am - 7:30 am		1		
7:30am -8:00 pm				.5 (busing)
8:00 pm - 3:00 pm				7 (school)
3:00 pm - 3:30 pm				.5 (busing)
3:30 pm - 6:00 pm		0.5	1	1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	2.5	1	0.5	1
Total	9	3.5	1.5	10

Older Child's Time Usage (6 - 12)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Spring				
12:00am - 7:30 am	7.5			
7:30 am - 8:30 am		1		
8:30am -12:00 pm		2	1.5	
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		1	2	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	2.5	1	
Total	9	8.5	4.5	2

Older Child's Time Usage (6 - 12)				
		5 Weekdays @ 11 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Summer				
12:00 am - 8:00 am	8			
8:00 am - 9:00 am		1		
9:00 am - 12:00 pm		1	2	
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		1	2	2
6:00 pm - 12:00am	1	2	1	2
Total	9	6	5	4

Older Child's Time Usage (6 - 12)				
		2 Weekend Days @ 11 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Summer				
12:00am - 7:30 am	7.5			
7:30 am - 8:30 am		1		
8:30am -12:00 pm		1	2.5	
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		1	2	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	1.5	1	1
Total	9	6.5	5.5	3

Attachment E - Table 1 Cont'd

Weeks	Older Child's Time Usage (6 - 12) 5 Weekdays Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall (13 weeks)	9	3.5	1.5	10
Winter (13 weeks)	9	3.5	1.5	10
Spring (13 weeks)	9	3.5	1.5	10
Summer (11 weeks)	9	6	5	4

Weeks	Older Child's Time Usage (6 - 12) 2 Weekend Days Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall (13 weeks)	9	8.5	4.5	2
Winter (13 weeks)	9	9.5	2.5	3
Spring (13 weeks)	9	8.5	4.5	2
Summer (11 weeks)	9	6.5	5.5	3

	Older Child's Time Usage (6 - 12) 5 Weekdays Sleeping	Inside of Home	Outside of Home (hr/season)	Away from Home
Fall (13 weeks)	585	227.5	97.5	650
Winter (13 weeks)	585	227.5	97.5	650
Spring (13 weeks)	585	227.5	97.5	650
Summer (11 weeks)	495	330	275	220
Total	2250	1012.5	567.5	2170

	Older Child's Time Usage (6 - 12) 2 Weekend Days Sleeping	Inside of Home	Outside of Home (hr/season)	Away from Home
Fall (13 weeks)	234	221	117	52
Winter (13 weeks)	234	247	65	78
Spring (13 weeks)	234	221	117	52
Summer (11 weeks)	198	143	121	66
Total	900	832	420	248

Sleeping	Older Child's Time Usage (6 - 12) Totals Inside of Home	Outside of Home (hr/350 day year)	Away from Home
3150	1844.5	987.5	2418

	Total Inside of Home (Sleeping + Inside of Home)	Older Child's Time Usage (6 - 12) Total Outside of Home (hr/350 day year)	Total Away From Home	
	4994.5	987.5	2418	8400
	59.5%	11.8%	28.8%	
Round to	60%	10%	30%	

Attachment E - Table 1 Cont'd

Teenager's Time Usage (13 - 19 yrs)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall				
12:00am - 6:30 am	6.5			
6:30 am - 7:30 am		1		
7:30am -8:00 pm				.5 (busing)
8:00 pm - 3:00 pm				7 (school)
3:00 pm - 3:30 pm				.5 (busing)
3:30 pm - 6:00 pm		0.5	1	1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	2.5	1	0.5	1
Total	9	3.5	1.5	10

Teenager's Time Usage (13 - 19 yrs)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall				
12:00am - 8:30 am	8.5			
8:30 am - 9:30 am		1		
9:30am -12:00 pm		1	0.5	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		1	2	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	1		2.5
Total	10	6	2.5	5.5

Teenager's Time Usage (13 - 19 yrs)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Winter				
12:00am - 6:30 am	6.5			
6:30 am - 7:30 am		1		
7:30am -8:00 pm				.5 (busing)
8:00 pm - 3:00 pm				7 (school)
3:00 pm - 3:30 pm				.5 (busing)
3:30 pm - 6:00 pm		0.5	1	1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	2.5	1	0.5	1
Total	9	3.5	1.5	10

Teenager's Time Usage (13 - 19 yrs)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Winter				
12:00am - 8:30 am	8.5			
8:30 am - 9:30 am		1		
9:30am -12:00 pm		1	0.5	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		1	1	3
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	1		2.5
Total	10	6	1.5	6.5

Attachment E - Table 1 Cont'd

Teenager's Time Usage (13 - 19 yrs)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Spring				
12:00am - 6:30 am	6.5			
6:30 am - 7:30 am		1		
7:30am -8:00 pm				
8:00 pm - 3:00 pm				.5 (busing)
3:00 pm - 3:30 pm				7 (school)
3:30 pm - 6:00 pm				.5 (busing)
		0.5	1	1
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	2.5	1	0.5	1
Total	9	3.5	1.5	10

Teenager's Time Usage (13 - 19 yrs)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Spring				
12:00am - 8:30 am	8.5			
8:30 am - 9:30 am		1		
9:30am -12:00 pm		1	0.5	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		1	2	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	1		2.5
Total	10	6	2.5	5.5

Teenager's Time Usage (13 - 19 yrs)				
		5 Weekdays @ 11 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Summer				
12:00 am - 8:00 am	8			
8:00 am - 9:00 am		1		
9:00 am - 12:00 pm		1	1	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		1	2	2
6:00 pm - 12:00am	1	1	2	2
Total	9	5	5	5

Teenager's Time Usage (1[illegible] - 19 yrs)				
		2 Weekend Days @ 11 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Summer				
12:00am - 8:30 am	8.5			
8:30 am - 9:30 am		1		
9:30am -12:00 pm		1	0.5	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		1	2	2
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	1		2.5
Total	10	6	2.5	5.5

Attachment E - Table 1 Cont'd

Weeks	Teenager's Time Usage (13 - 19 yrs) Sleeping	5 Weekdays Inside of Home	Outside of Home (hr/day)	Away from Home
Fall (13 weeks)	9	3.5	1.5	10
Winter (13 weeks)	9	3.5	1.5	10
Spring (13 weeks)	9	3.5	1.5	10
Summer (11 weeks)	9	5	5	5

Weeks	Teenager's Time Usage (13 - 19 yrs) Sleeping	2 Weekend Days Inside of Home	Outside of Home (hr/day)	Away from Home
Fall (13 weeks)	10	6	2.5	5.5
Winter (13 weeks)	10	6	1.5	6.5
Spring (13 weeks)	10	6	2.5	5.5
Summer (11 weeks)	10	6	2.5	5.5

	Teenager's Time Usage (13 - 19 yrs) Sleeping	5 Weekdays Inside of Home	Outside of Home (hr/season)	Away from Home
Fall (13 weeks)	585	227.5	97.5	650
Winter (13 weeks)	585	227.5	97.5	650
Spring (13 weeks)	585	227.5	97.5	650
Summer (11 weeks)	495	275	275	275
Total	2250	957.5	567.5	2225

	Teenager's Time Usage (13 - 19 yrs) Sleeping	2 Weekend Days Inside of Home	Outside of Home (hr/season)	Away from Home
Fall (13 weeks)	260	156	65	143
Winter (13 weeks)	260	156	39	169
Spring (13 weeks)	260	156	65	143
Summer (11 weeks)	220	132	55	121
Total	1000	600	224	576

Teenager's Time Usage (13 - 19 yrs) Totals (hr/350 day year)

Sleeping	Inside of Home	Outside of Home	Away from Home
3250	1557.5	791.5	2801

Teenager's Time Usage (13 - 19 yrs) (hr/350 day year)

	Total Inside of Home (Sleeping + Inside of Home)	Total Outside of Home	Total Away From Home
	4807.5	791.5	2801
	57.2%	9.4%	33.3%
Round to	55%	10%	35%

Attachment E - Table 1 Cont'd

Adult's Time Usage (20 - 30 yrs)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall				
12:00am - 6:30 am	6.5			
6:30 am - 7:30 am		1		
7:30am - 8:00 am				.5 (travel)
8:00 am - 5:00 pm				9 (work)
5:00 pm - 5:30 pm				.5 (travel)
5:30 pm - 6:00 pm			0.5	
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	1.5	1	1
Total	8	3.5	1.5	11

Adult's Time Usage (20 - 30 yrs)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Fall				
12:00am - 7:30 am	6.5			
7:30 am - 8:30 am		1		
8:30am - 12:00 pm		1	1.5	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		2	1.5	1.5
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	2.5		2
Total	8	8.5	3	4.5

Adult's Time Usage (20 - 30 yrs)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Winter				
12:00am - 6:30 am	6.5			
6:30 am - 7:30 am		1		
7:30am - 8:00 am				.5 (travel)
8:00 am - 5:00 pm				9 (work)
5:00 pm - 5:30 pm				.5 (travel)
5:30 pm - 6:00 pm			0.5	
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	1.5	1	1
Total	8	3.5	1.5	11

Adult's Time Usage (20 - 30 yrs)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Winter				
12:00am - 7:30 am	6.5			
7:30 am - 8:30 am		1		
8:30am - 12:00 pm		2	0.5	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		3	0.5	1.5
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	2.5		2
Total	8	10.5	1	4.5

Attachment E - Table 1 Cont'd

Adult's Time Usage (20 - 30 yrs)				
		5 Weekdays @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Spring				
12:00am - 6:30 am	6.5			
6:30 am - 7:30 am		1		
7:30am - 8:00 am				.5 (travel)
8:00 am - 5:00 pm				9 (work)
5:00 pm - 5:30 pm				.5 (travel)
5:30 pm - 6:00 pm			0.5	
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	1.5	1	1
Total	8	3.5	1.5	11

Adult's Time Usage (20 - 30 yrs)				
		2 Weekend Days @ 13 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Spring				
12:00am - 7:30 am	6.5			
7:30 am - 8:30 am		1		
8:30am - 12:00 pm		1	1.5	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		2	1.5	1.5
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	2.5		2
Total	8	8.5	3	4.5

Adult's Time Usage (20 - 30 yrs)				
		5 Weekdays @ 11 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Summer				
12:00am - 6:30 am	6.5			
6:30 am - 7:30 am		1		
7:30am - 8:00 am				.5 (travel)
8:00 am - 5:00 pm				9 (work)
5:00 pm - 5:30 pm				.5 (travel)
5:30 pm - 6:00 pm			0.5	
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	1	1.5	1
Total	8	3	2	11

Adult's Time Usage (20 - 30 yrs)				
		2 Weekend Days @ 11 weeks		
	Sleeping	Inside of Home	Outside of Home (hr/day)	Away from Home
Summer				
12:00am - 7:30 am	6.5			
7:30 am - 8:30 am		1		
8:30am - 12:00 pm		0.5	2	1
12:00 pm - 1:00 pm		1		
1:00 pm - 6:00 pm		0.5	3	1.5
6:00 pm - 7:00 pm		1		
7:00 pm - 12:00 am	1.5	1.5	1	2
Total	8	5.5	6	4.5

Attachment E - Table 1 Cont'd

Weeks	Sleeping	Adult's Time Usage (20 - 30 yrs) 5 Weekdays Inside of Home	Outside of Home (hr/day)	Away from Home
Fall (13 weeks)	8	3.5	1.5	11
Winter (13 weeks)	8	3.5	1.5	11
Spring (13 weeks)	8	3.5	1.5	11
Summer (11 weeks)	8	3	2	11

Weeks	Sleeping	Adult's Time Usage (20 - 30 yrs) 2 Weekend Days Inside of Home	Outside of Home (hr/day)	Away from Home
Fall (13 weeks)	8	8.5	3	4.5
Winter (13 weeks)	8	10.5	1	4.5
Spring (13 weeks)	8	8.5	3	4.5
Summer (11 weeks)	8	5.5	6	4.5

	Sleeping	Adult's Time Usage (20 - 30 yrs) 5 Weekdays Inside of Home	Outside of Home (hr/season)	Away from Home
Fall (13 weeks)	520	227.5	97.5	715
Winter (13 weeks)	520	227.5	97.5	715
Spring (13 weeks)	520	227.5	97.5	715
Summer (11 weeks)	440	165	110	605
Total	2000	847.5	402.5	2750

	Sleeping	Adult's Time Usage (20 - 30 yrs) 2 Weekend Days Inside of Home	Outside of Home (hr/season)	Away from Home
Fall (13 weeks)	208	221	78	117
Winter (13 weeks)	208	273	26	117
Spring (13 weeks)	208	221	78	117
Summer (11 weeks)	176	121	132	99
Total	800	836	314	450

Sleeping	Adult's Time Usage (20 - 30 yrs) Totals Inside of Home	Outside of Home (hr/350 day year)	Away from Home	Total Inside of Home (Sleeping + Inside of Home)	Adult's Time Usage (20 - 30 yrs) Total Outside of Home (hr/350 day year)	Total Away From Home
2800	1683.5	716.5	3200	4483.5	716.5	3200
				53.4%	8.5%	38.1%
			Round to	50%	10%	40%

ATTACHMENT F

Attachment F

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Attachment F – Table 1

TABLE 1: RESIDENT-FARMER, BELOW CUTLINE, MAXIMUM CONCENTRATIONS

DECAY SERIES	BABY	OLDER BABY	YOUNG CHILD	OLDER CHILD	TEENAGER	ADULT	TOTAL	MAX
				EXTERNAL EXPOSURE				
Uranium	7.95E-07	8.15E-07	2.02E-06	4.85E-06	4.57E-06	6.73E-06	1.98E-05	A
Thorium	1.11E-06	1.13E-06	2.81E-06	6.75E-06	6.35E-06	9.35E-06	2.75E-05	A
Actinium	7.28E-09	7.47E-09	1.85E-08	4.44E-08	4.18E-08	6.16E-08	1.81E-07	A
TOTAL	1.91E-06	1.95E-06	4.85E-06	1.16E-05	1.10E-05	1.61E-05	4.75E-05	A
MAX	T	T	T	T	T	T	T	
				PLANT INGESTION				
Uranium			1.94E-06	5.68E-06	5.95E-06	9.69E-06	2.33E-05	A
Thorium			1.38E-06	4.05E-06	4.25E-06	6.92E-06	1.66E-05	A
Actinium			2.97E-08	8.70E-08	9.12E-08	1.49E-07	3.57E-07	A
TOTAL			3.35E-06	9.82E-06	1.03E-05	1.68E-05	4.02E-05	A
MAX			U	U	U	U	U	
				SOIL INGESTION				
Uranium			4.96E-08	1.16E-07	5.79E-08	9.10E-08	3.15E-07	OC
Thorium			1.68E-08	3.93E-08	1.96E-08	3.09E-08	1.07E-07	OC
Actinium			1.37E-09	3.20E-09	1.60E-09	2.51E-09	8.68E-09	OC
TOTAL			6.78E-08	1.59E-07	7.91E-08	1.24E-07	4.30E-07	OC
MAX			U	U	U	U	U	
				DUST INHALATION (INCLUDING RADON)				
Uranium	1.53E-06	1.43E-06	3.88E-06	8.21E-06	7.60E-06	1.08E-05	3.35E-05	A
Thorium	6.53E-07	6.69E-07	1.68E-06	4.05E-06	3.83E-06	5.63E-06	1.65E-05	A
Actinium			1.42E-09	4.94E-09	5.50E-09	7.53E-09	1.94E-08	A
TOTAL	2.18E-06	2.10E-06	5.56E-06	1.23E-05	1.14E-05	1.64E-05	5.00E-05	A
MAX	U	U	U	U	U	U	U	
				TOTAL, ALL PATHWAYS				
Uranium	2.33E-06	2.25E-06	7.89E-06	1.89E-05	1.82E-05	2.73E-05	7.68E-05	A
Thorium	1.76E-06	1.80E-06	5.89E-06	1.49E-05	1.44E-05	2.19E-05	6.07E-05	A
Actinium	7.28E-09	7.47E-09	5.10E-08	1.40E-07	1.40E-07	2.21E-07	5.66E-07	A
TOTAL	4.10E-06	4.05E-06	1.38E-05	3.39E-05	3.28E-05	4.95E-05	1.38E-04	A
MAX	U	U	U	U	U	U	U	

B, OB, YC, OC, T, A = Baby, Older Baby, Young Child, Older Child, Teenager, Adult

U, T, A = Uranium, Thorium, Actinium Decay Series, respectively

Attachment F – Table 2

TABLE 2: RESIDENT-FARMER, BELOW CUTLINE, MAXIMUM

		EXTERNAL EXPOSURE	PLANT INGESTION	SOIL INGESTION	DUST INHALATION	TOTAL ALL PATHWAYS	MAX
BABY							
URANIUM DECAY SERIES							
	TOTAL	7.95E-07			1.53E-06	2.32E-06	D
	MAXIMUM	7.82E-07			1.53E-06	2.31E-06	D
	NUCLIDE	Rn-222 + D			Rn-222 + D	Rn-222 + D	Rn-222 + D
THORIUM DECAY SERIES							
	TOTAL	1.11E-06			6.53E-07	1.76E-06	E
	MAXIMUM	7.20E-07			6.53E-07	1.04E-06	E
	NUCLIDE	Rn-220 + D			Rn-220 + D	Rn-220 + D	Rn-220 + D
ACTINIUM DECAY SERIES							
	TOTAL	7.28E-09				7.28E-09	E
	MAXIMUM	6.54E-09				6.54E-09	E
	NUCLIDE	U-235 + D				U-235 + D	U-235 + D
MAX		U			U	U	
MAX		Rn-222 + D			Rn-222 + D	Rn-222 + D	
OLDER BABY							
URANIUM DECAY SERIES							
	TOTAL	8.15E-07			1.43E-06	2.25E-06	D
	MAXIMUM	8.03E-07			1.43E-06	2.23E-06	D
	NUCLIDE	Rn-222 + D			Rn-222 + D	Rn-222 + D	Rn-222 + D
THORIUM DECAY SERIES							
	TOTAL	1.13E-06			6.69E-07	1.80E-06	E
	MAXIMUM	7.38E-07			6.69E-07	1.41E-06	E
	NUCLIDE	Rn-220 + D			Rn-220 + D	Rn-220 + D	Rn-220 + D
ACTINIUM DECAY SERIES							
	TOTAL	7.47E-09				7.47E-09	E
	MAXIMUM	6.71E-09				6.71E-09	E
	NUCLIDE	U-235 + D				U-235 + D	U-235 + D
MAX		U			U	U	
MAX		Rn-222 + D			Rn-222 + D	Rn-222 + D	

Attachment F – Table 2 Cont'd

	EXTERNAL EXPOSURE	PLANT INGESTION	SOIL INGESTION	DUST INHALATION	TOTAL ALL PATHWAYS	MAX
YOUNG CHILD						
URANIUM DECAY SERIES						
TOTAL	2.02E-06	1.94E-06	4.96E-08	3.88E-06	7.88E-06	D
MAXIMUM	1.99E-06	1.02E-06	3.30E-08	3.86E-06	5.85E-06	D
NUCLIDE	Rn-222 + D	Ra-226	Pb-210+ D	Rn-222 + D	Rn-222 + D	Rn-222 + D
THORIUM DECAY SERIES						
TOTAL	2.81E-06	1.38E-06	1.68E-08	1.68E-06	5.88E-06	EE
MAXIMUM	1.83E-06	8.57E-07	8.06E-09	1.65E-06	3.48E-06	EE
NUCLIDE	Rn-220 + D	Ra-228	Ra-228	Rn-220 + D	Rn-220 + D	Rn-220 + D
ACTINIUM DECAY SERIES						
TOTAL	1.85E-08	2.97E-08	1.37E-09	1.42E-09	5.10E-08	PL
MAXIMUM	1.66E-08	[illegible].75E-08	1.03E-09	9.19E-10	3.11E-08	PL
NUCLIDE	U-235 + D	Pa-231	Pa-231	Pa-321	Pa-321	Pa-231
MAX	U	U	U	U	U	
MAX	Rn-222 + D	Ra-226	Pb-210+ D	Rn-222 + D	Rn-222 + D	
OLDER CHILD						
URANIUM DECAY SERIES						
TOTAL	4.85E-06	5.68E-06	1.16E-07	8.21E-06	1.89E-05	D
MAXIMUM	4.78E-06	3.00E-06	7.70E-08	8.16E-06	1.29E-05	D
NUCLIDE	Rn-222 + D	Ra-226	Pb-210 + D	Rn-222 + D	Rn-222 + D	Rn-222 + D
THORIUM DECAY SERIES						
TOTAL	6.75E-06	4.05E-06	3.93E-08	4.05E-06	1.49E-05	EE
MAXIMUM	4.39E-06	2.51E-06	1.88E-08	3.98E-06	8.37E-06	EE
NUCLIDE	Rn-220 + D	Ra-228	Ra-228	Rn-220 + D	Rn-220 + D	Rn-220 + D
ACTINIUM DECAY SERIES						
TOTAL	4.44E-08	8.70E-08	3.20E-09	4.94E-09	1.40E-07	PL
MAXIMUM	3.99E-08	6.34E-09	2.41E-09	3.19E-09	9.01E-08	EE
NUCLIDE	U-235 + D	U-235 + D	Pa-231	Pa-231	Pa-231	U-235 + D
MAX	U	U	U	U	U	
MAX	Rn-222 + D	Ra-226	Pb-210 + D	Rn-222 + D	Rn-222 + D	

Attachment F – Table 2 Cont'd

		EXTERNAL EXPOSURE	PLANT INGESTION	SOIL INGESTION	DUST INHALATION	TOTAL ALL PATHWAYS	MAX
TEENAGER							
	URANIUM DECAY SERIES						
	TOTAL	4.57E-06	5.95E-06	5.79E-08	7.60E-06	1.82E-05	D
	MAXIMUM	4.50E-06	3.15E-06	3.85E-08	**7.55E-06**	1.20E-05	D
	NUCLIDE	Rn-222 + D	Ra-226	Pb-210 + D	**Rn-222 + D**	Rn-222 + D	Rn-222 + D
	THORIUM DECAY SERIES						
	TOTAL	6.35E-06	4.25E-06	1.96E-08	3.83E-06	1.44E-05	EE
	MAXIMUM	4.13E-06	2.63E-06	9.40E-09	3.74E-06	7.88E-06	EE
	NUCLIDE	Rn-220 + D	Ra-228	Ra-228	Rn-220 + D	Rn-220 + D	Rn-220 + D
	ACTINIUM DECAY SERIES						
	TOTAL	4.18E-08	9.12E-08	1.60E-09	5.50E-09	1.40E-07	PL
	MAXIMUM	3.76E-08	8.43E-08	1.20E-09	3.56E-09	9.29E-08	PL
	NUCLIDE	U-235 + D	Pa-231	Pa-231	Pa-231	Pa-231	Pa-231
	MAX	U	U	U	U	U	
	MAX	Rn-222 + D	Ra-226	Pb-210 + D	Rn-222 + D	Rn-222 + D	
ADULT							
	URANIUM DECAY SERIES						
	TOTAL	6.73E-06	9.69E-06	9.10E-08	1.08E-05	6.73E-06	PL
	MAXIMUM	6.62E-06	5.12E-06	6.05E-08	**1.07E-05**	6.62E-06	EE
	NUCLIDE	Rn-222 + D	Ra-226	Pb-210 + D	**Rn-222 + D**	Rn-222 + D	Ra-226
	THORIUM DECAY SERIES						
	TOTAL	9.35E-06	6.92E-06	3.09E-08	1.11E-07	9.35E-06	EE
	MAXIMUM	6.09E-06	4.29E-06	1.48E-08	8.67E-08	6.09E-06	EE
	NUCLIDE	Rn-220 + D	Ra-228	Ra-228	Th-228	Rn-220 + D	Rn-220 + D
	ACTINIUM DECAY SERIES						
	TOTAL	6.16E-08	1.49E-07	2.51E-09	7.53E-09	6.16E-08	PL
	MAXIMUM	5.53E-08	1.37E-07	1.89E-09	4.87E-09	5.53E-08	PL
	NUCLIDE	U-235 + D	Pa-231	Pa-231	Pa-231	U-235 + D	Pa-231
	MAX	U	U	U	T	U	
	MAX	Rn-222 + D	Ra-226	Pb-210 + D	Th-228	Rn-222 + D	

Attachment F – Table 3

SUMMARY		RESIDENT-FARMER, BABY (0-1 YEARS) BELOW CUTLINE, MAXIMUM			
EXTERNAL EXPOSURE		RADON INHALATION		SUMMATIONS	
URANIUM DECAY SERIES		URANIUM DECAY SERIES		URANIUM DECAY SERIES	
U-238 + D	1.08E-08	U-238 + D		U-238 + D	1.08E-08
U-234	2.71E-12	U-234		U-234	2.71E-12
Th-230	1.06E-11	Th-230		Th-230	1.06E-11
Ra-226	1.52E-09	Ra-226		Ra-226	1.52E-09
Rn-222 + D	7.82E-07	Rn-222 + D	1.53E-06	Rn-222 + D	2.31E-06
Pb-210 + D	1.69E-11	Pb-210 + D		Pb-210 + D	1.69E-11
TOTAL	7.95E-07	TOTAL	1.53E-06	TOTAL	2.32E-06
THORIUM DECAY SERIES		THORIUM DECAY SERIES		THORIUM DECAY SERIES	
Th-232	2.70E-12	Th-232		Th-232	2.70E-12
Ra-228	0.00E+00	Ra-228		Ra-228	0.00E+00
Ac-228	3.83E-07	Ac-228		Ac-228	3.83E-07
Th-228	5.94E-11	Th-228		Th-228	5.94E-11
Ra-224	2.88E-09	Ra-224		Ra-224	2.88E-09
Rn-220 + D	7.20E-07	Rn-220 + D	6.53E-07	Rn-220 + D	1.37E-06
TOTAL	1.11E-06	TOTAL	6.53E-07	TOTAL	1.76E-06
ACTINIUM DECAY SERIES		ACTINIUM DECAY SERIES		ACTINIUM DECAY SERIES	
U-235 + D	6.54E-09	U-235 + D		U-235 + D	6.54E-09
Pa-231	6.69E-10	Pa-231		Pa-231	6.69E-10
Ac-227 + D	6.96E-11	Ac-227 + D		Ac-227 + D	6.96E-11
TOTAL	7.28E-09	TOTAL		TOTAL	7.28E-09
		TOTAL URANIUM (U-238 + U-234 + U-235)			1.74E-08
		TOTAL RADIUM (Ra-226 + Ra-228)			1.52E-09

Attachment F - Table 3 Cont'd

	SUMMARY	RESIDENT-FARMER, YOUNG CHILD (3-5 YEARS) BELOW CUTLINE, MAXIMUM			
EXTERNAL EXPOSURE		PLANT INGESTION		SOIL INGESTION	
URANIUM DECAY SERIES		URANIUM DECAY SERIES		URANIUM DECAY SERIES	
U-238 + D	2.74E-08	U-238 + D	1.9E-08	U-238 + D	2.86E-09
U-234	6.87E-12	U-234	1.05E-08	U-234	1.58E-09
Th-230	2.69E-11	Th-230	6.74E-09	Th-230	2.54E-09
Ra-226	3.87E-09	Ra-226	1.02E-06	Ra-226	9.63E-09
Rn-222 + D	1.99E-06	Rn-222 + D	0.00E+00	Rn-222 + D	3.27E-11
Pb-210 + D	4.28E-11	Pb-210 + D	8.77E-07	Pb-210 + D	3.30E-08
TOTAL	2.02E-06	TOTAL	1.94E-06	TOTAL	4.96E-08
THORIUM DECAY SERIES		THORIUM DECAY SERIES		THORIUM DECAY SERIES	
Th-232	6.86E-12	Th-232	3.36E-09	Th-232	1.26E-09
Ra-228	0.00E+00	Ra-228	8.57E-07	Ra-228	8.06E-09
Ac-228	9.71E-07	Ac-228	3.53E-10	Ac-228	5.31E-11
Th-228	1.51E-10	Th-228	5.29E-09	Th-228	1.99E-09
Ra-224	7.32E-09	Ra-224	5.17E-07	Ra-224	4.87E-09
Rn-220 + D	1.83E-06	Rn-220 + D	0.00E+00	Rn-220 + D	6.07E-10
TOTAL	2.81E-06	TOTAL	1.38E-06	TOTAL	1.68E-08
ACTINIUM DECAY SERIES		ACTINIUM DECAY SERIES		ACTINIUM DECAY SERIES	
U-235 + D	1.66E-08	U-235 + D	2.16E-09	U-235 + D	3.26E-10
Pa-231	1.70E-09	Pa-231	2.75E-08	Pa-231	1.03E-09
Ac-227 + D	1.77E-10	Ac-227 + D	8.74E-11	Ac-227 + D	1.31E-11
TOTAL	1.85E-08	TOTAL	2.97E-08	TOTAL	1.37E-09

Attachment F – Table 3 Cont'd

SUMMARY		RESIDENT-FARMER, YOUNG CHILD (3-5 YEARS)			
		BELOW CUTLINE, MAXIMUM			
DUST INHALATION			SUMMATIONS		
URANIUM DECAY SERIES		URANIUM DECAY SERIES--ALL PATHWAYS			
U-238 + D		3.14E-09	U-238 + D		5.25E-08
U-234		2.72E-09	U-234		1.48E-08
Th-230		6.37E-09	Th-230		1.57E-08
Ra-226		4.87E-10	Ra-226		1.04E-06
Rn-222 + D		3.86E-06	Rn-222 + D		5.85E-06
Pb-210 + D		6.90E-10	Pb-210 + D		9.11E-07
	TOTAL	3.88E-06		TOTAL	7.88E-06
THORIUM DECAY SERIES		THORIUM DECAY SERIES--ALL PATHWAYS			
Th-232		4.07E-09	Th-232		8.71E-09
Ra-228		1.72E-10	Ra-228		8.65E-07
Ac-228		5.87E-12	Ac-228		9.72E-07
Th-228		1.64E-08	Th-228		2.38E-08
Ra-224		4.02E-10	Ra-224		5.30E-07
Rn-220 + D		1.65E-06	Rn-220 + D		3.48E-06
	TOTAL	1.68E-06		TOTAL	5.88E-06
ACTINIUM DECAY SERIES		ACTINIUM DECAY SERIES--ALL PATHWAYS			
U-235 + D		4.94E-10	U-235 + D		1.96E-08
Pa-231		9.19E-10	Pa-231		3.11E-08
Ac-227 + D		9.05E-12	Ac-227 + D		2.86E-10
	TOTAL	1.42E-09		TOTAL	5.10E-08
		TOTAL URANIUM (U-238 + U-234 + U-235)			8.68E-08
		TOTAL RADIUM (Ra-226 + Ra-228)			1.90E-06

Attachment F - Table 3 Cont'd

SUMMARY								
			RESIDENT-FARMER, OLDER CHILD (6-12 YEARS)					
			BELOW CUTLINE, MAXIMUM					
EXTERNAL EXPOSURE			PLANT INGESTION			SOIL INGESTION		
URANIUM DECAY SERIES			URANIUM DECAY SERIES			URANIUM DECAY SERIES		
	U-238 + D	6.60E-08		U-238 + D	5.58E-08		U-238 + D	6.68E-09
	U-234	1.65E-11		U-234	3.07E-08		U-234	3.68E-09
	Th-230	6.47E-11		Th-230	1.97E-08		Th-230	5.92E-09
	Ra-226	9.30E-09		Ra-226	3.00E-06		Ra-226	2.25E-08
	Rn-222 + D	4.78E-06		Rn-222 + D	0.00E+00		Rn-222 + D	7.62E-11
	Pb-210 + D	1.03E-10		Pb-210 + D	2.57E-06		Pb-210 + D	7.70E-08
	TOTAL	4.85E-06		TOTAL	5.68E-06		TOTAL	1.16E-07
THORIUM DECAY SERIES			THORIUM DECAY SERIES			THORIUM DECAY SERIES		
	Th-232	1.65E-11		Th-232	9.84E-09		Th-232	2.95E-09
	Ra-228	0.00E+00		Ra-228	2.51E-06		Ra-228	1.88E-08
	Ac-228	2.34E-06		Ac-228	1.03E-09		Ac-228	1.24E-10
	Th-228	3.63E-10		Th-228	1.55E-08		Th-228	4.64E-09
	Ra-224	1.76E-08		Ra-224	1.52E-06		Ra-224	1.14E-08
	Rn-220 + D	4.39E-06		Rn-220 + D	0.00E+00		Rn-220 + D	1.42E-09
	TOTAL	6.75E-06		TOTAL	4.05E-06		TOTAL	3.93E-08
ACTINIUM DECAY SERIES			ACTINIUM DECAY SERIES			ACTINIUM DECAY SERIES		
	U-235 + D	3.99E-08		U-235 + D	6.34E-09		U-235 + D	7.60E-10
	Pa-231	4.08E-09		Pa-231	8.04E-08		Pa-231	2.41E-09
	Ac-227 + D	4.24E-10		Ac-227 + D	2.56E-10		Ac-227 + D	3.07E-11
	TOTAL	4.44E-08		TOTAL	8.70E-08		TOTAL	3.20E-09

Attachment F – Table 3 Cont'd

SUMMARY	RESIDENT-FARMER, OLDER CHILD (6-12 YEARS)				
	BELOW CUTLINE, MAXIMUM				
DUST INHALATION			SUMMATIONS		
URANIUM DECAY SERIES			URANIUM DECAY SERIES--ALL PATHWAYS		
U-238 + D		1.09E-08	U-238 + D		1.39E-07
U-234		9.46E-09	U-234		4.38E-08
Th-230		2.21E-08	Th-230		4.79E-08
Ra-226		1.69E-09	Ra-226		3.03E-06
Rn-222 + D		8.16E-06	Rn-222 + D		1.29E-05
Pb-210 + D		2.40E-09	Pb-210 + D		2.65E-06
	TOTAL	8.21E-06		TOTAL	1.89E-05
		THORIUM DECAY SERIES--ALL PATHWAYS			
Th-232		1.42E-08	Th-232		2.70E-08
Ra-228		5.99E-10	Ra-228		2.53E-06
Ac-228		2.04E-11	Ac-228		2.34E-06
Th-228		5.69E-08	Th-228		7.73E-08
Ra-224		1.40E-09	Ra-224		1.55E-06
Rn-220 + D		3.98E-06	Rn-220 + D		8.37E-06
	TOTAL	4.05E-06		TOTAL	1.49E-05
		ACTINIUM DECAY SERIES--ALL PATHWAYS			
U-235 + D		1.72E-09	U-235 + D		4.87E-08
Pa-231		3.19E-09	Pa-231		9.01E-08
Ac-227 + D		3.15E-11	Ac-227 + D		7.43E-10
	TOTAL	4.94E-09		TOTAL	1.40E-07
	TOTAL URANIUM (U-238 + U-234 + U-235)				2.32E-07
	TOTAL RADIUM (Ra-226 + Ra-228)				5.56E-06

Attachment F - Table 3 Cont'd

SUMMARY

RESIDENT-FARMER, TEENAGER (13 - 19 yr)
BELOW CUTLINE, MAXIMUM

EXTERNAL EXPOSURE		PLANT INGESTION		SOIL INGESTION	
URANIUM DECAY SERIES		**URANIUM DECAY SERIES**		**URANIUM DECAY SERIES**	
U-238 + D	6.21E-08	U-238 + D	5.85E-08	U-238 + D	3.34E-09
U-234	1.55E-11	U-234	3.22E-08	U-234	1.84E-09
Th-230	6.09E-11	Th-230	2.07E-08	Th-230	2.96E-09
Ra-226	8.75E-09	Ra-226	3.15E-06	Ra-226	1.13E-08
Rn-222 + D	4.50E-06	Rn-222 + D	0.00E+00	Rn-222 + D	3.81E-11
Pb-210 + D	9.69E-11	Pb-210 + D	2.69E-06	Pb-210 + D	3.85E-08
TOTAL	4.57E-06	TOTAL	5.95E-06	TOTAL	5.79E-08
THORIUM DECAY SERIES		**THORIUM DECAY SERIES**		**THORIUM DECAY SERIES**	
Th-232	1.55E-11	Th-232	1.03E-08	Th-232	1.47E-09
Ra-228	0.00E+00	Ra-228	2.63E-06	Ra-228	9.40E-09
Ac-228	2.20E-06	Ac-228	1.08E-09	Ac-228	6.19E-11
Th-228	3.41E-10	Th-228	1.62E-08	Th-228	2.32E-09
Ra-224	1.66E-08	Ra-224	1.59E-06	Ra-224	5.68E-09
Rn-222 +D	4.13E-06	Rn-222 +D	0	Rn-222 +D	7.09E-10
TOTAL	6.35E-06	TOTAL	4.25E-06	TOTAL	1.96E-08
ACTINIUM DECAY SERIES		**ACTINIUM DECAY SERIES**		**ACTINIUM DECAY SERIES**	
U-235 + D	3.76E-08	U-235 + D	6.65E-09	U-235 + D	3.80E-10
Pa-231	3.84E-09	Pa-231	8.43E-08	Pa-231	1.20E-09
Ac-227 + D	4.00E-10	Ac-227 + D	2.68E-10	Ac-227 + D	1.53E-11
TOTAL	4.18E-08	TOTAL	9.12E-08	TOTAL	1.60E-09

Attachment F – Table 3 Cont'd

	SUMMARY	RESIDENT-FARMER, TEENAGER (13 - 19 yr) BELOW CUTLINE, MAXIMUM	
DUST INHALATION (INCLUDES RADON)		**SUMMATIONS**	
URANIUM DECAY SERIES		**URANIUM DECAY SERIES--ALL PATHWAYS**	
U-238 + D	1.21E-08	U-238 + D	1.36E-07
U-234	1.05E-08	U-234	4.45E-08
Th-230	2.47E-08	Th-230	4.84E-08
Ra-226	1.88E-09	Ra-226	3.17E-06
Rn-222 + [	7.55E-06	Rn-222 + D	1.20E-05
Pb-210 + D	2.67E-09	Pb-210 + D	2.73E-06
TOTAL	7.60E-06	**TOTAL**	1.82E-05
THORIUM DECAY SERIES		**THORIUM DECAY SERIES--ALL PATHWAYS**	
Th-232	1.58E-08	Th-232	2.76E-08
Ra-228	6.68E-10	Ra-228	2.64E-06
Ac-228	2.27E-11	Ac-228	2.20E-06
Th-228	6.33E-08	Th-228	8.22E-08
Ra-224	1.56E-09	Ra-224	1.61E-06
Rn-220 +D	3.74E-06	Rn-220 +D	7.88E-06
TOTAL	3.83E-06	**TOTAL**	1.44E-05
ACTINIUM DECAY SERIES		**ACTINIUM DECAY SERIES--ALL PATHWAYS**	
U-235 + D	1.91E-09	U-235 + D	4.65E-08
Pa-231	3.56E-09	Pa-231	9.29E-08
Ac-227 + D	3.50E-11	Ac-227 + D	7.18E-10
TOTAL	5.50E-09	**TOTAL**	1.40E-07
	TOTAL URANIUM (U-238 + U-234 + U-235)		2.27E-07
	TOTAL RADIUM (Ra-226 + Ra-228)		5.81E-06

Attachment F - Table 3 Cont'd

SUMMARY — RESIDENT-FARMER, ADULT (20 - 30) BELOW CUTLINE, MAXIMUM

EXTERNAL EXPOSURE		PLANT INGESTION		SOIL INGESTION	
URANIUM DECAY SERIES		**URANIUM DECAY SERIES**		**URANIUM DECAY SERIES**	
U-238 + D	9.15E-08	U-238 + D	9.52E-08	U-238 + D	5.25E-09
U-234	2.29E-11	U-234	5.24E-08	U-234	2.89E-09
Th-230	8.97E-11	Th-230	3.37E-08	Th-230	4.65E-09
Ra-226	1.29E-08	Ra-226	5.12E-06	Ra-226	1.77E-08
Rn-222 +D	6.62E-06	Rn-222 +D	0.00E+00	Rn-222 +D	5.99E-11
Pb-210 + D	1.43E-10	Pb-210 + D	4.39E-06	Pb-210 + D	6.05E-08
TOTAL	6.73E-06	TOTAL	9.69E-06	TOTAL	9.10E-08
THORIUM DECAY SERIES		**THORIUM DECAY SERIES**		**THORIUM DECAY SERIES**	
Th-232	2.29E-11	Th-232	1.68E-08	Th-232	2.32E-09
Ra-228	0.00E+00	Ra-228	4.29E-06	Ra-228	1.48E-08
Ac-228	3.24E-06	Ac-228	1.76E-09	Ac-228	9.73E-11
Th-228	5.03E-10	Th-228	2.64E-08	Th-228	3.64E-09
Ra-224	2.44E-08	Ra-224	2.59E-06	Ra-224	8.92E-09
Rn-220 + D	6.09E-06	Rn-220 + D	0.00E+00	Rn-220 + D	1.11E-09
TOTAL	9.35E-06	TOTAL	6.92E-06	TOTAL	3.09E-08
ACTINIUM DECAY SERIES		**ACTINIUM DECAY SERIES**		**ACTINIUM DECAY SERIES**	
U-235 + D	5.53E-08	U-235 + D	1.08E-08	U-235 + D	5.97E-10
Pa-231	5.66E-09	Pa-231	1.37E-07	Pa-231	1.89E-09
Ac-227 + D	5.89E-10	Ac-227 + D	4.37E-10	Ac-227 + D	2.41E-11
TOTAL	6.16E-08	TOTAL	1.49E-07	TOTAL	2.51E-09

Attachment F – Table 3 Cont'd

	SUMMARY		RESIDENT-FARMER, ADULT (20 - 30)		
			BELOW CUTLINE, MAXIMUM		
DUST INHALATION				SUMMATIONS	
URANIUM DECAY SERIES			URANIUM DECAY SERIES		
	U-238 + D	1.33E-08		U-238 + D	2.05E-07
	U-234	1.44E-08		U-234	6.97E-08
	Th-230	3.38E-08		Th-230	7.22E-08
	Ra-226	2.58E-09		Ra-226	5.16E-06
	Rn-222 +D	1.07E-05		Rn-222 +D	1.73E-05
	Pb-210 + D	3.66E-09		Pb-210 + D	4.45E-06
	TOTAL	1.08E-05		TOTAL	2.73E-05
THORIUM DECAY SERIES			THORIUM DECAY SERIES		
	Th-232	2.16E-08		Th-232	4.07E-08
	Ra-228	9.14E-10		Ra-228	4.30E-06
	Ac-228	3.11E-11		Ac-228	3.24E-06
	Th-228	8.67E-08		Th-228	1.17E-07
	Ra-224	2.13E-09		Ra-224	2.62E-06
	Rn-220 + D	5.52E-06		Rn-220 + D	1.16E-05
	TOTAL	5.63E-06		TOTAL	2.19E-05
ACTINIUM DECAY SERIES			ACTINIUM DECAY SERIES		
	U-235 + D	2.62E-09		U-235 + D	6.94E-08
	Pa-231	4.87E-09		Pa-231	1.50E-07
	Ac-227 + D	4.80E-11		Ac-227 + D	1.10E-09
	TOTAL	7.53E-09		TOTAL	2.20E-07
	TOTAL URANIUM (U-238 + U-234 + U-235)				3.44E-07
	TOTAL RADIUM (Ra-226 + Ra-228)				9.46E-06

Attachment F – Table 4

TABLE 2 4 RESIDENT-FARMER, BELOW CUTLINE, 95UCL

DECAY SERIES	BABY	OLDER BABY	YOUNG CHILD	OLDER CHILD	TEENAGER	ADULT	TOTAL	MAX
EXTERNAL EXPOSURE								
Uranium	4.22E-07	4.33E-07	1.07E-06	2.58E-06	2.43E-06	3.57E-06	1.05E-05	A
Thorium	8.34E-07	8.56E-07	2.12E-06	5.09E-06	4.79E-06	7.06E-06	2.08E-05	A
Actinium	7.24E-09	7.43E-09	1.84E-08	4.42E-08	4.16E-08	6.13E-08	1.80E-07	A
TOTAL	1.26E-06	1.30E-06	3.21E-06	7.71E-06	7.26E-06	1.07E-05	3.14E-05	A
MAX	T	T	T	T	T	T	T	
PLANT INGESTION								
Uranium			1.03E-06	3.00E-06	3.15E-06	5.13E-06	1.23E-05	A
Thorium			1.03E-06	3.03E-06	3.18E-06	5.17E-06	1.24E-05	A
Actinium			2.97E-08	8.69E-08	9.11E-08	1.48E-07	3.56E-07	A
TOTAL			2.09E-06	6.12E-06	6.42E-06	1.04E-05	2.51E-05	A
MAX			U,T	U,T	U,T	U,T	U,T	
SOIL INGESTION								
Uranium			2.66E-08	6.20E-08	3.10E-08	4.87E-08	1.68E-07	OC
Thorium			1.23E-08	2.86E-08	1.43E-08	2.25E-08	7.77E-08	OC
Actinium			1.36E-09	3.18E-09	1.59E-09	2.50E-09	8.63E-09	OC
TOTAL			4.03E-08	9.38E-08	4.69E-08	7.37E-08	2.55E-07	OC
MAX			U	U	U	U	U	
DUST INHALATION (INCLUDING RADON)								
Uranium	8.04E-07	7.54E-07	2.04E-06	4.33E-06	4.01E-06	5.69E-06	1..6E-05	A
Thorium	4.83E-07	4.95E-07	1.24E-06	3.00E-06	2.83E-06	4.16E-06	1.22E-05	A
Actinium			1.42E-09	4.92E-09	5.48E-09	7.51E-09	1.93E-08	A
TOTAL	1.29E-06	1.25E-06	3.28E-06	7.33E-06	6.85E-06	9.86E-06	2.99E-05	A
MAX	U	U	U	U	U	U	U	
TOTAL, ALL PATHWAYS								
Uranium	1.23E-06	1.19E-06	4.17E-06	9.97E-06	9.62E-06	1.44E-05	4.06E-05	A
Thorium	1.32E-06	1.35E-06	4.40E-06	1.11E-05	1.08E-05	1.64E-05	4.54E-05	A
Actinium	7.24E-09	7.43E-09	5.09E-08	1.39E-07	1.40E-07	2.19E-07	5.64E-07	A
TOTAL	2.55E-06	2.55E-06	8.62E-06	2.13E-05	2.06E-05	3.11E-05	8.66E-05	A
MAX	T	T	T	T	T	T	T	

Attachment F – Table 5 Cont'd

	EXTERNAL EXPOSURE	PLANT INGESTION	SOIL INGESTION	DUST INHALATION	TOTAL	MAX
TEENAGER						
URANIUM DECAY SERIES						
TOTAL	2.43E-06	3.15E-06	3.10E-08	4.01E-06	9.61E-06	D
MAXIMUM	2.37E-06	1.66E-06	2.03E-08	**3.98E-06**	6.35E-06	D
NUCLIDE	Rn-222 + D	Ra-226	Pb-210 + D	**Rn-222 + D**	Rn-222 + D	Rn-222 + D
THORIUM DECAY SERIES						
TOTAL	4.79E-06	3.18E-06	1.43E-08	2.83E-06	1.08E-05	EE
MAXIMUM	3.15E-06	1.95E-06	6.96E-09	2.77E-06	5.92E-06	EE
NUCLIDE	Rn-220 + D	Ra-228	Ra-228	Rn-220 + D	Rn-220 + D	Rn-220 + D
ACTINIUM DECAY SERIES						
TOTAL	4.16E-08	9.11E-08	1.59E-09	5.48E-09	1.40E-07	PL
MAXIMUM	3.76E-08	8.43E-08	1.20E-09	3.56E-09	9.29E-08	PL
NUCLIDE	U-235 + D	U-235 + D	Pa-231	Pa-231	Pa-231	U-235 + D
MAX	T	T	U	U		
MAX	Rn-220 + D	Ra-228	Pb-210 + D	Rn-222 + D		
ADULT						
URANIUM DECAY SERIES						
TOTAL	3.57E-06	5.13E-06	4.87E-08	5.69E-06	1.44E-05	D
MAXIMUM	3.49E-06	2.70E-06	3.19E-08	**5.65E-06**	9.14E-06	D
NUCLIDE	Rn-222 + D	Ra-226	Pb-210 + D	**Rn-222 + D**	Rn-222 + D	Rn-222 + D
THORIUM DECAY SERIES						
TOTAL	7.06E-06	5.17E-06	2.25E-08	4.16E-06	1.64E-05	EE
MAXIMUM	4.64E-06	3.17E-06	1.09E-08	4.09E-06	8.73E-06	EE
NUCLIDE	Rn-220 + D	Ra-228	Ra-228	Rn-220 + D	Rn-220 + D	Rn-220 + D
ACTINIUM DECAY SERIES						
TOTAL	6.13E-08	1.48E-07	2.50E-09	7.51E-09	2.20E-07	PL
MAXIMUM	5.53E-08	1.37E-07	1.89E-09	4.87E-09	1.50E-07	PL
NUCLIDE	U-235 + D	Pa-231	Pa-231	Pa-231	Pa-231	Pa-231
MAX	T	T	U	U		
MAX	Rn-220 + D	Ra-228	Pb-210 + D	Rn-222 + D		

Attachment F – Table 5 Cont'd

		EXTERNAL EXPOSURE	PLANT INGESTION	SOIL INGESTION	DUST INHALATION	TOTAL	MAX
YOUNG CHILD							
URANIUM DECAY SERIES							
	TOTAL	1.07E-06	1.03E-06	2.66E-08	2.04E-06	4.17E-06	D
	MAXIMUM	1.05E-06	5.40E-07	1.74E-08	2.04E-06	3.08E-06	D
	NUCLIDE	Rn-222 + D	Ra-226	Pb-210 + D	Rn-222 + D	Rn-222 + D	Rn-222 + D
THORIUM DECAY SERIES							
	TOTAL	2.12E-06	1.03E-06	1.23E-08	1.24E-06	4.40E-06	EE
	MAXIMUM	1.39E-06	6.35E-07	5.97E-09	1.23E-06	2.62E-06	EE
	NUCLIDE	Rn-220 + D	Ra-228	Ra-228	Rn-220 + D	Rn-220 + D	Rn-220 + D
ACTINIUM DECAY SERIES							
	TOTAL	1.84E-08	2.97E-08	1.36E-09	1.42E-09	5.08E-08	PL
	MAXIMUM	1.66E-08	2.75E-08	1.03E-09	9.19E-10	3.11E-08	PL
	NUCLIDE	U-235 + D	Pa-231	Pa-231	Pa-231	Pa-231	Pa-231
MAX		T	T	U	U		
MAX		Rn-220 + D	Ra-228	Pb-210 + D	Rn-222 + D		
OLDER CHILD							
URANIUM DECAY SERIES							
	TOTAL	2.58E-06	3.00E-06	6.20E-08	4.33E-06	9.97E-06	D
	MAXIMUM	2.52E-06	1.58E-06	4.06E-08	4.31E-06	6.82E-06	D
	NUCLIDE	Rn-222 + D	Ra-226	Pb-210 + D	Rn-222 + D	Rn-222 + D	Rn-222 + D
THORIUM DECAY SERIES							
	TOTAL	5.09E-06	3.03E-06	2.86E-08	3.00E-06	1.11E-05	EE
	MAXIMUM	3.35E-06	1.86E-06	1.39E-08	2.95E-06	6.29E-06	EE
	NUCLIDE	Rn-220 + D	Ra-228	Ra-228	Rn-220 + D	Rn-220 + D	Rn-220 + D
ACTINIUM DECAY SERIES							
	TOTAL	4.42E-08	8.69E-08	3.18E-09	4.92E-09	1.39E-07	PL
	MAXIMUM	3.99E-08	8.04E-08	2.41E-09	3.19E-09	9.01E-08	PL
	NUCLIDE	U-235 + D	Pa-231	Pa-231	Pa-231	Pa-231	Pa-231
MAX		T	T	U	U		
MAX		Rn-220 + D	Ra-228	Pb-210 + D	Rn-222 + D		

Attachment F – Table 6

SUMMARY		RESIDENT-FARMER, BABY (0-1 YEARS) BELOW CUTLINE, 95UCL			
EXTERNAL EXPOSURE		**RADON INHALATION**		**SUMMATIONS**	
URANIUM DECAY SERIES		**URANIUM DECAY SERIES**		**URANIUM DECAY SERIES**	
U-238 + D	8.67E-09	U-238 + D		U-238 + D	8.67E-09
U-234	1.09E-12	U-234		U-234	1.09E-12
Th-230	4.77E-12	Th-230		Th-230	4.77E-12
Ra-226	8.03E-10	Ra-226		Ra-226	8.03E-10
Rn-222 + D	4.13E-07	Rn-222 + D	8.04E-07	Rn-222 + D	1.22E-06
Pb-210 + D	8.89E-12	Pb-210 + D		Pb-210 + D	8.89E-12
TOTAL	4.22E-07	TOTAL	8.04E-07	TOTAL	1.23E-06
THORIUM DECAY SERIES		**THORIUM DECAY SERIES**		**THORIUM DECAY SERIES**	
Th-232	1.40E-12	Th-232		Th-232	1.40E-12
Ra-228	0.00E+00	Ra-228		Ra-228	0.00E+00
Ac-228	2.83E-07	Ac-228		Ac-228	2.83E-07
Th-228	4.27E-11	Th-228		Th-228	4.27E-11
Ra-224	2.20E-09	Ra-224		Ra-224	2.20E-09
Rn-220 + D	5.49E-07	Rn-220 + D	4.83E-07	Rn-220 + D	1.03E-06
TOTAL	8.34E-07	TOTAL	4.83E-07	TOTAL	1.32E-06
ACTINIUM DECAY SERIES		**ACTINIUM DECAY SERIES**		**ACTINIUM DECAY SERIES**	
U-235 + D	6.54E-09	U-235 + D		U-235 + D	6.54E-09
Pa-231	6.69E-10	Pa-231		Pa-231	6.69E-10
Ac-227 + D	3.48E-11	Ac-227 + D		Ac-227 + D	3.48E-11
TOTAL	7.24E-09	TOTAL		TOTAL	7.24E-09
		TOTAL URANIUM (U-238 + U-234 + U-235)			1.52E-08
		TOTAL RADIUM (Ra-226 + Ra-228)			8.03E-10

Attachment F - Table 6 Cont'd

	SUMMARY	RESIDENT-FARMER, YOUNG CHILD (3-5 YEARS) BELOW CUTLINE, 95UCL			
EXTERNAL EXPOSURE		**PLANT INGESTION**		**SOIL INGESTION**	
URANIUM DECAY SERIES		**URANIUM DECAY SERIES**		**URANIUM DECAY SERIES**	
U-238 + D	2.20E-08	U-238 + D	1.53E-08	U-238 + D	2.30E-09
U-234	2.76E-12	U-234	4.21E-09	U-234	6.34E-10
Th-230	1.21E-11	Th-230	3.04E-09	Th-230	1.14E-09
Ra-226	2.04E-09	Ra-226	5.40E-07	Ra-226	5.08E-09
Rn-222 + D	1.05E-06	Rn-222 + D	0.00E+00	Rn-222 + D	1.72E-11
Pb-210 + D	2.26E-11	Pb-210 + D	4.62E-07	Pb-210 + D	1.74E-08
TOTAL	1.07E-06	TOTAL	1.03E-06	TOTAL	2.66E-08
THORIUM DECAY SERIES		**THORIUM DECAY SERIES**		**THORIUM DECAY SERIES**	
Th-232	3.55E-12	Th-232	1.74E-09	Th-232	6.54E-10
Ra-228	0.00E+00	Ra-228	6.35E-07	Ra-228	5.97E-09
Ac-228	7.19E-07	Ac-228	2.61E-10	Ac-228	3.93E-11
Th-228	1.08E-10	Th-228	3.79E-09	Th-228	1.43E-09
Ra-224	5.58E-09	Ra-224	3.94E-07	Ra-224	3.71E-09
Rn-220 + D	1.39E-06	Rn-220 + D	0.00E+00	Rn-220 + D	4.63E-10
TOTAL	2.12E-06	TOTAL	1.03E-06	TOTAL	1.23E-08
ACTINIUM DECAY SERIES		**ACTINIUM DECAY SERIES**		**ACTINIUM DECAY SERIES**	
U-235 + D	1.66E-08	U-235 + D	2.16E-09	U-235 + D	3.26E-10
Pa-231	1.70E-09	Pa-231	2.75E-08	Pa-231	1.03E-09
Ac-227 + D	8.83E-11	Ac-227 + D	4.37E-11	Ac-227 + D	6.57E-12
TOTAL	1.84E-08	TOTAL	2.97E-08	TOTAL	1.36E-09

Attachment F - Table 6 Cont'd

SUMMARY		RESIDENT-FARMER, OLDER BABY (1 - 2 YEARS) BELOW CUTLINE, 95UCL			
EXTERNAL EXPOSURE		RADON INHALATION		SUMMATIONS	
URANIUM DECAY SERIES		URANIUM DECAY SERIES		URANIUM DECAY SERIES	
U-238 + D	8.90E-09	U-238 + D		U-238 + D	8.90E-09
U-234	1.12E-12	U-234		U-234	1.12E-12
Th-230	4.89E-12	Th-230		Th-230	4.89E-12
Ra-226	8.24E-10	Ra-226		Ra-226	8.24E-10
Rn-222 + D	4.23E-07	Rn-222 + D	7.54E-07	Rn-222 + D	1.18E-06
Pb-210 + D	9.12E-12	Pb-210 + D		Pb-210 + D	9.12E-12
TOTAL	4.33E-07	TOTAL	7.54E-07	TOTAL	1.19E-06
THORIUM DECAY SERIES		THORIUM DECAY SERIES		THORIUM DECAY SERIES	
Th-232	1.44E-12	Th-232		Th-232	1.44E-12
Ra-228	0.00E+00	Ra-228		Ra-228	0.00E+00
Ac-228	2.91E-07	Ac-228		Ac-228	2.91E-07
Th-228	4.37E-11	Th-228		Th-228	4.37E-11
Ra-224	2.25E-09	Ra-224		Ra-224	2.25E-09
Rn-220 + D	5.63E-07	Rn-220 + D	4.95E-07	Rn-220 + D	1.06E-06
TOTAL	8.56E-07	TOTAL	4.95E-07	TOTAL	1.35E-06
ACTINIUM DECAY SERIES		ACTINIUM DECAY SERIES		ACTINIUM DECAY SERIES	
U-235 + D	6.71E-09	U-235 + D		U-235 + D	6.71E-09
Pa-231	6.86E-10	Pa-231		Pa-231	6.86E-10
Ac-227 + D	3.57E-11	Ac-227 + D		Ac-227 + D	3.57E-11
TOTAL	7.43E-09	TOTAL	0	TOTAL	7.43E-09
		TOTAL URANIUM (U-238 + U-234 + U-235)			1.56E-08
		TOTAL RADI (Ra-226 + Ra-228)			8.24E-10

Attachment F - Table 6 Cont'd

	SUMMARY	RESIDENT-FARMER, YOUNG CHILD (3-5 YEARS) BELOW CUTLINE, 95UCL			
EXTERNAL EXPOSURE		**PLANT INGESTION**		**SOIL INGESTION**	
URANIUM DECAY SERIES		**URANIUM DECAY SERIES**		**URANIUM DECAY SERIES**	
U-238 + D	2.20E-08	U-238 + D	1.53E-08	U-238 + D	2.30E-09
U-234	2.76E-12	U-234	4.21E-09	U-234	6.34E-10
Th-230	1.21E-11	Th-230	3.04E-09	Th-230	1.14E-09
Ra-226	2.04E-09	Ra-226	5.40E-07	Ra-226	5.08E-09
Rn-222 + D	1.05E-06	Rn-222 + D	0.00E+00	Rn-222 + D	1.72E-11
Pb-210 + D	2.26E-11	Pb-210 + D	4.62E-07	Pb-210 + D	1.74E-08
TOTAL	1.07E-06	TOTAL	1.03E-06	TOTAL	2.66E-08
THORIUM DECAY SERIES		**THORIUM DECAY SERIES**		**THORIUM DECAY SERIES**	
Th-232	3.55E-12	Th-232	1.74E-09	Th-232	6.54E-10
Ra-228	0.00E+00	Ra-228	6.35E-07	Ra-228	5.97E-09
Ac-228	7.19E-07	Ac-228	2.61E-10	Ac-228	3.93E-11
Th-228	1.08E-10	Th-228	3.79E-09	Th-228	1.43E-09
Ra-224	5.58E-09	Ra-224	3.94E-07	Ra-224	3.71E-09
Rn-220 + D	1.39E-06	Rn-220 + D	0.00E+00	Rn-220 + D	4.63E-10
TOTAL	2.12E-06	TOTAL	1.03E-06	TOTAL	1.23E-08
ACTINIUM DECAY SERIES		**ACTINIUM DECAY SERIES**		**ACTINIUM DECAY SERIES**	
U-235 + D	1.66E-08	U-235 + D	2.16E-09	U-235 + D	3.26E-10
Pa-231	1.70E-09	Pa-231	2.75E-08	Pa-231	1.03E-09
Ac-227 + D	8.83E-11	Ac-227 + D	4.37E-11	Ac-227 + D	6.57E-12
TOTAL	1.84E-08	TOTAL	2.97E-08	TOTAL	1.36E-09

Attachment F – Table 6 Cont'd

SUMMARY		RESIDENT-FARMER, YOUNG CHILD (3-5 YEARS)			
		BELOW CUTLINE, 95UCL			
DUST INHALATION			SUMMATIONS		
URANIUM DECAY SERIES			URANIUM DECAY SERIES--ALL PATHWAYS		
U-238 + D		2.52E-09	U-238 + D		4.21E-08
U-234		1.10E-09	U-234		5.95E-09
Th-230		2.87E-09	Th-230		7.06E-09
Ra-226		2.57E-10	Ra-226		5.48E-07
Rn-222 + D		2.04E-06	Rn-222 + D		3.08E-06
Pb-210 + D		3.64E-10	Pb-210 + D		4.80E-07
	TOTAL	2.04E-06		TOTAL	4.17E-06
THORIUM DECAY SERIES			THORIUM DECAY SERIES--ALL PATHWAYS		
Th-232		2.11E-09	Th-232		4.51E-09
Ra-228		1.28E-10	Ra-228		6.41E-07
Ac-228		4.34E-12	Ac-228		7.20E-07
Th-228		1.17E-08	Th-228		1.71E-08
Ra-224		3.07E-10	Ra-224		4.04E-07
Rn-220 + D		1.23E-06	Rn-220 + D		2.62E-06
	TOTAL	1.24E-06		TOTAL	4.40E-06
ACTINIUM DECAY SERIES			ACTINIUM DECAY SERIES--ALL PATHWAYS		
U-235 + D		4.94E-10	U-235 + D		1.96E-08
Pa-231		9.19E-10	Pa-231		3.11E-08
Ac-227 + D		4.53E-12	Ac-227 + D		1.43E-10
	TOTAL	1.42E-09		TOTAL	5.08E-08
		TOTAL URANIUM (U-238 + U-234 + U-235)			6.76E-08
		TOTAL RADIUM (Ra-226 + Ra-228)			1.19E-06

Attachment F - Table 6 Cont'd

SUMMARY		RESIDENT-FARMER, OLDER CHILD (6-12 YEARS) BELOW CUTLINE, 95UCL	
	EXTERNAL EXPOSURE	PLANT INGESTION	SOIL INGESTION
URANIUM DECAY SERIES			
U-238 + D	5.29E-08	4.47E-08	5.36E-09
U-234	6.64E-12	1.23E-08	1.48E-09
Th-230	2.91E-11	8.89E-09	2.66E-09
Ra-226	4.90E-09	1.58E-06	1.19E-08
Rn-222 + D	2.52E-06	0.00E+00	4.02E-11
Pb-210 + D	5.43E-11	1.3[illegible]E-06	4.06E-08
TOTAL	2.58E-06	3.0[illegible]E-06	6.20E-08
THORIUM DECAY SERIES			
Th-232	8.54E-12	5.[illegible]E-09	1.53E-09
Ra-228	0.00E+00	1.86E-06	1.39E-08
Ac-228	1.73E-06	7.65E-10	9.17E-11
Th-228	2.60E-10	1.11E-08	3.33E-09
Ra-224	1.34E-08	1.16E-06	8.65E-09
Rn-220 + D	3.35E-06	0.00E+00	1.08E-09
TOTAL	5.09E-06	3.03E-06	2.86E-08
ACTINIUM DECAY SERIES			
U-235 + D	3.99E-08	6.34E-09	7.60E-10
Pa-231	4.08E-09	8.04E-08	2.41E-09
Ac-227 + D	2.12E-10	1.28E-10	1.53E-11
TOTAL	4.42E-08	8.69E-08	3.18E-09

Attachment F – Table 6 Cont'd

SUMMARY	RESIDENT-FARMER, YOUNG CHILD (3-5 YEARS)			
	BELOW CUTLINE, 95UCL			
DUST INHALATION		SUMMATIONS		
URANIUM DECAY SERIES		URANIUM DECAY SERIES--ALL PATHWAYS		
U-238 + D	2.52E-09	U-238 + D		4.21E-08
U-234	1.10E-09	U-234		5.95E-09
Th-230	2.87E-09	Th-230		7.06E-09
Ra-226	2.57E-10	Ra-226		5.48E-07
Rn-222 + D	2.04E-06	Rn-222 + D		3.08E-06
Pb-210 + D	3.64E-10	Pb-210 + D		4.80E-07
TOTAL	2.04E-06		TOTAL	4.17E-06
THORIUM DECAY SERIES		THORIUM DECAY SERIES--ALL PATHWAYS		
Th-232	2.11E-09	Th-232		4.51E-09
Ra-228	1.28E-10	Ra-228		6.41E-07
Ac-228	4.34E-12	Ac-228		7.20E-07
Th-228	1.17E-08	Th-228		1.71E-08
Ra-224	3.07E-10	Ra-224		4.04E-07
Rn-220 + D	1.23E-06	Rn-220 + D		2.62E-06
TOTAL	1.24E-06		TOTAL	4.40E-06
ACTINIUM DECAY SERIES		ACTINIUM DECAY SERIES--ALL PATHWAYS		
U-235 + D	4.94E-10	U-235 + D		1.96E-08
Pa-231	9.19E-10	Pa-231		3.11E-08
Ac-227 + D	4.53E-12	Ac-227 + D		1.43E-10
TOTAL	1.42E-09		TOTAL	5.08E-08
	TOTAL URANIUM (U-238 + U-234 + U-235)			6.76E-08
	TOTAL RADIUM (Ra-226 + Ra-228)			1.19E-06

Attachment F - Table 6 Cont'd

	SUMMARY	RESIDENT-FARMER, TEENAGER (13 - 19 yr) BELOW CUTLINE, 95UCL			
EXTERNAL EXPOSURE		**PLANT INGESTION**		**SOIL INGESTION**	
URANIUM DECAY SERIES		**URANIUM DECAY SERIES**		**URANIUM DECAY SERIES**	
U-238 + D	4.98E-08	U-238 + D	4.69E-08	U-238 + D	2.68E-09
U-234	6.25E-12	U-234	1.29E-08	U-234	7.40E-10
Th-230	2.74E-11	Th-230	9.32E-09	Th-230	1.33E-09
Ra-226	4.61E-09	Ra-226	1.66E-06	Ra-226	5.93E-09
Rn-222 + D	2.37E-06	Rn-222 + D	0.00E+00	Rn-222 + D	2.01E-11
Pb-210 + D	5.11E-11	Pb-210 + D	1.42E-06	Pb-210 + D	2.03E-08
TOTAL	2.43E-06	TOTAL	3.15E-06	TOTAL	3.10E-08
THORIUM DECAY SERIES		**THORIUM DECAY SERIES**		**THORIUM DECAY SERIES**	
Th-232	8.04E-12	Th-232	5.34E-09	Th-232	7.63E-10
Ra-228	0.00E+00	Ra-228	1.95E-06	Ra-228	6.96E-09
Ac-228	1.63E-06	Ac-228	8.02E-10	Ac-228	4.58E-11
Th-228	2.45E-10	Th-228	1.16E-08	Th-228	1.66E-09
Ra-224	1.26E-08	Ra-224	1.21E-06	Ra-224	4.33E-09
Rn-220 +D	3.15E-06	Rn-220 +D	0	Rn-220 +D	5.40E-10
TOTAL	4.79E-06	TOTAL	3.18E-06	TOTAL	1.43E-08
ACTINIUM DECAY SERIES		**ACTINIUM DECAY SERIES**		**ACTINIUM DECAY SERIES**	
U-235 + D	3.76E-08	U-235 + D	6.65E-09	U-235 + D	3.80E-10
Pa-231	3.84E-09	Pa-231	8.43E-08	Pa-231	1.20E-09
Ac-227 + D	2.00E-10	Ac-227 + D	1.34E-10	Ac-227 + D	7.67E-12
TOTAL	4.16E-08	TOTAL	9.11E-08	TOTAL	1.59E-09

Attachment F – Table 6 Cont'd

SUMMARY	RESIDENT-FARMER, OLDER CHILD (6-12 YEARS)				
	BELOW CUTLINE, 95UCL				
DUST INHALATION (INCLUDES RADON)			SUMMATIONS		
URANIUM DECAY SERIES			URANIUM DECAY SERIES--ALL PATHWAYS		
U-238 + D		8.75E-09	U-238 + D		1.12E-07
U-234		3.81E-09	U-234		1.76E-08
Th-230		9.97E-09	Th-230		2.16E-08
Ra-226		8.92E-10	Ra-226		1.60E-06
Rn-222 + D		4.31E-06	Rn-222 + D		6.82E-06
Pb-210 + D		1.27E-09	Pb-210 + D		1.40E-06
	TOTAL	4.33E-06		TOTAL	9.97E-06
		THORIUM DECAY SERIES--ALL PATHWAYS			
Th-232		7.33E-09	Th-232		1.40E-08
Ra-228		4.44E-10	Ra-228		1.87E-06
Ac-228		1.51E-11	Ac-228		1.73E-06
Th-228		4.08E-08	Th-228		5.55E-08
Ra-224		1.07E-09	Ra-224		1.18E-06
Rn-220 + D		2.95E-06	Rn-220 + D		6.29E-06
	TOTAL	3.00E-06		TOTAL	1.11E-05
		ACTINIUM DECAY SERIES--ALL PATHWAYS			
U-235 + D		1.72E-09	U-235 + D		4.87E-08
Pa-231		3.19E-09	Pa-231		9.01E-08
Ac-227 + D		1.57E-11	Ac-227 + D		3.71E-10
	TOTAL	4.92E-09		TOTAL	1.39E-07
	TOTAL URANIUM (U-238 + U-234 + U-235)				1.78E-07
	TOTAL RADIUM (Ra-226 + Ra-228)				3.47E-06

Attachment F - Table 6 Cont'd

SUMMARY

RESIDENT-FARMER, ADULT (20 - 30)
BELOW CUTLINE, 95UCL

	EXTERNAL EXPOSURE		PLANT INGESTION		SOIL INGESTION
URANIUM DECAY SERIES		**URANIUM DECAY SERIES**		**URANIUM DECAY SERIES**	
U-238 + D	7.34E-08	U-238 + D	7.64E-08	U-238 + D	4.21E-09
U-234	9.21E-12	U-234	2.11E-08	U-234	1.16E-09
Th-230	4.04E-11	Th-230	1.52E-08	Th-230	2.09E-09
Ra-226	6.80E-09	Ra-226	2.70E-06	Ra-226	9.31E-09
Rn-222 +D	3.49E-06	Rn-222 +D	0.00E+00	Rn-222 +D	3.16E-11
Pb-210 + D	7.52E-11	Pb-210 + D	2.31E-06	Pb-210 + D	3.19E-08
TOTAL	3.57E-06	TOTAL	5.13E-06	TOTAL	4.87E-08
THORIUM DECAY SERIES		**THORIUM DECAY SERIES**		**THORIUM DECAY SERIES**	
Th-232	1.18E-11	Th-232	8.70E-09	Th-232	1.20E-09
Ra-228	0.00E+00	Ra-228	3.17E-06	Ra-228	1.09E-08
Ac-228	2.40E-06	Ac-228	1.31E-09	Ac-228	7.20E-11
Th-228	3.61E-10	Th-228	1.90E-08	Th-228	2.62E-09
Ra-224	1.86E-08	Ra-224	1.97E-06	Ra-224	6.80E-09
Rn-220 + D	4.64E-06	Rn-220 + D	0.00E+00	Rn-220 + D	8.49E-10
TOTAL	7.06E-06	TOTAL	5.17E-06	TOTAL	2.25E-08
ACTINIUM DECAY SERIES		**ACTINIUM DECAY SERIES**		**ACTINIUM DECAY SERIES**	
U-235 + D	5.53E-08	U-235 + D	1.08E-08	U-235 + D	5.97E-10
Pa-231	5.66E-09	Pa-231	1.37E-07	Pa-231	1.89E-09
Ac-227 + D	2.94E-10	Ac-227 + D	2.18E-10	Ac-227 + D	1.21E-11
TOTAL	6.13E-08	TOTAL	1.48E-07	TOTAL	2.50E-09

Attachment F – Table 6 Cont'd

		SUMMARY	RESIDENT-FARMER, TEENAGER (13 - 19 yr) BELOW CUTLINE, 95UCL		
DUST INHALATION (INCLUDES RADON)			**SUMMATIONS**		
URANIUM DECAY SERIES			**URANIUM DECAY SERIES--ALL PATHWAYS**		
U-238 + D		9.75E-09	U-238 + D		1.09E-07
U-234		4.24E-09	U-234		1.79E-08
Th-230		1.11E-08	Th-230		2.18E-08
Ra-226		9.93E-10	Ra-226		1.67E-06
Rn-222 + D		3.98E-06	Rn-222 + D		6.35E-06
Pb-210 + D		1.41E-09	Pb-210 + D		1.44E-06
	TOTAL	4.01E-06		**TOTAL**	9.61E-06
THORIUM DECAY SERIES			**THORIUM DECAY SERIES--ALL PATHWAYS**		
Th-232		8.16E-09	Th-232		1.43E-08
Ra-228		4.94E-10	Ra-228		1.96E-06
Ac-228		1.68E-11	Ac-228		1.63E-0
Th-228		4.54E-08	Th-228		5.90E-08
Ra-224		1.19E-09	Ra-224		1.23E-06
Rn-220 +D		2.77E-06	Rn-220 +D		5.92E-06
	TOTAL	2.83E-06		**TOTAL**	1.08E-05
ACTINIUM DECAY SERIES			**ACTINIUM DECAY SERIES--ALL PATHWAYS**		
U-235 + D		1.91E-09	U-235 + D		4.65E-08
Pa-231		3.56E-09	Pa-231		9.29E-08
Ac-227 + D		1.75E-11	Ac-227 + D		3.59E-10
	TOTAL	5.48E-09		**TOTAL**	1.40E-07
		TOTAL URANIUM (U-238 + U-234 + U-235)			1.74E-07
		TOTAL RADIUM (Ra-226 + Ra-228)			3.63E-06

Attachment F – Table 6 Cont'd

		SUMMARY		RESIDENT-FARMER, ADULT (20 - 30)		
				BELOW CUTLINE, 95UCL		
DUST INHALATION					SUMMATIONS	
URANIUM DECAY SERIES				URANIUM DECAY SERIES		
	U-238 + D		1.33E-08	U-238 + D		1.67E-07
	U-234		5.81E-09	U-234		2.81E-08
	Th-230		1.52E-08	Th-230		3.25E-08
	Ra-226		1.36E-09	Ra-226		2.72E-06
	Rn-222 +D		5.65E-06	Rn-222 +D		9.14E-06
	Pb-210 + D		1.93E-09	Pb-210 + D		2.35E-06
		TOTAL	5.69E-06		TOTAL	1.44E-05
THORIUM DECAY SERIES				THORIUM DECAY SERIES		
	Th-232		1.12E-08	Th-232		2.11E-08
	Ra-228		6.77E-10	Ra-228		3.18E-06
	Ac-228		2.30E-11	Ac-228		2.40E-06
	Th-228		6.22E-08	Th-228		8.42E-08
	Ra-224		1.63E-09	Ra-224		2.00E-06
	Rn-220 + D		4.09E-06	Rn-220 + D		8.73E-06
		TOTAL	4.16E-06		TOTAL	1.64E-05
ACTINIUM DECAY SERIES				ACTINIUM DECAY SERIES		
	U-235 + D		2.62E-09	U-235 + D		6.94E-08
	Pa-231		4.87E-09	Pa-231		1.50E-07
	Ac-227 + D		2.40E-11	Ac-227 + D		5.49E-10
		TOTAL	7.51E-09		TOTAL	2.20E-07
		TOTAL URANIUM (U-238 + U-234 + U-235)				2.65E-07
		TOTAL RADIUM (Ra-226 + Ra-228)				5.90E-06

Attachment F – Table 7

TABLE 5/7 WORKER-DREDGER

ABOVE CUTLINE, MAXIMUM

EXTERNAL EXPOSURE		SOIL INGESTION MAX		TOTAL		
DECAY SERIES		DECAY SERIES		DECAY SERIES		MAX
Uranium	3.01E-05	*Uranium*	4.12E-07	*Uranium*	3.05E-05	EE
Thorium	4.60E-05	*Thorium*	1.10E-07	*Thorium*	4.61E-05	EE
Actinium	1.74E-06	*Actinium*	5.13E-08	*Actinium*	1.80E-06	EE
TOTAL	7.78E-05	TOTAL	5.73E-07	TOTAL	7.84E-05	EE
MAX	T	MAX	U	MAX	T	

ABOVE CUTLINE, 95UCL

EXTERNAL EXPOSURE		SOIL INGESTION		TOTAL		
DECAY SERIES		DECAY SERIES		DECAY SERIES		MAX
Uranium	1.72E-05	*Uranium*	1.60E-07	*Uranium*	1.74E-05	EE
Thorium	3.03E-06	*Thorium*	7.76E-09	*Thorium*	3.04E-06	EE
Actinium	1.56E-07	*Actinium*	4.59E-09	*Actinium*	1.61E-07	EE
TOTAL	2.04E-05	TOTAL	1.72E-07	TOTAL	2.06E-05	EE
MAX	U	MAX	U	MAX	U	

Attachment F – Table 8

TABLE ~~6~~ 8: WORKER-DREDGER, ABOVE CUTLINE, MAXIMUM					
		EXTERNAL EXPOSURE	SOIL INGESTION	TOTAL	MAX
URANIUM DECAY SERIES					
	TOTAL	3.01E-05	4.12E-07	3.05E-05	EE
	MAXIMUM	2.81E-05	1.85E-07	2.81E-05	EE
	NUCLIDE	Rn-222 + D	Pb-210 + D	Rn-222 + D	Rn-222 + D
THORIUM DECAY SERIES					
	TOTAL	4.60E-05	1.10E-07	4.61E-05	EE
	MAXIMUM	**2.97E-05**	5.30E-08	2.98E-05	EE
	NUCLIDE	**Rn-220 + D**	Ra-228	Rn-220 + D	Rn-220 + D
ACTINIUM DECAY SERIES					
	TOTAL	1.74E-06	5.13E-08	1.80E-06	EE
	MAXIMUM	1.13E-06	2.78E-08	1.14E-06	EE
	NUCLIDE	U-235 + D	Pa-231	U-235 + D	U-235 + D

Attachment F – Table 9

TABLE ~~7~~ 9: WORKER-DREDGER, ABOVE CUTLINE, 95UCL

		EXTERNAL EXPOSURE	SOIL INGESTION	TOTAL	MAX
URANIUM DECAY SERIES					
	TOTAL	1.72E-05	1.60E-07	1.73E-05	EE
	MAXIMUM	1.70E-05	1.11E-07	1.70E-05	EE
	NUCLIDE	Rn-222 + D	Pb-210 + D	Rn-222 + D	Rn-222 + D
THORIUM DECAY SERIES					
	TOTAL	3.03E-06	7.76E-09	3.03E-06	EE
	MAXIMUM	1.90E-06	3.67E-09	3.67E-09	EE
	NUCLIDE	Rn-220 + D	Ra-228	Ra-228	Rn-220 + D
ACTINIUM DECAY SERIES					
	TOTAL	1.56E-07	4.59E-09	1.61E-07	EE
	MAXIMUM	8.50E-08	2.51E-09	8.75E-08	EE
	NUCLIDE	Ac-227 + D	Ac-227 + D	Ac-227 + D	Ac-227 + D

Attachment F – Table 10

SUMMARY		WORKER, DREDGER	ABOVE CUTLINE, MAXIMUM		
EXTERNAL EXPOSURE			**SOIL INGESTION**		**TOTAL**
URANIUM DECAY SERIES			**URANIUM DECAY SERIES**		
U-238 + D	1.91E-06		U-238 + D	7.89E-08	1.99E-06
U-234	7.95E-10		U-234	7.23E-08	7.30E-08
Th-230	5.80E-10		Th-230	2.17E-08	2.22E-08
Ra-226	5.47E-08		Ra-226	5.40E-08	1.09E-07
Rn-222 + D	2.81E-05		Rn-222 + D	1.83E-10	2.81E-05
Pb-210 + D	6.06E-10		Pb-210 + D	1.85E-07	1.85E-07
TOTAL	3.01E-05		**TOTAL**	4.12E-07	3.05E-05
THORIUM DECAY SERIES			**THORIUM DECAY SERIES**		
Th-232	9.87E-11		Th-232	7.20[illegible]-09	7.29E-09
Ra-228	0.00E+00		Ra-228	5.30E-08	5.30E-08
Ac-228	1.61E-05		Ac-228	3.49E-10	1.61E-05
Th-228	2.69E-09		Th-228	1.4[illegible]-08	1.67E-08
Ra-224	1.19E-07		Ra-224	3.13E-08	1.50E-07
Rn-220 + D	2.97E-05		Rn-220 + D	3.9[illegible]-09	2.97E-05
TOTAL	4.60E-05		**TOTAL**	1.10E-07	4.61E-05
ACTINIUM DECAY SERIES			**ACTINIUM DECAY SERIES**		
U-235 + D	1.13E-06		U-235 + D	8.76E-09	1.14E-06
Pa-231	1.15E-07		Pa-231	2.78E-08	1.43E-07
Ac-227 + D	5.01E-07		Ac-227 + D	1.48E-08	5.16E-07
TOTAL	1.74E-06		**TOTAL**	5.13E-08	1.80E-06
			TOTAL OF ALL RISK		7.84E-05
		TOTAL URANIUM RISK (U-238 +U-234+U-235)			3.20E-06
		TOTAL RADIUM RISK (Ra-226 + Ra-228)			1.62E-07

Attachment F – Table 11

SUMMARY		WORKER, DREDGER		ABOVE CUTLINE, 95UCL		
EXTERNAL EXPOSURE			**SOIL INGESTION**			**TOTAL**
URANIUM DECAY SERIES			**URANIUM DECAY SERIES**			
	U-238 + D	1.74E-07	U-238 + D		7.18E-09	1.81E-07
	U-234	6.04E-11	U-234		5.49E-09	5.55E-09
	Th-230	9.02E-11	Th-230		3.37E-09	3.46E-09
	Ra-226	3.30E-08	Ra-226		3.26E-08	6.56E-08
	Rn-222 + D	1.70E-05	Rn-222 + D		1.10E-10	1.70E-05
	Pb-210 + D	3.65E-10	Pb-210 + D		1.11E-07	1.12E-07
	TOTAL	1.72E-05		TOTAL	1.60E-07	1.73E-05
THORIUM DECAY SERIES			**THORIUM DECAY SERIES**			
	Th-232	8.32E-12	Th-232		6.07E-10	6.15E-10
	Ra-228	0.00E+00	Ra-228		3.67E-09	3.67E-09
	Ac-228	1.12E-06	Ac-228		2.42E-11	1.12E-06
	Th-228	2.31E-10	Th-228		1.21E-09	1.44E-09
	Ra-224	7.61E-09	Ra-224		2.00E-09	9.61E-09
	Rn-220 + D	1.90E-06	Rn-220 + D		2.50E-10	1.90E-06
	TOTAL	3.03E-06		TOTAL	7.76E-09	3.03E-06
ACTINIUM DECAY SERIES			**ACTINIUM DECAY SERIES**			
	U-235 + D	6.44E-08	U-235 + D		5.00E-10	6.49E-08
	Pa-231	6.58E-09	Pa-231		1.59E-09	8.17E-09
	Ac-227 + D	8.50E-08	Ac-227 + D		2.51E-09	8.75E-08
	TOTAL	1.56E-07		TOTAL	4.59E-09	1.61E-07
			TOTAL OF ALL RISK			2.05E-05
			TOTAL URANIUM RISK (U-238 +U-234+U-235)			2.51E-07
			TOTAL RADIUM RISK (Ra-226 + Ra-228)			6.93E-08

ATTACHMENT G

Attachment G

Table of Contents

Table1 ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999

ISOTOPIC URANIUM RESULTS (pCi/g)

background -AR99 2-5

residential - below cutline

SAMPLE I.D.						STATION	U-238	U-238 ug/g	U-234	U-234 ug/g	U-235	U-235 ug/g	TOTAL
AR99-	2-	0-	12	RAD		200	1.01	2.9997	1.38	0.0002208	0.0778	0.0360214	3.0359422
AR99-	2-	0-	12	RAD	LD	200	0.998	2.96406	1.22	0.0001952	0.0318	0.0147234	2.9789786
AR99-	2-	12-	31	RAD		200	0.940	2.7918	1.10	0.000176	0.0841	0.0389383	2.8309143
AR99-	2-	12-	31	RAD	FD	200	1.06	3.1482	1.15	0.000184	0.0288	0.0133344	3.1617184
AR99-	3-	0-	12	RAD		202	1.03	3.0591	1.14	0.0001824	0.0576	0.0266688	3.0859512
AR99-	3-	12-	24	RAD		202	0.976	2.89872	1.23	0.0001968	0.0739	0.0342157	2.9331325
AR99-	3-	36-	50	RAD		202	1.14	3.3858	0.999	0.00015984	0.0585	0.0270855	3.41304534
AR99-	3-	36-	50	RAD	FD	202	1.05	3.1185	1.09	0.0001744	0.0481	0.0222703	3.1409447
AR99-	3-	50-	62	RAD		202	1.15	3.4155	1.13	0.0001808	0.0784	0.0362992	3.45198
AR99-	4-	0-	12	RAD		199	1.25	3.7125	1.10	0.000176	0.121	0.056023	3.768699
AR99-	4-	12-	24	RAD		199	1.20	3.564	1.29	0.0002064	0.0693	0.0320859	3.5962923
AR99-	4-	48-	60	RAD		199	0.637	1.89189	0.666	0.00010656	0.0547	0.0253261	1.91732266
AR99-	4-	68-	80	RAD		199	0.650	1.9305	0.788	0.00012608	0.0436	0.0201868	1.95081288
AR99-	5-	0-	12	RAD		198	0.629	1.86813	0.588	0.00009408	0.0847	0.0392161	1.90744018
AR99-	5-	12-	24	RAD		198	1.22	3.6234	1.19	0.0001904	0.0484	0.0224092	3.6459996
AR99-	5-	24-	33	RAD		198	0.709	2.10573	0.696	0.00011136	0.0623	0.0288449	2.13468626
AR99-	1-	0-	12	RAD		196	0.953	2.83041	1.17	0.0001872	0.0419	0.0193997	2.8499969
AR99-	1-	36-	48	RAD		196	2.77	8.2269	2.72	0.0004352	0.248	0.114824	8.3421592
AR99-	1-	70-	82	RAD		196	3.63	10.7811	3.80	0.000608	0.149	0.068987	10.850695
AR99-	6-	0-	12	RAD		195	1.11	3.2967	1.16	0.0001856	0.141	0.065283	3.3621686
AR99-	6-	12-	30	RAD		195	0.865	2.56905	0.833	0.00013328	0.0318	0.0147234	2.58390668
AR99-	6-	12-	30	RAD	FD	195	0.790	2.3463	0.839	0.00013424	0.0555	0.0256965	2.37213074
AR99-	6-	60-	72	RAD		195	6.88	20.4336	6.52	0.0010432	0.277	0.128251	20.5628942
AR99-	6-	72-	84	RAD		195	13.6	40.392	14.3	0.002288	0.945	0.437535	40.831823
AR99-	6-	94-	106	RAD		195	1.11	3.2967	1.07	0.0001712	0.0639	0.0295857	3.3264569
AR99-	7-	0-	12	RAD		187 (160W)	0.568	1.68696	0.759	0.00012144	0.110	0.05093	1.73801144
AR99-	7-	12-	24	RAD		187 (160W)	0.831	2.46807	0.700	0.000112	0.0529	0.0244927	2.4926747
AR99-	7-	12-	24	RAD	FD	187 (160W)	0.634	1.88298	0.744	0.00011904	0.0710	0.032873	1.91597204
AR99-	7-	24-	36	RAD		187 (160W)	0.722	2.14434	0.653	0.00010448	0.0644	0.0298172	2.17426168
AR99-	7-	36-	48	RAD		187 (160W)	0.710	2.1087	0.945	0.0001512	0.0883	0.0408829	2.1497341
AR99-	7-	36-	48	RAD	LD	187 (160W)	0.815	2.42055	0.834	0.00013344	0.0902	0.0417626	2.46244604
AR99-	7-	48-	60	RAD		187 (160W)	0.739	2.19483	0.742	0.00011872	0.0827	0.0382901	2.23323882
AR99-	7-	60-	72	RAD		187 (160W)	2.20	6.534	2.23	0.0003568	0.166	0.076858	6.6112148
AR99-	7-	72-	84	RAD		187 (160W)	4.05	12.0285	3.83	0.0006128	0.284	0.131492	12.1606048
AR99-	7-	84-	96	RAD		187 (160W)	6.09	18.0873	5.96	0.0009536	0.460	0.21298	18.3012336
AR99-	7-	96-	108	RAD		187 (160W)	7.51	22.3047	8.28	0.0013248	0.425	0.196775	22.5027998
AR99-	7-	108-	127	RAD		187 (160W)	7.22	21.4434	6.99	0.0011184	0.531	0.245853	21.6903714
AR99-	8-	0-	12	RAD		187 (0)	0.567	1.68399	0.694	0.00011104	0.0812	0.0375956	1.72169664
AR99-	8-	12-	24	RAD		187 (0)	0.675	2.00475	0.665	0.0001064	0.0641	0.0296783	2.0345347
AR99-	8-	24-	36	RAD		187 (0)	0.717	2.12949	0.713	0.00011408	0.8080	0.374104	2.50370808
AR99-	8-	36-	48	RAD		187 (0)	1.12	3.3264	1.06	0.0001696	0.0769	0.0356047	3.3621743
AR99-	8-	60-	72	RAD		187 (0)	1.41	4.1877	1.00	0.00016	0.168	0.077784	4.265644
AR99-	8-	60-	72	RAD	LD	187 (0)	1.53	4.5441	0.997	0.00015952	0.107	0.049541	4.59380052
AR99-	8-	72-	84	RAD		187 (0)	2.61	7.7517	2.47	0.0003952	0.183	0.084729	7.8368242
AR99-	8-	84-	96	RAD		187 (0)	6.74	20.0178	6.85	0.001096	0.694	0.321322	20.340218
AR99-	8-	96-	108	RAD		187 (0)	7.67	22.7799	7.83	0.0012528	0.679	0.314377	23.0955298
AR99-	8-	108-	139	RAD		187 (0)	5.48	16.2756	5.67	0.0009072	0.414	0.191682	16.4681892
AR99-	8-	108-	139	RAD	FD	187 (0)	14.2	42.174	13.8	0.002208	0.820	0.37966	42.555868
AR99-	9-	0-	12	RAD		187 (180E)	5.83	17.3151	3.79	0.0006064	0.521	0.241223	17.5569294
AR99-	9-	12-	24	RAD		187 (180E)	5.68	16.8696	6.24	0.0009984	0.387	0.179181	17.0497794
AR99-	9-	24-	36	RAD		187 (180E)	4.79	14.2263	4.27	0.0006832	0.263	0.121769	14.3487522
AR99-	9-	36-	48	RAD		187 (180E)	2.91	8.6427	2.89	0.0004624	0.240	0.11112	8.7542824
AR99-	9-	36-	48	RAD	FD	187 (180E)	2.36	7.0092	2.46	0.0003936	0.135	0.062505	7.0720986
AR99-	9-	48-	60	RAD		187 (180E)	7.72	22.9284	8.28	0.0013248	0.511	0.236593	23.1663178
AR99-	9-	48-	60	RAD	FD	187 (180E)	4.37	12.9789	4.66	0.0007456	0.293	0.135659	13.1153046
AR99-	9-	60-	72	RAD		187 (180E)	5.26	15.6222	5.26	0.0008416	0.344	0.159272	15.7823136
AR99-	9-	72-	84	RAD		187 (180E)	5.31	15.7707	4.72	0.0007552	0.389	0.180107	15.9515622
AR99-	9-	84-	96	RAD		187 (180E)	4.58	13.6026	4.55	0.000728	0.392	0.181496	13.784824
AR99-	10-	0-	12	RAD		182 (120E)	0.752	2.23344	0.837	0.00013392	0.0558	0.0258354	2.25940932
AR99-	10-	60-	72	RAD		182 (120E)	1.02	3.0294	1.01	0.0001616	0.141	0.065283	3.0948446
AR99-	10-	93-	105	RAD		182 (120E)	7.15	21.2355	7.19	0.0011504	0.743	0.344009	21.5806594
AR99-	10-	93-	105	RAD	FD	182 (120E)	6.57	19.5129	6.01	0.0009616	0.478	0.221314	19.7351756
AR99-	10-	147-	159	RAD		182 (120E)	4.89	14.5233	5.85	0.000936	0.389	0.180107	14.704343
AR99-	11-	0-	12	RAD		182 (20W)	0.651	1.93347	0.584	0.00009344	0.0887	0.0410681	1.97463154
AR99-	11-	33-	51	RAD		182 (20W)	9.78	29.0466	10.2	0.001632	0.696	0.322248	29.37048
AR99-	11-	33-	51	RAD	FD	182 (20W)	45.5	135.135	57.9	0.009264	6.59	3.05117	138.195434
AR99-	11-	60-	72	RAD		182 (20W)	9.50	28.215	9.91	0.0015856	0.540	0.25002	28.4666056
AR99-	11-	72-	84	RAD		182 (20W)	9.81	29.1357	10.4	0.001664	0.571	0.264373	29.401737
AR99-	12-	0-	12	RAD		182 (80W)	0.533	1.58301	0.666	0.00010656	0.0428	0.0198164	1.60293296
AR99-	12-	12-	24	RAD		182 (80W)	0.656	1.94832	0.680	0.0001088	0.0803	0.0371789	1.9856077
AR99-	12-	30-	42	RAD		182 (80W)	0.730	2.1681	0.682	0.00010912	0.0705	0.0326415	2.20085062
AR99-	12-	72-	90	RAD		182 (80W)	0.723	2.14731	0.597	0.00009552	0.0564	0.0261132	2.17351872
AR99-	12-	72-	90	RAD	LD	182 (80W)	0.532	1.58004	0.621	0.00009936	0.0788	0.0364844	1.61662376
AR99-	12-	72-	90	RAD	FD	182 (80W)	0.607	1.80279	0.713	0.00011408	0.0568	0.0262984	1.82920248
AR99-	13-	0-	12	RAD		177	1.06	3.1482	1.18	0.0001888	0.126	0.058338	3.2067268
AR99-	13-	90-	102	RAD		177	12.9	38.313	12.1	0.001936	0.485	0.224555	38.539491
AR99-	13-	119-	131	RAD		177	19.3	57.321	18.2	0.002912	0.807	0.373641	57.697553
AR99-	13-	152-	164	RAD		177	3.43	10.1871	3.18	0.0005088	0.236	0.109268	10.2968768
AR99-	14-	0-	12	RAD		173	1.19	3.5343	1.07	0.0001712	0.0498	0.0230574	3.5575286
AR99-	14-	95-	113	RAD		173	8.44	25.0668	8.59	0.0013744	0.492	0.227796	25.2959704

Table1 ASHTABULA RIVER SEDIMENT SAMPLING, AUGUST 1999 CONTINUED — ISOTOPIC URANIUM RESULTS (pCi/g)

SAMPLE I.D.			STATION	U-238	U-238 ug/g	U-234	U-234 ug/g	U-235	U-235 ug/g	TOTAL
AR99- 14 - 95 - 113	RAD	FD	173	8.73	25.9281	8.85	0.001416	0.436	0.201868	26.131384
AR99- 14 - 130 - 142	RAD		173	22.1	65.637	22.5	0.0036	1.14	0.52782	66.16842
AR99- 14 - 159 - 171	RAD		173	1.14	3.3858	1.17	0.0001872	0.112	0.051856	3.4378432
AR99- 15 - 0 - 12	RAD		163	1.10	3.267	1.07	0.0001712	0.0581	0.0269003	3.2940715
AR99- 15 - 24 - 36	RAD		163	2.15	6.3855	2.31	0.0003696	0.0865	0.0400495	6.4259191
AR99- 15 - 42 - 54	RAD		163	3.36	9.9792	3.86	0.0006176	0.264	0.122232	10.1020496
AR99- 15 - 65 - 72	RAD		163	6.35	18.8595	6.95	0.001112	0.358	0.165754	19.026366
AR99- 16 - 0 - 12	RAD		160	0.672	1.99584	0.795	0.0001272	0.0819	0.0379197	2.0338869
AR99- 16 - 12 - 24	RAD		160	0.833	2.47401	0.757	0.00012112	0.102	0.047226	2.52135712
AR99- 17 - 0 - 12	RAD		156	0.666	1.97802	0.682	0.00010912	0.0668	0.0309284	2.00905752
AR99- 17 - 37 - 49	RAD		156	1.39	4.1283	1.57	0.0002512	0.123	0.056949	4.1855002
AR99- 17 - 94 - 106	RAD		156	4.80	14.256	5.17	0.0008272	0.403	0.186589	14.4434162
AR99- 17 - 123 - 135	RAD		156	8.27	24.5619	7.75	0.00124	0.483	0.223629	24.786769
AR99- 18 - 0 - 12	RAD		153+50	0.748	2.22156	0.724	0.00011584	0.0660	0.030558	2.25223384
AR99- 18 - 12 - 30	RAD		153+50	1.14	3.3858	1.27	0.0002032	0.132	0.061116	3.4471192
AR99- 18 - 12 - 30	RAD	FD	153+50	0.770	2.2869	0.723	0.00011568	0.0397	0.0183811	2.30539678
AR99- 18 - 12 - 30	RAD	LD	153+50	0.638	1.89486	0.912	0.00014592	0.0863	0.0399569	1.93496282
AR99- 18 - 36 - 48	RAD		153+50	0.746	2.21562	0.812	0.00012992	0.0783	0.0362529	2.25200282
AR99- 18 - 63 - 75	RAD		153+50	0.911	2.70567	0.773	0.00012368	0.0983	0.0455129	2.75130658
AR99- 19 - 0 - 12	RAD		149	0.546	1.62162	0.557	0.00008912	0.0283	0.0131029	1.63481202
AR99- 19 - 12 - 24	RAD		149	0.656	1.94832	0.610	0.0000976	0.0383	0.0177329	1.9661505
AR99- 19 - 24 - 36	RAD		149	0.583	1.73151	0.690	0.0001104	0.0631	0.0292153	1.7608357
AR99- 19 - 70 - 82	RAD		149	0.850	2.5245	0.791	0.00012656	0.0791	0.0366233	2.56124986
AR99- 20 - 0 - 12	RAD		136	1.02	3.0294	1.23	0.0001968	0.153	0.070839	3.1004358
AR99- 20 - 12 - 24	RAD		136	0.394	1.17018	0.467	0.00007472	0.115	0.053245	1.22349972
AR99- 20 - 24 - 36	RAD		136	1.29	3.8313	1.27	0.0002032	0.129	0.059727	3.8912302
AR99- 20 - 58 - 71	RAD		136	0.664	1.97208	0.573	0.00009168	0.0308	0.0142604	1.98643208
AR99- 21 - 0 - 12	RAD		132	1.03	3.0591	1.01	0.0001616	0.0904	0.0418552	3.1011168
AR99- 21 - 0 - 12	RAD	LD	132	1.35	4.0095	0.889	0.00014224	0.0503	0.0232889	4.03293114
AR99- 21 - 12 - 30	RAD		132	1.09	3.2373	1.12	0.0001792	0.0735	0.0340305	3.2715097
AR99- 21 - 12 - 30	RAD	FD	132	1.23	3.6531	1.24	0.0001984	0.0962	0.0445406	3.697839
AR99- 21 - 30 - 42	RAD		132	1.11	3.2967	1.16	0.0001856	0.0498	0.0230574	3.319943
AR99- 21 - 63 - 75	RAD		132	1.26	3.7422	1.36	0.0002176	0.132	0.061116	3.8035336
AR99- 22 - 0 - 12	RAD		129	0.774	2.29878	0.653	0.00010448	0.0723	0.0334749	2.33235938
AR99- 22 - 12 - 24	RAD		129	0.663	1.96911	0.779	0.00012464	0.0669	0.0309747	2.00020934
AR99- 22 - 49 - 61	RAD		129	0.949	2.81853	0.814	0.00013024	0.0921	0.0426423	2.86130254
AR99- 23 - 0 - 12	RAD		128	0.728	2.16216	0.735	0.0001176	0.0868	0.0401884	2.202466
AR99- 23 - 12 - 24	RAD		128	0.669	1.98693	0.875	0.00014	0.0570	0.026391	2.013461
AR99- 23 - 24 - 36	RAD		128	0.753	2.23641	0.680	0.0001088	0.0374	0.0173162	2.253835
AR99- 23 - 36 - 58	RAD		128	0.885	2.62845	0.959	0.00015344	0.0861	0.0398643	2.66846774
AR99- 24 - 0 - 12	RAD		125	0.656	1.94832	0.604	0.00009664	0.0503	0.0232889	1.97170554
AR99- 24 - 12 - 30	RAD		125	0.798	2.37006	0.732	0.00011712	0.0448	0.0207424	2.39091952
AR99- 24 - 12 - 30	RAD	FD	125	0.606	1.79982	0.765	0.0001224	0.0767	0.0355121	1.8354545
AR99- 24 - 47 - 65	RAD		125	0.777	2.30769	0.681	0.00010896	0.0744	0.0344472	2.34224616
AR99- 24 - 47 - 65	RAD	FD	125	0.813	2.41461	0.783	0.00012528	0.0905	0.0419015	2.45663678
AR99- 25 - 0 8	RAD		121	0.980	2.9106	1.27	0.0002032	0.0940	0.043522	2.9543252
				U-238		U-234		U-235		
			MAXIMUM (NON-BACKGROUND)	45.5		57.9		6.59		

FD	=	Field Duplicate
LD	=	Lab Duplicate
125	=	Priority samples, analyzed 11/99
125	=	Non-priority samples, analyzed after 11/99

Background sites AR99-2 to AR99-5, inclusive

RESIDENT FARMER		
average	2.63789072	*using average of ar9924 and it's duplicate*
std dev	0.85121935	
conf.	0.01598397	
95UCL	2.65387469	

Attachment G – Table 2

Table 2: Hazard Indices for Residential Scenario - Dermal and Incidental Ingestion Pathways for Uranium as a Chemical Hazard

Below the cutline data

Soil (Sediment applied to land)

Dermal pathway

	95UCL	
	Ur-0-18yrs.	**Ur -18+ yrs.**
Conc.Soil	2.63	2.63
Conv.Fctr.	0.000001	0.000001
Surf.Area	2800	5700
Adh.Fctr.	0.2	0.07
Absrpt.	0.01	0.01
Exp.Fctr.	200	200
Exp.Dur.	18	52
BodyWt.	40.2	70
Ave.TimeNC	6570	18980
Ave.TimeC	25550	25550
IntakeNC	2.0075E-07	8.2142E-08
IntakeC	5.16E-08	6.10E-08
RfD	->	0.003
Hazard Index	lifetime	9.49E-05

Incidental ingestion of soil pathway

	95UCL	
	Ur - 0-18yrs	**Ur-18+yrs.**
Conc.Soil	2.63	2.63
Ing.Rate	200	100
Conv.Fctr.	0.000001	0.000001
Frct.Ing.	1	1
Exp.Freq.	200	200
Exp.Dur.	18	52
BodyWt.	40.2	70
Ave.TimeNC	6570	18980
Ave.TimeC	25550	25550
IntakeNC	7.1696E-06	2.0587E-06
IntakeC	1.8436E-06	1.5293E-06
RfD	->	0.003
Hazard Index	lifetime	3.08E-03

Dermal pathway

	MAX	
	Ur-0-18yrs.	**Ur -18+ yrs.**
Conc.Soil	3.9	3.9
Conv.Fctr.	0.000001	0.000001
Surf.Area	2800	5700
Adh.Fctr.	0.2	0.07
Absrpt.	0.01	0.01
Exp.Fctr.	200	200
Exp.Dur.	18	52
BodyWt.	40.2	70
Ave.TimeNC	6570	18980
Ave.TimeC	25550	25550
IntakeNC	2.9769E-07	1.2181E-07
IntakeC	7.65E-08	9.05E-08
RfD	->	0.003
Hazard Index	lifetime	1.40E-04

Incidental ingestion of soil pathway

	MAX	
	Ur - 0-18yrs	**Ur-18+yrs.**
Conc.Soil	3.9	3.9
Ing.Rate	200	100
Conv.Fctr.	0.000001	0.000001
Frct.Ing.	1	1
Exp.Freq.	200	200
Exp.Dur.	18	52
BodyWt.	40.2	70
Ave.TimeNC	6570	18980
Ave.TimeC	25550	25550
IntakeNC	1.0632E-05	3.0528E-06
IntakeC	2.7339E-06	2.2678E-06
RfD	->	0.003
Hazard Index	lifetime	4.56E-03

Adding both pathways:

	95UCL		Max
TOTAL	3.17E-03	TOTAL	4.70E-03

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX H

ASHTABULA RIVER RECONTAMINATION ASSESSMENT

Ashtabula River Recontamination Assessment

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Ashtabula River Recontamination Assessment

Introduction

The Ashtabula River is located in northeast Ohio and drains a watershed of 137 square miles into Lake Erie (Figure 1). The mainstem is approximately 23 miles long and originates at the confluence of the East and West Branches which are 10 and 16 miles long. The average flow for the river is 160 cubic feet per second (cfs). Major tributaries include Fields Brook, Hubbard Run and Ashtabula Creek.

The Fields Brook Watershed has been identified as the primary source of PCB contamination in the sediments of the Ashtabula River. It joins the Ashtabula River on the right bank at approximately Station 187+00 and is shown on Figure 1. The mainstem is 3.5 miles long with five tributaries. It drains a 5.6 square mile basin containing a high concentration of industries and waste disposal sites. During certain times of the year, the flow is due completely to industrial wastewater discharge. The Fields Brook Superfund Site includes all areas within the watershed, including wetlands, floodplains and properties that surround the brook and drain into the river. The clean up levels that have been determined for the remediation of sediments are based upon human health risk analysis. For the industrial areas, the acceptable level has been determined to be 3.1 ppm and for the residential areas the acceptable level is 1.3 ppm. This is a concern of the Corps of Engineers because the acceptable levels for open lake disposal of dredged sediments from the Ashtabula River have not been based upon the same criteria.

Purpose of the Study

At the present time, there is a plan being considered to totally clean up the river. This involves removing all of the sediments in the federal navigation channel including the contaminated PCB material. The question arises that if the contaminated sediments in the river have been completely removed, and a continued source of PCB's exists in the Fields Brook Watershed, will the future sediments that are deposited in the river require confinement in a disposal dike. This recontamination analysis will predict the concentration of PCB that will be deposited in the river for various possible scenarios. One of the scenarios is a low flow event on the Ashtabula River with a constant supply of PCB from Fields Brook. The second scenario is a high flow event on the Ashtabula River with a constant supply of PCB from Fields Brook. The third scenario is the long term average flow on the Ashtabula River and a constant supply of PCB from Fields Brook.

In addition to evaluating the amount of future contamination in the river, this analysis will also determine the future dredging quantities and intervals for maintenance purposes.

Parameters of Interest

The criteria for determining if dredged sediment is suitable for open lake disposal is based upon the concentration of PCB. In the past, an arbitrary value of 1 ppm was used as a cutoff for determining if sediments could be disposed in the open lake. If any one sample exceeded that concentration, the area where that sample was collected could not be dredged. One reason that dredging has not been conducted in some areas of the Ashtabula River Navigation channel is that there is not a suitable disposal facility for the contaminated sediment. Recently the criteria for determining the suitability of sediment for open lake disposal was based on what has been referred to as environmental risk. This analysis is called a bioassay test and is conducted by sampling certain contaminant sensitive organisms and measuring the rate at which they die when exposed to the contaminated sediments. At this time, there is no way to relate concentration. of a particular contaminant to the results of bioassay test. It is not known what specific contaminant causes the die-off. For the recontamination assessment, the only contaminant that was analyzed was PCB as that has historically been the contaminant that was used in evaluating the sediment for open lake disposal.

Methods of Analysis

Hydraulic Data Input

The data used for the hydraulic analysis of the Ashtabula River was developed from the USGS gage Number 4212500. That gage was operational from the years 1924 through 1979 with the exception of from 1936 through 1939 and 1948 to 1950. It was recently activated again in 1994 and continues to operate. The flow duration curve for this period of record is shown on Figure 2. This was used to determine the long term average conditions. Individual storm events were also analyzed to determine the short term affect. A 2 year event was analyzed and compared to the affect of larger individual events. In addition to individual storms, the long term average conditions were required to simulate dredging quantities and intervals as well as the long term affect of a low concentration continuous point source of PCB. Since there is no gage on Fields Brook, the hydrology had to be simulated using rainfall-runoff programs. The flow duration curve for Fields Brook (Figure 3) was derived by scaling down the Ashtabula River flow duration curve. Ratios of the volume of water from Fields Brook to the Ashtabula River for various events resulted in the final curve.

The discharge hydrographs that were used for both the Ashtabula River and Fields Brook were previously developed for an analysis in 1994. The basin runoff was simulated using HEC-1, the unit hydrograph and loss rate parameters and precipitation data for storms with percent chance exceedance of 50%, 20%, 10%, 2% and 1%. Precipitation for these events was from Bulletin 71 "Rainfall Frequency Atlas of the Midwest" by Floyd A Huff and James R Angle, Midwestern Climate Center 1992. Figures 4 through 8 show the 2 year, 10 year, 25 year, 50 year and 100 year storms. Runoff hydrographs for Fields Brook were also determined for the 1994 study. An HEC-1 model using Bulletin 71 precipitation resulted in the runoff hydrographs shown on Figures 9 through 13. The discharge frequency curve for the Ashtabula River at the gage is shown on Figure 14. The discharge frequency curve for Fields Brook is shown on Figure 15.

The sediment loads for the Ashtabula River were based upon data from "Fluvial Sediment in Ohio, USGS Water Supply Paper No. 2045." The sediment discharge curve for the Ashtabula River is shown on Figure 16. There is no gage that measures flow or sediment load on Fields Brook thus no long term sediment field data is available. Short term field verification of the sediment discharge for Fields Brook was conducted for the Woodward-Clyde Sediment Quantification Design Investigation Phase II study. Results are shown on Figure 17. Estimates of low, medium and high sediment loads for Fields Brook are summarized below in Table 1. The estimates are based upon the Woodward-Clyde sediment Quantification Design Investigation.

Table 1 Fields Brook Sediment Loads

	Fields Brook Sediment Loads	
Low	800 tons/year	725,776 kg/year
Medium	1800 tons/year	1,632,960 kg/year
High	3000 tons/year	2,721,600 kg/year

Chemical Data Input

The chemical data input to the model that was used in the recontamination analysis for the Ashtabula River is based on the following assumptions. After a total cleanup there will be no background levels of PCB's. The cleanup for Fields Brook will not result in complete removal of all contaminated sediments. It will result in the average concentration of PCB at each exposure unit to a value of less than or equal to 1.3 ppm in the residential areas and 3.1 ppm in the industrial areas. For this analysis, Fields Brook was assumed to be a continuous point source with an average input concentration of 1.3 ppm. This was based upon the average of all the samples shown in Attachment 1. This data was collected by Woodward-Clyde for the Sediment Quantification Design Investigation.

The average concentration of PCB was determined from only the brook sediments. Upland erosion and any sediment input from the floodplain was not considered. The reason for not including the upper watershed and floodplain was to use a worse case scenario for the initial assessment. Based on the results using only the brook sediments, if the resulting concentrations are insignificant then the addition of the upland sediments would most likely only reduce the concentration to lower levels.

Wasp 5 Modeling

Purpose

The method of analysis that was used to determine the concentration of PCB in the river after total cleanup of the Ashtabula River and partial cleanup of Fields Brook is an EPA contaminant transport model called WASP5/TOXI5. This model was used for a similar study on the Buffalo River, Buffalo, New York. For that study a significant amount of field data was collected to calibrate the model. The results of that study were considered in the development of the boundary conditions and the input data for the Ashtabula River analysis. A simplified approach was used for the Ashtabula River model because all of the input data was derived from existing data or assumed based on the results of the Buffalo River Study. The WASP5 model has the capability to simulate transport and fate processes for the following:

1. Input of TSS and contaminants via various external loadings
2. Advection and dispersion in the water column
3. Settling, Resuspension and burial
4. Porewater transport
5. Air-water exchange
6. Partitioning of contaminants between water and TSS

Results from the Buffalo River Study showed that volatilization and pore water transport were insignificant in the fate of PCB. Because the sediment characteristics of the Ashtabula River are similar to the Buffalo, air-water exchange and porewater transport were not simulated in the Ashtabula River model. Burial was also not taken into account in this analysis because the times that were simulated were not considered to be long enough for burial to be a significant factor.

Ashtabula River Model

The Ashtabula River model system contained 36 segments in the water and sediment combined. The water column was divided into 18 segments in one layer. Figure 18 shows the segments. Segment 17 is beyond the map limit on the figure and segment 18 represents the boundary with Lake Erie. Segments 19 through 36 represent the sediment layer. Only one layer was assumed for simplification. Table 2 contains the morphometry for each water column segment.

Lengths and widths of water column segments were measured using the dredging sounding maps. Water column volumes, surface areas depths and cross sectional areas were measured using a planimeter. The sediment morphometry was taken to be the same as the overlying water column segment. The depths for sediment were assumed to be 5 feet.

Table 2. Ashtabula River Water Column Morphometry

WC Segment #	Volume (m3)	Surface Area (m2)	Average Depth (m)	Adjacent WC Segment #
1	68,709.22	10,636.10	6.46	2
2	50,399.01	7,801.70	6.46	3
3	191,981.64	29,718.52	6.46	4
4	12,954.65	19,497.62	6.46	5
5	81,630.47	12,636.30	6.46	6
6	57,380.16	8,882.38	6.46	7
7	58,604.92	9,071.97	6.46	8
8	57,502.64	8,901.34	6.46	9
9	70,913.80	10,977.37	6.46	10
10	41,552.85	5,877.35	7.07	11
11	31,499.73	4,455.41	7.07	12
12	50.935.74	7,204.49	7.07	13
13	73.856.83	10,446.51	7.07	14

14	123,117.05	17,414.01	7.07	15
15	90,477.96	12,797.45	7.07	16
16	88,065.22	12,456.18	7.07	17
17	89,606.69	12,674.21	7.07	18
18	96,844.93	13,698.01	7.07	lake

Model Input Data

The WASP framework requires specific input data and parameters. The requirements depend on the nature of the simulation. For this contaminant transport model the following items were necessary in the input data sets: time step, segment morphometry, dispersion coefficients, flows, settling and resuspension rates, boundary conditions, loadings, partitioning parameters (Koc, kow, foc and Kd) and initial conditions. The values used in this model and how they were derived are discussed below.

Time Step

The WASP model uses a first order Euler method for numerical integration and the time step used was very small to avoid the problem of numerical instability. The time step is limited by the hydraulic residence time of the smallest water column segment volume. In the Buffalo River Study and this analysis, this value had to be reduced to achieve stability in the model.

Flows

Flows that were used were derived by simulating storms and by using the long term average from the gage data as described above. For the recontamination portion of the analysis, a 2 year storm was used to represent the low flow, the 100 year storm was used to represent the high flow and the flow duration was used to assess overall average conditions.

Settling Rates

The characteristics of the sediment in the lower Ashtabula River are very similar to the sediments in the Buffalo River. It was assumed that the settling rates would therefore be similar and as there was no other data available the following settling rates were used for this study (Table 3).

Table 3. Ashtabula River Settling Rates

River Reach	Settling Rate (m/sec)
Upstream	1.56e-4
Midstream	8.10e-5
Downstream	5.6e-5

Resuspension Rates

The resuspension rates that were used for this analysis were derived from the Buffalo River Study. A rate of 1.25e-11 m/s was applied for all of the segments.

Boundary Conditions

The upstream boundary conditions for inflowing suspended sediment that were used for this model were taken from recorded long term average concentrations. This long term value is 72 mg/l. The same value was used for all of the scenarios. The assumptions for the boundary contaminants were zero contaminants from the river and 1.3 mg/l from Fields Brook. Based on previous sampling on the river, it was determined that there is no dissolved PCB in the water column therefore no dissolved phase was considered. The downstream water level boundary condition that was used represented Lake Erie. An average lake level of 571.8 feet was used as a downstream constant head boundary.

Loads

The total loading of sediment for the river that was used for each scenario is summarized below. The PCB loading for the brook was varied to assess the affect of low, medium and high flows. The loads that were used for each scenario are summarized below in Table 4.

Table 4 Loading Summary Table

Ashtabula River Sediment Loads	**Kg/day**	**Tons/day**
2 Year Flow	454	0.5
100 Year Flow	907,200	1,000
Flow Duration	30,322.85	33
Fields Brook PCB Loads	**kg/day**	**lb/day**
Low Flow	0.0026	0.006
Medium Flow	0.0058	0.013
High Flow	0.0097	0.021

Partition Coefficients

The chemical parameters that were used in the modeling were: (1) the hydrophobicity of PCB (kow); (2) partitioning of organics between an aqueous phase and the soil (kd); (3) the organic carbon water partitioning coefficient (koc); and (4) the fraction of naturally occurring carbon in the soil (foc). The transport of dissolved organic constituents is partially controlled by the partitioning of organics between an aqueous phase and the soil. The octanol-water partition coefficient (kow) is a measure of the distribution of a chemical at equilibrium between an octanol (an organic solvent) and water (a polar solvent). This factor indicates whether a chemical is hydrophobic (does not combine with water)or hydrophilic (ave an affinity for water). Chemicals with values of kow greater than 10,000 (log low >4) are hydrophobic. The PCB's from Fields Brook had values for kow ranging from a low of 562,000 (log kow = 5.72) to a high of 1,070,000 (log kow 6.02). The tendency for PCB to partition between water and organic carbon in soil can be described by the organic carbon-water partitioning coefficient (koc) which was estimated from the kow and summary by Woodward Clyde in Response to USEPA Preliminary Comments dated 2/8/96 Floodplain Wetlands Area, Fields Brook Site Results ranged from a low of 42,000 (log =4.63) to a high of 530,000 (log = 5.72). The partitioning of organic compounds between an aqueous phase and soil (kd) can be determined by multiplying koc by the fraction of organic carbon naturally present in the soil. For this analysis, the following is a summary of the coefficients that were used.

Table 5. Partitioning Coefficients

Partitioning Coefficients	
foc 0.25	log koc 4.63
doc 25%	kd 10,625

Scenarios

The scenarios that were modeled for the recontamination assessment included combinations of Ashtabula River sediment loads and Fields Brook PCB loads. The following summary shows all of the combinations that were modeled.

Table 6 Wasp Model Scenarios

Ashtabula Sediment Load	2 Year Flow 454 kg/day	100 Year Flow 907,200 kg/day	Average Flow 30,322 kg/day
Fields Brook PCB Load			
Low Flow 0.0025 kg/day		x	
Average Flow 0.0058 kg/day	x	x	x
High Flow 0.0097 kg/day	x	x	

Results and Analysis of WASP5 Modeling

The results from the contaminant transport model for the 2 year event are summarized in Figures 19 and Figure 20. These figures show the concentration at each segment for a point in time for that flow. Figure 19 shows the final concentration at each segment after the 2 year event for an average PCB load from Fields Brook. The range of PCB concentrations for this scenario begins at 0.12 ppb and increases to 0.55 ppb. Figure 20 shows the final concentrations after the 2 year event with a high PCB load from Fields Brook. The results range from 0.20 ppb to 0.92 ppb.

The results for the 100 year event are summarized on Figures 21 through Figure 23. Figure 21 shows the final concentration at each segment after the 100 year event with the low load from Fields Brook. Results show a range from 0.22 ppb to 1.1 ppb. Figure 22 shows the 100 year event with the average load from Fields Brook. The results range from 0.002 ppb to 0.1 ppb. Figure 23 shows the results after the 100 year event with the high PCB load from Fields Brook. The results range from 0.0028 ppb to 0.18 ppb. The results using the flow duration with the average sediment load are summarized on Figure 24 and shows the final concentration ranges from 0.001 to 0.09 ppb.

Conclusions

Based upon the results of the recontamination assessment, it appears that the low level of P0 that is deposited into the Ashtabula River from Fields Brook is diluted to less than 2 ppb under all of the scenarios that were modeled.

Probability Method

The probability that the Ashtabula River sediments will contain sediment of a certain PCB concentration as a result of the contaminated Fields Brook sediment input can be found by using the **theory of coincident frequency analysis**. The probability of an event (some sediment having a PCB concentration greater than a given value) is determined from the probability of two independent events (sediment discharges from Fields Brook and the Ashtabula River). Two independent event probability curves are required to do this. The sediment discharge curves from each river are independent variables assuming that the hydrologic events on each watershed are independent.

Figure 2 is the flow duration for the Ashtabula River. It was derived from "Fluvial Sediment in Ohio - Geological Survey Water-Supply Paper 2045" and computer printouts from the USGS. Figure 3 presents a Fields Brook flow duration. This type of data is not available for Fields Brook so the curve was derived using the following methods. This curve was approximated by prorating the Ashtabula River curve by drainage areas of the two basins and the volumes of the 2, 10, 25, 50, and 100-year hydrographs for the two basins. Figure 16 is the Ashtabula River sediment-discharge curve from the above referenced water-supply paper. Figure 17 shows the Fields Brook sediment discharge relationship from the Woodward-Clyde Sediment Quantification Design Investigation.

Combining Figures 2 and 16 and Figures 3 and 17 produce sediment probability or percent chance of Exceedence curves for the Ashtabula River and Fields Brook, respectively. The Ashtabula sediment frequency is shown in Figure 25 and the Fields Brook frequency in Figure 26 for the Woodward-Clyde sediment curve. This curve will be referenced as the Fields Brook Woodward-Clyde sediment curve. It was noted that for a given discharge, the sediment discharge is greater for Fields Brook than the Ashtabula River. Because of this, another sediment discharge curve was derived. The flow duration curve for Fields Brook (Figure 3) was combined with the Ashtabula River sediment discharge curve (Figure 16) to produce Figure 27 which will be referred to as the Fields Brook Ashtabula sediment curve.

The relative concentration of the Fields Brook sediments with respect to the Ashtabula River sediments can be obtained by the application of the **total probability theorem**. This is equivalent to weighting each of the sediment discharge exceedence frequency relationships for Fields Brook for a given Ashtabula River sediment discharge by the percent of time during which the individual relations apply. Figure 28 shows the Ashtabula sediment frequency curve with 6 average sediment discharges chosen as index points (sediment loadings marked along the y-axis and the corresponding durations (in % of time). Figure 29 shows the sediment loading curves with the Ashtabula River index points (sediment loadings marked along the y-axis with their corresponding durations) and calculation points for corresponding points the Fields Brook curves with exceedence values shown with arrows. For each Ashtabula River index sediment discharge, different Fields Brook sediment discharges (on a specific selected sediment curve are selected, and the corresponding dilution factor is calculated (total sediment load for both streams divided by the Fields brook sediment load). From these calculations and the corresponding exceedence frequencies, curves can be plotted for each index point.

For example: for an average Ashtabula River sediment discharge of 50 tons/day and a duration of 6 percent (0.06), a sediment load from the Fields Brook Ashtabula sediment curve of 10 tons/day with a frequency of 0.022 (2.2%) gives a point on the 6% curve (one of the Ashtabula index point percent enceedence values) of a dilution D = (10 + 50) / 10 = 6 at 0.022. This point is shown on Figure 32. The corresponding family of curves (developed for each of the picked Ashtabula River index points) for these calculations are given in Figures 30 through 33 for mixing with the full and half of the Ashtabula River sediment discharge for the Fields Brook Woodward-Clyde and the Fields Brook Ashtabula sediment discharges, respectively.

The dilution factor for the Fields Brook sediments is found by summing the six individual frequencies in each of Figures 30 through 33 each weighted by percent of time of occurrence for a given dilution. The total probability that the dilution factor is **greater** is the

SUM (percentage of dilution of Fields Brook) x
time of occurrence of Ashtabula sediment flow)

The percentage of dilution is the value to the right of the curve at a given dilution factor. For example, for Figure 30 and a dilution factor of 10, the total probability that the dilution factor is **greater** is the

$$(95)(0.05) + (89.5)(0.06) + (81)(0.13) + (63)(0.20) + (34)(0.23) + (19)(0.33) = 47.3\%$$

For the Fields Brook Woodward-Clyde sediment curve and using Figure 32 at a dilution factor of 10

$$(100)(0.05) + (97)(0.06) + (93.2)(0.13) + (80.5)(0.20) + (58.5)(0.23) + (33)(0.33) = 63.4\%$$

for the Fields Brook Ashtabula sediment curve. These points are shown on Figure 34. Similar calculations were performed for Fields Brook sediment mixing with half of the Ashtabula River sediment (Figure 35). The overall calculations giving the probability that a dilution will be met result in the curves shown in Figures 34 and 35.

The probable PCB concentration of the Fields Brook sediment was calculated as 1.3 ppm. When reference lake sediments were tested in 1992, the PCB concentrations ranged from nondetectable to 0.26 ppm, while the lake reference sediments ranged from 0.09 ppm to 0.16 ppm for the 1993 bioaccumulation and toxicity studies. Lower river material up to PCB concentrations of 0.53 ppm were shown to be statistically nonsignificant when compared to the lake reference sediments using bioassay protocols. The Ohio EPA obtained a grant from the USEPA Great Lakes National Program Office to study PCB concentrations in the Maumee Bay area. An action level 0.4 ppm was used for this project. Based upon this study, this value indicates that concentrations above 0.4 ppm result toxic effects among most organisms.

To use Figures 34 and 35, a dilution factor for Fields Brook sediments must be established that would give an acceptable sediment PCB concentration for disposal of Ashtabula River sediments. For example, a factor of 2 with a Fields Brook concentration of 1.3 ppm gives 0.65 ppm and a factor of 3 gives a concentration of 0.43 ppm. If a dilution factor of 3 is acceptable and the Fields Brook sediments are totally mixed with the Ashtabula River sediments (Figure 34) then there is a 24% chance and a 39% chance that there is some sediment with a concentration greater than 0.43 ppm PCB for the Fields Brook Ashtabula and the Fields Brook Woodward-Clyde sediment discharge curves,respectively.

Using Figure 35 where the Fields Brook sediment is initially mixed with only half of the incoming Ashtabula River sediments for a dilution factor of 3 there is a 29% and a 48% chance of the sediment failing the criteria of being lower than 0.43 ppm.

Because the sediment is deposited in layers, the above analysis shows there is a 29% chance that there is a layer with concentrations greater than 0.43 ppm. A lower dilution factor gives a lower probability of failure. During the dredging process, all the material is removed and mixed together, thus the high concentration layered sediments would be mixed with the lower concentration layered sediments to produce a lower overall PCB concentration sediment for disposal.

The expected average maximum PCB concentration of the Ashtabula River sediments to be dredged can be approximated by integrating Figures 25 and 26 weighted by the PCB concentrations. The tables below give an idea of expected concentrations, where yearly is 365 days, low flow is 297 days, and high flow is 68 days. For total sediment mixing:

		Ashtabula River		
		Yearly	High	Low
Fields	Yearly	0.20 ppm	--	--
Brook	High	--	0.20 ppm	1.07 ppm
	Low	--	--	0.10 ppm

For Fields Brook sediments mixing with half of the Ashtabula River sediments:

		Ashtabula River		
		Yearly	High	Low
Fields	Yearly	0.34 ppm	--	--
Brook	High	--	0.34 ppm	1.18 ppm
	Low	--	--	0.16 ppm

For Fields Brook sediments mixing with a quarter of the Ashtabula River sediments:

		Ashtabula River		
		Yearly	High	Low
Fields	Yearly	0.54 ppm	--	--
Brook	High	--	0.54 ppm	1.23 ppm
	Low	--	--	0.29 ppm

For complete total sediment mixing, the concentration of the Fields Brook sediments can approach values of 2.8 ppm which would give a value of 0.41 ppm in the Ashtabula River sediments.As can be seen from the above tables, a low flow period on the Ashtabula River accompanied by an extremely high flow regime on Fields Brook could produce an overall unacceptable Ashtabula River sediment PCB concentration. However, this would be extremely unlikely. For a yearly average sediment discharge, incomplete mixing of the two sediment sources still can produce an acceptable disposal concentration. If Fields Brook sediment mixed only with half or a quarter of the Ashtabula River sediment, a PCB sediment concentration around 0.4 to 0.5 ppm could be realized.

HEC-6 Analysis

The Hydrologic Engineering Center' s computer program HEC- 6, Scour and Deposition in Rivers and Reservoirs, was used to determine the sediment deposition in the Federal navigation
• channel after various cleanup scenarios. This version of the program is a modified version of the original HEC-6 program that has been developed collectively by the Hydrologic Engineering Center and the Waterways Experiment Station and has the. capability to erode silt and clay sediments based on critical erosion shear stress and erosion rate coefficients.

This model was assembled, tested, and calibrated for an earlier study (Appendix D, Sediment & Dredging Analysis, Ashtabula Harbor). The same model cross-sections, parameters, and coefficients were used for this study. The only addition was Fields Brook. In 1995, WES took some cores from the river to ascertain shearing strength of the sediments and erosion rates (Ashtabula River Field Data Collection, December 1995, WES) This model was tested using these new values, however, the results did not vary appreciably from the runs using the original data.

The flow durations were used to represent the yearly averaged flows for the Ashtabula River and Fields Brook. The distribution of the Fields Brook flow to the Ashtabula River flows made no difference on a yearly basis. Flows were repeated on a yearly basis for a 50-year period using an average lake level of 571.8 IGLD.

A map showing some of the cross-sections used in the study is presented in Figure 36. The initial scenario was "total cleanup" of all the sediments in the river by dredging. This would bring the bottom elevation down to 548.6 feet IGLD including 1-foot overdredging from the lake upstream to section 160 (Figure 36). From this section upstream to the end of the Federal navigation channel, at section 207, the bottom would be dredged down to an elevation of 550.6 feet IGLD including the 1-foot of overdredging. This scenario includes bank to bank dredging. Because of the uncertainty of stream bank stability, a buffer zone of no dredging was established approximately 15 feet along the banks for analysis purposes.

The model was simulated for a 50-year period allowing the river to shoal up. Since the "total cleanup" scenario would in essence create a large sink, runs were made with and without Fields Brook to ascertain the extent of the area influenced by the Fields Brook inflow. Fields Brook affects the upper turning basin, downstream to approximately Section 170 (Figure 36), particularly at the mouth of the brook, the upper turning basin, and downstream of the Conrail bridge to approximately Section 180.

The river was allowed to shoal up to an elevation of 562.6 feet IGLD at which point the river was dredged to an elevation of 559.6 feet IGLD including the 1-foot of over dredging. The river was then allowed to shoal up again. Generally, no dredging is required for 25 years. The dredging cycles, quantities, and locations are summarized below.

Time Period years	Quantity Cubic Yards	Location
25	5,000	190 to 207
31	10,000	190 to 207
39	16,000	190 to 207
47	28,000	185 to 207

The least amount needed to be dredged on the above table is from the mouth of Fields Brook upstream to the end of navigation including the upper turning basin area. Any contamination from Fields Brook will be found in the turning basin and downstream. Sediments downstream of section 170 would be generally well mixed. The first three dredging periods above encompass dredging in the upper reach where it is expected there would be no Fields Brook contamination.

Attachment 1

Concentration of PCB's in Fields Brook Before and After Cleanup

	PCB Concentration		
Sample Field ID	Before Cleanup	After Cleanup Total	After Cleanup to 1.3 ppm
Exposure Unit 1	**PPM**	**PPM**	**PPM**
SA1QS1	10	0	1.3
SA1QS2	13	0	1.3
SE02201S-12	1.3	1.3	1.3
SA1QS3	1.3	1.3	1.3
SA1BD0	8.4	0	1.3
SA1CS0	1.5	1.5	1.5
SE01104S-11	0	0	0
SA1ES0	12	0	1.3
SA1FS0	5.5	5.5	5.5
SA1FS1	1.9	1.9	1.9
SA1GS0	0	0	0
SA1GS1	1.9	1.9	1.9
SA1HS1	0	0	0
SE01109S-11	0	0	0
SA1IS1	3.2	3.2	3.2
SA1IS2	0	0	0
SA1JS1	0.27	0.27	0.27
SE01111S-11	0	0	0
Average EU-1	3.35	0.94	1.23
Exposure Unit 2	**Before**		**After**
SE02102S-11	0	0	0
SE02106S-11	0	0	0
SE2108S-11	15	0	1.3
SE02110S-11	13	0	1.3

SE02113S-11	7.5	0	1.3
SE09101S-11	4.8	0	1.3
SE09103S-11	0	0	0
SE02201S-11	2	0	1.3
SE02203S-11	8.6	0	1.3
Average EU-2	5.66	0	0.87
Exposure Unit 3	**Before**		**After**
SE03101S-11	8.4	0	1.3
SC1BS1	0	0	0
SC1BS0	2.6	2.6	2.6
SC1CS0	12	0	1.3
SC1CS1	12	0	1.3
SC1CS2	15	0	1.3
SC1DS0	16	0	1.3
SE03105S-11	47	0	1.3
SC1FS0	6.7	0	1.3
SC1FS1	9.5	0	1.3
SC1GS0	13	0	1.3
SC1GS1	12	0	1.3
SC1HS0	5	0	1.3
SE03109S-11	6.4	0	1.3
SC1JS0	2.5	2.5	2.5
SC1KS0	8.2	0	1.3
SC1LS0	3.3	3.3	3.3
SC1MS0	5.6	0	1.3
SE03114S-11	0	0	0
SC1MS1	3.8	3.6	3.8
SC1NS1	6.7	0	1.3
Average EU-3	9.32	0.58	1.51
Exposure Unit 4	**Before**		**After**
SE04101S-11	14	0	3.1
SD1AS1	0	0	0

SD1BS0	6.4	6.4	6.4
SD1CS0	0	0	0
SE04104S-11	0	0	0
SD1DS1	0	0	0
SD1ES0	1.5	1.5	1.5
SE04107S-11	24	0	3.1
SD1FS0	2.3	2.3	2.3
SD1HS0	23	0	3.1
SD1IS0	29	0	3.1
SD1JS0	8.8	8.8	8.8
SE04111S-11	0	0	0
SD1JS1	0	0	0
SD1KS1	0	0	0
SD1KS0	0	0	0
Average EU-4	9.19	1.19	2.16
Exposure Unit 5	**Before**		**After**
SK1AS0	7.5	0	3.1
Exposure Unit 6	**Before**		**After**
TE1BS0	82	0	3.1
SE05102S-11	11	0	3.1
SE1CS0	15	0	3.1
SE1ES0	0	0	0
SE05104S-11	8.4	0	3.1
SE2CS1	14	0	3.1
SE2CS2	93	0	3.1
SE05204S-11	0	0	0
SE2ES0	3	3	3
SE2CS1	0	0	0
SE05209S-11	7.9	0	3.1
SE05207S-11	1.9	1.9	1.9
SE2JS0	2.8	2.6	2.8
SE2JS1	0	0	0

SE05211S-11	8.9	0	3.1
SE2HS1	0	0	0
SE2KS1	31	0	3.1
SE05212S-11	0	0	0
TE2LS2	42	0	3.1
SE05214S-11	24	0	3.1
SE05214S-21	0	0	0
Average EU-6	16.42	1.19	1.99
Exposure Unit 7	**Before**		**After**
SK3AS0	0	0	0
SK3AS1	0	0	0
SE11302S-12	0	0	0
SK3BS1	0	0	0
SK3DS0	0	0	0
SK3DS3	0	0	0
SK3DS1	0	0	0
SK3DS2	0	0	0
SK3ES0	0	0	0
SK3ES1	0	0	0
SE11306S-11	0	0	0
SK4AS1	0	0	0
SK4AS2	0	0	0
SK4AS3	0	0	0
SK4AS4	0	0	0
SE11402S-11	0	0	0
Average EU-7	0	0.37	0
Exposure Unit 8	**Before**		**After**
SE06101S-11	1100	0	3.1
SF1AS1	0	0	0
SF1BS0	1600	0	3.1
SF1BS1	3.6	3.6	3.6
SE06103S-11	7.1	7.1	7.1

SF1ES0	4.1	4.1	4.1
SE06107S-11	0	0	0
SF1HS0	0	0	0
SF1HS1	0	0	0
SE06110S-11	0	0	0
SE12101S-11	0	0	0
SG1BS0	0	0	0
SE07102S-11	0	0	0
SG1CS0	0	0	0
SG1ES0	0	0	0
SE07108S-11	0	0	0
SG1HS1	0	0	0
SG1HS2	0	0	0
Average EU-8	150.82	0.82	1.17
Exposure Unit 9	**Before**		**After**
SE07201S-11	0	0	0
SG2BS0	0	0	0
SG2ES0	0	0	0
SH1BS0	0	0	0
SE08103S-11	0	0	0
SH1BS1	0	0	0
SH1CS1	0	0	0
SH1CS2	0	0	0
SH1CS3	0	0	0
SH1DS0	0	0	0
SH1ES0	0	0	0
SE08106S-11	0	0	0
SH1FS1	0	0	0
SH1GS0	0	0	0
SH1GS2	0	0	0
SH1GS3	0	0	0
SH1GS1	0	0	0

SE08109S-11	0	0	0
Average EU-9	0	0	0
Final Average		0.43	1.3

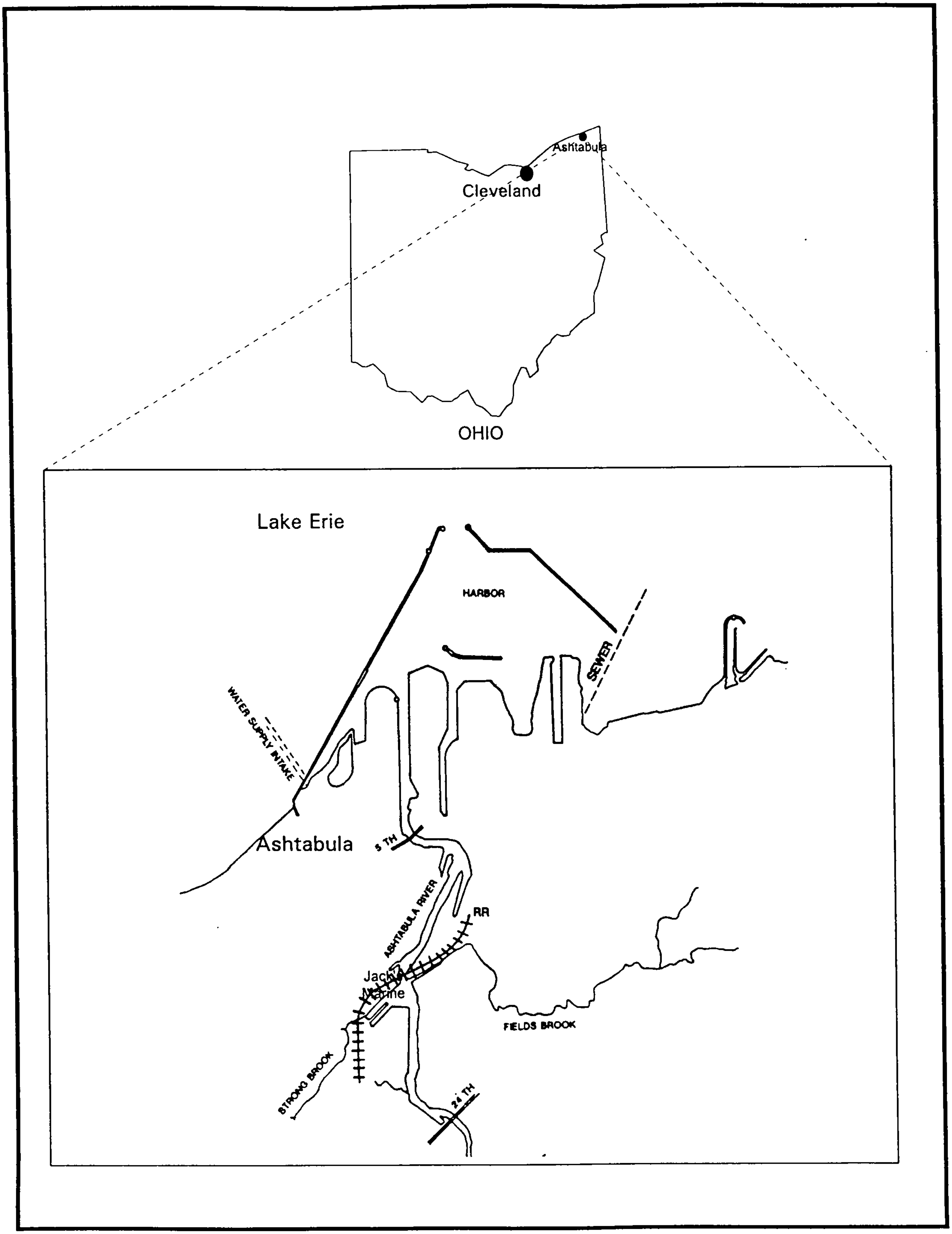


Figure 1 Vicinity Map of Ashtabula River

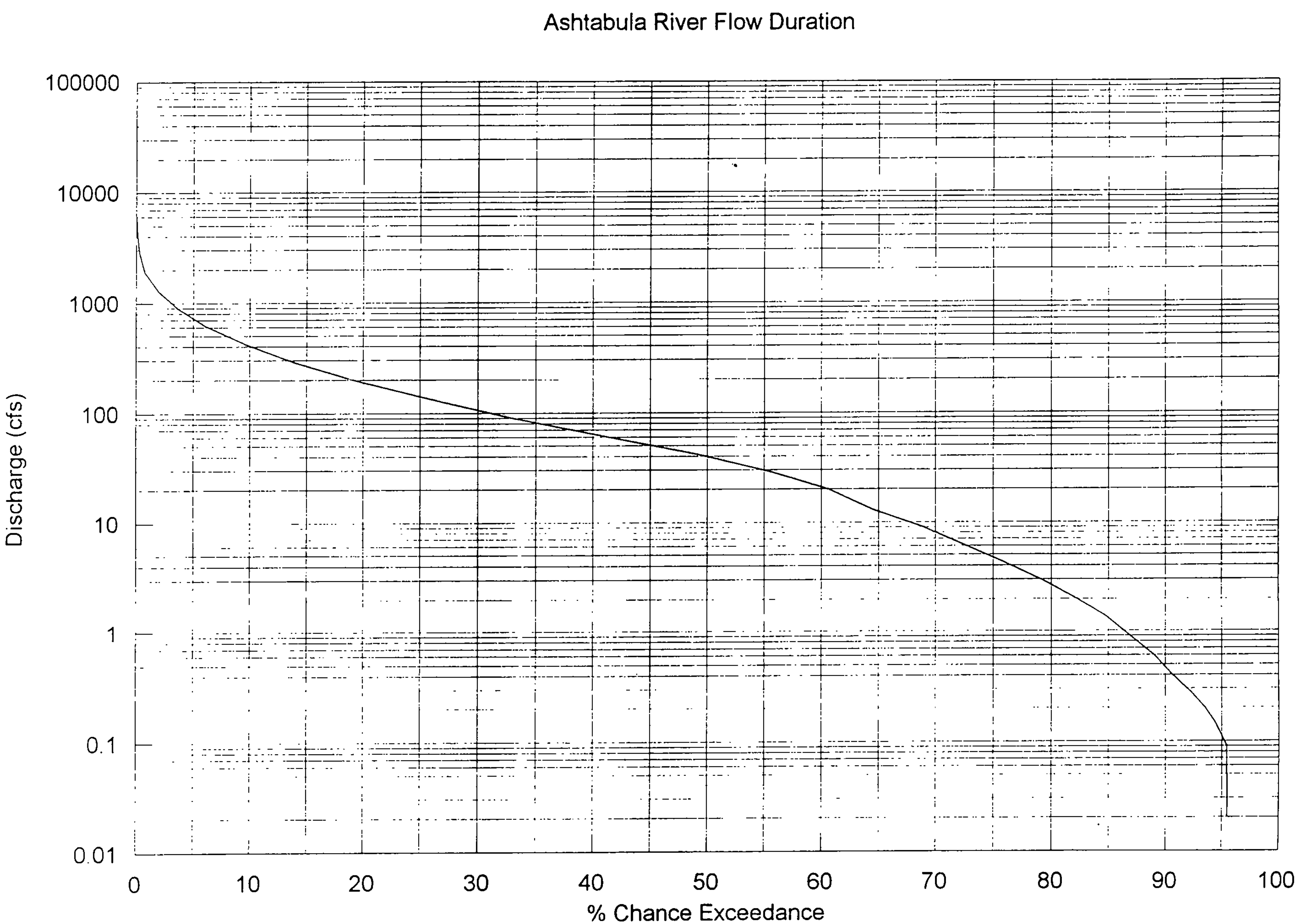

Ashtabula River Flow Duration
Discharge (cfs)
100000
10000
1000
100
10
1
0.1
0.01
0
10
20
30
40
50
60
70
80
90
100
% Chance Exceedance

Figure 2

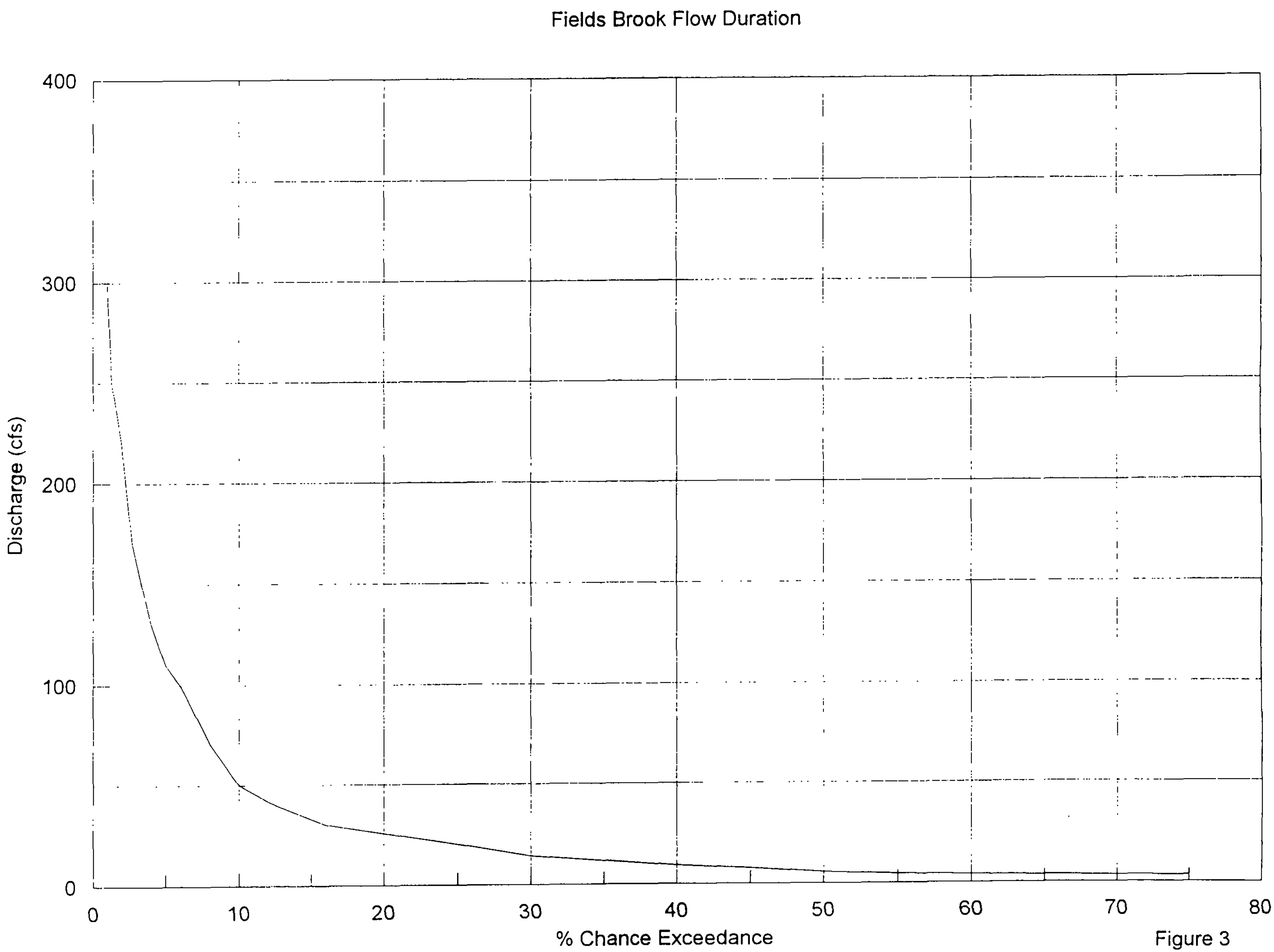
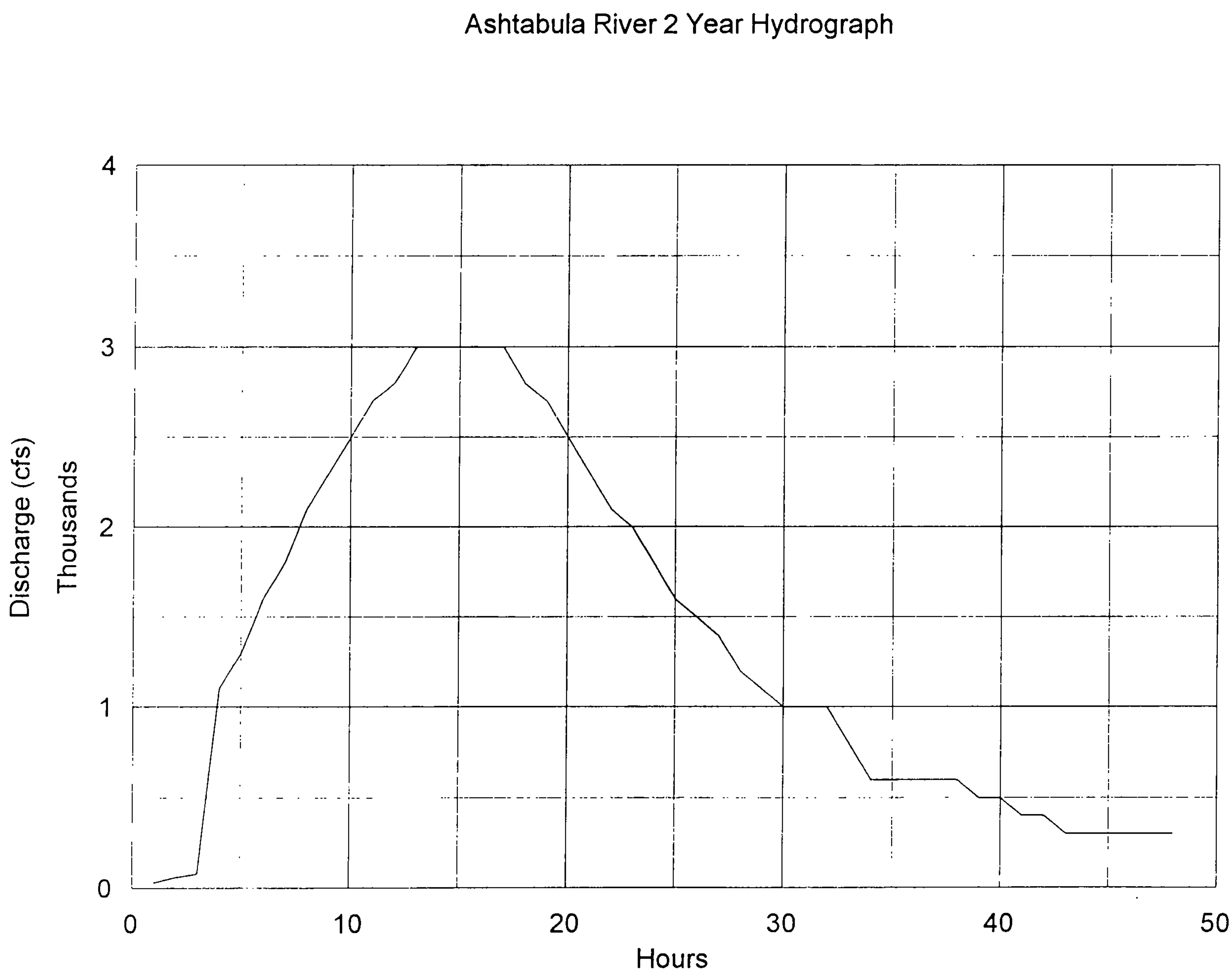

Fields Brook Flow Duration
Discharge (cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
% Chance Exceedance

Figure 3



Ashtabula River 2 Year Hydrograph
Discharge (cfs)
Thousands
4
3
2
1
0
0
10
20
30
40
50
Hours

Figure 4

Ashtabula River 10 Year Hydrograph

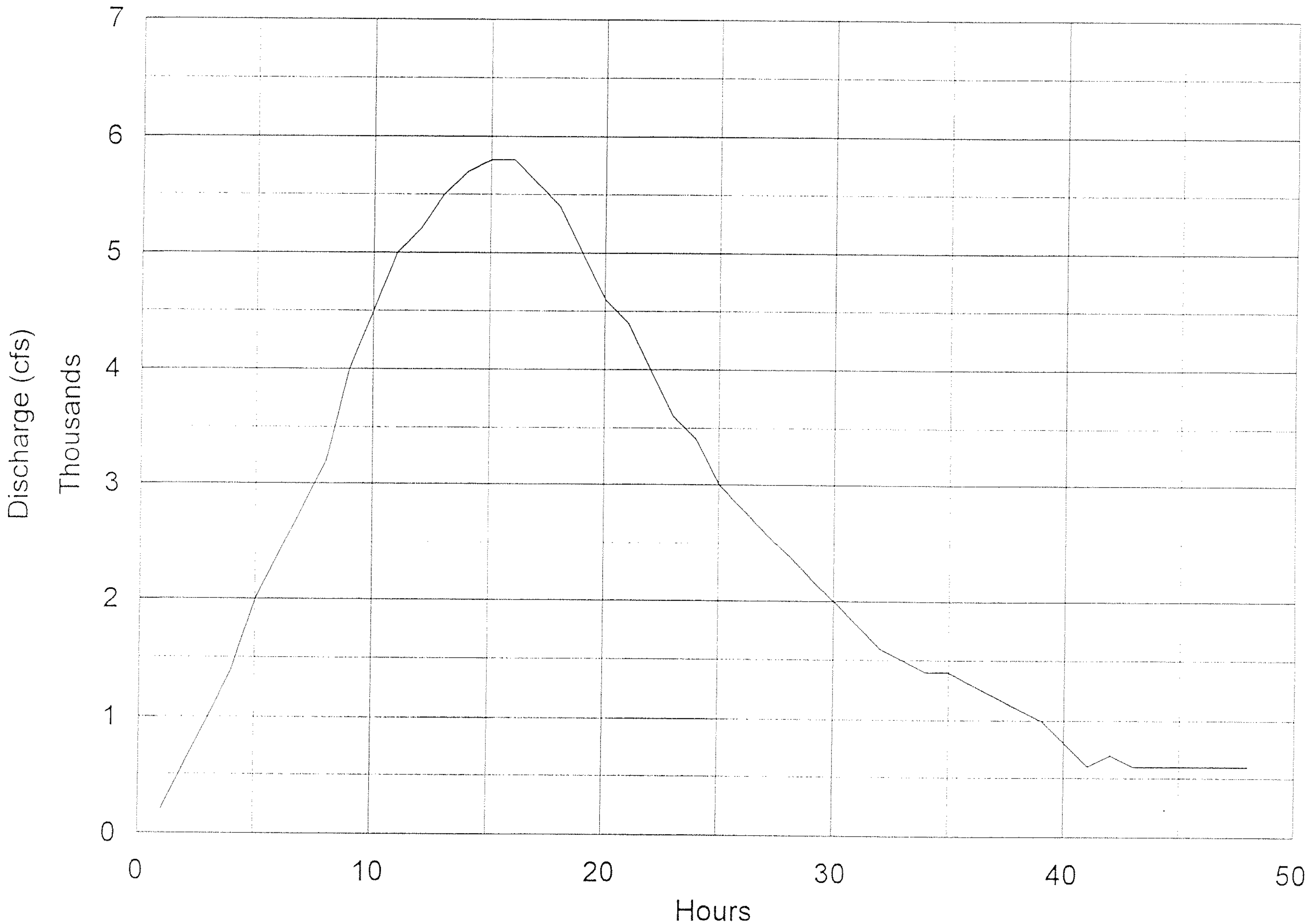


Figure 5

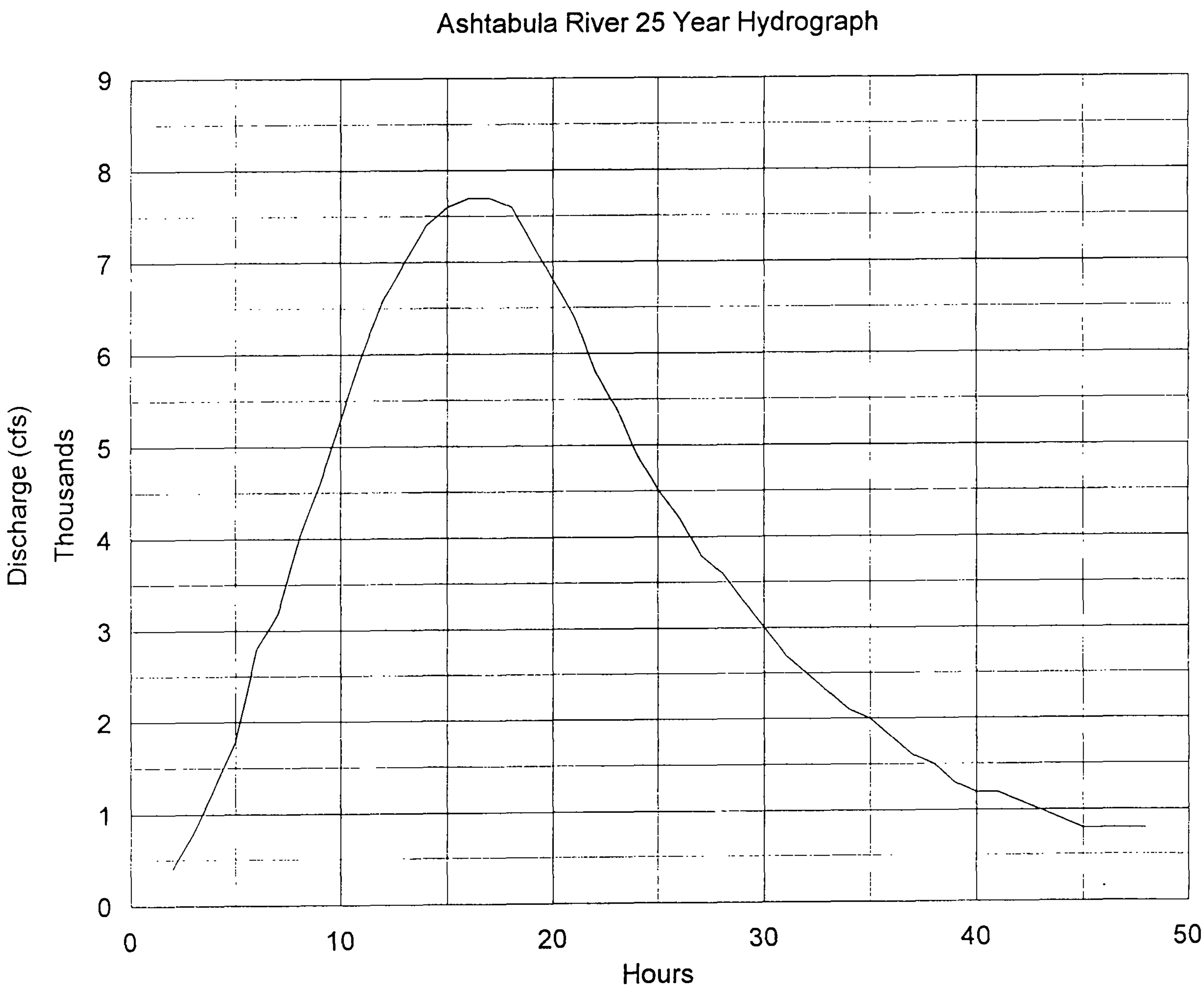

Ashtabula River 25 Year Hydrograph
Discharge (cfs)
Thousands
0
1
2
3
4
5
6
7
8
9
0
10
20
30
40
50
Hours

Figure 6

Ashtabula River 50 Hydrograph

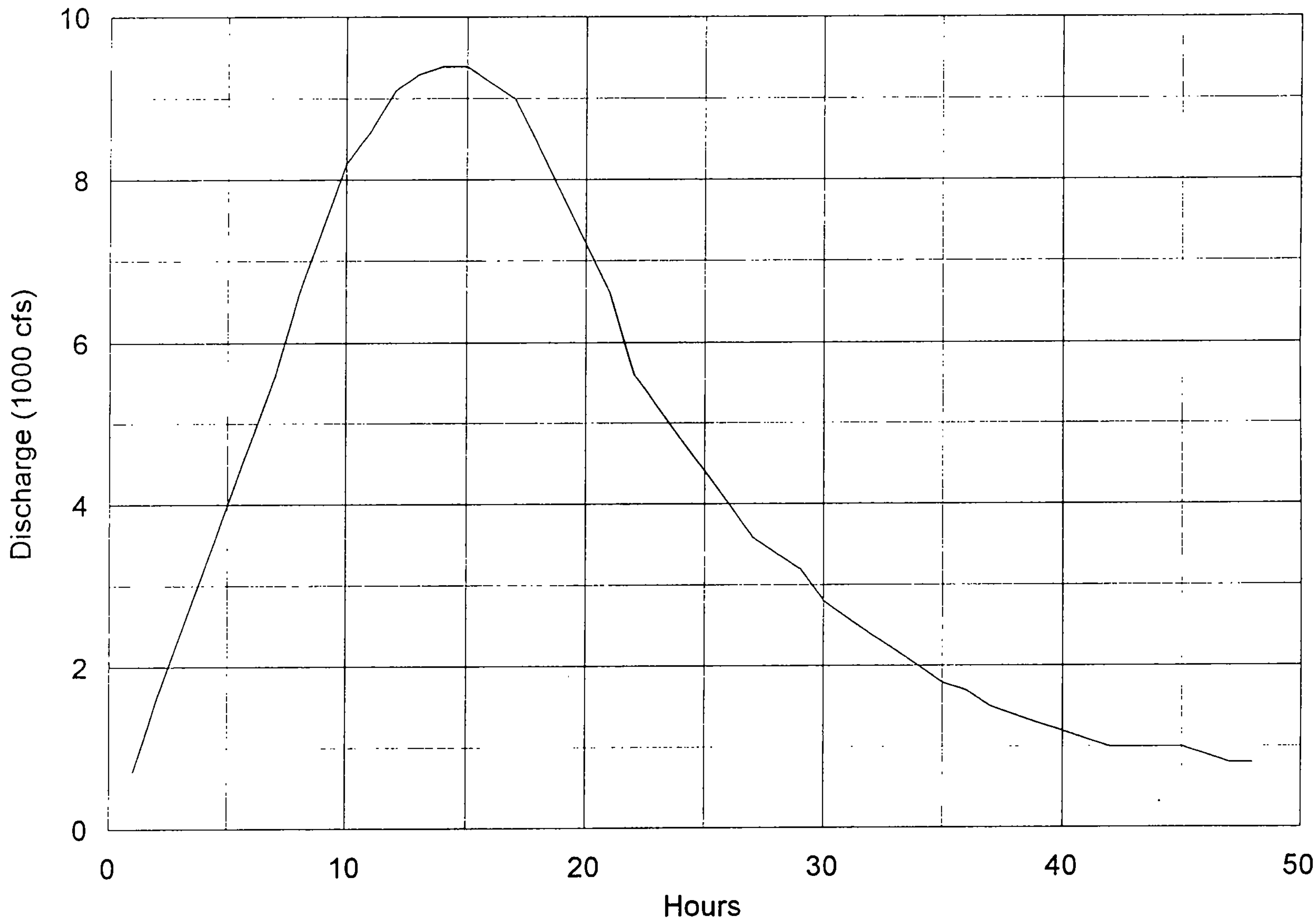


Figure 7

Ashtabula River 100 Year Hydrograph

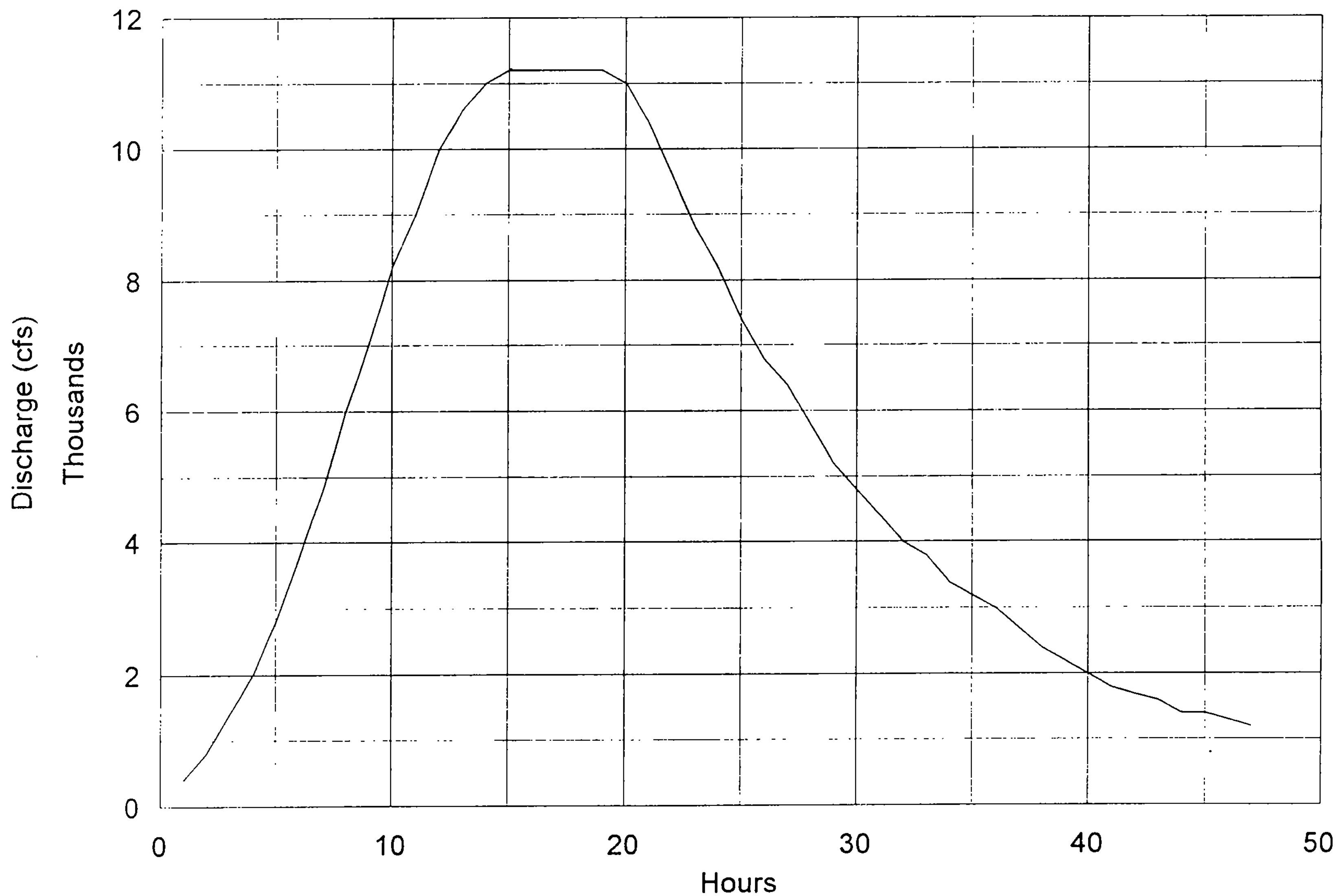
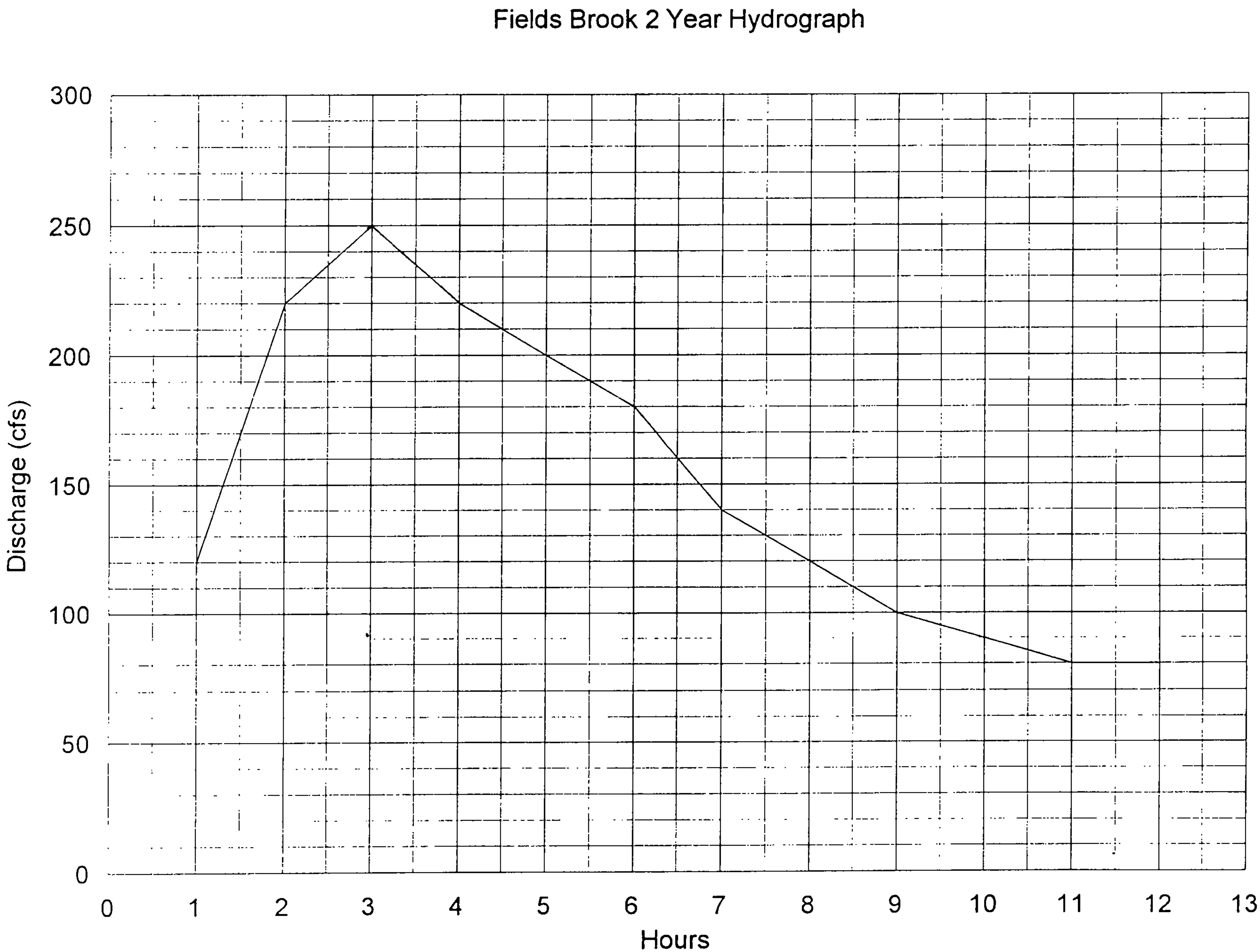


Figure 8


Fields Brook 2 Year Hydrograph
Discharge (cfs)
300
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Hours
Figure 9

Fields Brook 10 Year Hydrograph

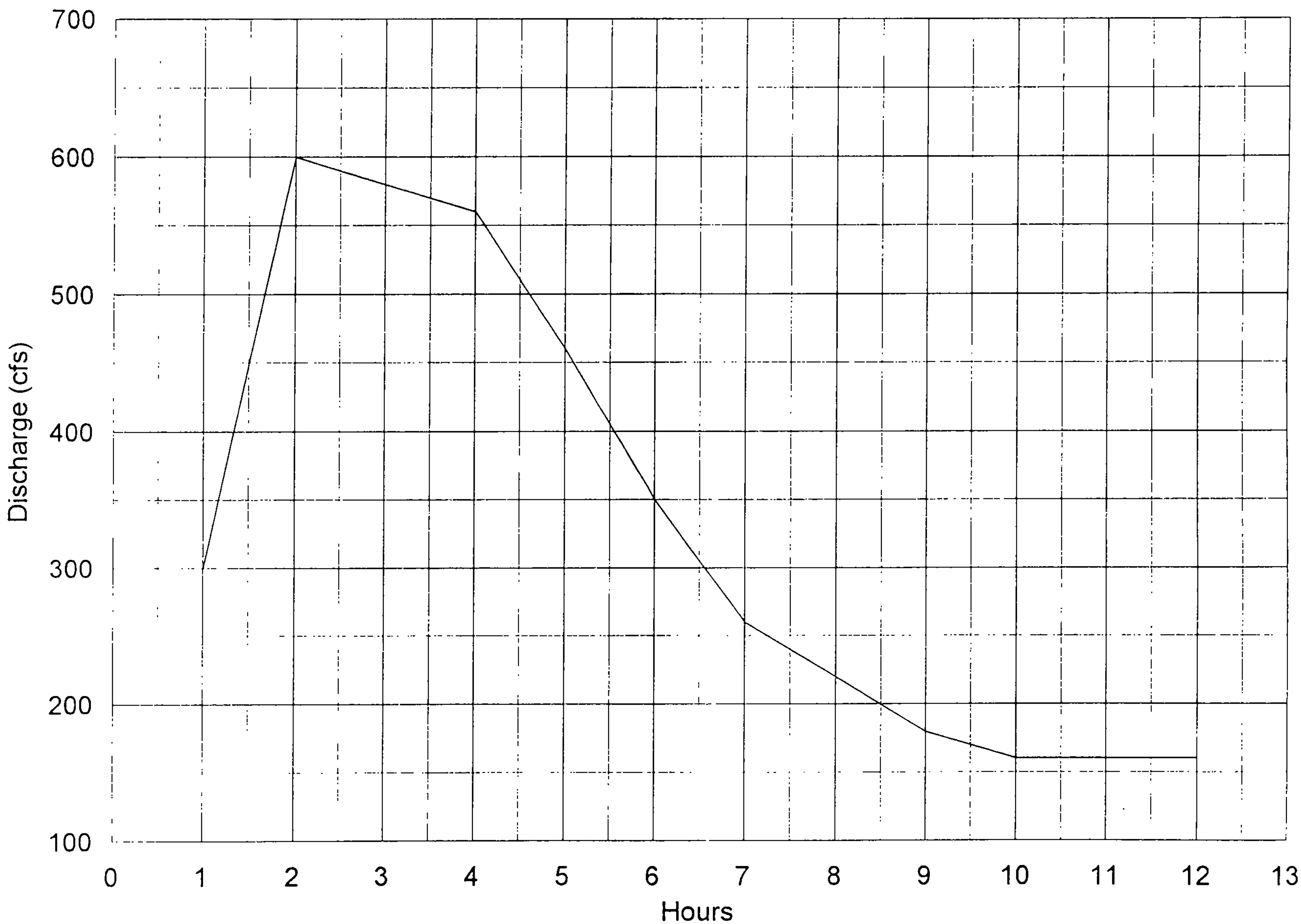
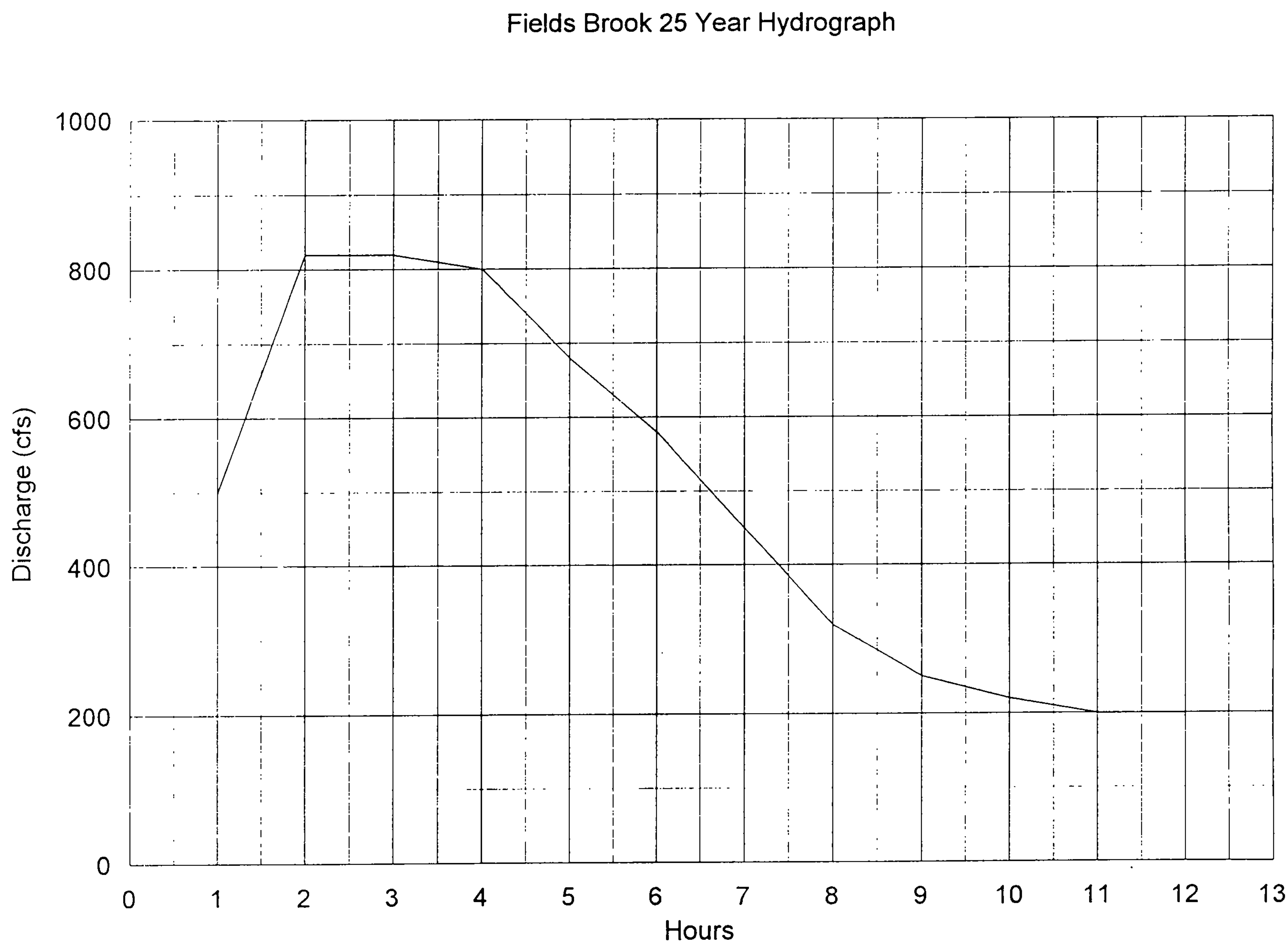


Figure 10



Fields Brook 25 Year Hydrograph
Discharge (cfs)
1000
800
600
400
200
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Hours

Figure 11

Fields Brook 50 Year Hydrograph

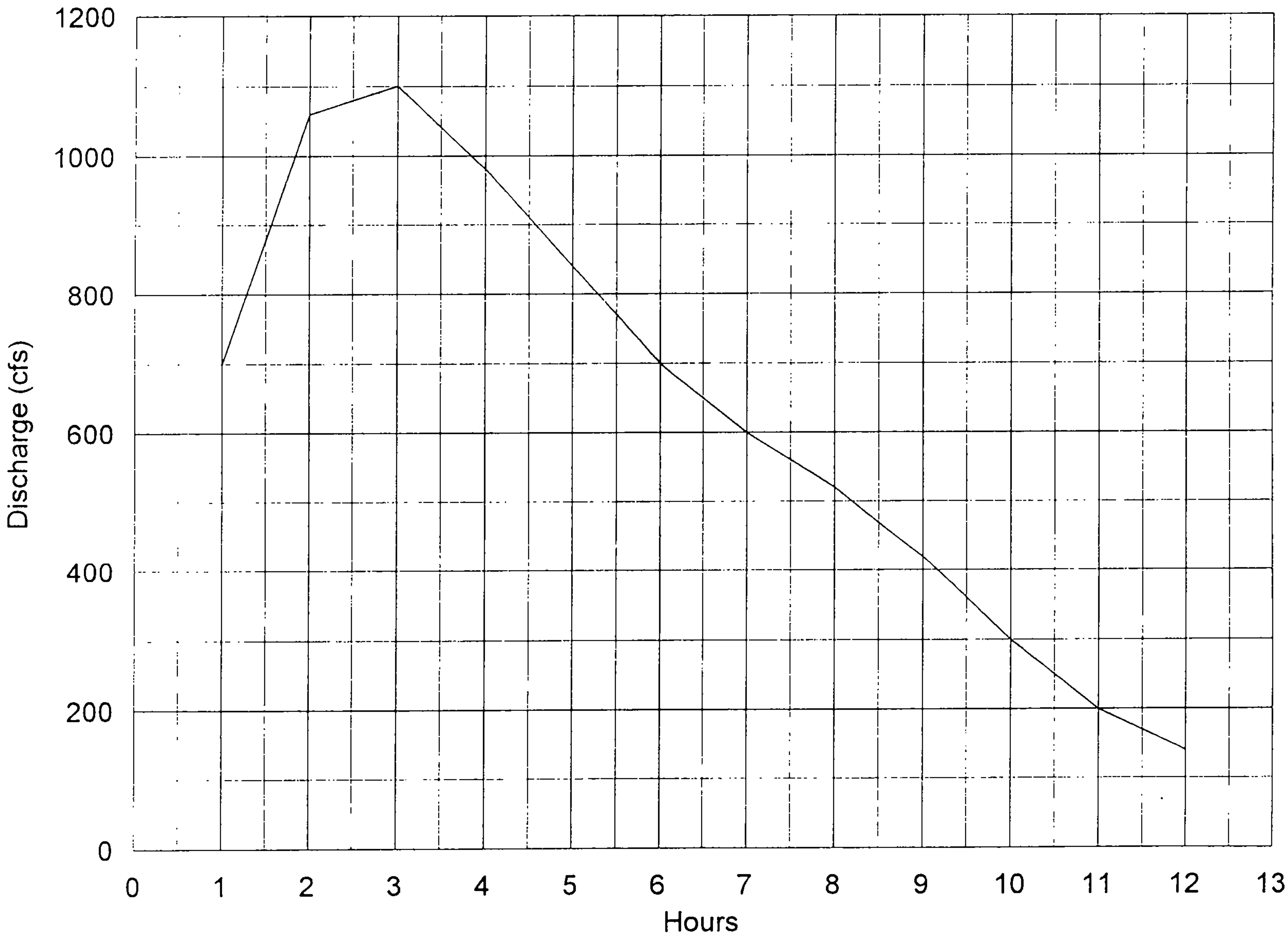


Figure 12

Fields Brook 100 Year Hydrograph

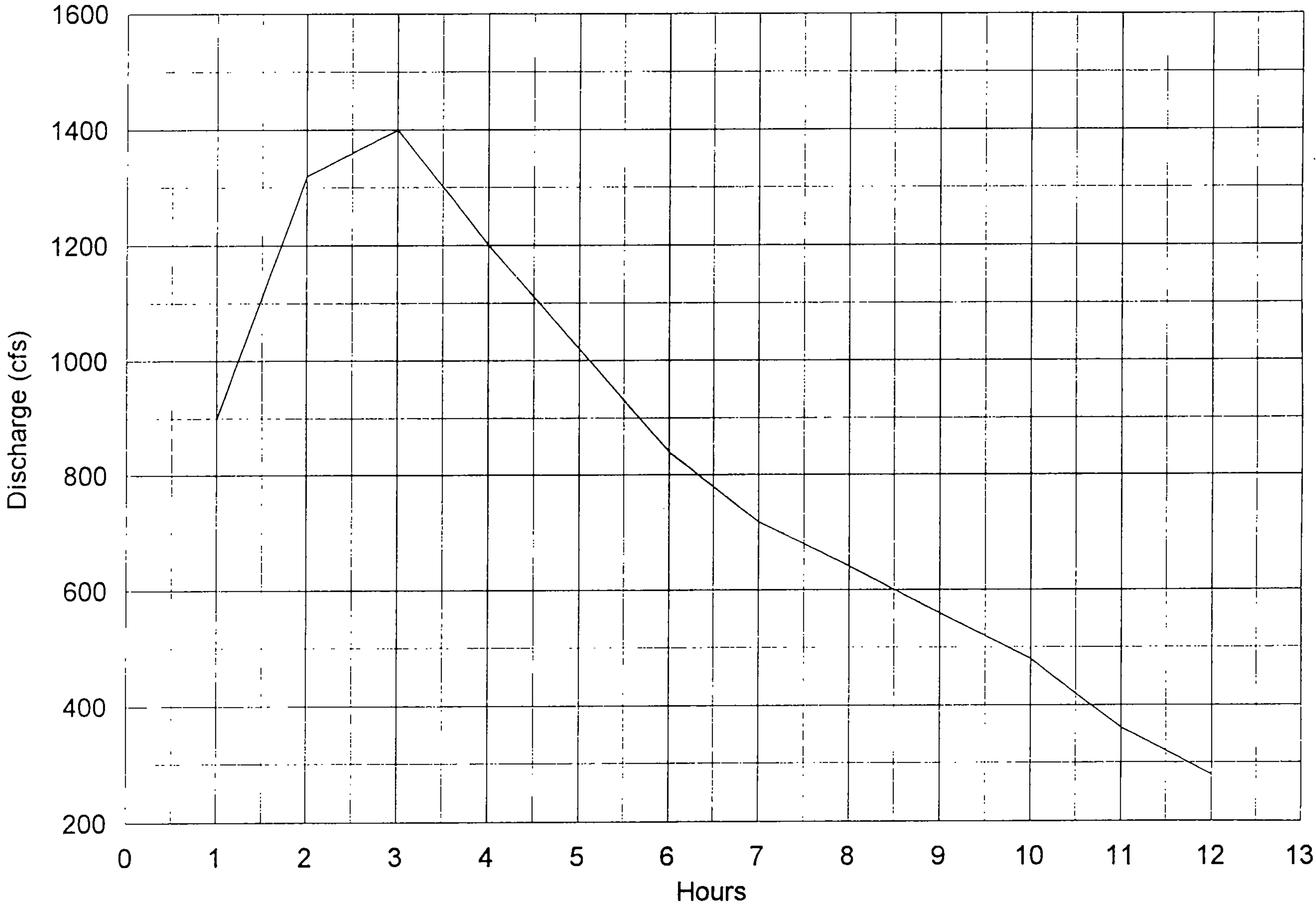


Figure 13

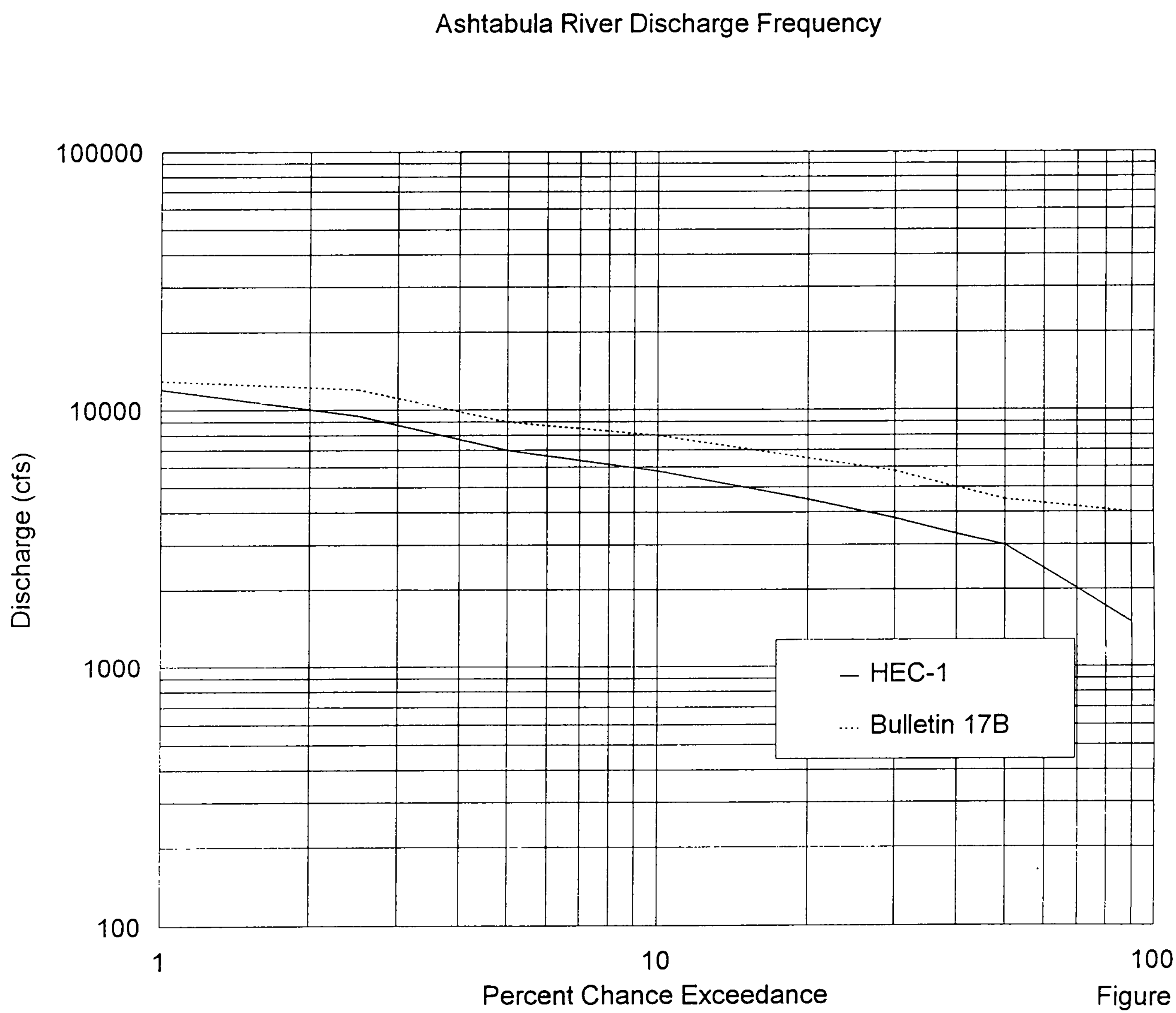

Ashtabula River Discharge Frequency
Discharge (cfs)
100000
10000
1000
100
1
10
100
Percent Chance Exceedance
HEC-1
Bulletin 17B

Figure 14

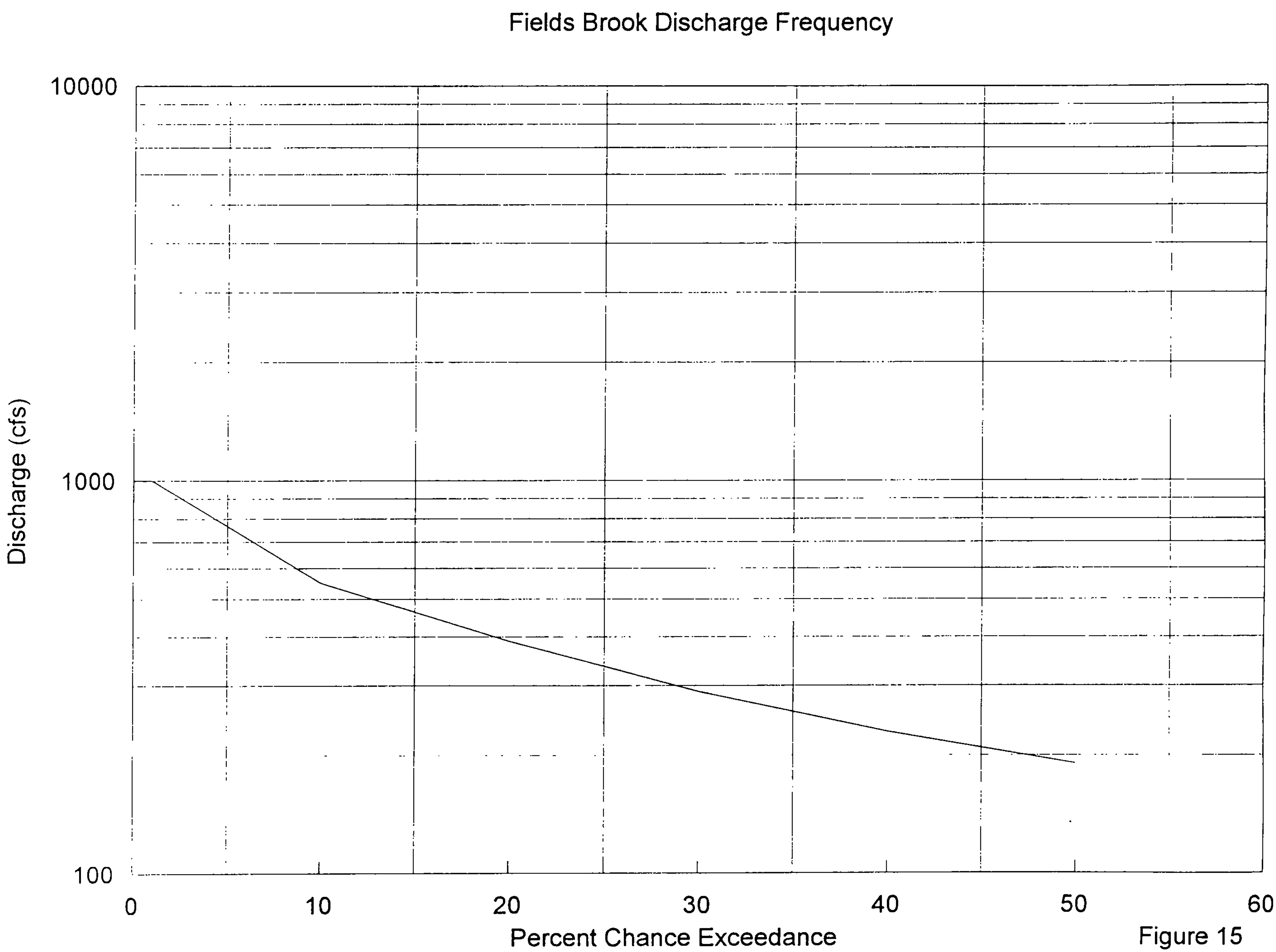

Fields Brook Discharge Frequency
Discharge (cfs)
10000
1000
100
0
10
20
30
40
50
60
Percent Chance Exceedance

Figure 15

Ashtabula River Sediment Discharge

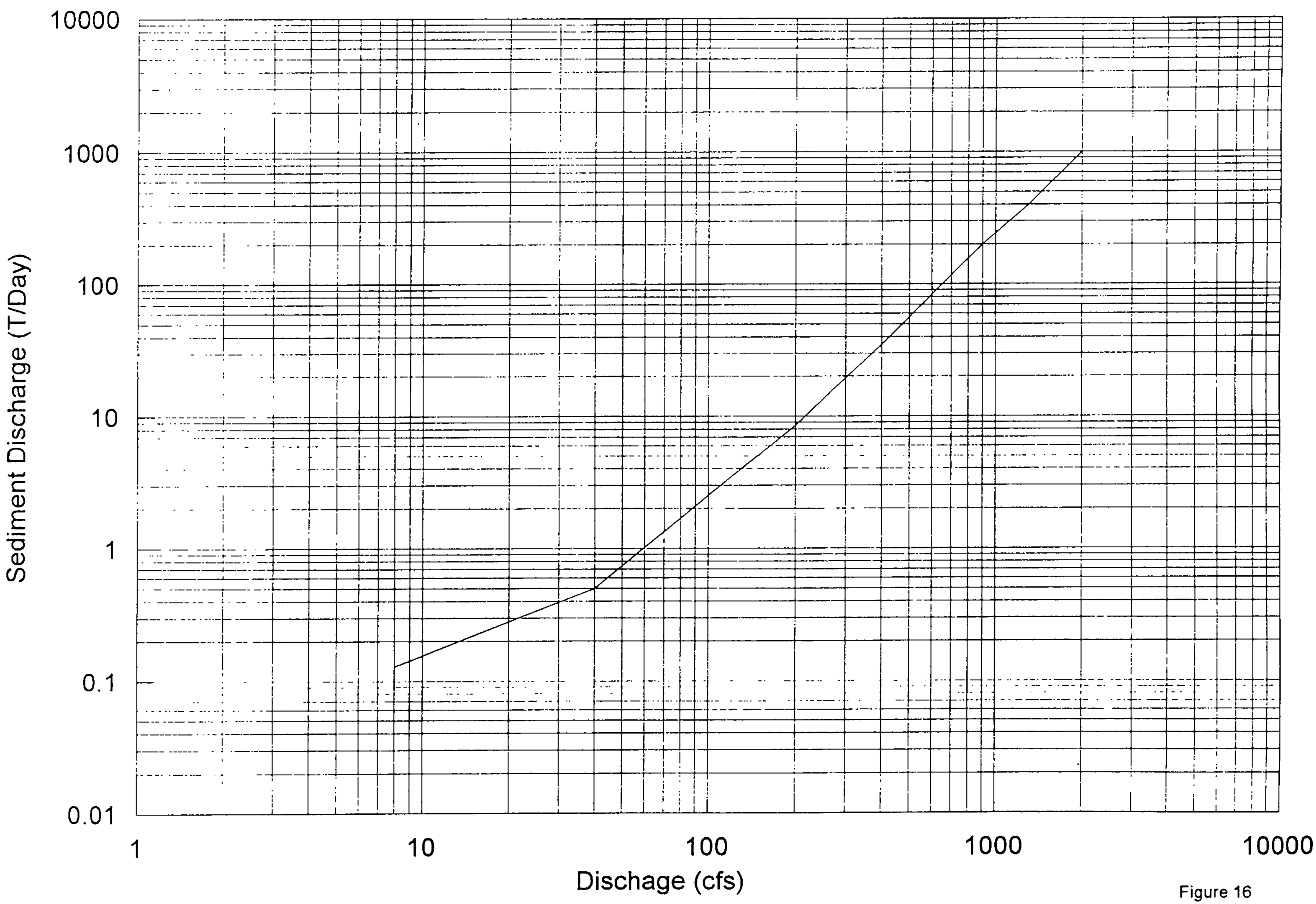


Figure 16

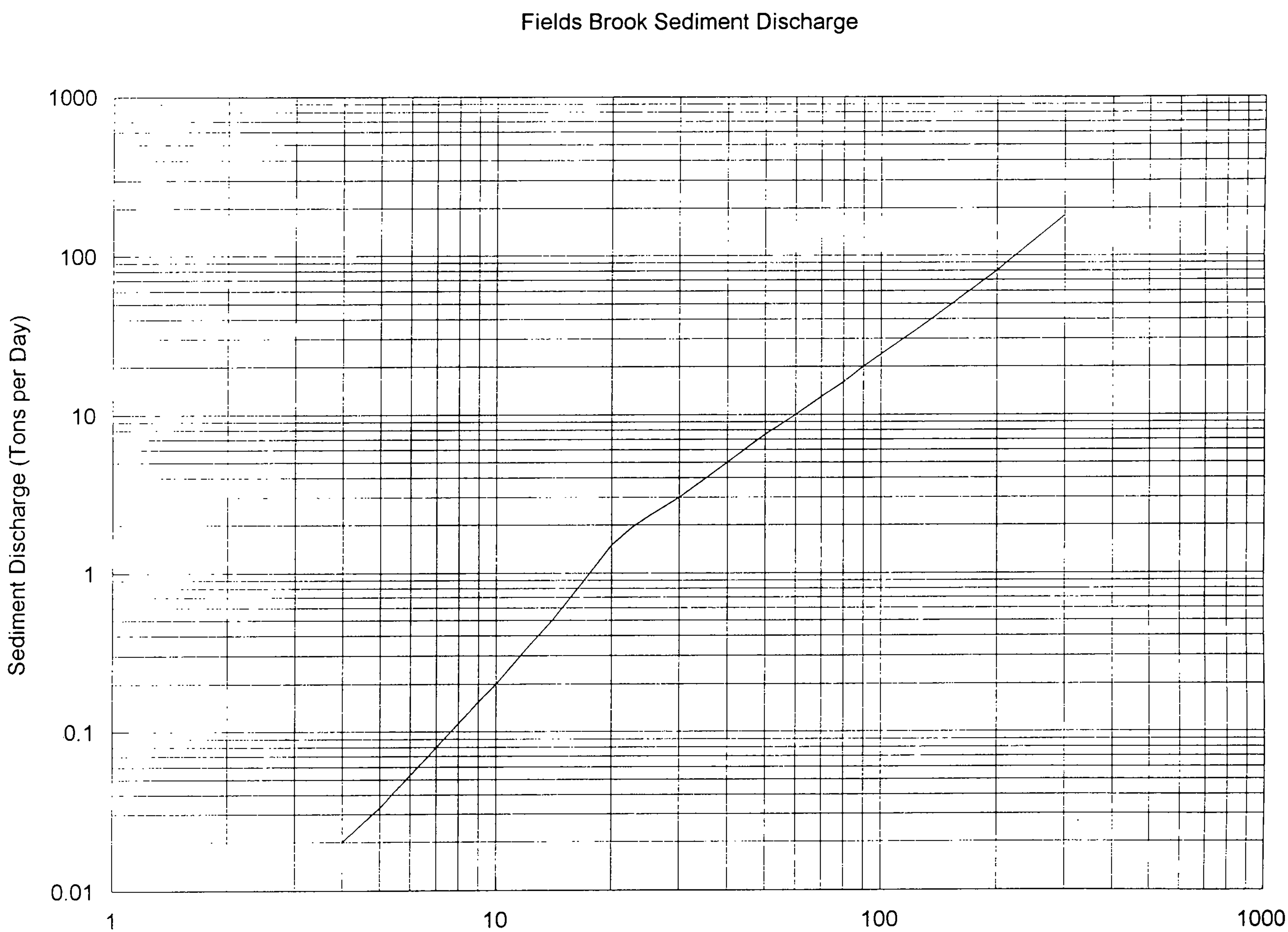

Fields Brook Sediment Discharge
1000
100
10
1
0.1
0.01
Sediment Discharge (Tons per Day)
1
10
100
1000
Discharge (cfs)

Figure 17

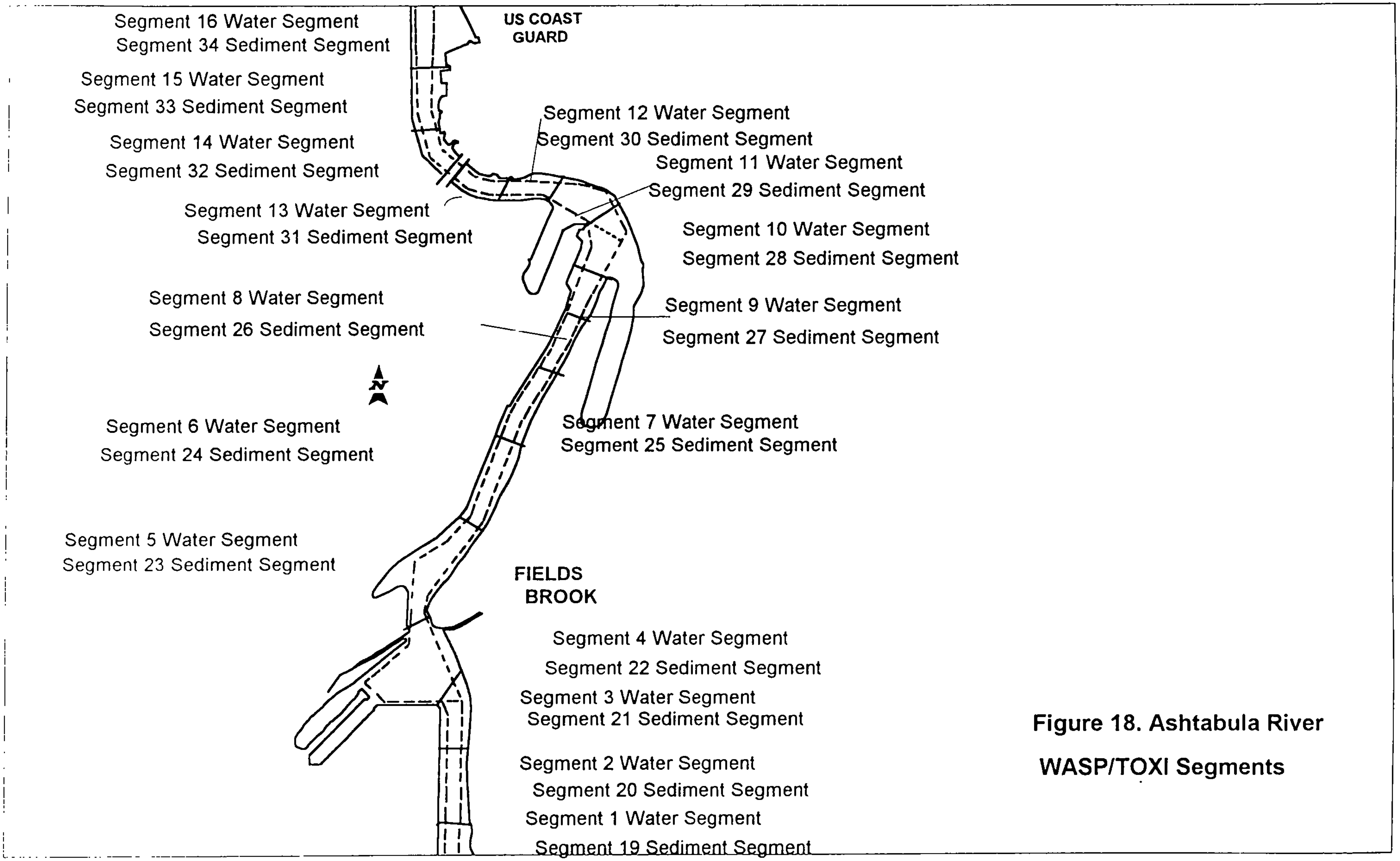


Figure 18. Ashtabula River WASP/TOXI Segments

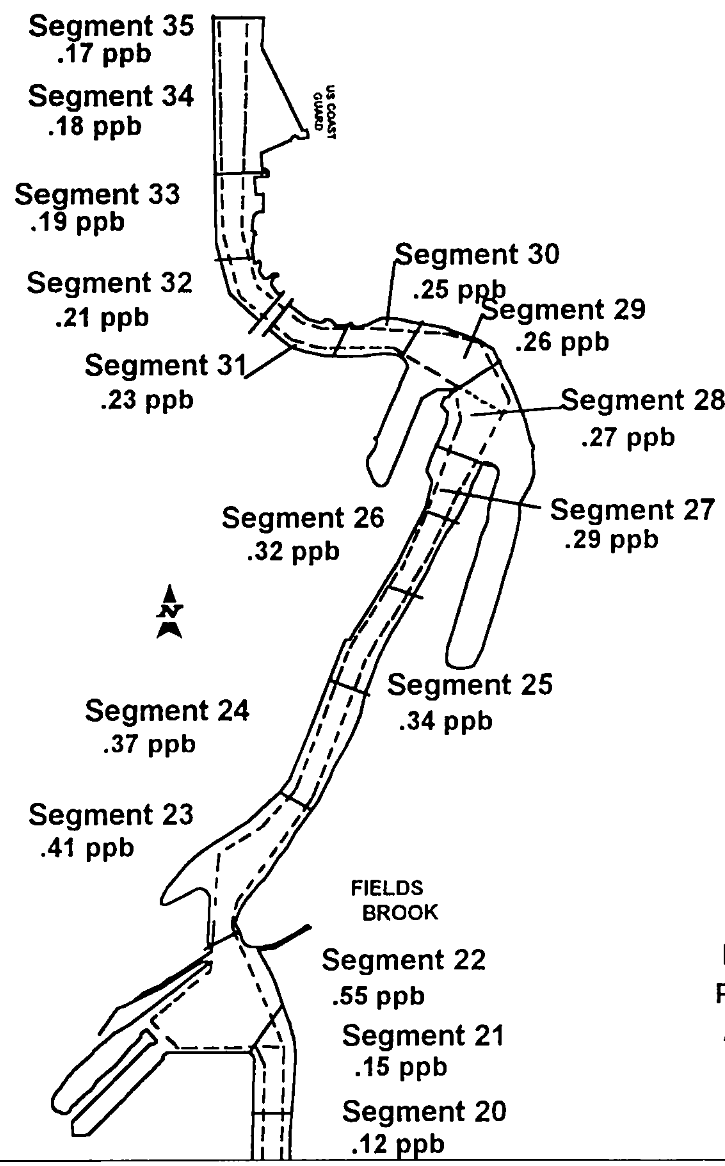


Figure 19. Ashtabula River
PCB Concentration After 2 Year Event
And Average Load On Fields Brook

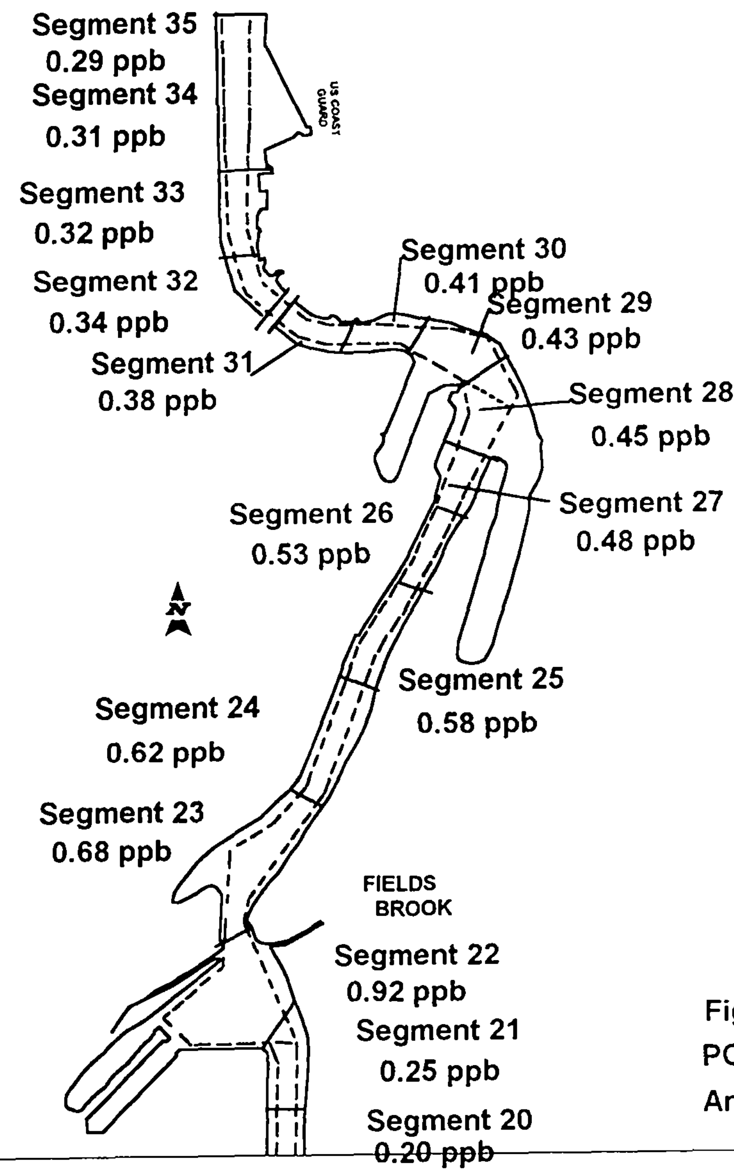


Figure 20. Ashtabula River
PCB Concentration After 2 Year Event
And High Loads on Fields Brook

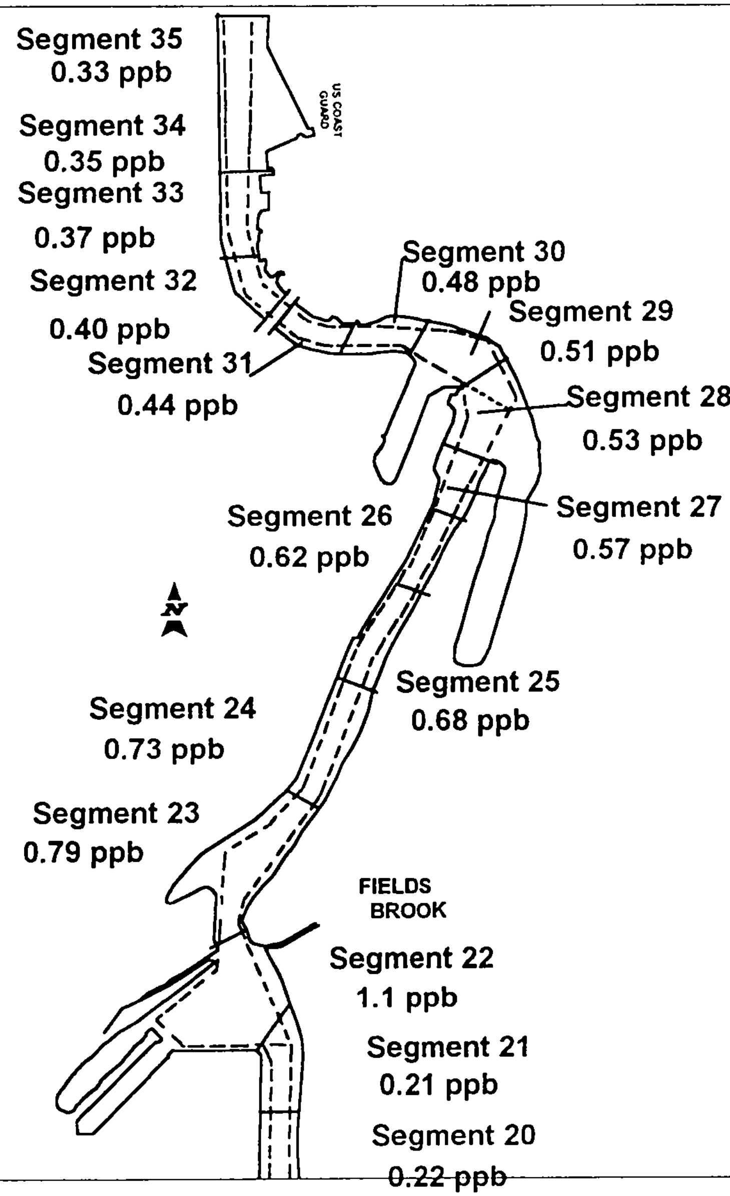


Figure 21. Ashtabula River
PCB Concentration For 100 Year Flow
And Low Sediment Loads on Fields Brook

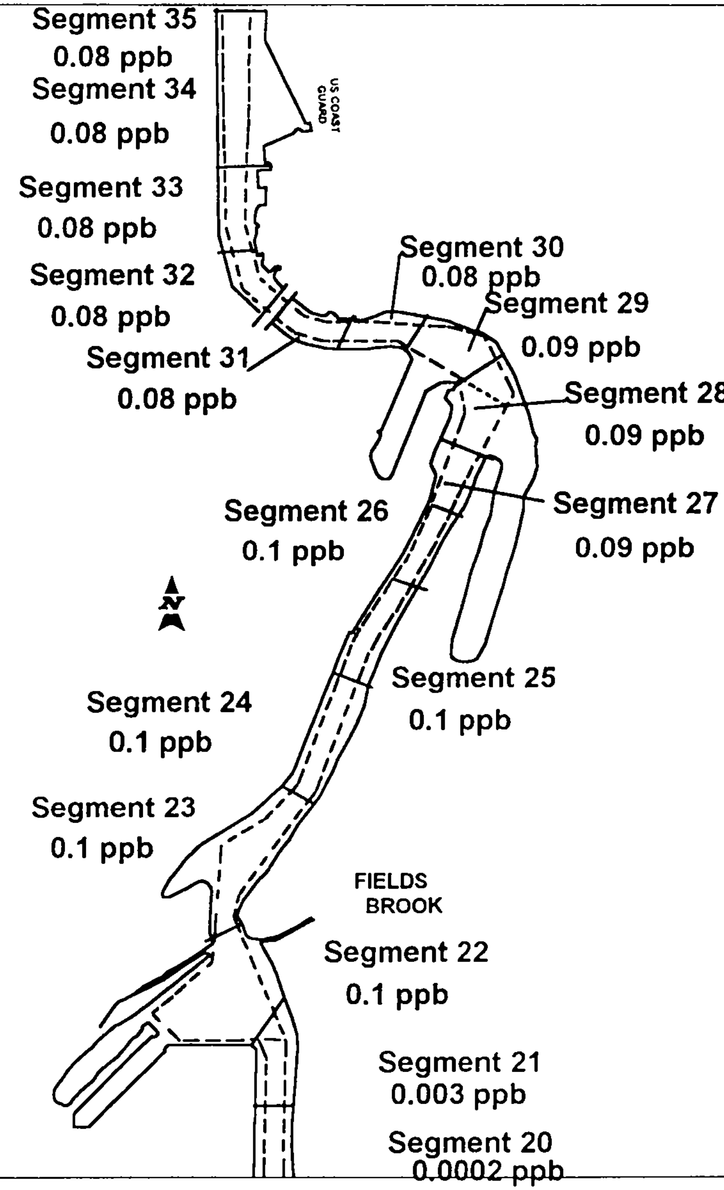


Figure 22. Ashtabula River
PCB Concentration After 100 Year Event
And Average Loads on Fields Brook

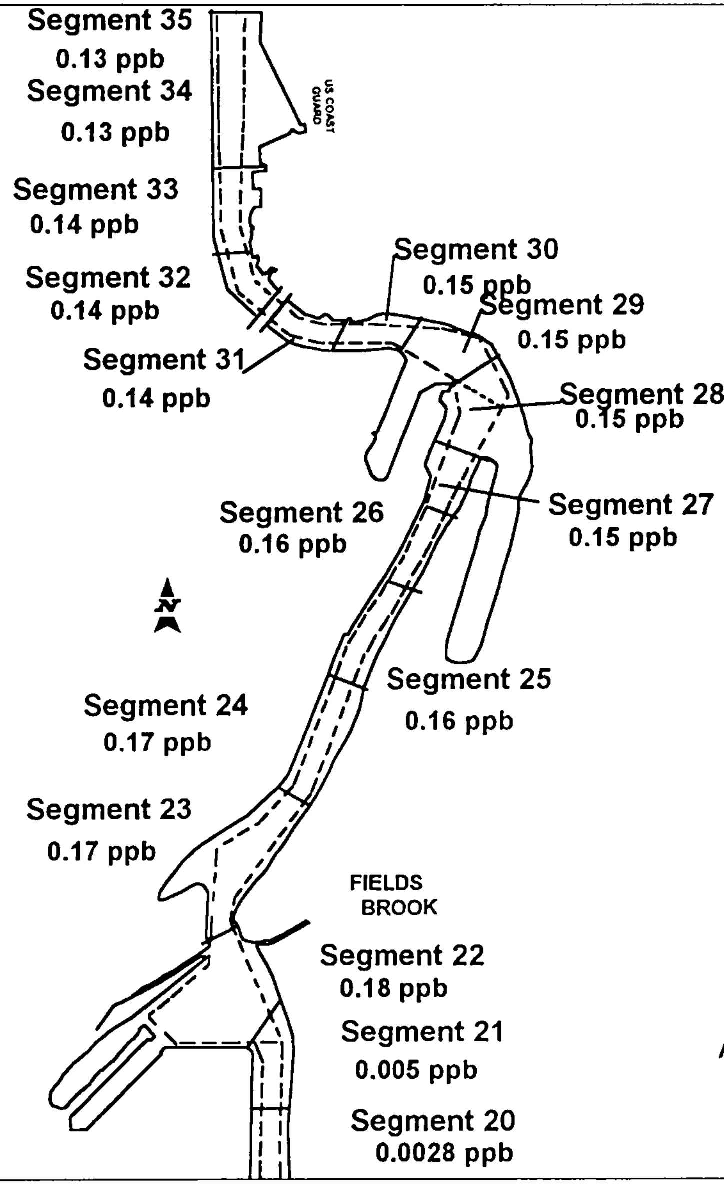


Figure 23. Ashtabula River
PCB Concentration After 100 Year Event
And High Loads on Fields Brook

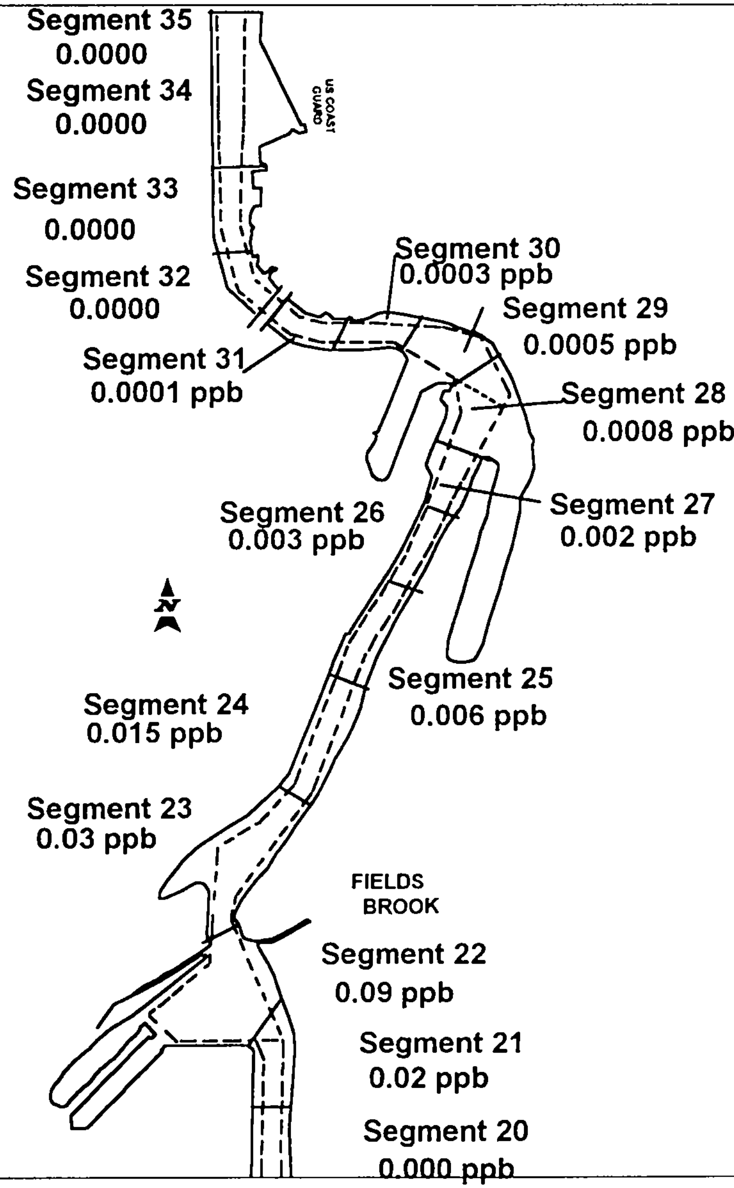


Figure 24. Ashtabula River
PCB Concentration For Flow Duration Analysis
And Average Load on Fields Brook

Ashtabula River Sediment Loading

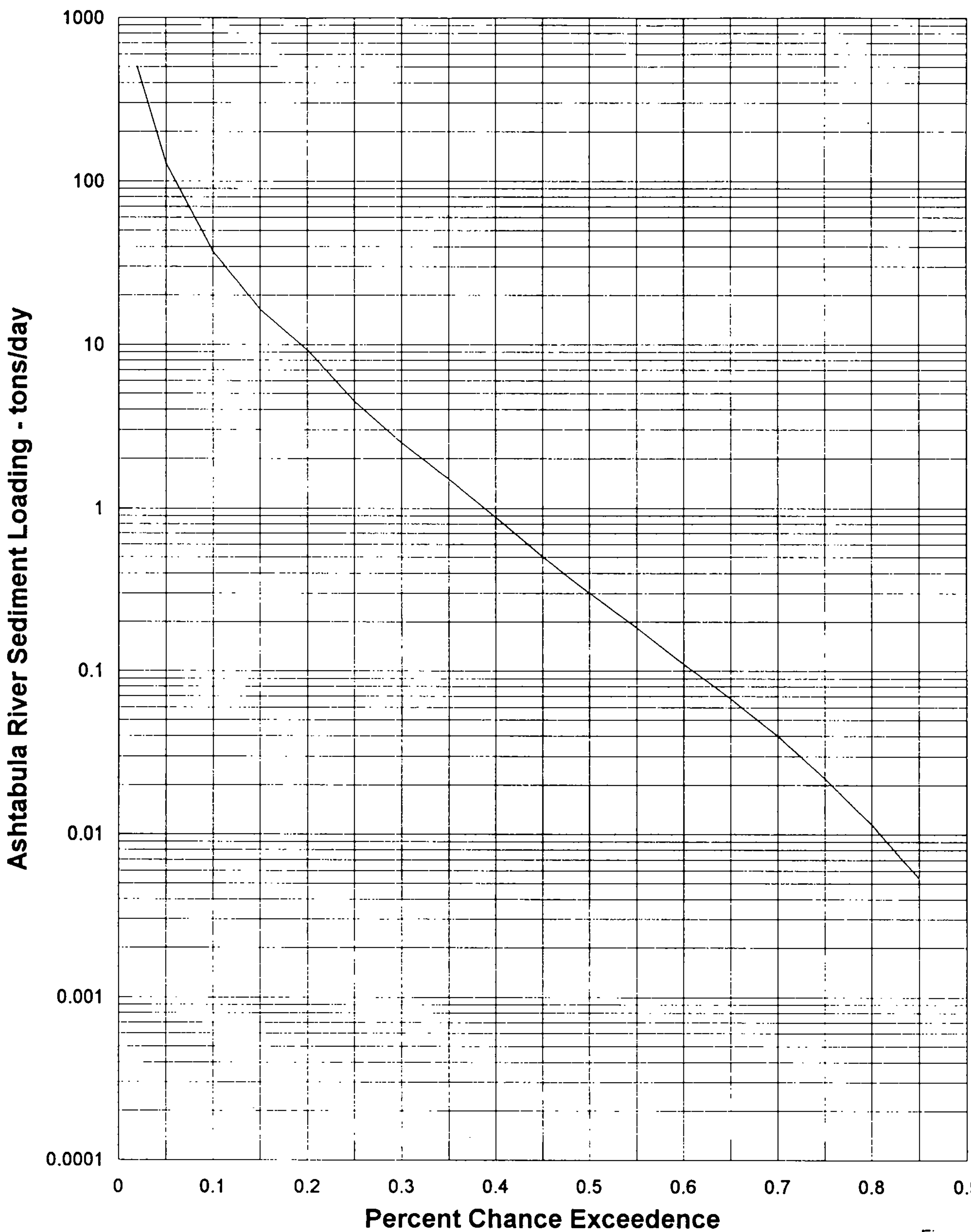


Figure 25

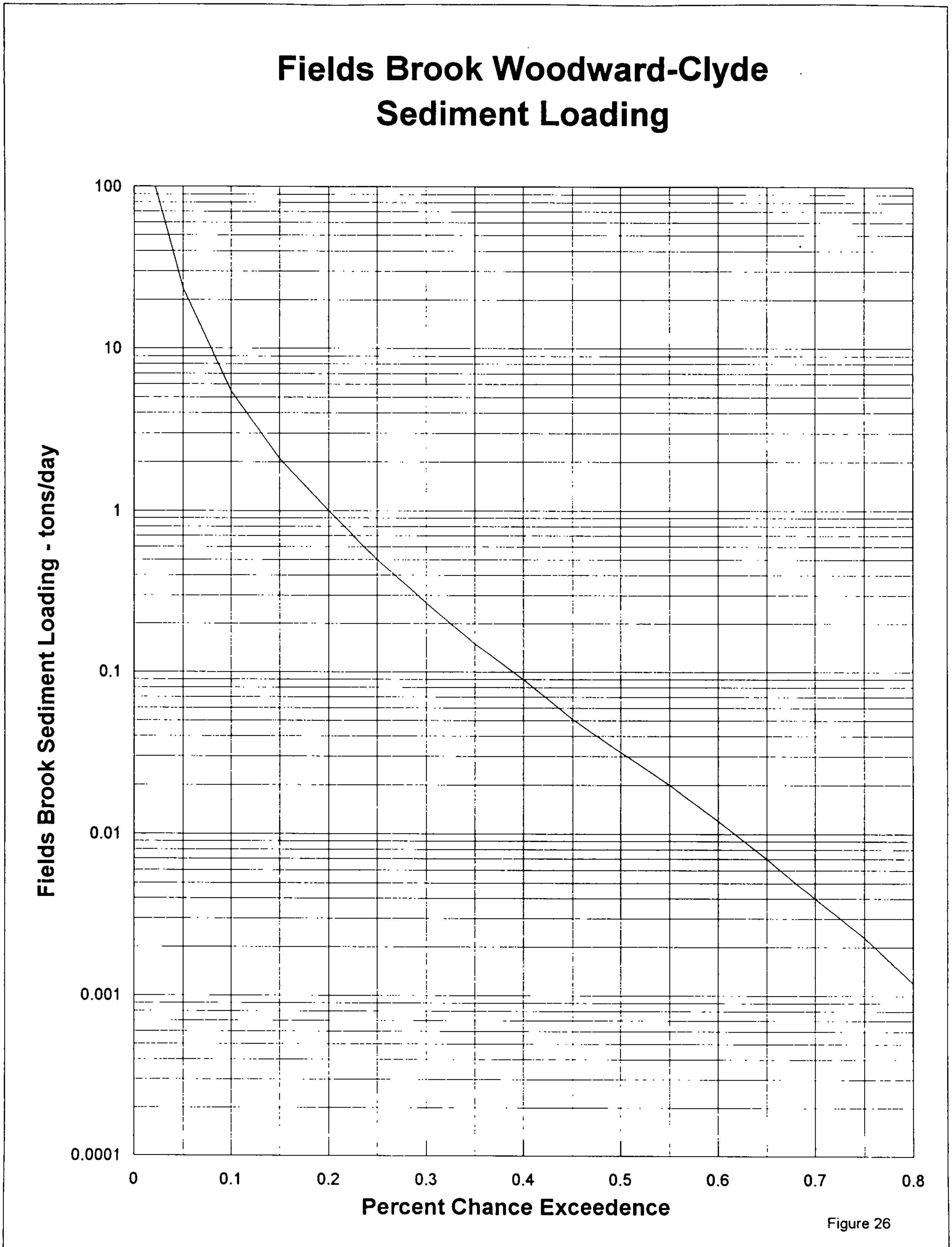
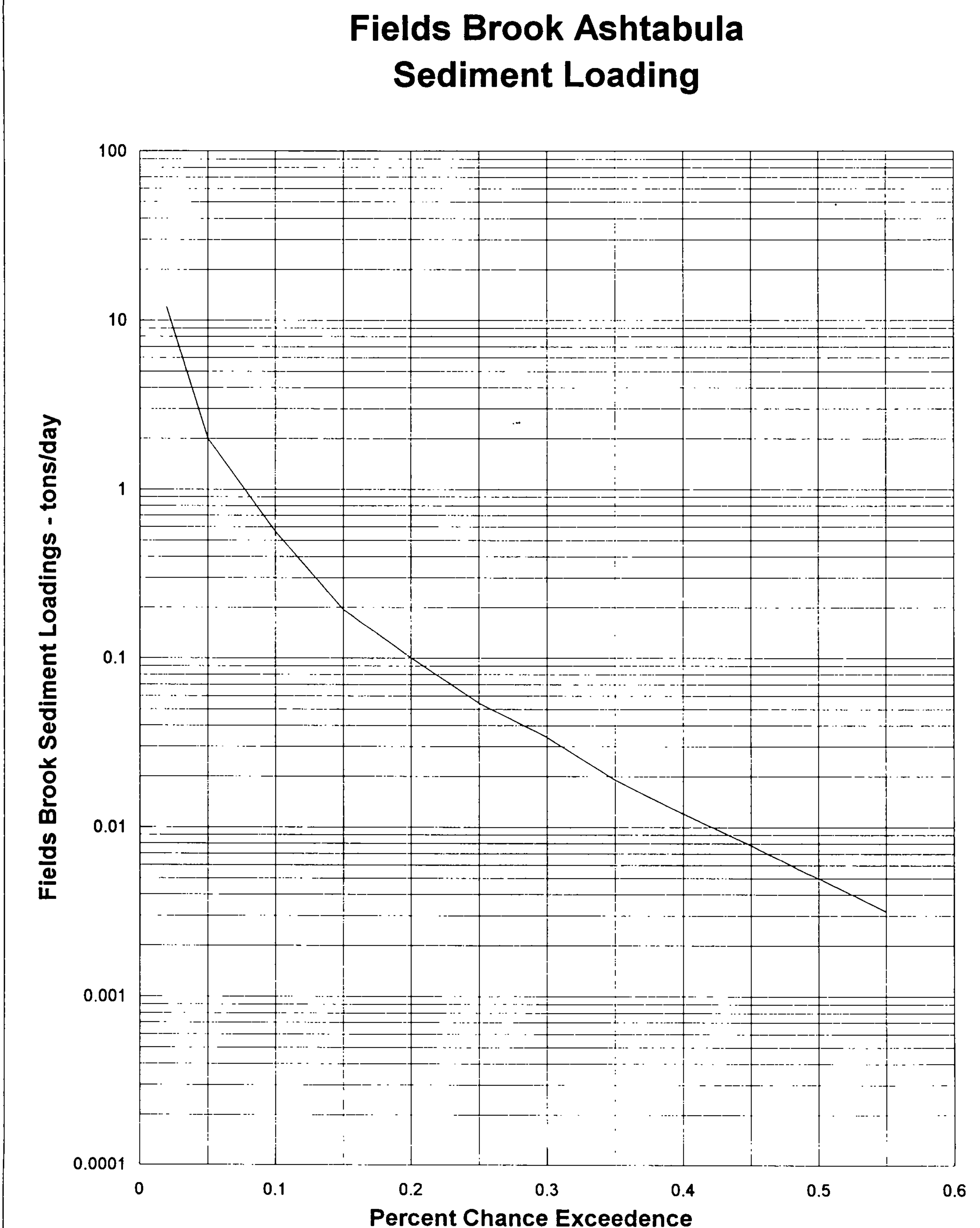

Fields Brook Woodward-Clyde
Sediment Loading
100
10
1
0.1
0.01
0.001
0.0001
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Fields Brook Sediment Loading - tons/day
Percent Chance Exceedence

Figure 26



Fields Brook Ashtabula
Sediment Loading
Fields Brook Sediment Loadings - tons/day
100
10
1
0.1
0.01
0.001
0.0001
0
0.1
0.2
0.3
0.4
0.5
0.6
Percent Chance Exceedence

Figure 27

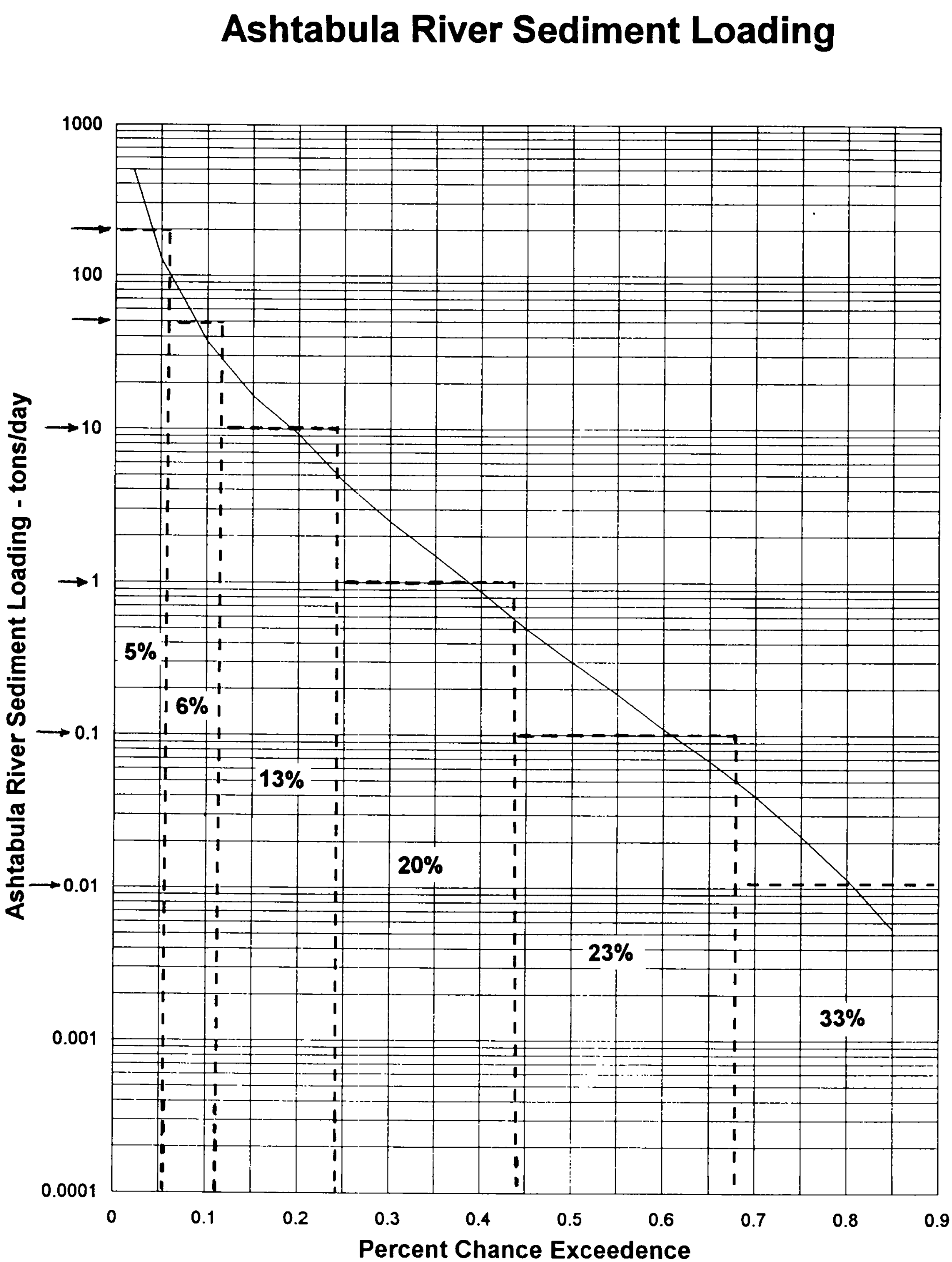
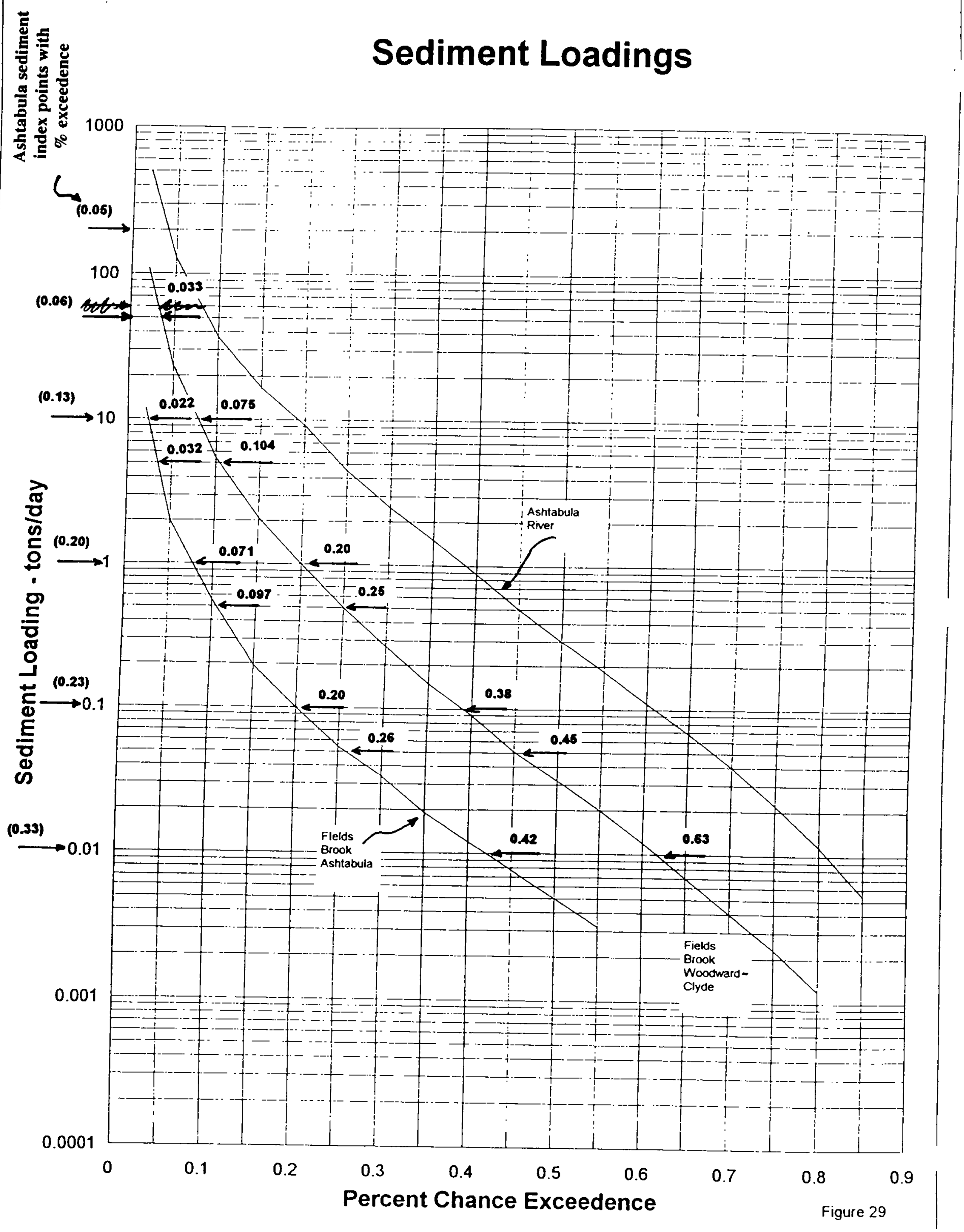

Ashtabula River Sediment Loading
Ashtabula River Sediment Loading - tons/day
1000
100
10
1
0.1
0.01
0.001
0.0001
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Percent Chance Exceedence
5%
6%
13%
20%
23%
33%

Figure 28



Sediment Loadings
Ashtabula sediment index points with % exceedence
Sediment Loading - tons/day
Percent Chance Exceedence
1000
100
10
1
0.1
0.01
0.001
0.0001
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
(0.05)
(0.06)
(0.13)
(0.20)
(0.23)
(0.33)
0.033
0.022
0.075
0.032
0.104
0.071
0.20
0.097
0.25
0.20
0.38
0.26
0.45
0.42
0.63
Ashtabula River
Fields Brook Ashtabula
Fields Brook Woodward-Clyde

Figure 29

Fields Brook Woodward-Clyde Curve
Full Ashtabula River Mixing

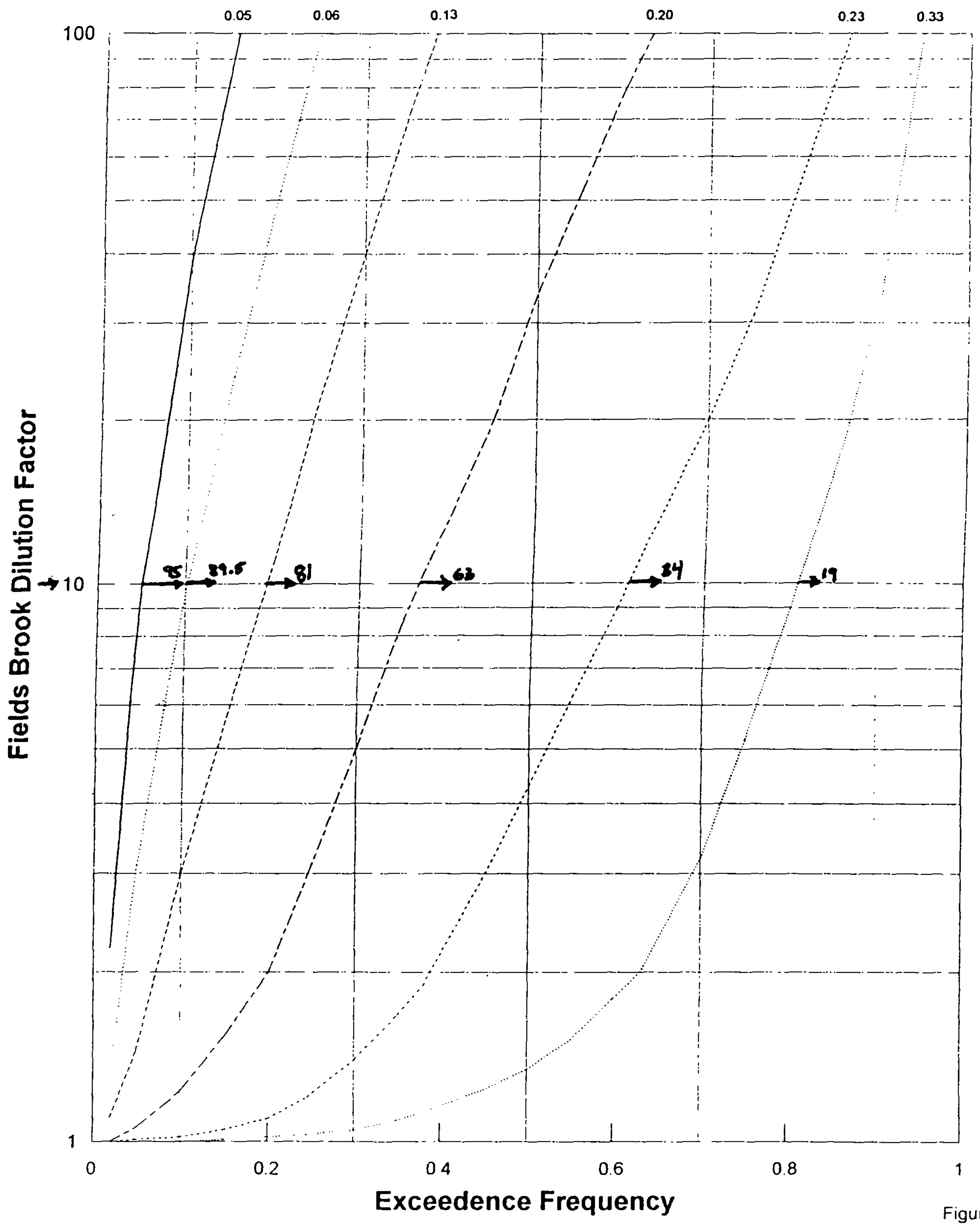


Figure 30

Fields Brook Woodward-Clyde Curve
Half Ashtabula River Mixing

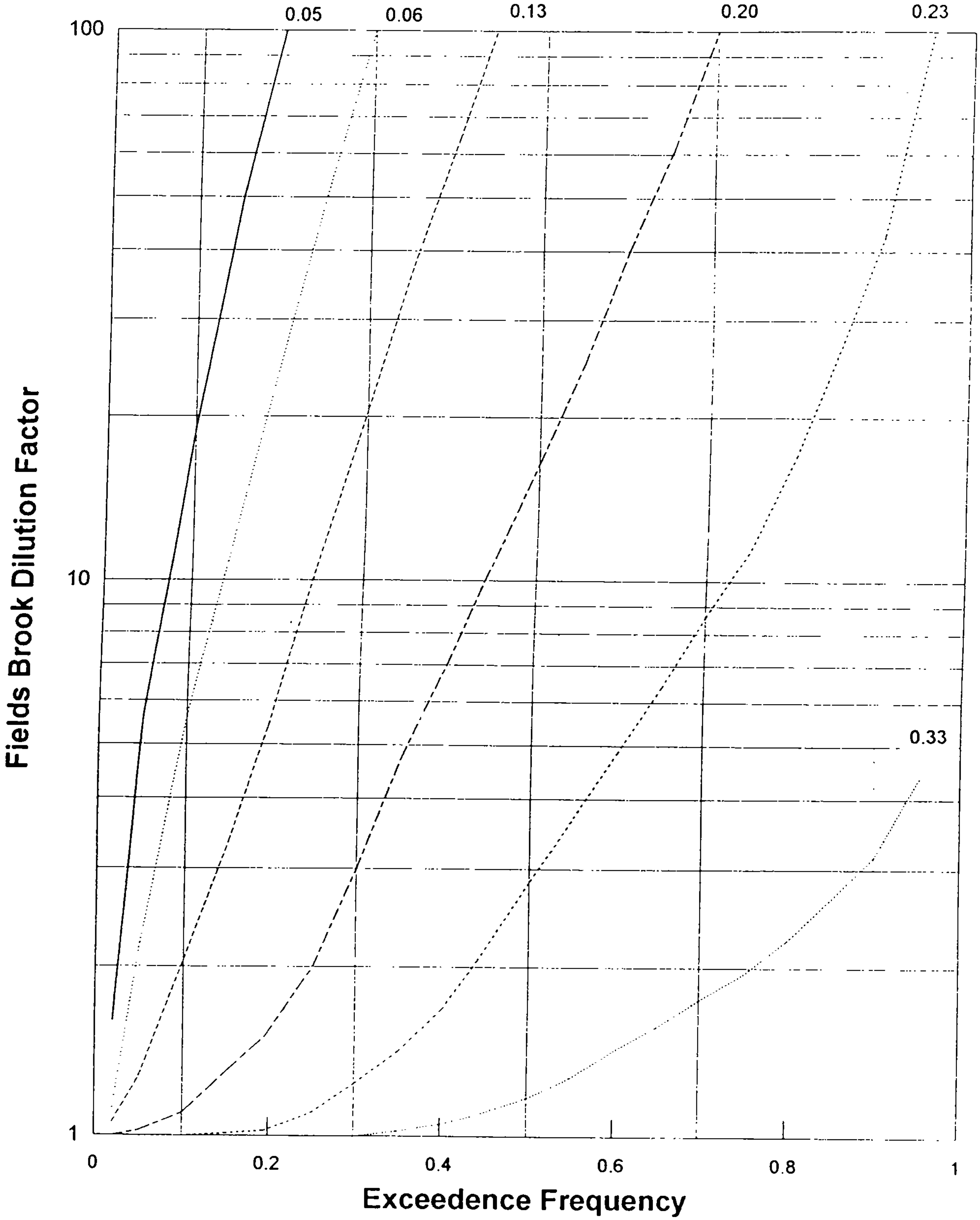


Figure 31

Fields Brook Ashtabula Curve
Full Ashtabula River Mixing

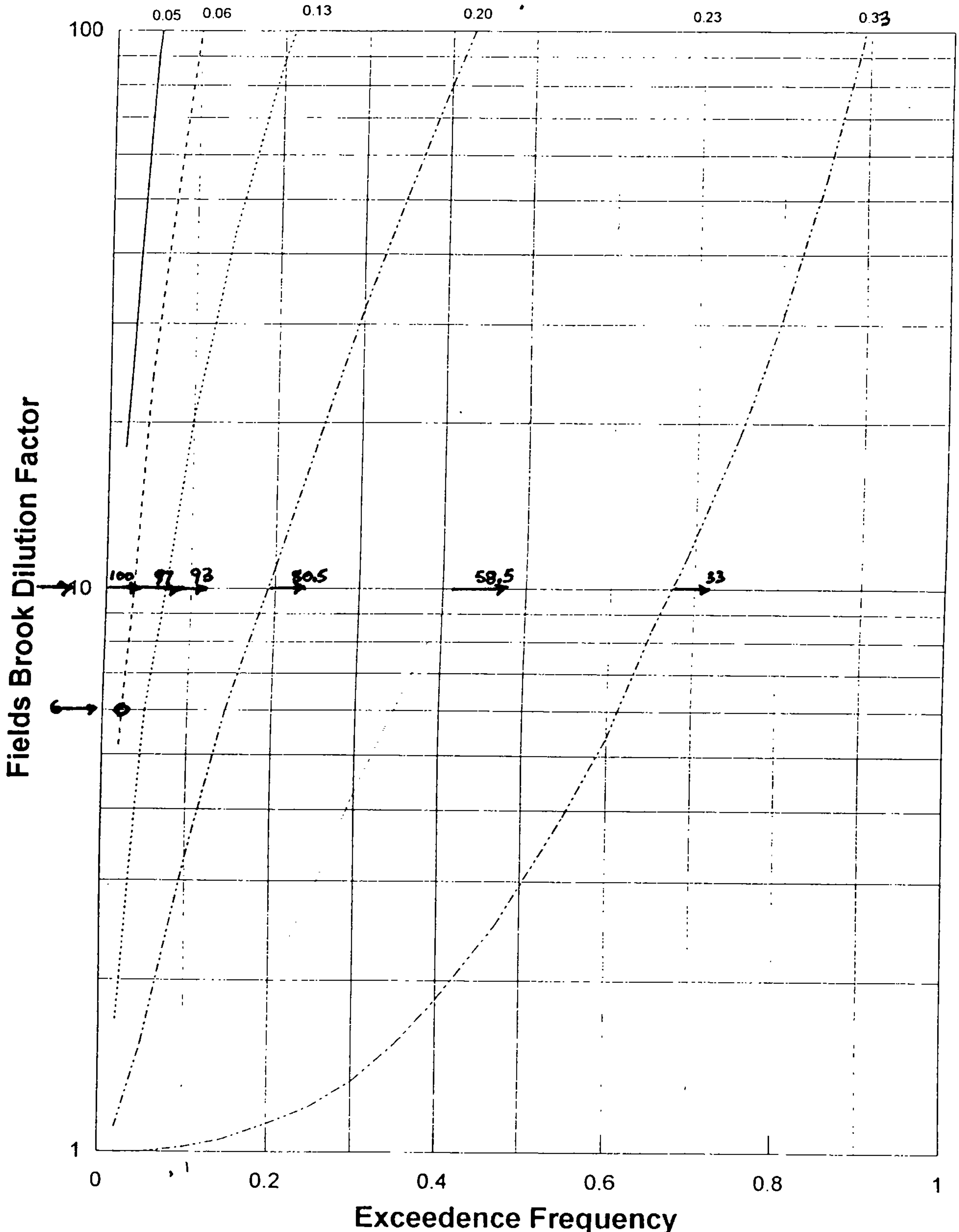
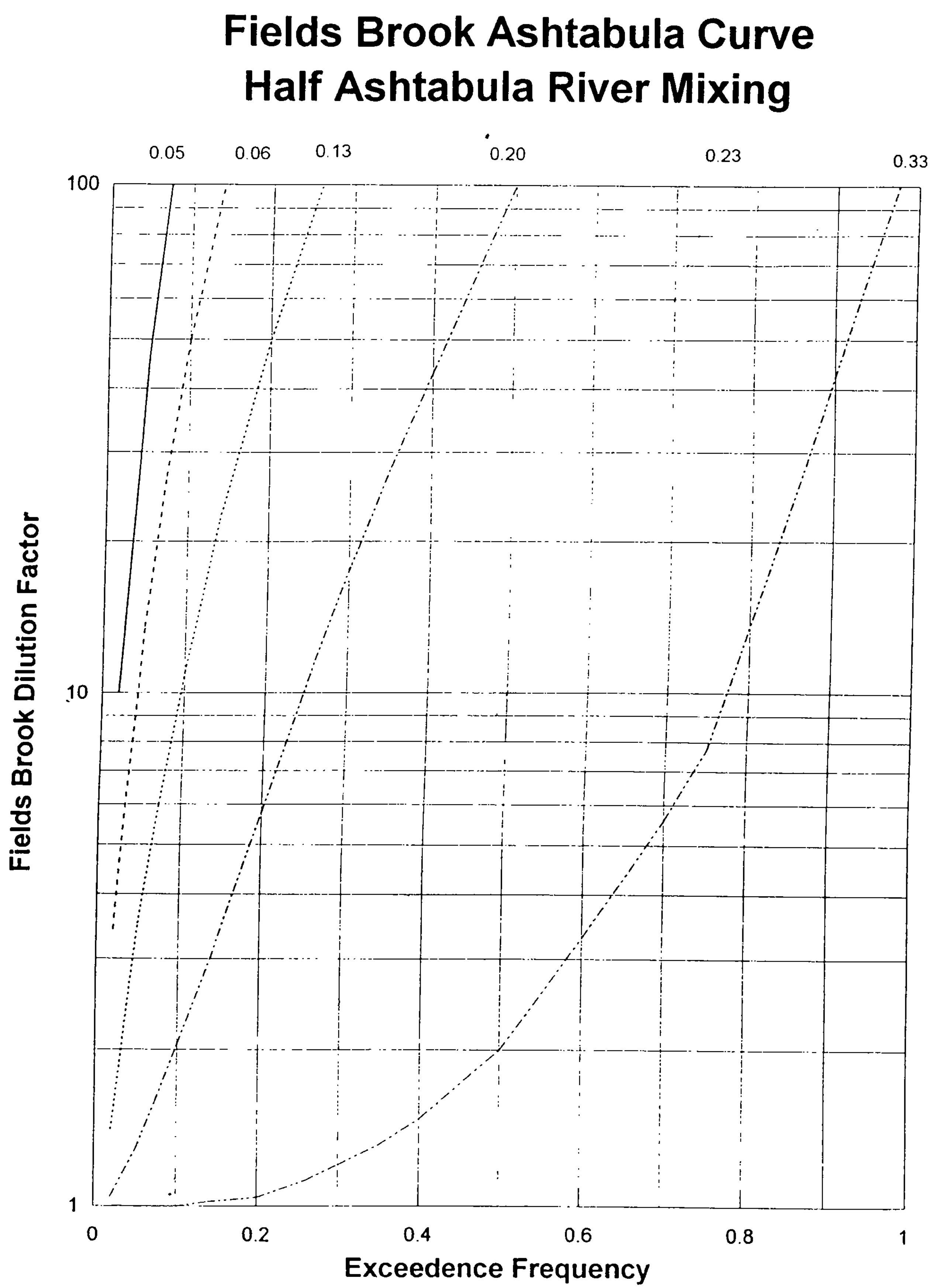


Figure 32



Fields Brook Ashtabula Curve
Half Ashtabula River Mixing
0.05
0.06
0.13
0.20
0.23
0.33
100
10
1
Fields Brook Dilution Factor
0
0.2
0.4
0.6
0.8
1
Exceedence Frequency

Figure 33

Fields Brook Sediment Full Mixing with Ashtabula River Sediments

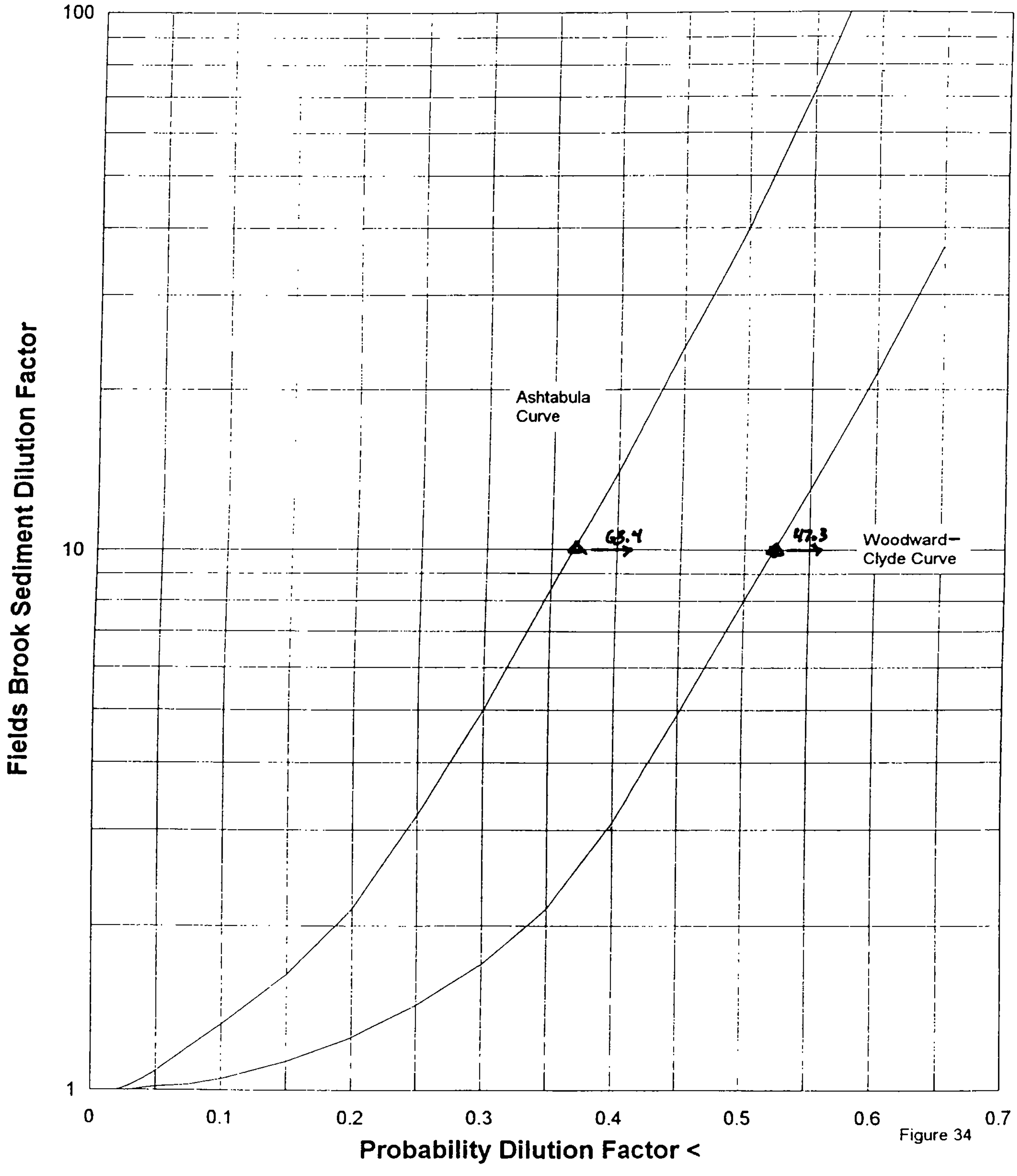


Figure 34

Fields Brook Sediment Mixing with Half Ashtabula River Sediments

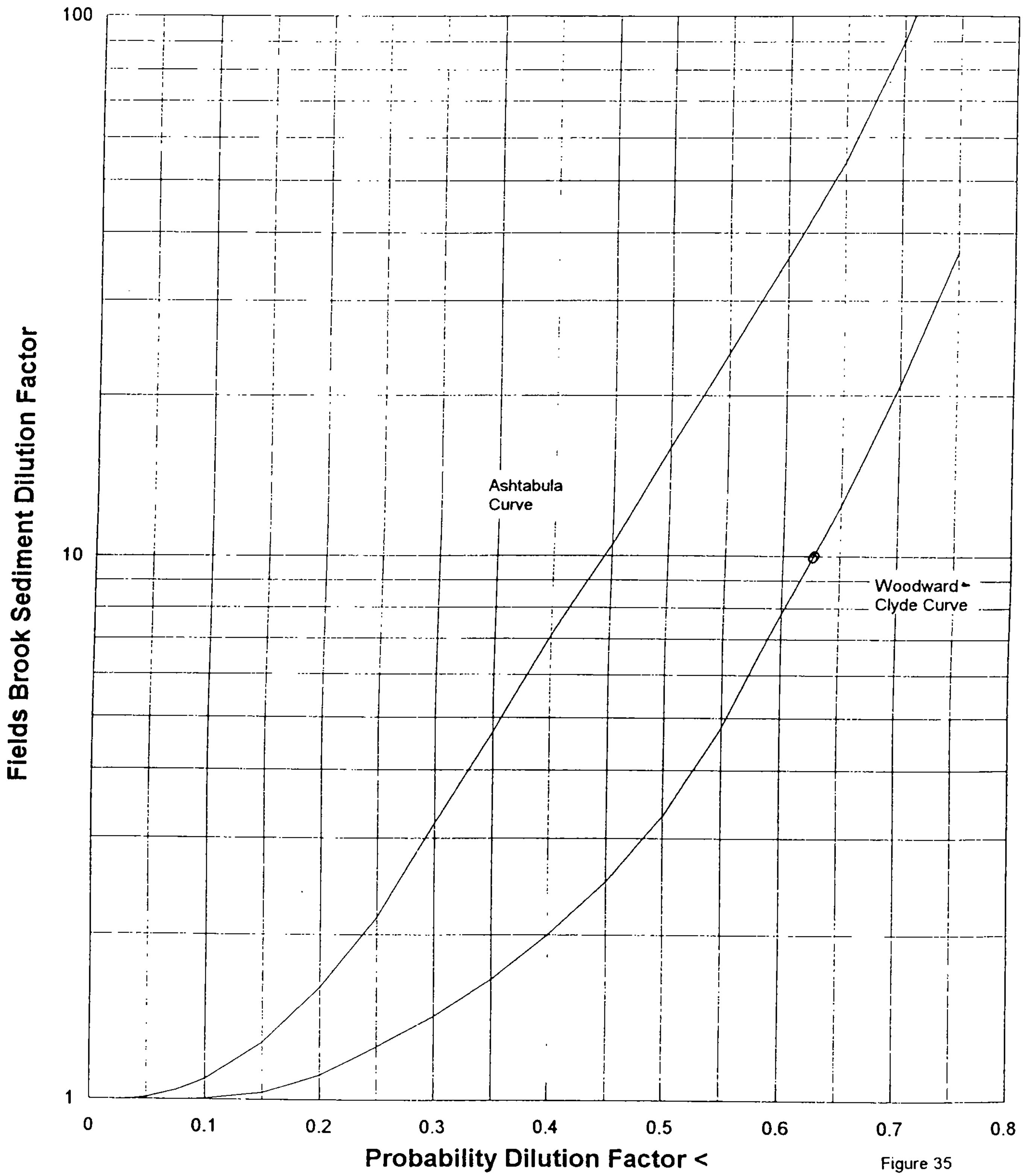


Figure 35

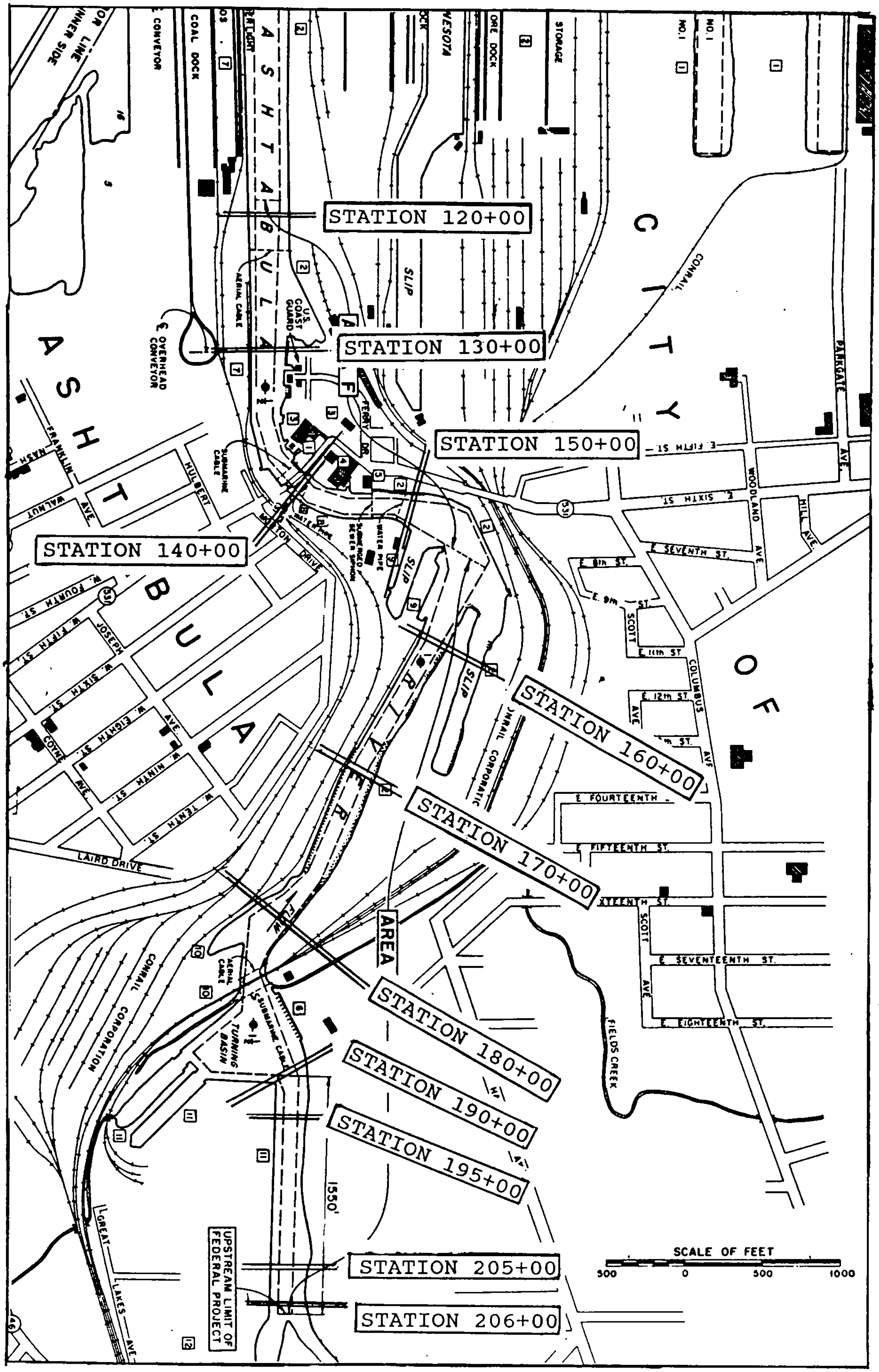

STATION 120+00
STATION 130+00
STATION 140+00
STATION 150+00
STATION 160+00
STATION 170+00
STATION 180+00
STATION 190+00
STATION 195+00
STATION 205+00
STATION 206+00
ASHTABULA
CITY OF
AREA
UPSTREAM LIMIT OF FEDERAL PROJECT
SCALE OF FEET
500
0
500
1000
1550'
COAL DOCK
ORE DOCK
STORAGE
SLIP
TURNING BASIN
FIELDS CREEK
CONRAIL CORPORATION
LAIRD DRIVE
E. FOURTEENTH
E. FIFTEENTH ST.
E. SEVENTEENTH ST.
E. EIGHTEENTH ST.
COLUMBUS AVE
WOODLAND AVE.
PARKGATE AVE.
GREAT LAKES AVE

Figure 36

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX I

DREDGING ALTERNATIVES AND SELECTION

PREPARED BY:

Environmental Engineering Section
U.S. Army Corps of Engineers, Buffalo District
August 1997

ASHTABULA RIVER DREDGING

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1.0 PURPOSE AND OBJECTIVE

Sediments are soils that have been deposited in water bodies after having eroded from land surfaces, moved along shorelines by littoral process, or washed off of streets and paved areas. The removal or excavation of sediments from a water body is known as dredging and is a process that is carried out routinely around the world. The most common purpose of dredging is to construct or maintain channels for navigation or flood control. The term "environmental dredging" has evolved in recent years to distinguish dredging operations for the primary purpose of environmental restoration from those operations for the purpose of maintaining channels. This appendix briefly describes the history of maintenance dredging in the Ashtabula River (Figure 1), reviews the available dredging technologies and identifies the recommended dredging method(s) for the Ashtabula River environmental dredging project.

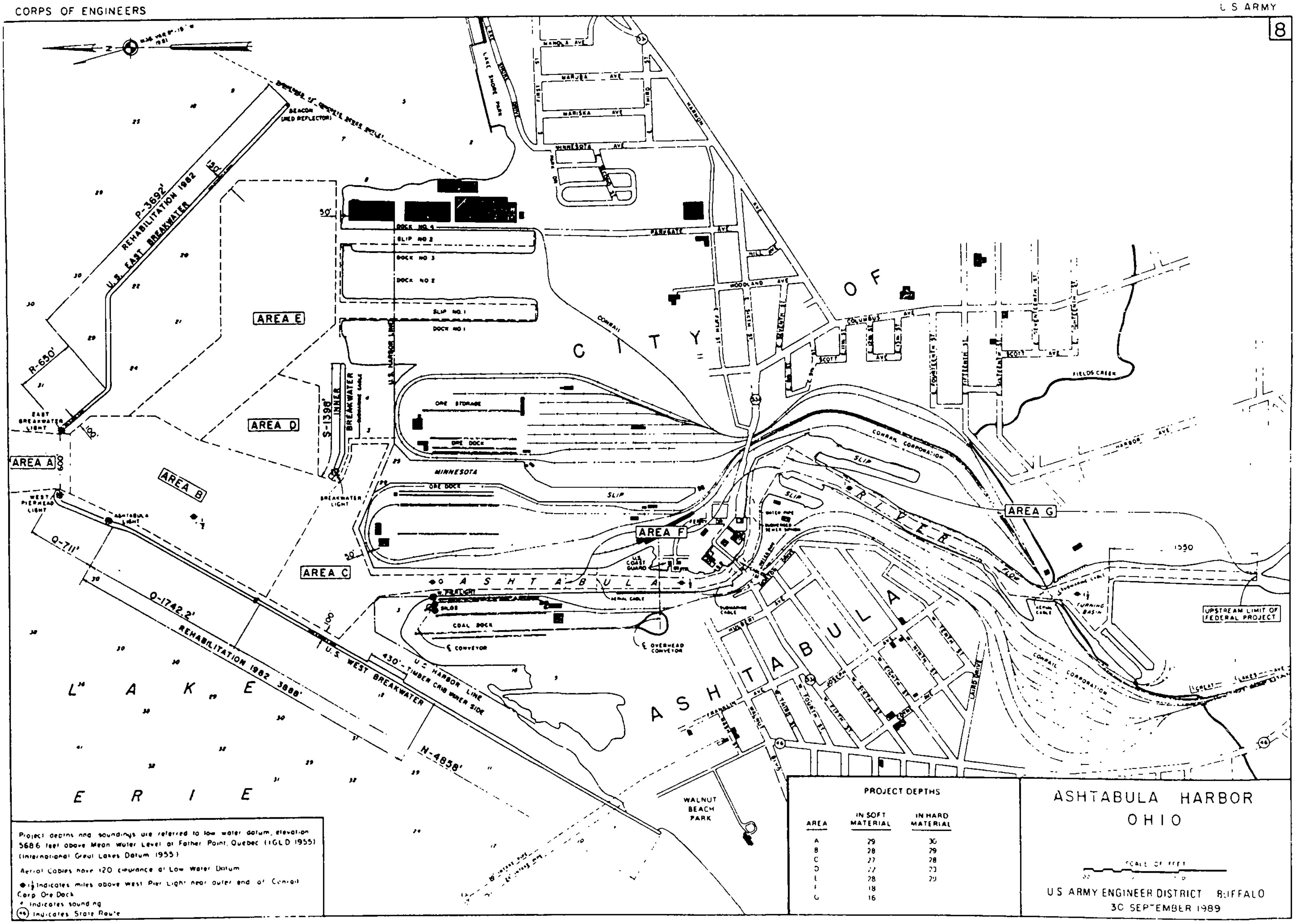
2.0 HISTORY OF DREDGING

The U.S. Army Corps of Engineers is authorized by Congress to operate and maintain over 125 navigation projects around the Great Lakes. These projects include major commercial and industrial ports, smaller commercial and fishing harbors, and recreational harbors. Project features that must be maintained include breakwaters and piers, which provide shelter from high waves, locks, and navigation channels in rivers and harbors. The depths and widths to which navigation channels are maintained are prescribed in the Congressional authorization for each project. Dredging beyond these channel limits must be done in accordance with all applicable laws and regulations. Section 312 of the Water Resources Development Act of 1990 (PL 101-640) gave the Corps the authority to dredge outside the navigation channel for "the purpose of environmental enhancement and water quality improvement." The law requires that a local, non-Federal, sponsor must provide the funds for 50 percent of the dredging costs and 100 percent of the disposal costs for the dredged material. Aside from projects conducted under Section 312, any other dredging outside an authorized Federal channel must be funded by other sources or specifically authorized by Congress.

In order to maintain navigation channels at authorized depths the Corps of Engineers dredges bottom sediments that accumulate in the channels. The Corps dredges roughly 4 million cubic yards of sediments annually from authorized Federal projects around the Great Lakes.

The Ashtabula River was last dredged in 1993 by the Corps of Engineers under special Congressional authorization. Approximately 23,800 cubic yards of sediment was dredged from the navigation channel between the Fifth Street bridge and the

Figure 1


CORPS OF ENGINEERS
U S ARMY
8
U.S. EAST BREAKWATER
REHABILITATION 1982
P-3692'
R-650'
EAST BREAKWATER LIGHT
AREA A
AREA B
AREA C
AREA D
AREA E
AREA F
AREA G
WEST PIERHEAD LIGHT
Q-711'
Q-1742.2'
REHABILITATION 1982 3888'
U.S. WEST BREAKWATER
430' TIMBER CRIB INNER SIDE
U.S. HARBOR LINE
H-4858'
INNER BREAKWATER
S-1398'
BREAKWATER LIGHT
DOCK NO. 4
SLIP NO. 2
DOCK NO. 3
DOCK NO. 2
SLIP NO. 1
DOCK NO. 1
ORE STORAGE
ORE DOCK
MINNESOTA
SLIP
COAL DOCK
CONVEYOR
OVERHEAD CONVEYOR
CONRAIL
CONRAIL CORPORATION
CITY OF ASHTABULA
RIVER
ASHTABULA
LAKE ERIE
WALNUT BEACH PARK
FIELDS CREEK
UPSTREAM LIMIT OF FEDERAL PROJECT
TURNING BASIN
Project depths and soundings are referred to low water datum, elevation 568.6 feet above Mean Water Level at Father Point, Quebec (IGLD 1955) (International Great Lakes Datum 1955)
Aerial Cables have 120 clearance at Low Water Datum
Indicates miles above West Pier Light near outer end of Conrail Corp Ore Dock
Indicates sounding
Indicates State Route
PROJECT DEPTHS
AREA
IN SOFT MATERIAL
IN HARD MATERIAL
A 29 30
B 28 29
C 27 28
D 22 23
E 28 29
F 18
G 16
ASHTABULA HARBOR
OHIO
SCALE OF FEET
U S ARMY ENGINEER DISTRICT BUFFALO
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upstream end of the navigation channel (Figure 1). An enclosed watertight level-cut bucket was specified for dredging this material. The dredged sediment was placed in a specially constructed confinement facility on private property along the Ashtabula River. This facility was intended to be temporary although the dredged material is still contained within this cell.

Prior to 1993 the Ashtabula River was last dredged in 1979. Approximately 16,600 cubic yards of sediment was removed from the turning basin by a Corps of Engineers contractor (Figure 1). This material was excavated with a clamshell bucket and was open-lake disposed.

3.0 SELECTION CRITERIA FOR DREDGING EQUIPMENT

The selection of dredging equipment to excavate sediment at a particular job is normally based on numerous factors(COE,1983), including:

* Quantity of sediment to be removed
* Sediment characteristics (particle size, density, debris, etc.)
* Site physical characteristics (water depth, channel width, areal extent of dredging, obstructions, etc.)
* Location of the disposal site
* Compatibility with disposal operations
* Availability of equipment
* Cost of equipment use
* Dredge environmental characteristics

These criteria will be used to determine the recommended dredging method(s) for the Ashtabula River project.

3.1 Quantity of Sediment to be Removed

The proposed project involves dredging a total of approximately 696,000 cubic yards of contaminated sediment from the lower Ashtabula River. Approximately 150,000 cubic yards of this material may be classified as TSCA material due to elevated levels of PCBs. It is anticipated that this material will be dredged over a 3 year period, resulting in between 200,000 and 300,000 cubic yards of sediment being dredged during each construction season. Assuming a 6 month dredging season and a 6 day a week operation 1,300 to 2,000 cubic yards of sediment will need to be dredged each day. Conventional mechanical and hydraulic dredges are capable of operating at production rates equal to or greater than this while some of the special purpose dredges are not capable of operating consistently at these production rates.

3.2 Sediment Characteristics

The sediments to be dredged from the lower Ashtabula River are predominantly fine-grained soil particles, i.e., silts and clays, and are not highly consolidated. Most dredge methods are capable of excavating this type of sediment, although some dredges are not well suited for removing this type of material. It is likely that a fair amount of debris and oversized material is present within the sediments to be dredged. This may include cobbles, boulders, construction debris, timber, etc. This type of material can cause significant problems for most dredges, particularly hydraulic dredges whose cutterheads and intake lines may become clogged.

3.3 Site Physical Characteristics

Much of the lower Ashtabula River to be dredged has water depths of less than 10 feet based on August 1995 sounding data. This includes significant portions of the authorized Federal navigation channel. Some portions of the Federal channel have water depths of approximately 5 to 6 feet, while areas outside the channel are even shallower in depth. Significant portions of the upper reaches of the Federal channel are as little as 100 feet in width. The channel dimensions, depth and width, would prevent the use of the largest hydraulic dredges and could affect the selection of some mechanical and/or special purpose dredges. The size of the area to be dredged will also affect the dredge selection process.

3.4 Location of the Disposal Site

The distance to the disposal facility as well as the type of disposal facility, i.e., in-lake, upland, off-site, influence the dredge selection process. If the disposal facility is not in the immediate area of the dredging project, hydraulic dredging and pipeline transportation may not be economically feasible. The cost of constructing a lengthy pipeline across roads, railroads, and private property may be prohibitive as would be the cost of transporting low density hydraulic slurrys by barge long distances. Mechanically dredged sediment could be transported by truck or rail to upland disposal facilities or by barge to an in-lake disposal facility.

3.5 Compatibility With Disposal Operation

The selected disposal method may influence the dredge selection process. A relatively small upland disposal facility may not have sufficient storage capacity to allow adequate settling of hydraulic dredge slurrys unless they are first dewatered before disposal. Similarly, sediment transported to on-site or off-site TSCA disposal facilities may require dewatering before disposal in order to satisfy regulatory requirements.

3.6 Availability of Equipment

Some dredge methods are readily available in the United States and the Great Lakes area while other dredging technologies are not available in the United States or have had very limited exposure in the States. The Ashtabula River project is a full scale dredging project, not a small scale cleanup action. In order to achieve this dredging work in a timely manner it is going to be necessary to use proven reliable equipment with sufficient production rates. This is not a project that should involve searching out unproven dredging technologies for demonstration of their effectiveness. This will result in the elimination of some of the specialty dredges from consideration.

3.7 Cost of Equipment Use

Corps of Engineers contracts are advertised to all dredging contractors and the lowest qualified bidder is awarded the contract. The actual costs of dredging by contractors takes into account all of the factors described above. Dredging costs are normally compared in units of dollars per cubic yard.

3.8 Dredge Environmental Characteristics

As stated above, this project involves the dredging of several hundred thousand cubic yards of contaminated Ashtabula River sediments, including roughly 150,000 cubic yards of TSCA classified sediments. Typically contaminants are associated with the fine grained sediments, including the PCBs of concern in the Ashtabula River. Therefore, it becomes important to select a dredge that is capable of excavating the sediment of interest without generating excessive quantities of resuspended sediment. It is also desirable to utilize a dredge with adequate horizontal and vertical control in order to accomplish the dredging of the material of interest without removing excessive quantities of material that does not need to be removed. Removing unnecessary material results in unnecessary costs associated with dredging, transporting, disposal, and possibly treatment prior to disposal.

4.0 **AVAILABLE DREDGING TECHNOLOGIES**

Dredging may be performed using a variety of dredging equipment. Most dredges may be categorized as mechanical or hydraulic dredges based on the basic means of moving the material (Figure 2). Mechanical dredging removes sediments through mechanical action by physically grabbing the sediments at the bottom of the water body and lifting them through the water column. Hydraulic dredging removes sediments in a water slurry

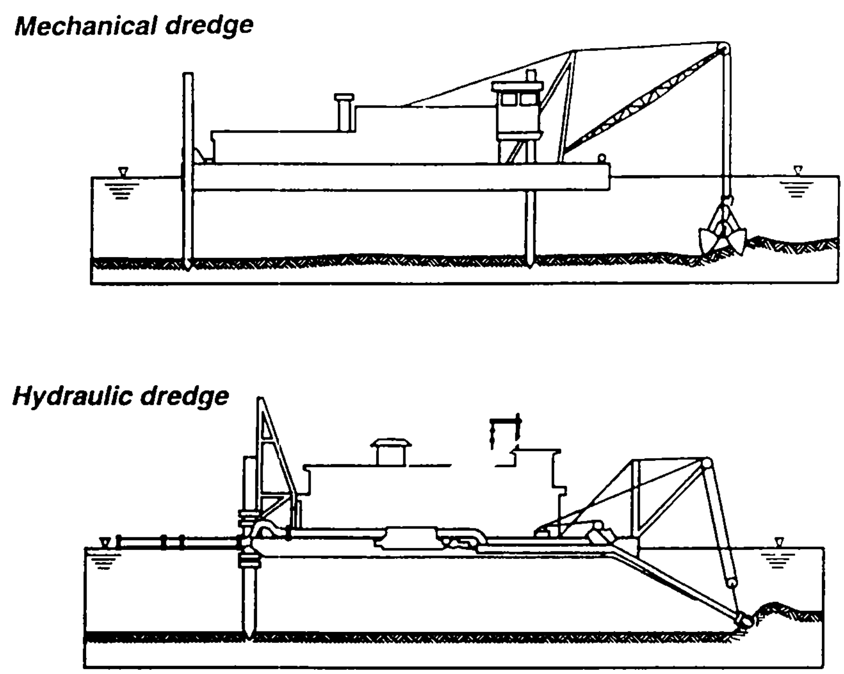


Figure 2 - General Dredge Types

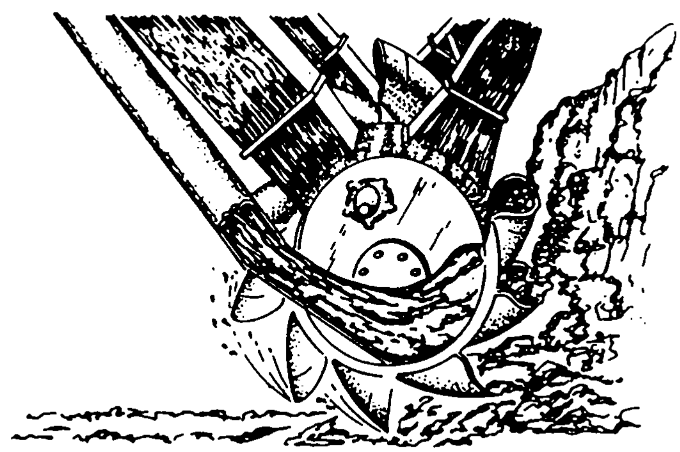


Figure 3 - Bucket Wheel Dredgehead

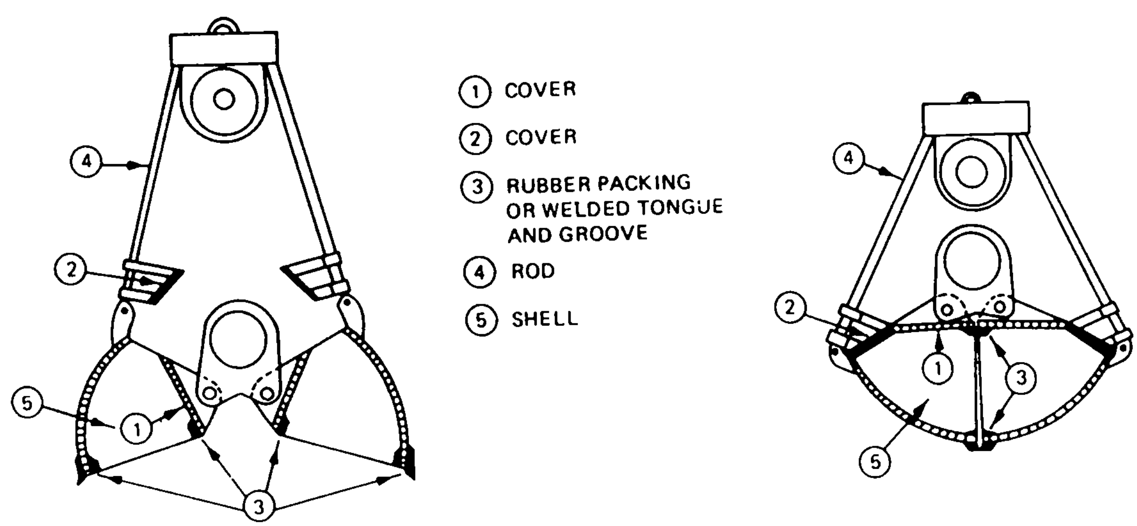


Figure 4 - Open and Closed Positions of the Closed-Bucket Clamshell

through hydraulic action after the sediments are removed from the water body with the help of a vacuum. A number of equipment options are available for each category. Additionally, there are a number of special purpose dredges for specific applications. For "environmental dredging" it is desirable to select a dredge method that resuspends limited amounts of sediment because contaminants are likely to be associated with these sediments and it becomes necessary to control the movement of the resuspended material in order to control the redistribution of contaminants.

4.1 Mechanical Dredges

Numerous mechanical dredges were evaluated for their potential use in excavating sediments from the Ashtabula River for this project. Sediments excavated with a mechanical dredge are typically placed into a barge, scow or hopper for transport to a transfer or disposal facility. Mechanical dredging removes sediment with little or no change in the water content, i.e., at near in situ solids content.

The backhoe is a boom or dipper arm with an open bucket attached to the boom (Averett 1990). The backhoe may be mounted on a crawler or floating barge and is hydraulically operated. Dredge operating characteristics of the backhoe are shown in Table 1. Resuspension rates for the backhoe are expected to be high because the bucket is open as the dredged material is raised through the water column. Because of the high turbidity associated with the use of this dredge, the backhoe will not be considered for the environmental dredging of the Ashtabula River.

The bucket ladder dredge consists of an inclined submersible ladder supporting a number of buckets that rotate around the circumference of the ladder (Averett 1990). The buckets pick up sediment at the bottom of the ladder and bring the material to the top of the ladder where the sediment is removed by the dumping action produced when the bucket rotates around the top ladder pivot. Bucket leakage and the mechanical agitation of the sediments cause high turbidity and therefore the bucket ladder dredge will not be considered for this dredging work.

The bucket wheel dredge consists of a submersible wheel supporting a number of bottomless buckets that rotate with the wheel (Figure 3). The dredge material is force fed toward the center of the wheel which contains a suction pipe for collecting the sediments and bringing them to the surface. The positive-feed feature allows control over the percent solids passing into the pump by controlling the wheel rotating speed and/or the dredge swing speed (Palermo 1988). Data are not available on the turbidity generation caused by the bucket wheel dredge but it will be considered as a possible dredging alternative for this project.

Table 1 - Summary of Dredge Operating Characteristics[a]

Dredge Classification	Dredge Type	Percent Solids in Slurry by Weight[b]	Turbidity Caused	Compatible With Soil Types	Vessel Draft (Ft.)	Approximate Range of Production Rates (cu yd/hr)	Dredging Depths (ft.)		Availability	Lateral Dredging Accuracy (ft.)	Vertical Dredging Accuracy (ft.)
							Minimum	Maximum			
Mechanical	Backhoe	in situ	high		c	25-200	0[d]	30-80	Available	3	1
	Bucket Ladder	Near in situ	high			low-high			Available		
	Bucket Wheel	low	NA	Consolidated					Available		
	Clamshell (Open)	in situ	high	soft or cohesive sediment	c	30-500	0[d]	100[e]	Available	1	2
	Closed-Bucket Clamshell	in situ	low	soft or cohesive sediment	c	30-500	0[d]	100	Available	1	2
	Dipper	in situ	high	best suited for rock, hard compact material	c	30-500	0[d]	50	Available	1/2	
	Dragline		very high		c			100	Available		
	Orange-Peel				c			100	Available		
Hydraulic	Cutterhead	10-20%	average	wide range	3-14	25-10,000	3-14	12-65	Available	2-3	1
	Dustpan	10-20%	average	sand and gravel	5-14	25-5,700	5-14	50-60	Limited	2-3	1/2
	Hopper	10-20%	average	clay, silt, sand, gravel	12-31	500-2,000	10-28	80	available	10	2
	Suction	10-15%	low	free flowing, sand, unconsolidated, little debris	3-14	25-5,000	3-14	12-65	Available	2-3	1
	Sidecasting	10-20%	high	clay, silt, sand, gravel	5-9	325-650	6	25		10	

Dredge Classification	Dredge Type	Percent Solids in Slurry by Weight[b]	Turbidity Caused	Compatible With Soil Types	Vessel Draft (Ft.)	Approximate Range of Production Rates (cu yd/hr)	Dredging Depths (ft.)		Availability	Lateral Dredging Accuracy (ft.)	Vertical Dredging Accuracy (ft.)
							Minimum	Maximum			
Special Purpose	Airlift	33%±		wide range	c	NA	20-30	f	Available	1	1
	Clean-Up System	30-40%	low	clay, silt, sand		500-2,000	3-16	13-70	Foreign	2-3	1
	Delta	high	low			low			Proprietary		
	Eddy Pump	Up to 50%				up to-400+		>100	Proprietary		
	Hand-Held Hydraulic		low			low			Available		
	Horizontal Auger	10-40	low	clay, silt, sand, gravel	<5 ft.	60-150	2	20	Available	1/2	1/2
	Matchbox Suction Head	near in situ	low	fine grained		25-80	3-16	13-70	Proprietary	3	1
	Pneuma Pump	Up to 80% of in situ	low	sand, silt, clay	c	60-2,600	12	>150	Proprietary	1	1
	Oozer Pump	Up to 80% of in situ	low	wide range	c	450-650	0[d]	>150	Foreign	2-3	1
	Refresher System	30-40%	low	clay, silt, sand		200-1,300	3-16	13-70	Foreign	2-3	1
	Waterless	30-50%	low						Proprietary		

NOTE: NA - Not Available

a. Prepared with information from COE and USEPA documents
b. Percent solids could theoretically be 0, but these are normal working ranges. Percent solids = $\frac{\text{wt. of dry sediment}}{\text{wt. of wet slurry}}$
c. Depends on floating structure; if barge-mounted, approximately 5- to 6-ft draft.
d. Zero if used alongside of waterway; otherwise, draft of vessel will determine the minimum operational depth.
e. Demonstrated depth; theoretically could be used much deeper
f. Theoretically unlimited.

The open clamshell dredge consists of a bucket or clamshell operated from a crane that can be mounted on a floating barge or used on land to remove sediments from a water body. Clamshell dredges are available in different sizes, boom lengths, and bucket sizes. The clamshell dredge is used primarily in the removal of soft or cohesive sediment and is particularly useful for excavating sediment in deep water and for dredging in locations alongside structures (Averett 1990). Anchors and spuds or tug boats are used to position and move the barge during dredging. The clamshell dredging process resuspends solids when the bucket impacts the sediment, is drawn from the sediment, and is pulled up through the water column. In addition, the clamshell dredge usually leaves an irregular, cratered bottom (Herbich 1991). Due to the large amount of turbidity generated by operation of the open clamshell dredge this alternative will not be considered for removal of the contaminated sediments in the Ashtabula River.

The closed-bucket clamshell (Figure 4) is a conventional clamshell dredge fitted with a special bucket designed to enclose the excavated sediments so that sediment resuspension caused by pulling the bucket through the water column and draining above the water is minimized (Averett 1990). Operation of the closed-bucket clamshell is similar to that of the open clamshell bucket. One closed-bucket design uses tongue-in-groove edges that seal the bucket when it is closed. The top of the bucket is also covered to minimize the loss of dredged material as the full bucket is drawn up through the water column. The closed-bucket can be used on an open-bucket dredge with no modification required to the dredge. A comparison of an open and closed bucket clamshell indicated that the closed-buckets generated 30 to 70 percent less turbidity in the water column. The closed-bucket clamshell is suitable for dredging the fine grained silt and clay expected to be encountered during the dredging of the Ashtabula River. It is also capable of removing larger sediment particles and debris that are likely to be encountered during dredging and has a shallow draft that will allow its operation in shallow portions of the Ashtabula River that will be dredged. This dredge bucket is readily available in the Great Lakes region and is capable of production rates that will allow the completion of this project in a reasonable timeframe. Due to the closed-bucket clamshell's versatility, availability, and ability to dredge while generating reduced amounts of turbidity this dredge method will be considered for this project.

The dipper dredge is a barge mounted power shovel equipped with a power-driven ladder structure (Figure 5). An open bucket is firmly attached to the ladder structure and is forcibly thrust into the material to be removed. The dipper dredge is best suited for excavating hard compacted materials, rock, or other solid materials after blasting (Averett 1990). The dipper dredge is not recommended for use in dredging contaminated sediment or

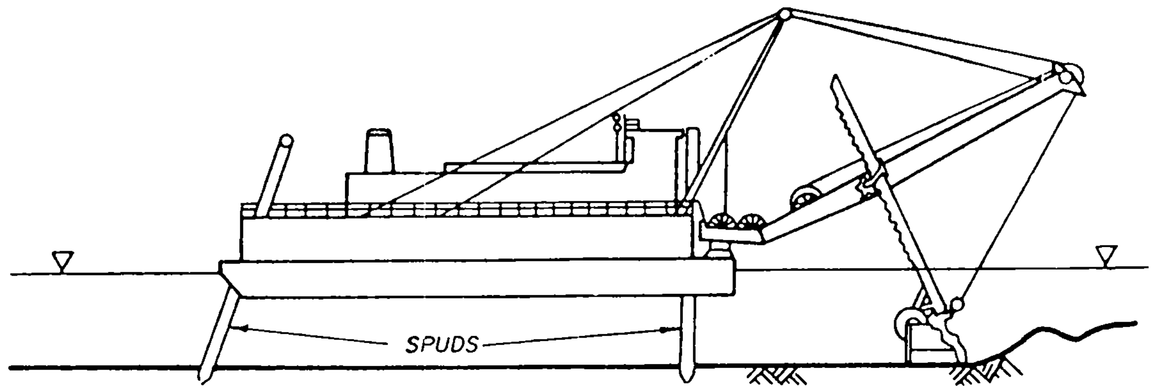


Figure 5 - Dipper Dredge

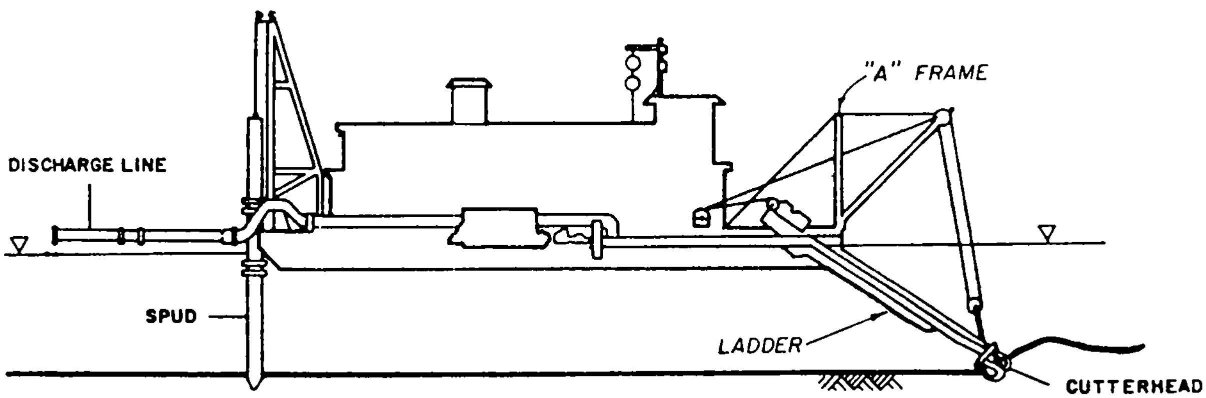


Figure 6 - Hydraulic Pipeline Cutterhead Dredge

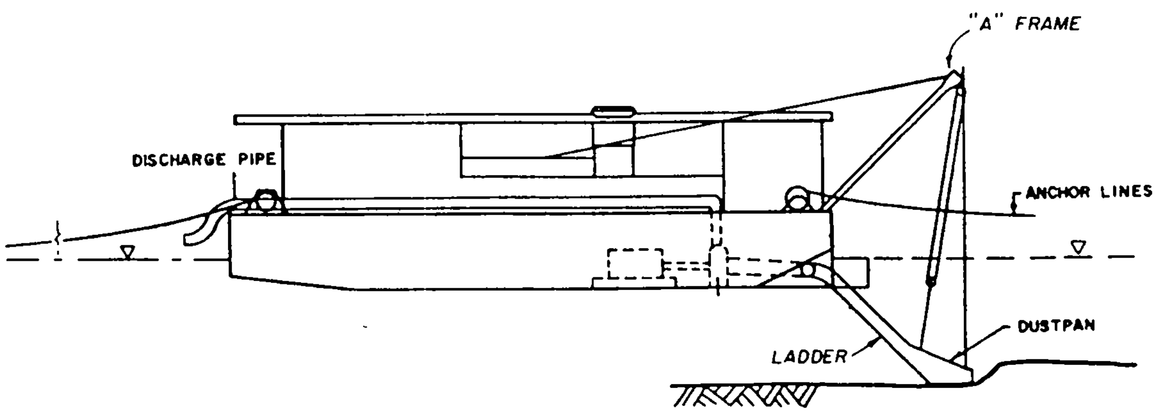


Figure 7 - Dustpan Dredge

where resuspension of sediment must be controlled. The dredging action of the dipper dredge may cause considerable sediment disturbance and resuspension, particularly during the dredging of fine-grained material. A significant loss of the fine-grained material will also occur from the open bucket as it is raised through the water column. For this reason, the dipper dredge will not be considered as an alternative for removing the Ashtabula River sediments.

The dragline dredge has been used for years in the excavation of sediments and other materials. Draglines are readily available with varying boom lengths and bucket sizes and are very reliable at removing sediment (Averett 1990).Because the open bucket must be pulled through the sediment for filling and lifted through the water column, sediment resuspension will be very high. Therefore, draglines are inappropriate for contaminated sediment removal or where resuspension is an issue (Averett 1990). The dragline dredge will not be considered for the removal of the contaminated Ashtabula River sediments.

None of the literature reviewed for this appendix contained information on orange-peel dredges. However, orange-peel buckets are not suitable for dredging fine-grained material but are better suited for the removal of gravel, cobbles, and oversized debris. An orange-peel bucket would result in very high resuspension rates if it were used to excavate fine-grained sediments. For this reason, the orange-peel bucket will not be considered for dredging the fine-grained contaminated Ashtabula River sediment to be removed under this project.

4.2 Hydraulic Dredges

Several hydraulic dredges were evaluated for their potential use in excavating sediments from the Ashtabula River for this project (Table 1). Hydraulic dredges remove and transport sediment in a liquid slurry form (Averett 1990). They are usually barge mounted and carry diesel or electric-powered centrifugal pumps. The pump produces a vacuum on its intake side and atmospheric pressure forces water and sediments through the suction pipe. Cutterhead, dustpan, hopper, suction, and special purpose dredges are all types of hydraulic dredges. In order to remove sediments, the four traditional hydraulic dredges add large volumes of water to each volume of in-place sediment removed, resulting in a solids content typically in the 10-20 percent range. Some of the special purpose dredges are capable of removing sediments at near in situ, i.e., at a solids content at a concentration close to the in place solids content.

The hydraulic pipeline cutterhead suction dredge (Figure 6) is the most commonly used dredging plant and is generally the most efficient and versatile (COE 1983). It can efficiently dredge all types of materials including clay, silt, sand, compacted deposits, hardpan, gravel, and rock (Averett 1990). This dredge has the capability of pumping dredged material long distances to upland disposal areas. The cutterhead dredge was evaluated for removing contaminated sediment during the New Bedford Harbor Superfund Pilot Study. Compared to two other dredge types, the cutterhead was superior for minimizing sediment resuspension. Averett reported that Havis (1988) reviewed various dredging options and concluded that "the cutterhead is a logical selection for controlling sediment resuspension while maintaining efficient production." The cutterhead dredge is capable of production rates that will allow the completion of this project in a reasonable time frame, although a cutterhead of adequate size may have to dredge its way upriver in order to satisfy the vessel draft requirements. Due to the cutterhead's versatility, availability, and ability to dredge while generating reduced amounts of turbidity, this dredge method will be considered for this project.

The dustpan dredge is a hydraulic suction dredge that uses a widely flared dredge head containing high-pressure water jets (Figure 7). The jets loosen and agitate sediment and the sediment is captured in the dustpan head as the dredge is winched forward. The dustpan dredge was designed to dredge large volumes of loose materials such as sands and gravels from the navigation channels of open reaches of major rivers (COE 1983 and McLellan 1989). Dustpan dredges generate suspended solids plumes with concentrations equal to or greater than plumes generated by cutterhead dredges (Averett 1990). Because this dredge is more suited for excavating sands and gravels and the sediments to be removed from the Ashtabula River are predominantly silts and clays, this dredge type will not be considered for removal of the Ashtabula River sediments.

Hopper dredges (Figure 8) are designed to operate in open waters and are best suited for dredging deep harbors and rough water shipping channels (Averett 1990). Dredged material is raised by dredge pumps through dragarms connected to drags in contact with the channel bottom and discharged into hoppers built in the vessel (COE 1983). Once the hopper is fully loaded, the dredge moves to the disposal site to unload before resuming dredging. Because of the limitations on open-water disposal, most hopper dredges have direct pumpout capability for disposal to upland confined sites. The hopper dredges deep draft precludes its use in shallow water. In addition, the hopper dredge excavates with less precision than other types of dredges (Table 1). Also, the sediment load of the hopper is reduced when dredging contaminated sediments since pumping past hopper overflow is prohibited resulting in low density material being transported to and pumped into disposal areas. For these reasons the hopper dredge will not be considered for removal of the contaminated sediments from the Ashtabula River.

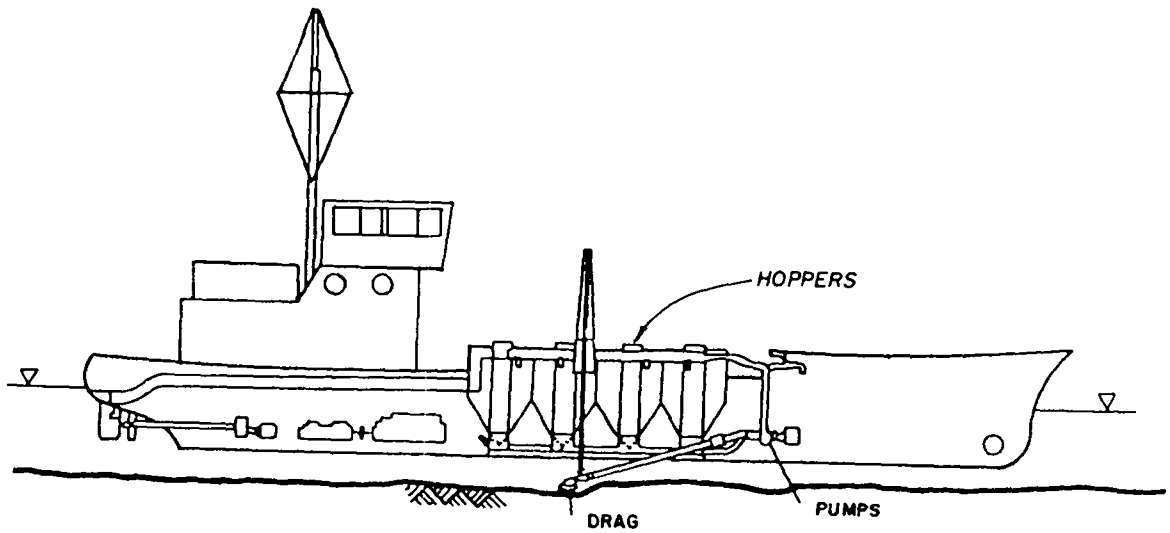


Figure 8 - Hopper Dredge

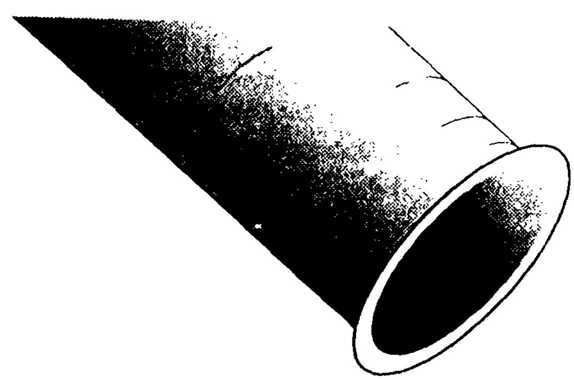


Figure 9 - Plain Suction Dredgehead

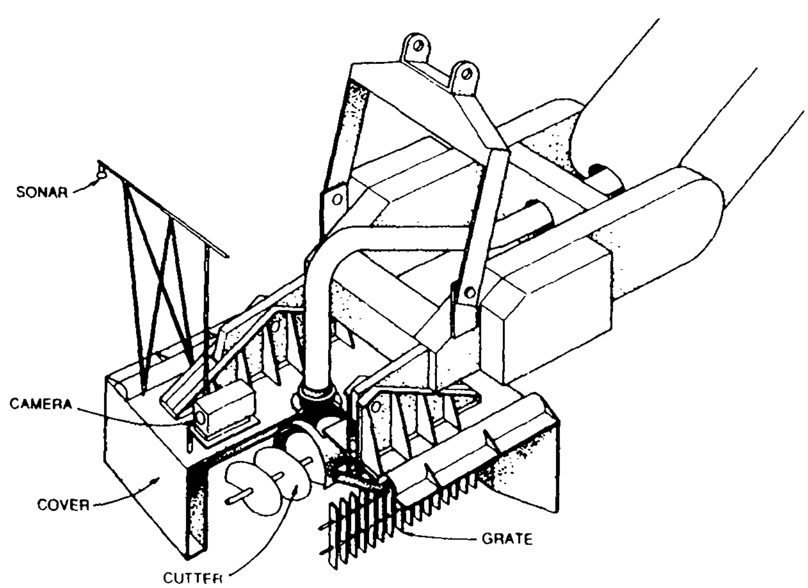


Figure 10 - Clean-Up Dredgehead

The suction dredge is a pipeline cutterhead dredge with the cutterhead removed (Figure 9). The operation and dredging depths for the suction dredge are comparable to those for the cutterhead pipeline dredge. Since this dredge has no cutterhead and operates on suction only it is limited to dredging soft, free-flowing sand. Debris in the dredged material will clog the suction pipe and greatly reduce the effectiveness of the dredge (Averett 1990). Since this dredge has no cutterhead it generates low levels of turbidity, lower levels than the cutterhead dredge. However, since the suction dredge is limited to removing free-flowing sand with little or no debris, this dredge will not be considered for removing the silt and clay sediment in the Ashtabula River.

The sidecasting dredge is similar in design to the hopper dredge except sidecasting dredges do not normally have hopper bins (COE 1983). Instead of collecting the sediments in onboard hoppers, the sidecasting dredge pumps the material directly overboard through an elevated discharge boom. The dredge picks up the sediment through two dragarms and pumps it through a discharge pipe supported by the discharge boom. The Corps of Engineers developed the shallow-draft sidecasting dredge for use in places too shallow for hopper dredges and too rough for pipeline dredges. The type of material that can be excavated with the sidecasting dredge is the same as for the hopper dredge, i.e., clay, silt, sand, and gravel. The method of sediment disposal, open-water disposal over the side, makes this dredge unsuitable for dredging contaminated sediments or dredging in areas where turbidity must be limited. Therefore, the sidecasting dredge will not be considered for dredging the contaminated sediments in the Ashtabula River.

4.3 Special Purpose Dredges

Past dredging practices in the United States have evolved to achieve the greatest possible economic returns through maximizing production with only secondary considerations given to environmental impacts (Herbich 1991). Conventional mechanical and hydraulic dredges are not specifically designed or intended for use in dredging highly contaminated sediments. There are numerous special-purpose hydraulic dredges that have been developed in the United States and in foreign countries to pump dredged material slurry with a high solids content and/or minimize the resuspension of sediment. Most of these special-purpose dredges are not designed for use on typical maintenance dredging operations; however, they may provide alternative methods for unusual dredging projects such as those involving contaminated sediments. Several of these dredges are discussed below.

Airlift dredges use compressed air to dislodge and transport sediment, sand, coarse-grained material, and free-flowing unconsolidated material (Averett 1990). Airlift dredges are supported by cranes and can be mounted on shore or on barges. Compressed air flows from the bottom of an open, vertical pipe that is controlled by a crane. The air expands and rises, causing upward currents that force water and sediment up the pipe. A rotating cutter attachment assisting in dislodging solids prior to lifting must be used and water jets may be attached to the rotating heads for maximum suspension of fine materials. Typically, 33 percent solid slurries can be achieved using the airlift dredge. The minimum water depth in which the airlift dredge will operate economically is 20 to 30 feet (Averett 1990). In addition, while the operation of the airlift dredge reportedly minimizes sediment resuspension, no data were available to verify this (Zappi 1991). Due to the water depth required for economical operation of the dredge as well as the question concerning sediment resuspension, the airlift dredge will not be considered for removal of the contaminated Ashtabula River sediment, much of which is in water depths of 10-12 feet or less.

The cleanup dredge head, developed in Japan for the cleanup of highly contaminated sediment, consists of a shielded auger that collects sediment as the dredge swings back and forth and guides the sediment towards the suction of a submerged centrifugal pump (Figure 10). To minimize sediment resuspension, the auger is shielded and a moveable wing covers the sediment as it is being collected by the auger (Herbich 1991). While the cleanup dredge generates low suspended sediment concentrations, it is not known to have been used in the United States and is not known to be available in the Great Lakes region or in the United States. This is not a small scale dredging operation or a dredging demonstration project. The Ashtabula River sediment removal project is a full scale dredging operation involving the removal of roughly 696,000 cubic yards of sediment, including roughly 150,000 cubic yards of TSCA material. The Ashtabula River project is not intended to be a proving ground for specialty dredges. Because of the scope of this project, questions concerning the availability of the cleanup dredge, and the lack of knowledge and experience concerning this dredge method, the cleanup dredge will not be considered for this project.

The Delta dredge (Figure 11) was developed as a small portable dredge that removes material at a high solids concentration using a submerged pump coupled with two counter-rotating, low speed reversible cutters (Averett 1990). Reportedly the Delta dredge is capable of making a relatively shallow cut without disturbing the surrounding material. Therefore turbidity levels in the vicinity of the cutterhead are

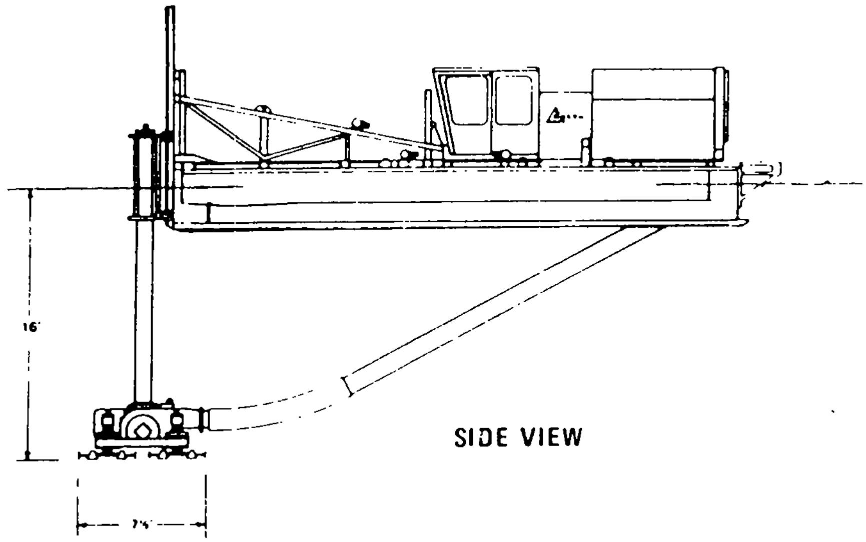


Figure 11 - Delta Dredge

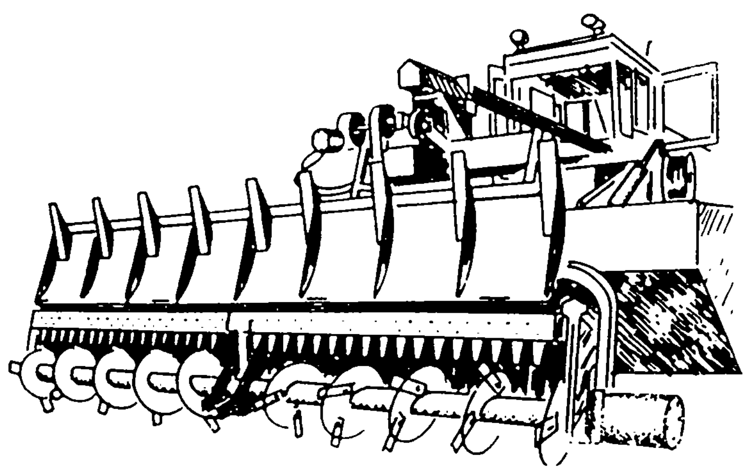


Figure 12 - Horizontal Auger Dredge

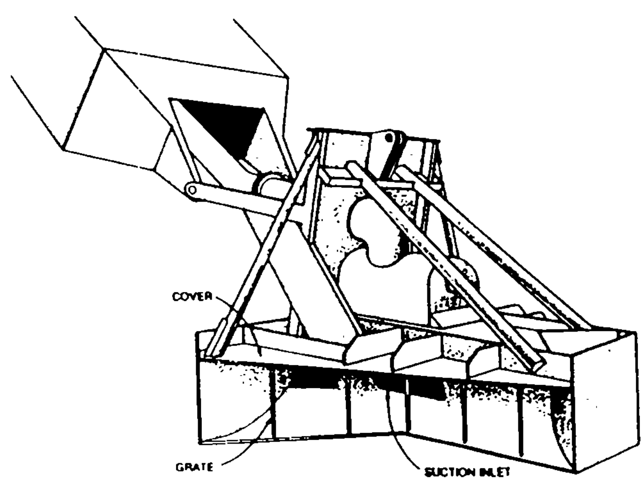


Figure 13 - Matchbox Dredgehead

low. However, because the Delta dredge is a small portable dredge it will not be considered for dredging the large quantity of sediments to be removed under this project.

The Eddy pump is a new technology that uses hydraulic eddy current principles to create a swirling column of fluid in the center of the intake pipe that agitates the material to be dredged, causing the material to flow upward by reverse flow in the eddy current (Averett 1990).The swirling sediment travels up the intake pipe, into the body of the pump, and out the discharge line. An Eddy pump with a cutterhead built around it has been built and operated in the United States. The pump is capable of pumping 38 percent solids with the cutterhead operating and 50 percent solids without the cutterhead. No operating data have been reported for the resuspension of sediment in the vicinity of an Eddy pump (Averett 1990). Due to the lack of data available concerning sediment resuspension the Eddy pump will not be considered for the Ashtabula River dredging at this time. If favorable data becomes available this dredge technology may be considered at a later date.

Hand-held hydraulic dredges have been used underwater by divers, above water by operators wading in shallow water or may be used by operators using the dredge from a boat (Averett 1990). The dredge equipment varies from a hose/collector arrangement to a skid mounted machine. Due in part to the small dredging capacity of these units and the method of operation, hand held, the major use of hand-held dredges is for projects with small volumes of hazardous material in shallow, calm waters. Because of the size of the Ashtabula River project, several hundred thousand cubic yards of sediment dredged from a several thousand foot reach of the river, and because of the nature of operation of these units, i.e., hand held, hand-held hydraulic dredges will not be considered as a dredging alternative for this project.

The horizontal auger dredge, designed to remove fine-grained sediment, is a relatively small portable hydraulic dredge used for projects where a relatively small discharge rate is sufficient (Figure 12). The dredge is one of several dredging systems developed to pump dredged material slurry with a high solids content or to minimize sediment resuspension (Herbich 1991). The horizontal auger dredge has a horizontal cutterhead equipped with cutter knives and a spiral auger that cuts the sediment and moves it laterally toward the center of the auger where it is picked up by suction (Averett 1990). This cutterhead can remove a layer of material 8 feet wide and 1.5 feet thick in water depths ranging from 2 to 20 feet, leaving the dredged bottom flat and free of windrows that are characteristic of the typical cutterhead dredging operation. Movement of the dredge through the water is controlled by conveying along a cable in a direction perpendicular to the auger. A unique retractable mud shield shrouds the cutterhead, entrapping suspended material and minimizing sediment resuspension (Herbich 1991). Several hundred horizontal auger dredges are in operation. These dredges have good horizontal and vertical control, a distinct advantage when performing "environmental dredging" (Table 1). While the horizontal auger dredge is a relatively small capacity dredge when compared to traditional dredging methods, it will be considered for removal of the contaminated fine-grained sediments in the Ashtabula River. This dredge is designed to remove fine-grained sediments and is readily available. It has very good horizontal and vertical control and is capable of operating in water depths anticipated for this project. The horizontal auger dredge is also capable of operating while generating low rates of sediment resuspension and leaving the dredged bottom flat and free of windrows of contaminated sediment. However, this dredge is not capable of handling large debris or oversized material such as cobble and boulders.

The matchbox suction head dredge (Figure 13) is a plain suction dredgehead enclosed in a housing that resembles a matchbox and was developed to dredge highly contaminated sediments in Rotterdam Harbor (Palermo 1988). The housing collects escaping gas bubbles and valved openings on each side of the suction head allow the leeward opening on each swing to be closed to avoid an influx of water. The suction head was designed to dredge fine-grained sediments at near the in situ density and keep resuspension to a minimum while dredging layers of varying thickness and operating with restricted maneuverability (McLellan 1989). Cutter and water jet devices commonly found on dredgeheads are not used in order to limit the resuspension of sediments. Vertical positioning equipment is used to indicate the depth of the dredge head while horizontal positioning equipment is used to hold the matchbox parallel to the sediment surface. A comparison test of sediment resuspension reported that the matchbox suction head is capable of removing sediment with very little resuspension (Averett 1990). While the reported production rate of the matchbox suction head dredge, 25-80 cubic yards per hour, is quite low, this dredge head has been used in the United States and will be considered for the Ashtabula River dredging. This dredge head is capable of removing fine-grained sediments at near in situ density while generating very little resuspended sediment.

Pneumatic dredge systems use compressed air instead of centrifugal motion to pump slurry through a pipeline. The Pneuma pump (Figure 14) was the first such dredging system (Averett 1990). The principle under which the pump operates is the pressure differential between the pressure in the chamber and the hydrostatic pressure of water outside the pump. The chamber is

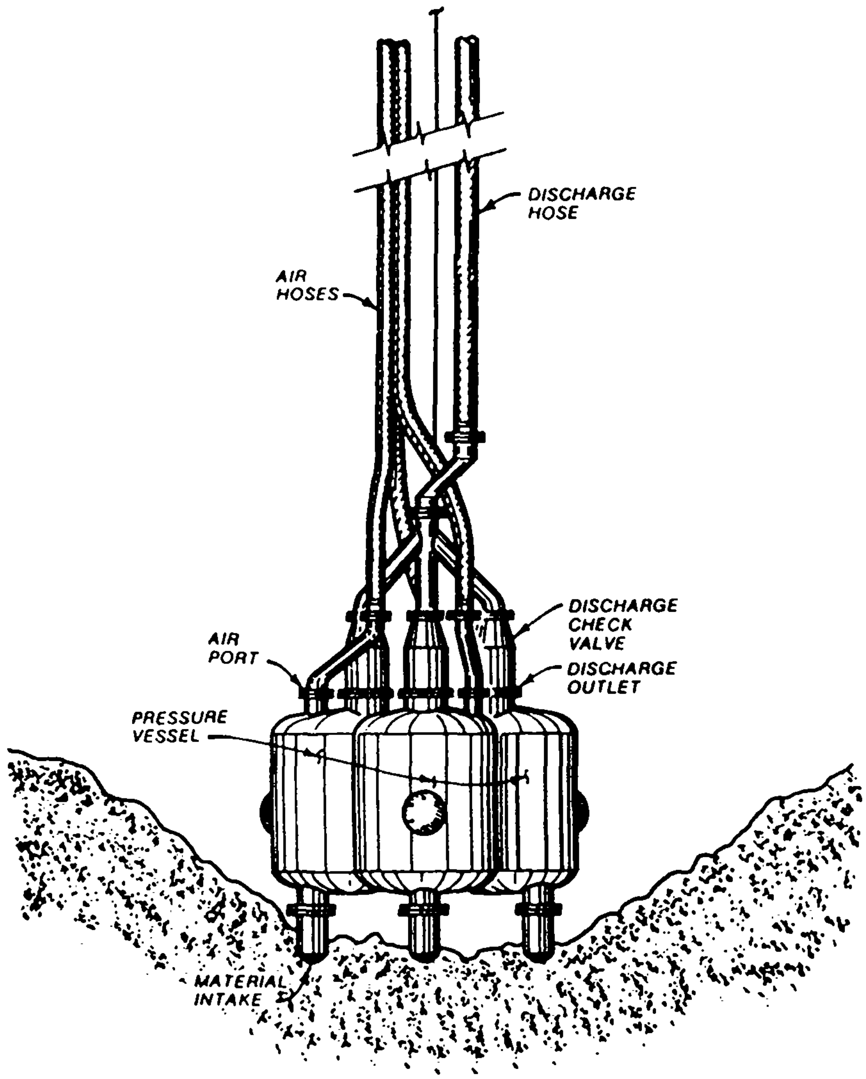


Figure 14 - Pneuma Pump

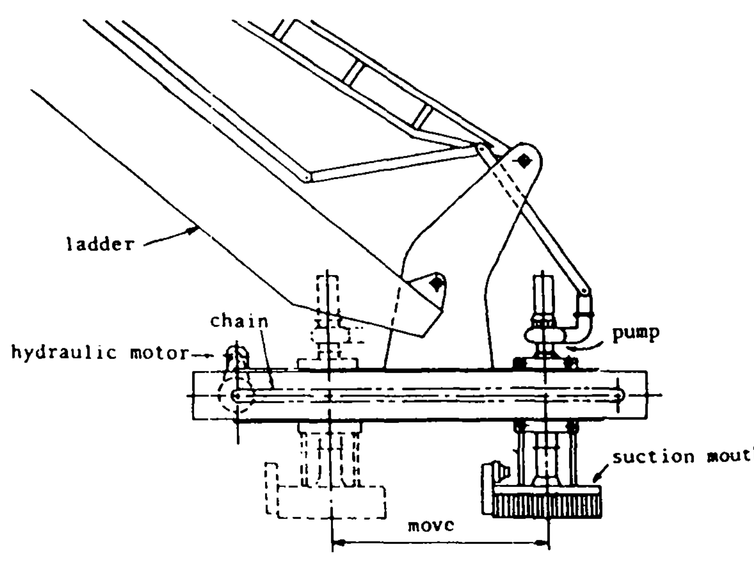


Figure 15 - Oozer Dredgehead

lowered into position and the inside air is released to the atmosphere, producing atmospheric pressure in the chamber. The pressure difference between the inside and the outside of the chamber forces water and sediment into the chamber. The entrance valve is then closed and air is pumped into the chamber, increasing pressure and forcing the slurry out the discharge valve (Palermo 1988). The Pneuma pump was developed in Italy and consists of three chambers, each connected to a common discharge line above the pressure vessels. The chambers are operated so that the filling and emptying cycles are out of phase but overlap enough to minimize discharge surging. Ladder mounted versions of the Pneuma pump dredge operate much like the conventional cutterhead dredge and are applicable to similar dredging conditions (Zappi 1991). Different types of attachments may be fitted on the intakes for removal of varying types of bottom material. The Corps of Engineers has tested and used the Pneuma pump at several locations in the United States. Results of turbidity monitoring, while not definitive, seemed to support the manufacturer's claim that the pump generates a low level of turbidity when operating in loosely consolidated fine-grained sediment. Results also indicate that the Pneuma pump was able to dredge at almost in situ density in loosely compacted silty clay (Averett 1990). The capacity of a large Pneuma pump is 2,600 cubic yards per hour and may operate in water depths in excess of 150 feet. However, the Pneuma pump will not operate satisfactorily at water depths of less than approximately 12 feet. Since much of the sediment to be dredged from the Ashtabula River is at water depths of less than 12 feet, the Pneuma dredge will not be considered as a dredging alternative for this project.

The Oozer dredge pump (Figure 15), developed in Japan, operates in a manner similar to the Pneuma pump system except it has two cylinders instead of three and a partial vacuum is applied during the cylinder-filling stage to achieve more rapid filling of the cylinders (Averett 1990) and to overcome the problem of operating in shallow water depths (Palermo 1988). The pump is usually mounted on a dredge ladder and is equipped with special suction and cutter heads depending on the type of material being dredged. A large Oozer pump has a dredging capacity of up to 650 cubic yards per hour and produces a slurry of up to 80 percent of the in situ density (Table 1). During testing in Japan, suspended solids concentrations in the vicinity of the dredge head were found to be quite low. While it appears that the Oozer pump may be suitable for dredging the contaminated Ashtabula River sediments, none of the reports reviewed for this appendix indicated that the pump had been used in the United States. One Corps of Engineers document (Zappi 1991) reports that the pump was available from a California firm in 1981. Due to the Oozer pump's apparent limited availability and previous use in the United States, this dredging alternative will not be considered for use in performing the Ashtabula River dredging at this time. If more information concerning the pump's availability and use in the United States becomes available, this dredge method may be considered at a later date.

The Refresher dredge head was developed in Japan and is a modification to the cutterhead hydraulic dredge. The Refresher uses a helical-shaped head to feed sediments into the suction pipe and has a cover over the head to reduce sediment resuspension (Palermo 1988). During several tests in similar material researchers felt that the Refresher dredge head produced one fiftieth of the total resuspension produced by the operation of a cutterhead dredge (Averett 1990). Three Refresher dredges are reported to be operating in Japan (EPA 1994), while none of the literature reviewed for this appendix reported the availability of the Refresher system in the United States. Due to the apparent lack of availability of the Refresher dredge head in the United States, the system will not be considered for dredging the contaminated Ashtabula River sediments. If, at a later date, it is found that the Refresher system is available in the States and suitable for the Ashtabula River project it will be considered at that time.

The Waterless dredge is a dredging system that encloses the cutter and centrifugal pump in a half-cylindrical shroud (Palermo 1988). As the cutterhead is forced into the sediment, the cutting blades remove the material near the front of the cutterhead with little entrainment of water. The manufacturer estimates a solids content of 30 to 50 percent by weight with very little turbidity generation. Dredge pipeline sizes range from 6 to 12 inches in diameter. While the Waterless dredge was used in the removal of lead contaminated sediment in Connecticut (Averett 1990) experience with this type of dredge is limited since it is a relatively new (1978) development (Herbich 1991). Since there is limited experience with this dredge and there was no sediment resuspension data available in the reports reviewed for this appendix, the Waterless dredge will not be considered for the Ashtabula River dredging project at this time. If more information becomes available, this dredge may be considered for this project at a later date.

5.0 SELECTION OF DREDGING EQUIPMENT

Of the 24 dredging technologies discussed, two mechanical dredges, the bucket wheel and closed-bucket clamshell; one hydraulic dredge, the cutterhead; and two special purpose dredges, the horizontal auger and matchbox suction head, are carried forward for consideration. For this early study phase it is suggested that three dredging alternatives be considered for removal of sediments from the Ashtabula River under this project. The final selection of a dredging method will be made at a later date, after more information is available on the cost of dredging alternatives and the ultimate disposal of the dredged material.

The first alternative considered for removal of the sediments involves a mechanical dredging operation. A closed bucket would be used to dredge the 696,000 cubic yards of sediment and place it in scows. In addition to the clamshell bucket a second type of closed bucket that should be considered is the Cable Arm Bucket (Figure 16).The Cable Arm leaves a level bottom cut rather than a cratered bottom typical of the clamshell bucket. The material would be transported to a transfer facility where it would be off loaded with a closed bucket and transported to an upland CDF or an offsite disposal facility. Any necessary pretreatment of the material, suck as screening and/or dewatering, would be conducted at either the transfer facility or the disposal facility. A suboption under this dredging alternative would involve the transport of some or all the sediments directly from the dredge site to an in lake CDF where the material would be of f loaded and disposed of. Clamshell dredges are capable of high production rates, are able to remove both sediments and debris, and can navigate the Ashtabula River. Clamshell dredging equipment is also commonly available and used on the Great Lakes (EPA 1994). The use of a closed bucket clamshell, also available on the Great Lakes, as well as restrictions on the dredging operation and the possible use of turbidity barriers would help to reduce the adverse environmental affects caused by this dredging action.

The second alternative considered involves the use of a hydraulic dredge. A cutterhead dredge would be used to remove the 696,000 cubic yards of Ashtabula River sediments (Figure 17). Depending on the disposal option chosen, the sediment slurry may be transported by hydraulic pipeline directly to the disposal site where any necessary pretreatment would be conducted prior to disposal of the sediments. If a nearby in lake CDF is selected as the disposal site, the dredged slurry could be transported to the disposal facility by hydraulic pipeline or by barge for offloading. If a distant upland disposal facility is selected as the disposal site the dredge slurry would be transported to a nearby transfer facility where the sediment would be dewatered prior to shipment in order to keep transportation costs reasonable. Liquid from the dewatering process would require treatment. The hydraulic pipeline cutterhead dredge is the most commonly used dredging plant and is versatile, capable of dredging clays, silts, sands, gravels, etc. (Averett 1990).The cutterhead dredge is able to dredge while generating reduced amounts of turbidity. Restrictions on the dredging operations and the possible use of turbidity barriers and oil booms will help to further reduce adverse environmental impacts caused by this dredging alternative.

The third proposed dredging alternative involves the use of both mechanical and special purpose dredging equipment. A closed bucket clamshell dredge would be used to first remove the vast

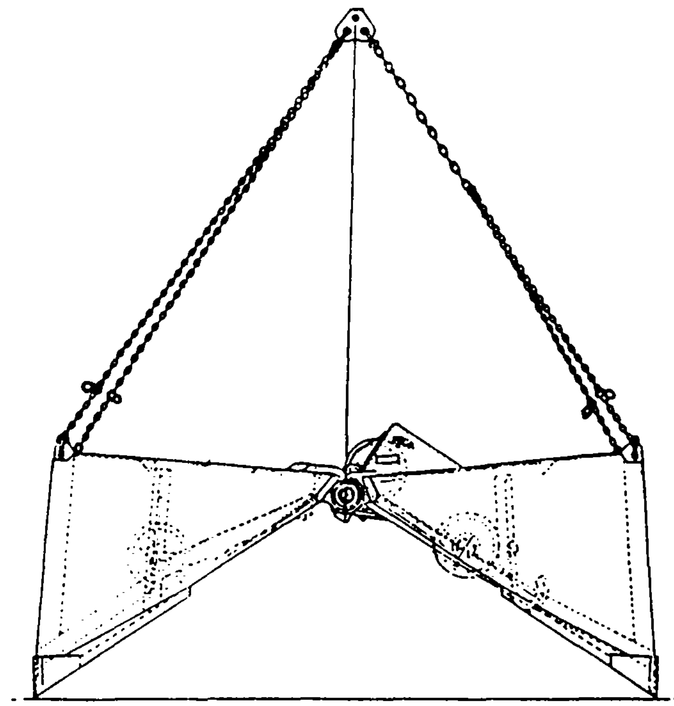


Figure 16 - Cable Arm Bucket

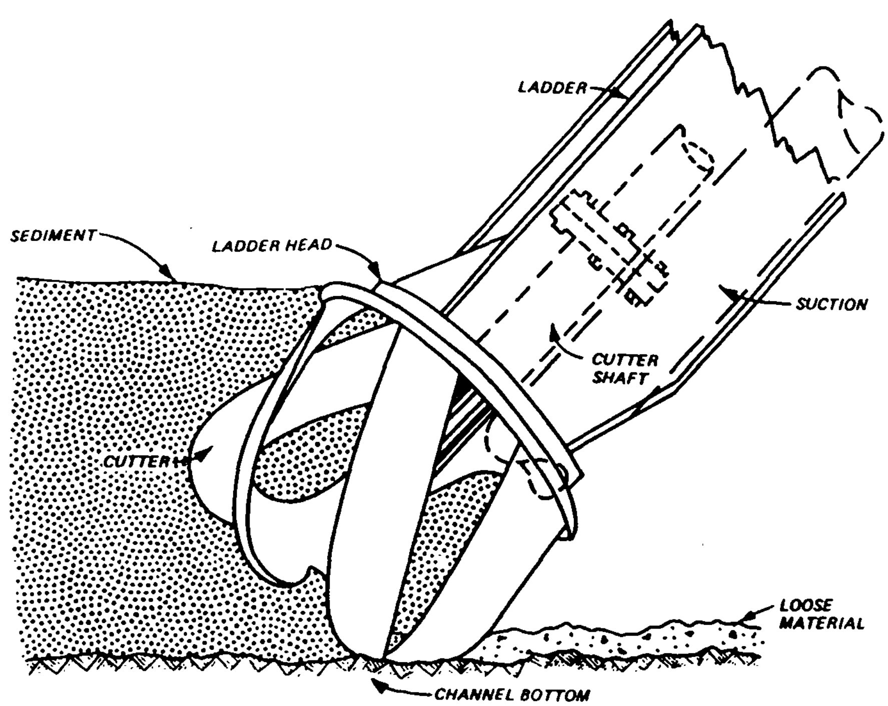


Figure 17 - Conventional Cutterhead Dredgehead

majority of the 696,000 cubic yards of sediment to be removed under this project. The dredging, loading, transporting, and disposal of this mechanically removed material would be similar to the above description for the closed bucket. The closed bucket is selected for the reasons cited above and adverse environmental impacts would be addressed as previously described. However, the clamshell dredge does not have the vertical accuracy that some dredge types have. Therefore, some of the sediments intended for removal may be left in the river unless significant "overdredging" is performed, resulting in unnecessary increased project costs. In order to remove the last of the sediment intended for removal without performing significant overdredging, a special purpose dredge with greater vertical control than the closed bucket would complete the dredging operation. Two special purpose dredges that have greater vertical control and generate relatively low amounts of turbidity may be considered, the horizontal auger dredge and the Matchbox suction head dredge. Both of these dredge types are available in the United States and have been used in the United States. The dredged slurry would be handled in a manner similar to the cutterhead slurry and adverse environmental impacts would be addressed as described above.

6.0 ENVIRONMENTAL CONTROLS

Dredging causes the resuspension of sediments and associated contaminants that generally are bound most strongly to the smaller soil particles (Romke van der Veen, 1993). The significance of dredging related environmental impacts vary with the method of dredging, characteristics of the sediments, and the hydraulic and environmental characteristics of the waterway. When dredging contaminated sediment it may be desirable to limit the spread of contaminants by using physical barriers around the dredging operation. Such barriers may be appropriate when contaminant concentrations are high or conditions dictate the need for minimal adverse impacts. A number of physical barriers commonly used in the construction industry may be adapted to this purpose (EPA 1994). At sites where the geometry of the waterway permits, dikes, sheet piling, caissons, and other structural barriers may be effectively used. Depending on site-specific characteristics nonstructural barriers including oil booms pneumatic barriers, sediment traps, silt curtains and silt screens, may be effective.

Oil booms are used to help contain oil spills or films on the water surface and are appropriate for sediments that are likely to release oils when disturbed. Such booms typically consist of a series of synthetic foam floats encased in fabric and connected with a chain or cable (EPA 1994) and may be supplemented with oil absorbent materials.

Silt curtains and silt screens are flexible barriers that hang from the water surface using a series of floats on the surface and a ballast chain and/or anchors along the bottom (Figure 18). Silt curtains are made from impervious material such as coated nylon, while silt screens are made from synthetic geotextile fabrics, which allow water to flow through but retain a fraction of the suspended solids. Silt curtains are not recommended for dredging operations in currents exceeding 2 feet per second, in areas frequently exposed to high winds or large breaking waves, or around dredging operations where frequent curtain movement would be necessary (Herbich 1991). Considerable attention should be paid to the silt curtain's/silt screen's movement since careless handling could negate any advantage from its use (Zappi 1991).

The effectiveness of a silt curtain, defined as the degree of turbidity reduction outside the curtain relative to the turbidity levels inside the curtain, depends on the nature of the operation; the characteristics of the material in suspension; the type, condition of, and method for deploying the silt curtain; the configuration of the enclosure; and the hydrodynamic regime present at the site. It is anticipated that the portion of the Ashtabula River to be dredged will be under low current or medium current conditions, as described below, during dredging operations. Under quiescent conditions, turbidity levels outside a properly deployed and maintained curtain may be reduced by 80 to 90 percent of the levels inside. The effectiveness of the silt curtains can be significantly reduced in high-energy regimes where currents are high. Increased turbulence around the silt curtain can resuspend the material and can increase the turbidity level outside the silt curtain (Herbich 1991).

Herbich reported that Johanson (1976) conducted analytical investigations and field tests on silt curtains at four different sites. His conclusions on the study were as below:

a. Under low current (0.2 ft/sec or less), a well-deployed, well maintained top-tension curtain can be effective in reducing the turbidity in the upper water column beyond the curtain. There may be a turbid layer of material flowing under the curtain.

b. Under conditions of medium current (0.8 ft/sec or less), a well maintained center-tension curtain can be effective. However, turbulence generated by the curtain may cause the turbidity layer flowing under the curtain to quickly resurface beyond the curtain.

c. Silt curtains are not recommended for operations in currents exceeding 2 ft/sec, in areas frequently exposed to high winds, or around hopper or cutterhead dredges.

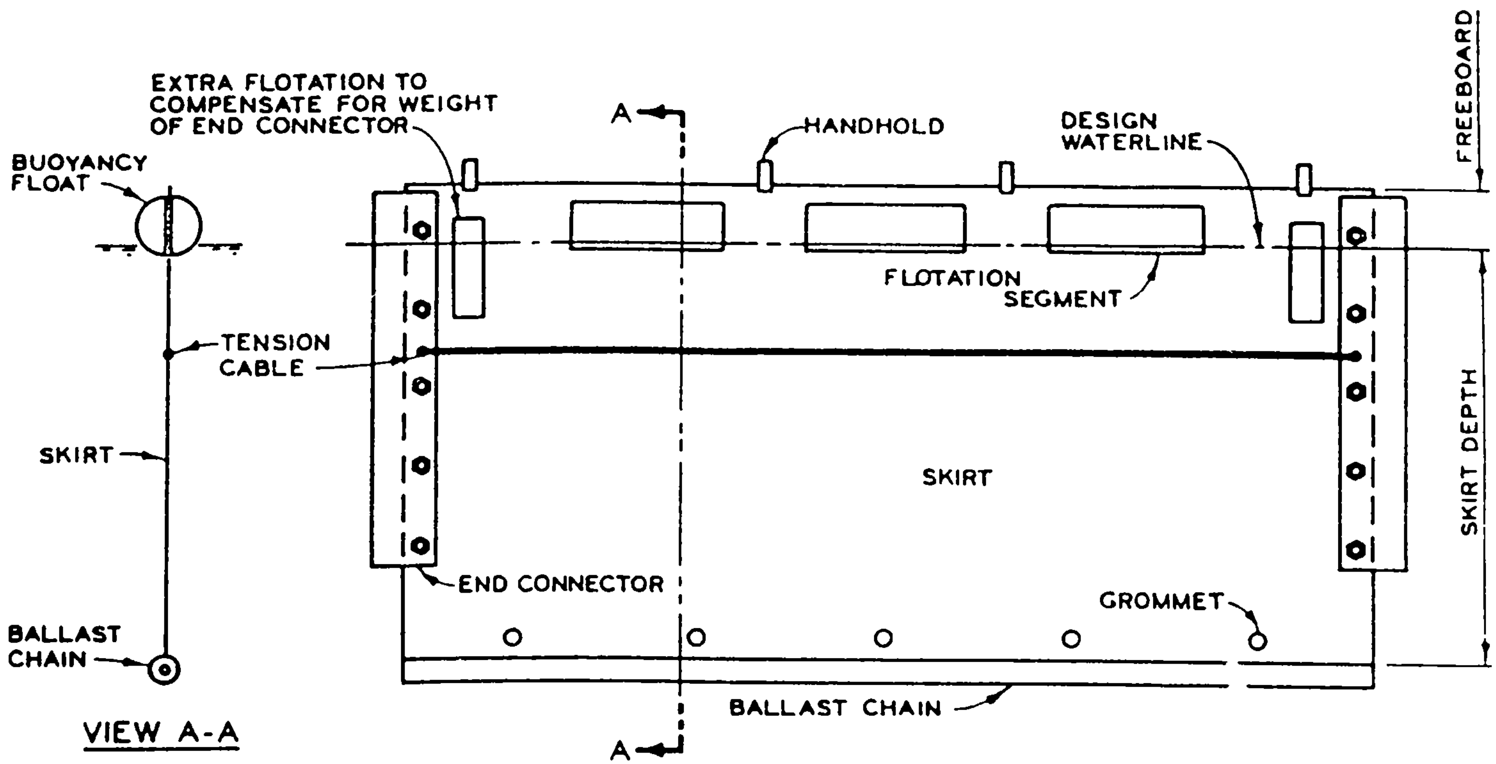


Figure 18 - Typical Center-Tension Silt Curtain Section

d. Curtain deployment geometries are critical to the performance of the curtain. The curtain length must be such that the skirt does not lie on the bottom during any part of the tidal cycle.

e. Curtain maintenance procedures, as presently practiced, are totally inadequate.

f. The maze configuration has been used on rivers but appears to be relatively ineffective because of direct flow through the gap between two separate curtains.

Pneumatic barriers or bubble screens have been used to create a barrier to floating or suspended materials. In order for these barriers to be effective, current velocity must be minimal and sufficient power must be available to supply adequate amounts of compressed air. The Corps of Engineers and others have tried to use this technique to confine turbidity and contain oil but the power requirement was found to be very high and the technique was not found practical (Herbich 1991). Effectiveness of pneumatic barriers is rated low because they may actually increase sediment and contaminant mobility (Averett 1990).

Caissons, dikes, and sheet piles could be used only for small projects with shallow water depths and suitable foundation materials to allow for their constructability (Averett 1990). In 1995 a King pile wall was used as a turbidity barrier at a Superfund site in Massena, New York during sediment removal operations. In excess of 2,000 lineal feet of wall was installed in water up to 20 feet in depth. The barrier proved to be very effective in reducing turbidity outside of the remediation area. A second steel sheet pile wall is planned as a turbidity barrier at a second Superfund site involving sediment removal operations in Massena, New York. This wall is to be in excess of 3,000 feet in length and will be installed in water up to approximately 35 feet deep.

Silt curtains and silt screens have been shown to be quite effective at reducing turbidity levels given the proper site conditions, i.e., relatively shallow, quiescent water bodies. Structural options such as caissons, dikes, and sheet pile, can also be effective turbidity barriers in relatively shallow water bodies and relatively small dredge areas.

The cost of structural options will normally be considerably more expensive than most of the nonstructural barriers. In general, structural options are also more rigid than nonstructural options, that is they are more difficult to remove and reinstall as dredging operations advance. Also, both classes of turbidity barriers can significantly impact on the movement of dredging equipment and transport of dredged sediments, thus slowing production and increasing costs. This is true of both silt curtains and sheet pile walls.

The Ashtabula River sediment dredging involves the removal of contaminated sediments from a several thousand foot reach of the river, both within and outside the navigation channel. Rather than restrict commercial and recreational activities from the upper portion of the navigation channel during the entire dredging operation, at least one full construction season, by installing turbidity barriers, it may be more logical to use turbidity barriers in a more localized fashion. The relatively shallow water conditions and anticipated low river velocities during the dredging operation would seem to make the use of silt screens and silt curtains a viable alternative for turbidity barriers within the river. The high cost of the structural turbidity barriers and their rigidity would appear to make this type of barrier less desirable than silt curtains or silt screens.

Monitoring conducted by the Corps of Engineers and others during numerous dredge equipment demonstrations has shown that the plume created by dredging contaminated sediment with standard dredging equipment was generally approximately 500 to 1,000 feet long. Plumes of resuspended sediment generated by "specialty dredges" during equipment demonstrations have generally been considerably shorter in length. If the dredging sequence started at the upstream end of the navigation channel and proceeded downstream, it is expected that the majority of the resuspended sediment and associated contaminants would be carried downstream, deposited within 1,000 feet of the dredging operation and subsequently excavated and removed from the water body as the dredging operation proceeded downstream. This redeposition and subsequent removal of the resuspended sediments would appear to reduce the need for turbidity barriers. For this project it is recommended that silt curtains be used as turbidity barriers during the removal of TSCA regulated sediments, as well as during removal of non TSCA sediments as necessary, to maintain environmental quality. If mechanical dredge equipment is used or if hydraulically dredged material is loaded in scows, the barrier should remain open on the upstream end to allow the movement of scows from the dredge site to the transfer facility/disposal facility. This is likely to generate less turbidity than opening and closing the silt curtain every time a loaded scow is removed and an empty scow is delivered. If sediment is removed from the dredge site via pipeline the turbidity barrier could surround the dredging operation. Periodically, the silt curtain would have to be redeployed as dredging operations proceeded to a new area.

There is a possibility that oil and grease will be released from the Ashtabula River sediments during dredging operations and an oil film will be produced on the water surface. Oil booms are used to contain oil spills or films on the surface of water while adsorbents are used to remove oil from water. Sufficient oil boom and adsorbent material to contain and adsorb any dredge related oil film caused by dredging the Ashtabula River sediments will be readily available on site if needed. There are a number of proprietary products available for adsorbing oil or grease contained by an oil boom. If an oil film occurs during dredging operations, adsorbents would be placed within an area enclosed by an oil boom and periodically replaced as they become saturated with oil.

7.0 IMPACTS OF DREDGING

Normally the goal of a contaminated sediment remediation project is to reduce the long-term losses of contaminants to the environment. In the short-term, dredging will cause the resuspension of contaminated sediments, thus causing losses of contaminants to the surrounding waterbody. However, since contaminated sediments act as a source of contaminants to the water column, the long-term contribution of contaminants to the water column, and subsequently the surrounding environment, are significantly reduced by removing the sediments from the waterway.

7.1 Impacts on the Environment

Although dredging the Ashtabula River sediments will have short-term detrimental effects on the river, and to a lesser extent on Ashtabula Harbor and Lake Erie, the long-term beneficial impacts should far outweigh the adverse effects. Dredging the sediments from the river will remove those contaminants associated with the sediments from the aquatic ecosystem. This will eliminate the ability of these contaminants to be resuspended and transported down river and into Lake Erie.

This project involves the removal of a total of approximately 696,000 cubic yards of contaminated sediment from the lower Ashtabula River. Approximately 150,000 cubic yards of this material may be classified as TSCA material due to elevated levels of PCBs. Existing sediment contaminant data was examined to determine what depth of sediment would need to be dredged in order to reach a "clean layer." Once all the contaminated sediments are removed from the lower river and clean sediments are left exposed the long-term detrimental effect of contaminated sediments on the aquatic ecosystem will have been eliminated. This assumes that future sediments entering the lower Ashtabula River are clean.

When contaminated sediments are distributed, such as during dredging operations or flood events, contaminants may be transferred to the water column through resuspension of sediment solids, dispersal of interstitial water, or desorption from the resuspended solids (EPA 1993). An investigation of the dredging of RCB contaminated sediment has shown that almost all of the transfer of contaminants to the water column was the result of resuspension of solids (EPA 1993). The release of contaminants could therefore be reduced by selecting a dredge type that would minimize the resuspension of sediment during dredging operations.

Three dredging options, mechanical dredging, hydraulic dredging, and mechanical dredging followed by the use of special purpose dredging equipment, were presented in Section 5.0 as alternatives for excavating the Ashtabula River sediments. Each of the dredge methods proposed is capable of removing sediments while generating low levels of turbidity, thus limiting the loss of sediment associated contaminants to the water column. While the cutterhead dredge (hydraulic) was designed to perform routine maintenance dredging, field demonstrations have shown this dredge is capable of minimizing sediment resuspension while maintaining efficient production. The other dredges presented as alternatives for this sediment removal, the closed-bucket clamshell (mechanical dredge - including the Cable-Arm bucket), the horizontal auger dredge, and the Matchbox suction head dredge (special purpose dredge), were all designed with the idea of excavating sediments while minimizing sediment resuspension. Proper operation of each of these pieces of dredging equipment can significantly reduce the quantity of resuspended sediment, thus significantly reducing the amount of contaminants transferred to the water column since almost all of the transfer of contaminants to the water column has been shown to be the result of the resuspension of solids.

7.2 Contaminant Losses

One of the major concerns associated with a remediation process is the nature and extent of the contaminants lost to the environment during the process (EPA 1993). The best alternative for remediation is one that minimizes losses and risks while maximizing treatment and/or containment effectiveness. However, no alternative offers zero environmental losses or risks. Contaminant loss estimates have been prepared for "concept plans" involving the removal of 10,000 cubic yards and 100,000 cubic yards of sediment from each of several rivers/harbors within the Great Lakes. The contaminant loss calculations were based on techniques described in a draft guidance document prepared by the U.S. Army Corps of Engineers (Myers 1994). The current state-of-the-art does not allow for highly accurate quantification of losses and the contaminant loss estimates present in the EPA document are "order-of-magnitude" estimates.

The portions of a remedial action that may result in losses include:

- Dredging
- Transport and off-loading
- Temporary storage prior to remediation
- Pre treatment
- Treatment of sediments
- Final Disposal

The primary mechanisms of contaminant loss are as follows:

- Resuspension of sediment
- Volatilization of dissolved contaminants from the liquid to the vapor phase
- Volatilization of contaminants from moist sediment
- Spillage of sediment
- Leaching or seeping of contaminants

7.3 Remediation Components

7.3.1 Dredging In the concept plan involving the remediation of PCB contaminated Ashtabula River sediments, it was assumed that a clamshell bucket dredge would be used to remove the sediment from the river bottom (EPA 1993). The loss mechanisms that were discussed for the dredging operation included resuspension of the contaminated sediment and desorption of sediment contaminants into the water column. The amount of PCBs desorbed would be small because of the hydrophobic nature of PCBs. In addition, volatile losses from the water would be low because of the very low contaminant concentrations in the water column (due to their hydrophobic nature) and the large volume of water available for dispersion of the dissolved PCBs before they become available for volatilization.

Two options were examined to determine the losses associated with the Ashtabula River remedial action concept plans. The first option, called the "worst-case" option, considered losses associated with the remediation process without any controls applied. The second option, called the "best-case" scenario, considered how the losses associated with the remediation can be reduced or mitigated by applying engineering controls. Both options assumed a PCB concentration of 60 mg/kg (dry weight), which is considered typical of significant portions of the sediment in the Ashtabula River. The worst-case scenario assumed the use of an open clamshell bucket, with a dredge cycle time of one minute. The best-case scenario assumed the use of a closed bucket, with a cycle time of two minutes. The cycle time refers to the time it takes to lower the bucket through the water column, retrieve a bucket full of sediment, raise the bucket through the water column, deposit the sediments in the scow, and return the empty bucket to the water body to start a new cycle. The estimated loss of PCBs during dredging was approximately 435 grams/hour for the worst-case scenario, while the estimated loss under the best-case scenario was only 14 gram/hour, approximately three percent of the rate under the worst-case scenario. The loss of PCBs to the environment during the best and worst case scenarios for the removal of 100,000 cubic yards of Ashtabula River sediment are shown in Table 2. In the worst-case scenario 4.3 percent of the total PCBs in the removed sediment are "lost" while under the best-case scenario only 0.28 percent of the total

PCBs in the sediment are "lost." The total PCBs lost during the best-case scenario is six percent of the total PCBs lost during the worst-case scenario, rather than three percent, because the dredging duration in the best-case scenario is twice the duration of dredging in the worst-case scenario. This is because the bucket cycle time was doubled for the best-case scenario, thus cutting the dredge production rate in half.

TABLE 2
Comparison of PCB Losses Associated with
Remediation Options for the 100,000 cy Scenario

Remediation Component	Worst-Case Scenario		Best-Case Scenario	
	Grams Lost	% of Total PCBs Treated	Grams Lost	% of Total PCBs Treated
Dredging	145,000g	4.3	9,100g	0.28
Transportation and Offloading	1,400g	0.04	1,400g	0.04
Temporary Storage	7,080g	0.22	1,000g	0.03
TOTAL	153kg	4.5	11.5kg	0.35

The use of silt curtains and oil booms could further reduce the loss of PCBs resulting from the dredging operation. In addition much of the resuspended sediment and associated contaminants that are "lost" during the dredging process should settle out of the water column within 500 to 1000 feet of the dredging operation. If dredging proceeds in the downstream direction much of this resettled material should subsequently be dredged.

7.3.2 Transport and Off-Loading - One of the three dredging alternatives for dredging the 696,000 cubic yards of contaminated sediments in the Ashtabula River involves mechanical dredging and transport of the sediments to a disposal facility or transfer facility by scow. A second alternative involves the hydraulic dredging of the sediments where the dredged material may be transported by scow or by pipeline, depending in part on the disposal option chosen. The third alternative involves both mechanical and hydraulic dredging. The mechanically dredged material would be transported by scow while the hydraulically dredged material may be transported by scow or by pipeline, again depending on the disposal option chosen.

In the concept plan involving the remediation of contaminated sediments from the Grand Calumet River and Indiana Harbor Canal it was stated that, during the transport of sediment, contaminant loss is most likely to occur through spillage of the sediment and volatilization of contaminants for sediment transported in scows (EPA 1993). Since there would be some water intermingled with the sediment, some of the contaminant would be dissolved in the water in the scow. However, this loss source should be minimal due to the extremely low solubilities of PCBs and the small volume of pooled water in the scow (during mechanical dredging operations). In addition, spillage during transportation and off-loading can result in the loss of contaminants to the environment. These losses can be limited by filling the scows only partially full, by using only watertight scows, and by careful operation during off loading. Off-loading should be performed with a closed-bucket clamshell and any spillage should be collected and cleaned up.

Contaminant losses occurring during the hydraulic transport of sediments should be minimal. A properly designed, constructed and maintained pipeline should have very little spillage. Volatile losses should be nonexistent unless there is spillage resulting from a leak.

If the sediments are off loaded at a transfer facility, equipment used to transfer sediment to the ultimate disposal site must be water tight. Sediment should also be covered to reduce the volatilization of contaminants during overland transport.

7.3.3 Storage - The most significant loss mechanism associated with a disposal facility may be the volatilization of contaminants from moist sediment. The contaminant flux from moist sediment is extremely high immediately after exposure to air (EPA 1993). The flux then drops off quickly as the sediment pore water evaporates. However, the flux increases if the sediment resaturates, as would be the case during and after a significant rainfall. Loss calculations have shown that the volatilization loss of PCBs from a temporary storage area with a canopy cover would be one third of the volatilization losses occurring from an uncovered storage area (EPA 1993). The same general trend can be expected for a disposal facility containing PCB contaminated sediment. Therefore, in order to reduce PCB volatilization losses from the disposal facility, sediment should be covered as areas of the facility become full.

It is anticipated that an impervious membrane, clay liner, and leachate collection system would be constructed as part of the disposal facility, unless an in-lake confined disposal facility (CDF) is used to contain the less contaminated sediments. Therefore losses from leachate are expected to be minimal.

7.4 Impact on Water Quality

Dredging will cause temporary and localized increases in the levels of suspended solids and turbidity. The turbidity of the water column around dredging operations will be monitored to determine if the dredging operation is causing unacceptable levels of resuspension. If so, modifications could be made to the dredging operation to lower the turbidity levels and any unacceptable levels of contaminants.

Dredging may increase the oxygen demand upon the water column in two ways. Sediments that are uncovered by dredging may exert a higher sediment oxygen demand than the existing surficial sediments (Chicago District 1994). This impact will continue until the new surface sediments are oxidized or are covered by incoming sediments. In addition, sediment resuspension will increase oxygen demand in the vicinity of the dredge which may result in localized dissolved oxygen reduction.

A small amount of oil and grease in the sediments will be released by resuspension during dredging and form a film or sheen on the water surface. Hydrophobic contaminants such as PCBs will be dissolved in the oil and grease (Chicago District 1994). The migration of the oil film can be minimized by the use of an oil boom and adsorbents to remove the contained oil and dissolved contaminants.

The impacts to water quality from the dredging operation will not be significantly different than those already occurring during storm events. However, the impacts from dredging will cause localized effects in the vicinity of the dredge, whereas the flooding impacts a much larger area. The long-term benefits to the water quality should far outweigh any short-term impacts.

7.5 Impacts on Aquatic Life

The excavation of bottom sediments will permanently remove existing benthic organisms from the Ashtabula River. Recolonization would likely occur within a few years in the newly exposed sediments and future sediment deposits. Future deposits should be less contaminated and be able to support less pollution-tolerant benthic organisms. This may enable the river to achieve a higher diversity of aquatic species.

The physical operation of the dredge (noise and increased turbidity) may disturb the activities of local fish populations, attracting some species, and dispersing others. Some fish may be captured, injured or killed by physical contact with the dredging equipment. The resuspension of sediment and food particles will increase the availability of contaminants to visiting and local fish populations and subsequently result in a temporary increase in the potential for bioaccumulation and toxic effects.

Localized degradation of water quality around the dredge may be severe enough to cause death to some fish. Increased levels of ammonia and reduction of dissolved oxygen may cause acute toxicity effects to some fish (Chicago District 1994). However, those fish more likely to be attracted to the dredging operation are more pollution-tolerant. Less pollution tolerant fish are likely to avoid disturbances caused by the dredge and localized water quality impairments.

Oil released by sediment disturbance will cause some surface slicks. These slicks would be a thin film and should be contained in the immediate area encircled by the oil boom. Fish should not be affected by these slicks to any significant degree and the removal of the oil by the use of adsorbents should minimize effects on other organisms.

8.0 **Summary**

Dredging is planned to remove 696,000 cubic yards of contaminated sediments from the Ashtabula River, including 150,000 cubic yards that may be classified as TSCA material due to elevated levels of PCBs. Criteria for selecting the dredging equipment to accomplish this removal action were identified and described. More than twenty dredge types, including mechanical, hydraulic and special purpose dredges, were described and evaluated using the selection criteria. Dredges from each of the three main categories were identified as potential alternatives for removing the contaminated sediments from the Ashtabula River. Rather than selecting one dredge type this early in the study phase it was decided that more than one dredging alternative would be presented.

The first alternative involves the use of a closed bucket clamshell, a mechanical dredge, to remove all 696,000 cubic yards of contaminated sediments. This dredge is capable of high production rates, is able to remove both sediments and debris, and can navigate the Ashtabula River. The use of a closed bucket clamshell, readily available within the Great Lakes region, as well as restrictions on the dredging operation and the possible use of turbidity barriers would help to reduce adverse environmental affects caused by this dredge.

The second alternative identified involves the use of a cutterhead dredge, a hydraulic dredge, to excavate the Ashtabula River sediments. This dredge is the most commonly used dredging plant and is versatile; capable of dredging clays, silts, sands, gravels, etc. The cutterhead dredge is also able to dredge while generating reduced amounts of turbidity. As with the closed bucket, restrictions placed on the dredging operations and the possible use of turbidity barriers and oil booms will help to further reduce adverse environmental impacts caused by this dredge.

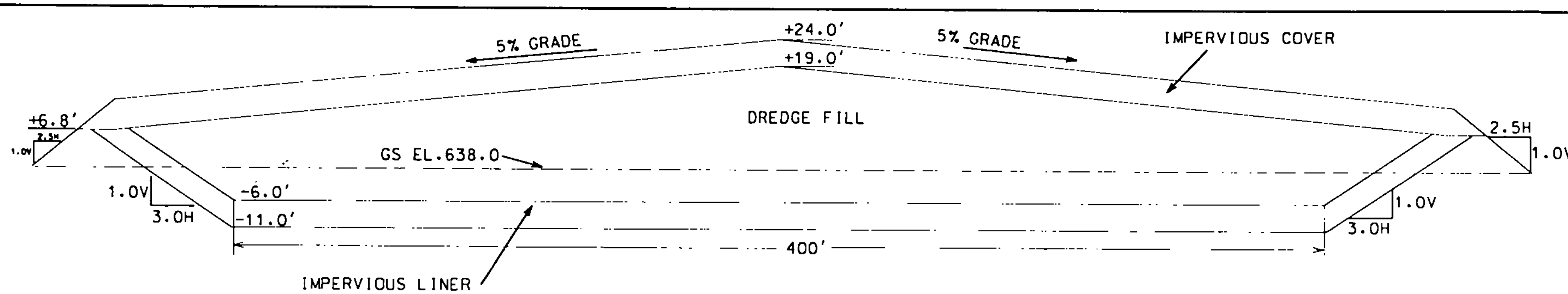
The third identified alternative involves the use of both mechanical and special purpose dredging equipment. A closed bucket clamshell dredge would be used to first remove the majority of the contaminated sediments. In order to excavate the last of the sediment intended for removal without performing significant overdredging, a special purpose dredge with greater vertical control than the closed bucket would complete the dredging operation. Two special purpose dredges that have greater vertical control and generate relatively low amounts of turbidity include the horizontal auger dredge and the Matchbox suction head dredge.

Rather than select one dredge type as being the piece of equipment that can best accomplish this removal action, it seems more logical to place water quality controls, dredge operation controls, and/or environmental controls on the dredging operation to limit adverse impacts of this sediment removal action. Water quality controls may include placing limits on the amount of turbidity or concentrations of PCBs or other contaminants allowed in the water column outside the immediate dredging area. Dredge operation controls might include limiting the bucket cycle time, prohibiting nighttime dredging operations and allowing scows to be only partially filled. Environmental controls that should be used around the dredging operation include oil booms and adsorbents to capture oil film released by the dredging action. Silt curtains may also be used, especially during the dredging of the TSCA material, to limit the spread of resuspended sediment and associated contaminants. In addition, water tight scows should be required for transporting sediments. While it is virtually impossible to completely eliminate the adverse environmental impacts of this dredging action, controls such as these can greatly reduce the affect of the impacts. The long-term benefits of removing these sediments from the Ashtabula River should far outweigh the short term detrimental effects of this dredging action.

9.0 Report Recommendations

The primary purpose of the specialty dredge was to excavate the last of the sediment intended for removal without performing significant over-dredging since it would provide greater vertical control versus the enclosed clamshell bucket. Inhouse discussions have indicated that experienced operators may be able to perform dredging with an clamshell bucket equipment within 6 inches or less of specified cut (dredge) lines (depths and side slope requirements in the contract documents). Subsequent detailed design efforts will need to be performed and cost estimates prepared in order to compare the effectiveness of overdredging using an enclosed clamshell bucket and subsequently providing for the anticipated additional landfill/dewatering of the those sediment volumes versus using the specialty dredge, in order to reduce over-dredging quantities, and treatment of additional water anticipated from that particular operation.

It was determined that the special purpose dredging equipment would involve excessive amounts of effluent water (primarily from the sediment dewatering process) that would require treatment in comparison to the enclosed clamshell bucket. It is anticipated this increased water treatment and delays in dewatering the dredged sediments for upland disposal would significantly affect project costs and implementation. Furthermore, the enclosed clamshell bucket operations will be able to perform within the contract plans and specifications. Therefore, the project scope and costs were prepared using only an environmentally acceptable enclosed clamshell bucket.



ASHTABULA RIVER DREDGING
LANDFILL DESIGN
NON-TSCA (SHALLOW SCENARIO)

FIGURE - M14

FILE:NTSCA-S.DGN

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Zappi, Paul A., and Hayes, Donald F. 1991. Innovative Technologies For Dredging Contaminated Sediments. Miscellaneous Paper EL-91-20. Vicksburg, MS: U.S. Army Engineer Waterways Experiment Station.

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX J

SEDIMENT DEWATERING ALTERNATIVES AND SELECTION

PREPARED BY:

Environmental Engineering Section
U.S. Army Corps of Engineers, Buffalo District
August 1997

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1.0 INTRODUCTION

Pretreatment is a component of a remedial alternative in which material is modified or conditioned prior to final treatment or disposal. Pretreatment technologies are designed to accelerate treatment in a disposal site, to reduce the water content of the material, or to separate fractions of the material by particle size. Pretreatment technology process options include dewatering, particle classification, and slurry injection and are primarily applicable to hydraulically dredged sediment (Averett, 1990).

There are two primary reasons for pretreating contaminated sediments. The first reason is to condition the material such that it meets the requirements of the treatment and/or disposal components of the remedial alternative (EPA, 1994). Most treatment technologies require that the feed material, i.e., sediment, be relatively homogenous and that its physical characteristics, i.e., solids content, particle size, be within a narrow range for efficient processing. Pretreatment technologies may be employed to modify the physical characteristics of the feed material to meet subsequent processing needs. Sediment treatment technologies that use a continuous feed system generally have more stringent requirements for pretreatment than those using a batch feed system. Pretreatment requirements for sediment disposal are generally less stringent than those for treatment. The second reason for pretreatment of contaminated sediments is to reduce the volume and/or weight of sediment that require transport, treatment and/or disposal.

Dewatering technologies are used in sediment remedial alternatives to reduce the amount of water in sediments or residues and to prepare the sediments for further treatment or disposal. The need for dewatering is determined by the water requirements or limitations of the treatment or disposal technologies and the solids content of the sediments following excavation and transport. Selection of the most appropriate dewatering method depends on factors such as the volume of material, solids content of the waste stream, land space available, and the degree of dewatering required prior to treatment or disposal of the material. Although several of the dewatering methods are very effective in removing water, the solids often are not sufficiently dry to meet requirements for final disposal, and require further treatment to fixate or solidify the material (EPA, 1985). The water generated during the dewatering of contaminated dredged sediment will contain contaminants as well as suspended solids and will require treatment.

1.1 Project

The U.S. Army Corps of Engineers is authorized by Congress to operate and maintain over 125 navigation projects around the Great Lakes. Project features that must be maintained include navigation channels in rivers and harbors. In order to maintain navigation channels at authorized depths the Corps of Engineers dredges bottom sediments that accumulate in the channels. The depths and widths to which navigation channels are maintained are prescribed in the Congressional authorization for each project. Dredging beyond these channel limits must be done in accordance with all applicable laws and regulations. Section 312 of the Water Resources Development Act of 1990 (PL 101-640) gave the Corps the authority to dredge outside the navigation channel for "the purpose of environmental enhancement and water quality improvement."

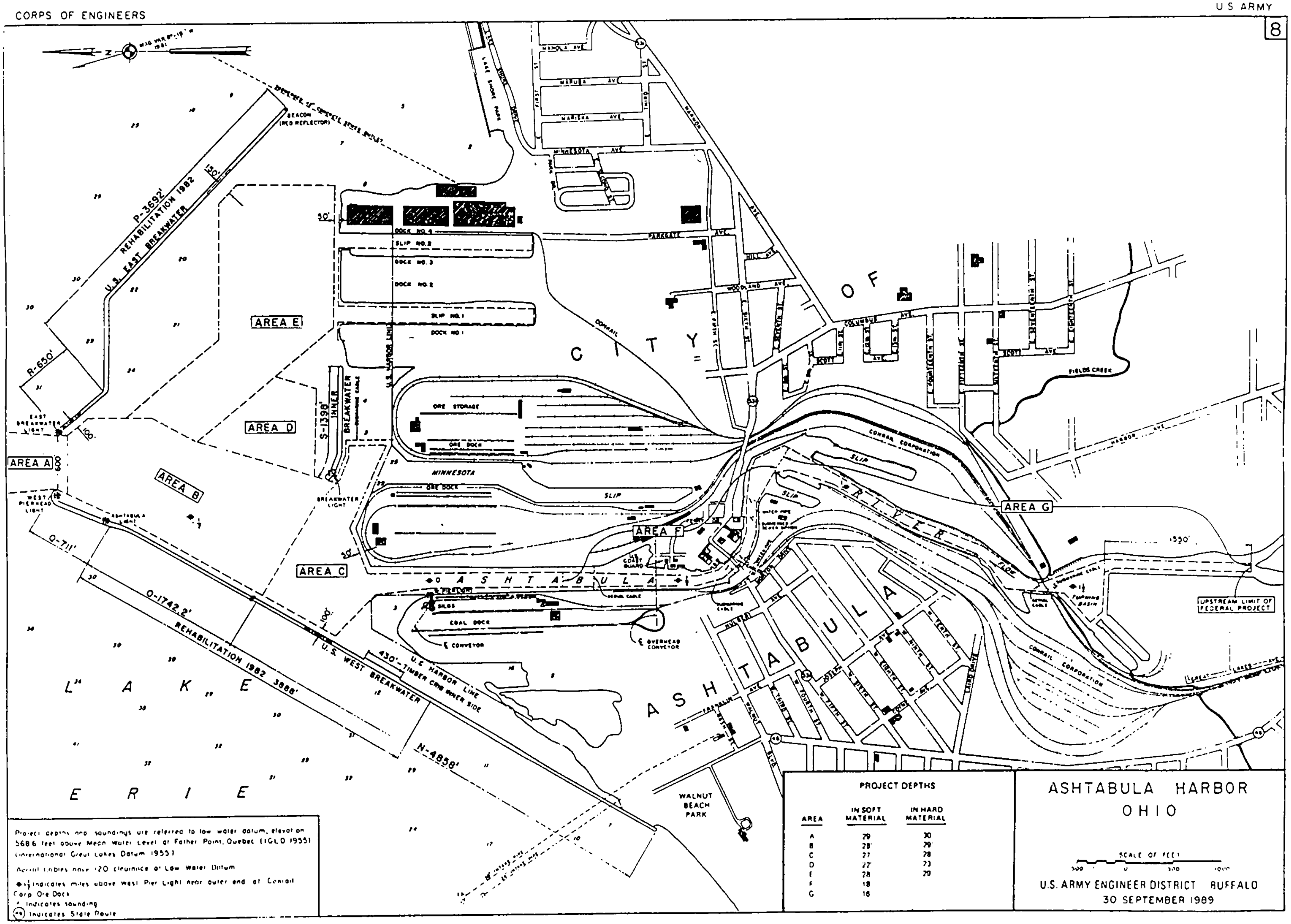
The proposed project involves dredging a total of approximately 696,000 cubic yards of contaminated sediment from the lower Ashtabula River in Ashtabula, Ohio (Figure 1). Approximately 150,000 cubic yards of this material may be classified as TSCA material due to elevated levels of PCBs. It is expected that the sediment will be dredged over a 3 year period, resulting in between 200,000 and 300,000 cubic yards of material being dredged during each construction season. Assuming a 6 month dredging season and a 6 day per week operation, an average of 1,300 to 2,000 cubic yards of sediment will need to be dredged each day. At the time of this writing, it had not been determined if the Ashtabula River sediments, including the TSCA sediments, would be dredged using mechanical dredges or hydraulic dredges (see Appendix on dredging alternatives).

The sediments to be dredged from the lower Ashtabula River are predominantly fine-grained soil particles, i.e., silts and clays. It is likely that a fair amount of debris and oversized material is present within the sediments to be dredged. This may include cobbles, boulders, construction debris, timber, etc.

2.0 DEWATERING

Mechanically dredged sediments typically have a solids content comparable to that of in situ sediments, about 50 percent by weight for most fine-grained sediments. Hydraulically dredged sediments are in a slurry with a solids content typically in the range of 10 to 20 percent (EPA, 1994). Some hydraulic dredge pumps are capable of moving slurries with higher solids content, but the average solids content during a large scale dredging operation is rarely greater than 20 percent. To prepare dredged sediments for most treatment or disposal technologies, water must be removed and/or the solids content of the sediment must be made more uniform. Dewatering will be required for most sediment remedial alternatives that involve hydraulic dredging or

Figure 1


CORPS OF ENGINEERS
U S ARMY
8
P-3692'
REHABILITATION 1982
U.S. EAST BREAKWATER
R-650'
EAST BREAKWATER LIGHT
AREA A
AREA B
AREA C
AREA D
AREA E
AREA F
AREA G
S-1398'
INNER BREAKWATER
BREAKWATER LIGHT
WEST PIERHEAD LIGHT
ASHTABULA LIGHT
O-711'
O-1742.2'
REHABILITATION 1982 3888'
U.S. WEST BREAKWATER
430'-TIMBER CRIB INNER SIDE
U.S. HARBOR LINE
N-4858'
LAKE
ERIE
DOCK NO. 4
SLIP NO. 2
DOCK NO. 3
DOCK NO. 2
SLIP NO. 1
DOCK NO. 1
ORE STORAGE
ORE DOCK
MINNESOTA
SLIP
COAL DOCK
SILOS
CONVEYOR
OVERHEAD CONVEYOR
COAST GUARD
ASHTABULA
RIVER
CITY OF
ASHTABULA
CONRAIL CORPORATION
FIELDS CREEK
TURNING BASIN
UPSTREAM LIMIT OF FEDERAL PROJECT
WALNUT BEACH PARK
LAKE SHORE PARK
MINNESOTA AVE
MARIETTA AVE
PARKGATE AVE
WOODLAND AVE
COLUMBUS AVE
HARBOR AVE
Project depths and soundings are referred to low water datum, elevation 568.6 feet above Mean Water Level at Father Point, Quebec (IGLD 1955) (International Great Lakes Datum 1955)
Aerial cables have 120 clearance at Low Water Datum
● 1½ Indicates miles above West Pier Light near outer end of Conrail Corp Ore Dock
Indicates sounding
(46) Indicates State Route
PROJECT DEPTHS
AREA | IN SOFT MATERIAL | IN HARD MATERIAL
A 29 30
B 28' 29'
C 27 28
D 27' 23
E 28 20
F 18
G 16
ASHTABULA HARBOR
OHIO
SCALE OF FEET
U.S. ARMY ENGINEER DISTRICT BUFFALO
30 SEPTEMBER 1989

3

transport. However, if the sediments are mechanically dredged and transported, the dewatering requirements may be greatly reduced or eliminated.

Another function of dewatering is the reduction of the volume and weight of the sediments, which decreases the subsequent costs of handling, transport, and treatment and/or disposal of solids. Dewatering will reduce the weight of dredged material, but the effects of dewatering on the volume of dredged material are more complex. When a sediment slurry is dewatered, the removal of free water will reduce the volume of material remaining in a nearly one-to-one relationship. Sediments that have been partially dewatered or mechanically dredged may lose additional water, but the volume will not always be reduced because the water driven from the voids between sediment particles may be replaced by air. Some dewatering processes may even increase the volume of the sediment. Three general types of dewatering technologies include passive dewatering, mechanical dewatering, and active evaporative technologies.

The Ashtabula River sediments classified as TSCA material would require dewatering prior to disposal in a TSCA approved landfill, the alternative selected for the treatment/disposal of this portion of the dredged sediments. The placement of hazardous waste containing free liquid in any landfill is prohibited by 40 CFR 264.314 of the Code of Federal Regulations. To demonstrate the absence or presence of free liquids in a waste, Method 9095 (Paint Filter Liquids Test) as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Publication Number SW-846) must be used.

2.1 Passive Dewatering Technologies

The term passive dewatering refers to dewatering techniques that rely on natural evaporation and drainage to remove moisture. Drainage may occur by gravity or may be assisted by mechanical devices such as vacuum pumps. Dewatering of dredged material has traditionally been accomplished in confined disposal facilities (CDFs), which rely on primary settling, surface drainage, consolidation, and evaporation. Subsurface drainage and wick (vertical strip) drains have also been demonstrated or used at CDFs to promote dewatering and consolidation. These technologies require significant amounts of land and are most effective if the sediments can be spread in thin layers on "lifts." Sediments can also be dewatered in temporary holding facilities, tanks, and lagoons using the same design principles developed for CDFs. Passive dewatering technologies are discussed below.

2.1.1 Primary Settling - Within a confined disposal facility a hydraulic slurry will be dewatered by several processes, including settling, drainage, and evaporative drying.

With hydraulic dredging and transport, a CDF functions as a large settling pond (Averett, 1990). Coarse sediments will deposit rapidly near the discharge while finer particles may require detention times of several hours or several days to settle. The settling efficiency of a CDF is controlled by the hydraulic characteristics of the settling pond and the drainage mechanism. With most CDFs designed for hydraulic dredges, an overflow weir is used to drain surface water. The weir overflow is controlled by the static head and the effective weir length provided. The weir crest elevation controls the depth of ponded water. The ponded surface area of the site will be less than the overall surface area enclosed by the dikes because of the mounding of the coarse-grained solids and the minimum freeboard requirements. The effective settling area is reduced by wind, turbulence, and short-circuiting, the loss of water through the CDF's dikes and the bottom of the CDF. Internal dikes can be built to improve the settling efficiency by altering flow patterns, modifying currents, and allowing longer periods for settling.

The solids that accumulate in the disposal facility will decrease the effective size and settling effectiveness of the disposal facility. Therefore, treatment requirements for the effluent water may increase as filling progresses. Accumulated solids may be removed periodically to maintain the settling efficiency. Once active disposal operations are completed, the dredged material solids continue to consolidate. Lowering the weir elevation allows drainage of the surface water.

2.1.2 Solar Evaporation - Evaporation and transpiration of water from the surface remove water and promote further consolidation of sediments. In solar evaporation water is evaporated by solar energy, leaving a concentrated mass of solids. A solids concentration comparable with mechanical dewatering equipment may be achieved over a period of several months. This desiccation of dredged material by evaporative drying results in the formation of a crust at the sediment surface. The thickness of the crust and the rate of evaporative drying and consolidation are dependent on local conditions and sediment properties. While solar heating contributes to the dewatering of dredged material in a CDF, it is not the only mechanism involved. Consolidation and surface drainage also contribute to dewatering. Solar evaporation as a stand alone process is suitable only for arid climates and is considered ineffective for the Great Lakes region (Averett, 1990).

2.1.3 Surface Drainage - Surface water conditions within a CDF will depend on the type of facility and method for dredging/disposal. In-water CDFs will have a permanent pond until sediments have been deposited to an elevation above ambient lake levels. Once filled to this level the surface water conditions in an in-water CDF will be similar to an upland facility. Upland CDFs will have ponded conditions during hydraulic dredge/disposal operations. With mechanical dredge/disposal operations, limited amounts of free water are released from the sediments for possible ponding. Heavy rains may also cause ponding of water.

Drainage of surface water can be accomplished through a number of mechanisms. Most existing in-water CDFs on the Great Lakes have dikes constructed of stone and granular material and remain permeable as they are filled. As dredged materials are deposited into the CDF, the water level rises from displacement (Averett, 1990). This static head drives water through permeable sections of the dike. The dike's permeability is greatly reduced as suspended sediments become entrapped by dike materials and when dredged materials are placed on the dike face. When dikes are no longer permeable enough to pass flow equivalent to the dredge disposal, surface water is drained using overflow weirs or is pumped from secondary basins.

With hydraulic dredging/disposal to upland CDFs overflow weirs are most commonly used for surface drainage. The outlet weir is initially set at a predetermined elevation to ensure that the ponded water will be deep enough for settling as the containment area is being filled. Initially no effluent is released until the water level reaches the weir crest elevation. Effluent is then released at about the same rate as sediment slurry is pumped into the facility. The ponding depth decreases as the thickness of the dredged material increases. After completion of the disposal operation the ponded water is removed as quickly as effluent water quality standards allow.

Following the dredging operation the removal of water can be expedited by managing inlets and weirs during the disposal operation to place a dredge material deposit so that it slopes continually and as steeply as practical toward the outlet. Once the dredging operation has been completed and the ponded water has been decanted, site management efforts should be concentrated on maximizing the containment storage capacity gained from continued drying and consolidation of dredged material and foundation soils. The weir crest elevation must be kept at levels allowing efficient release of runoff water. This will require periodic lowering of the weir crest elevation as the dredged material surface settles.

One method employed to aid in drainage and evaporation of the water in dredged material placed into CDFs is progressive trenching. Evaporation is accelerated by rapid removal of any precipitation by trench construction and by prevention of surface water ponding. These trenches are progressively deepened as drying occurs. The drying time required to achieve the desired solids content may be several months to years and may still be inadequate for destruction or treatment technologies (Averett, 1990).

2.1.4 Subsurface Drainage - A subsurface drainage system may be used at a CDF for dewatering of dredged material and/or leachate collection. One approach is to place perforated pipe under or around the perimeter of a CDF that drain into a series of sumps from which water is withdrawn. Spacing between the pipes and sizing of the pipes depends on the static head that is allowed in the disposal facility and the rate at which water must be removed. An underdrain system aids in dewatering dredged material placed in a CDF by collecting leachate and by promoting consolidation of the solids. Underdrainage filter material must be free draining and free of fine-grained soil particles, i.e., less than 5 percent passing the U.S. sieve No 200 (Averett, 1990). The feasibility of subsurface drainage as a sediment dewatering technology may be limited where several layers of fine-grained sediments are to be disposed because they may clog the drainage materials. Also, the permeability of fine-grained sediments following compaction may be so low as to limit drainage to the system.

Several variations of subsurface drainage systems may be used, including the gravity underdrain, vacuum-assisted underdrain, vacuum-assisted drying beds, and electro-osmosis. The gravity underdrain system provides free drainage at the base of the dredged material by the gravity-induced downward flow of water. The vacuum-assisted underdrain is the same as the gravity fed system, but uses an induced partial vacuum in the underdrainage layer. This system improves dewatering efficiency by 50 percent over the gravity underdrain system.

2.1.5 Wick Drains - Wick drains or "wicks" have been used to promote dewatering and consolidation of fine-grained wet materials in confined disposal facilities. These polymeric vertical strips provide a conduit for the upward transport of pore water, which is under pressure from the weight of the overlying material. Placing the vertical drains on center to one another through the confined sediment promotes both radial and vertical drainage. Wick drains may reduce consolidation time by a factor of 10 when compared to natural consolidation.

2.2 Mechanical Dewatering Technologies

Mechanical dewatering systems have been used extensively for conditioning municipal and industrial sludges and slurries. These systems require the input of energy to squeeze, press or draw water from the feed material. Generally mechanical dewatering technologies can increase the solids content up to 70 percent by weight (EPA, 1994).

The performance of a mechanical dewatering system is measured by a number of parameters, including (1) chemical conditioning dosage, measured as the mass of conditioner per mass of dry solids, (2) solids capture, defined as the dry mass of dewatered solids per dry mass of solids feed into the process, and (3) solids content of the dewatered material.

With sewage sludges, the dosage of organic (polymer) conditioner in mechanical dewatering systems is generally less than 0.1 percent by weight, while the dosage of inorganic conditioners is substantially higher. For example, lime and ferric chloride may be used in dosages as high as 20 percent.

A high solids capture is desirable, because solids lost from the process, i.e., in the filtrate, represent a route for contaminant loss. Some particulate loss during mechanical dewatering is inevitable and therefore the effluent stream will require treatment.

Most mechanical dewatering processes increase the solids content of the feed material to a level comparable to that of the in situ sediment deposits, about 50 percent solids. These dewatering processes work best with homogeneous waste streams at a constant flow rate. Because hydraulic dredging produces highly variable flow rates and solids concentrations, direct dewatering of hydraulically dredged slurries would be inappropriate. Temporary storage in a tank, lagoon, or CDF would be necessary to equalize flows and concentrations prior to dewatering with a mechanical process. The dredged sediments would also require screening prior to mechanical dewatering in order to remove debris and oversized material that the mechanical device would be unable to handle. Several mechanical dewatering devices are discussed below.

2.2.1 Belt Filter Press - Belt filter presses use single or double moving belts to dewater material (Figure 2). The belt filter press process involves three stages, (1) conditioning by either the addition of a flocculant or by a thickening drum section, (2) gravity drainage of free water, (3) the compression zone (Averett, 1990). A flocculant is injected to facilitate solids separation or a thickener drum screen section removes some of the filtrate by gravity. The slurry then flows to a gravity drain section consisting of a conveyor belt where more filtrate is removed. The slurry leaving this stage should have a solids content of approximately 30 percent, depending on the slurry feed concentration. The belt filtration section consists of two filter belts operating on drive and guide rollers at each end like conveyor belts, with the upper belt operating as the press belt and the lower belt operating as the filter belt. The upper side of the filter belt is supported by two rollers pressed against the press belt which runs in the same direction and speed as the filter belt. An adjustable pressure roller system maximizes the static and shear pressure applied to the filter belt by the press belt. Slurry flowing from the gravity drain section is pressed between the two belts and dewatered. Shear forces are applied by the adjustment of the supporting rollers of

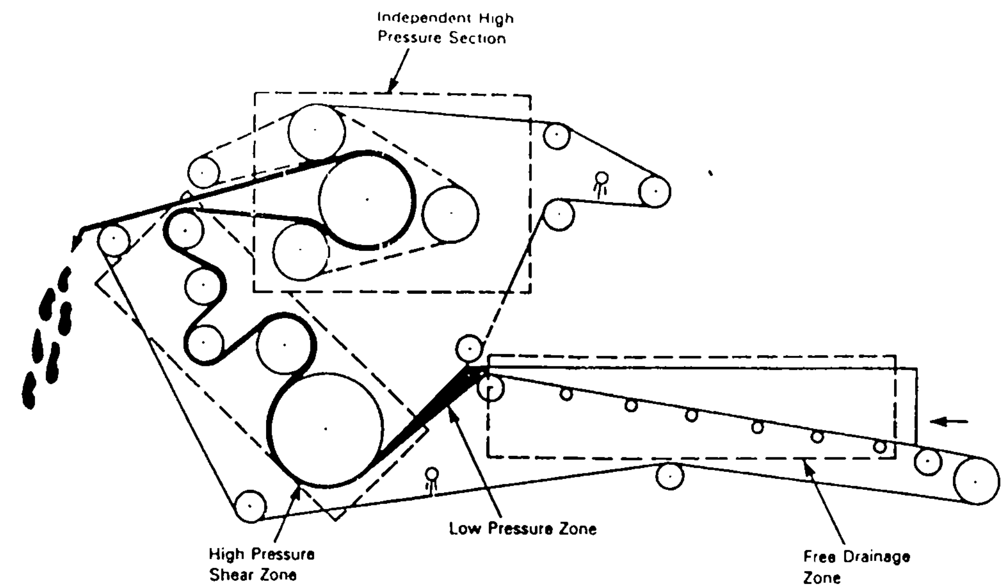


Figure 2 - Belt Filter Press

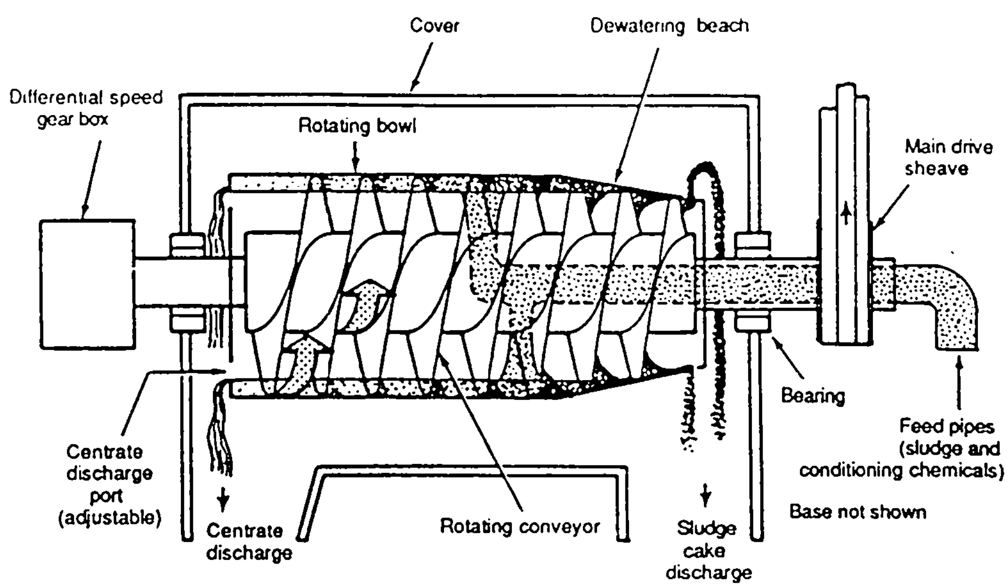


Figure 3 - Solid Bowl Centrifuge

the filter belt and the pressure rollers of the press belt so that the belts and the slurry between them form an S-shaped curve. The dewatered solids cake is then removed.

Belt filter presses operating continuously have been successfully demonstrated on river sediments and on industrial and municipal wastewater treatment facility sludges. Sediment slurries varying from 1 to 40 percent solids by weight can be processed by the belt filter press. The higher the sediment solids feed concentration the drier the resulting sediment cake will be.

A belt filter press was demonstrated to obtain 50 to 60 percent solids by weight while processing river sediment from the Ashtabula River, Ohio. The throughput was approximately 25 tons per hour of solids feed for an 8.2 foot wide belt filter press. The typical solids capture rates were 95 to 98 percent for this sediment, with the majority of the lost solids captured in the belt wash water. A belt filtration system for a 500,000 cubic yard facility was estimated to cost $6,000,000 in capital costs and $3 per ton of dry solids for operation and maintenance costs (Averett, 1990). Tests have demonstrated that high density dredged materials can be dewatered to a cake solids concentration of 70 percent using belt press filtration (EPA, 1985).

2.2.2 Centrifugation - Centrifugation is a dewatering technology that uses rapid rotation of a fluid mixture inside a rigid vessel to separate the particles based on their mass. Centrifuges are generally used in conjunction with flocculants and can be used to dewater or concentrate soils and sediments ranging in size from fine gravel to silt. While they are capable of removing particles as small as one micron, removal efficiencies are drastically reduced for particles smaller than 10 microns (Averett, 1990). The forces in centrifugation are similar to the gravitational forces in sedimentation with the exception that centrifugal forces are thousands of times stronger. Centrifugation is a clean, simple, and reliable option for sludge and solids dewatering. They are less effective than filtration processes and dewatering lagoons, but more effective than gravity thickeners.

Three types of centrifuges available are the solid bowl, basket, and disc centrifuge. Dewatering is usually accomplished using solid bowl or basket centrifuges. Disc centrifuges are mainly used for clarification and thickening. The operation of the solid bowl centrifuge is a continuous process. The unit consists of a long bowl, normally mounted horizontally and tapered at one end (Figure 3). Sludge is introduced into the unit continuously and the solids concentrate on the periphery. A helical scroll within the bowl, spinning at a slightly different speed, move the accumulated sludge towards the tapered end where additional solids concentration occurs prior to discharging the solids (EPA, 1985).

In the basket centrifuge flow enters the machine and is directed toward the outer wall of the basket (Figure 4). Cake continually builds up within the basket until the centrate, which overflows a weir at the top of the unit, begins to increase in solids. Feed into the unit is then shut off, the machine decelerates, and a skimmer enters the bowl to remove the liquid layer remaining in the unit. A knife then enters the bowl to cut out the solids cake which falls out the open bottom of the machine. The unit is a batch device with alternate charging of feed and discharging of dewatered cake.

In the disc centrifuge, the incoming feed material is distributed between a multitude of narrow channels formed by stacked conical discs (Figure 5). Suspended particles have only a short distance to settle, so that small and low density particles are readily collected and discharged continuously through fairly small orifices in the bowl wall. The clarification capability and throughput range are high, but sludge concentration is limited by the necessity of discharging through orifices of 0.05 inches to 0.1 inches in diameter. Therefore this centrifuge is generally considered a thickener rather than a dewatering device.

Data from municipal sludge dewatering operations indicate that solids concentrations of 15-40 percent are possible with the solid bowl centrifuge. Approximately 85 to 97 percent of the solids are captured with chemical conditioning for both the solid bowl and basket centrifuge (Averett, 1990). The solids cake concentration for the basket centrifuge ranges from approximately 9 to 25 percent. Disc centrifuges can concentrate a 1 percent sludge to 6 percent solids. The cost of a fixed centrifuge unit with a throughput capacity of 50 pounds per hour (dry) are $500,000 for capital and $84,000 for operation and maintenance.

2.2.3 Gravity Thickeners - Gravity thickening is usually performed in a circular tank constructed of concrete or steel and similar in design to a conventional clarifier (Figure 6). The slurry enters the thickener through a center feedwell designed to dissipate the velocity and stabilize the density currents of the incoming stream. The feed sludge is allowed to thicken and compact by gravity settling. A sludge blanket is maintained on the bottom of the thickener to help concentrate the sludge. The clarified liquid overflows the tank and the underflow solids are raked to the center of the tank and removed by gravity or pumping (EPA, 1985). Flocculants may be added to the feed stream to enhance the agglomeration of solids and to promote a quicker more effective settling.

The size and specifications of a gravity thickener depend on several factors, including maximum flow, waste type, volume of solids per day, percent solids, specific gravity, surface

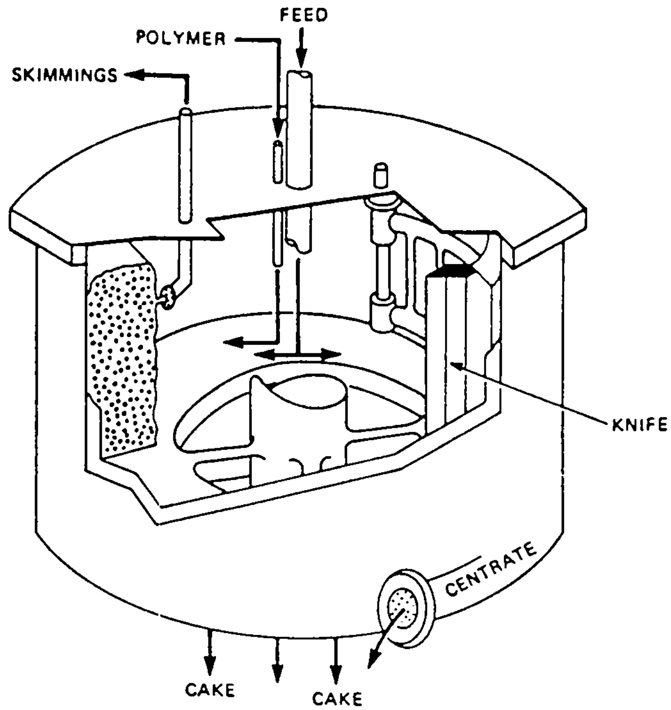


Figure 4 - Basket Centrifuge

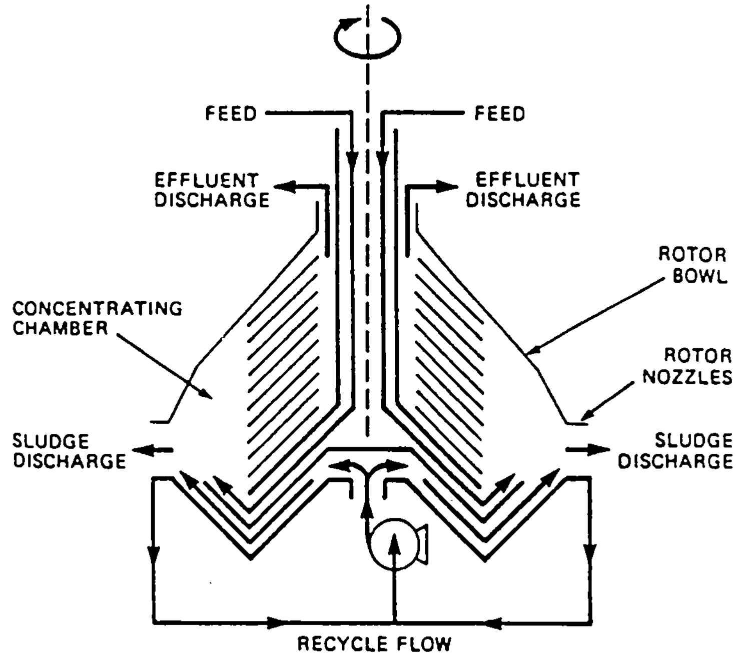


Figure 5 - Disc Centrifuge

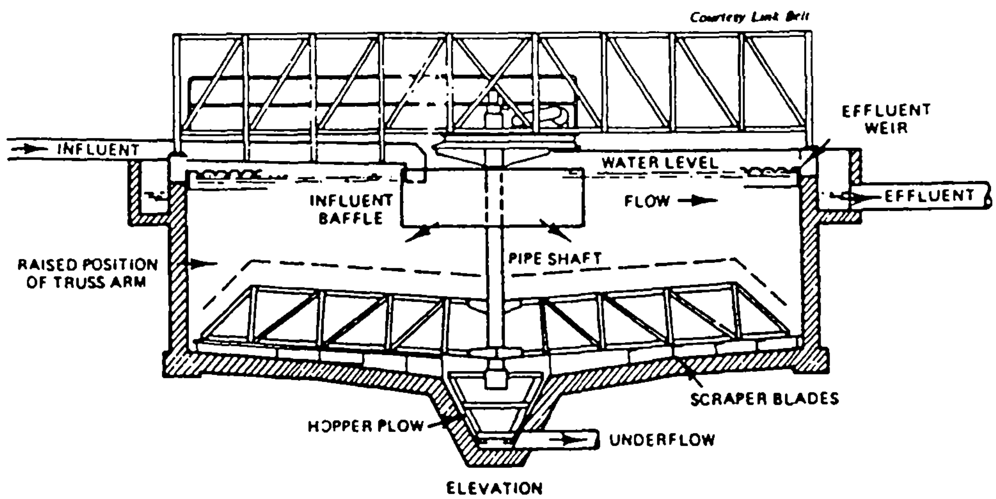


Figure 6 - Gravity Thickener

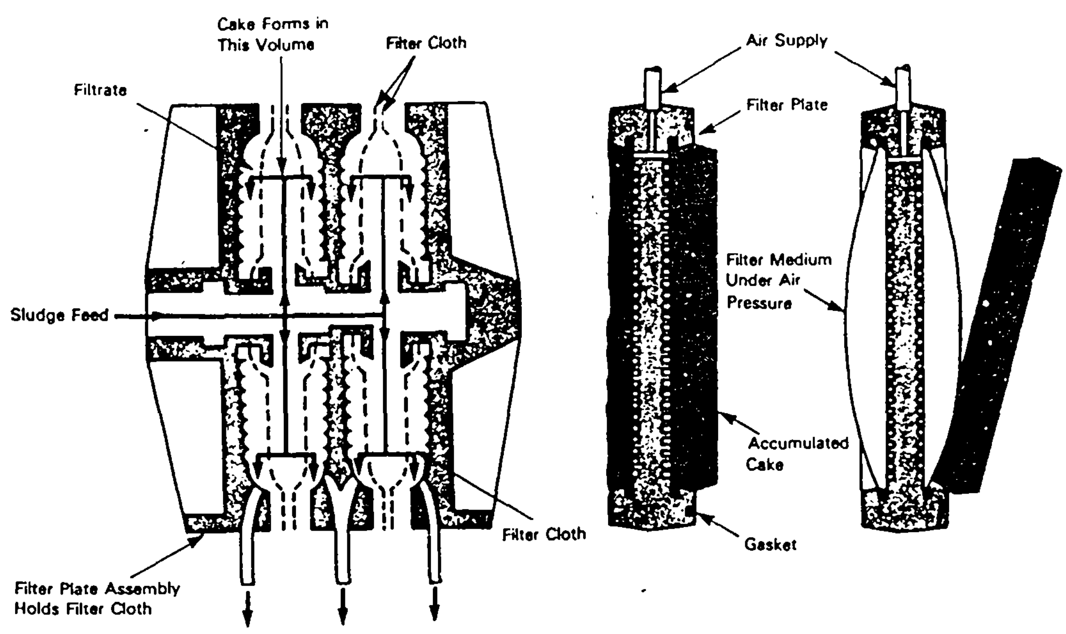


Figure 7 - Plate and Frame Filter Press

chemistry, maximum particle size, and percent solids required in the underflow. Gravity thickeners are used to concentrate slurries and are capable of achieving a solids concentration of approximately 2 to 15 percent. They generally produce the thinnest and least concentrated sludge of the mechanical dewatering technologies. The intent of using a gravity thickener is usually to reduce the hydraulic load of a slurry that is to be fed to a more efficient dewatering method, such as filtration or centrifugation. Conventional gravity thickeners require large land areas for operation and are not applicable where space is restricted or for large dredged material flow rates (Averett, 1990). High rate gravity thickeners provide up to 15 times the throughput of conventional thickeners and can reduce land requirements.

2.2.4 Chamber Filtration - Chamber filtration utilizes rigid individual filtration chambers operated in parallel under high pressure to dewater a slurry. The most common chamber filtration unit is the plate and frame filter press (Figure 7). The plate and frame filter press is a semicontinuous conventional dewatering technology that effectively dewaters wastewater sludges, sediment, and hard to handle slurries (Averett, 1990). The filter press can be used in situations requiring a large area of filtration in minimal area. The unit consists of parallel vertical plates placed in series and covered on both sides with a monofilament filter. The plates are held firmly in a frame and are pressed together between a fixed end and a moving end. The slurry is pumped under pressure into the filter press and passes through feed pores in trays that lie along the length of the filter press. Water in the slurry flows through filter media covering the plates while solids form a cake on the filter's surface. Feed of material into the presses ceases and dewatering is complete when filtrate ceases draining through the filter. The filter press is then opened and the individual vertical plates are moved over a gap between the plates and the moving end in order to allow the solids cake to fall off of the filters. After the solids cakes have been removed the plates are pushed back into place by the moving end and the press is closed for the next dewatering cycle.

Plate and frame filter press units have been proven effective in the dewatering of industrial and municipal wastewater treatment facility sludges. Filter cake solids content have been improved to greater than 50 percent due to advances in the working pressures associated with the press. Filter presses also offer improved solids capture rates, improved clarity of the filtrate and reduced chemical consumption. Manufacturers' data indicates that filter press filtration is capable of producing a filter cake of up to 70 to 80 percent solids when dewatering coal slurries.

The diaphragm plate filter press is similar to the plate and frame filter press except that an inflatable diaphragm is incorporated into the design (Figure 8). At the end of the pumping cycle pressures up to 14-17 atmospheres are applied to the diaphragm for additional dewatering. Percent solids are usually 5-8 percent higher than those of conventional filter press cakes.

2.2.5 Vacuum Filtration - The vacuum filter unit consists of a rotating cylindrical drum mounted horizontally and partially submerged in a vat of slurry (Figure 9). A continuous belt filter made of fabric or wire mesh covers the drum. A vacuum applies negative pressure to the inside of the drum, causing liquid to flow through the filter and into the center of the drum while the moist solids adhere to the filter (Averett, 1990). The filtrate exits the drum through the vacuum hose into a separator where the effluent exits the unit for further treatment or disposal. The solids cake adhering to the drum is removed either by knives that scrape against the drum as it rotates or is blown off with compressed air. Several operating parameters within the vacuum filtration system can be altered to affect the performance of the unit. These parameters include, (1) the vacuum drawn during cake formation and dewatering, (2) the degree of drum submergence, i.e., a high drum submergence may increase the filter yield, but the moisture content in the filter cake may also increase, (3) drum speed, and (4) filter media porosity.

Vacuum filtration units have been proven effective in dewatering industrial and municipal wastewater treatment facility sludges. The cake solids content usually ranges from 20 to 40 percent while the solids capture rate usually ranges from 85 to 99.5 percent. A vacuum filtration unit was used on dredged material from Toledo Harbor, Ohio. The solids content prior to conditioning with lime ranged from 15 to 23 percent. After treatment the solids content of the cake were consistently above 43 percent. Averett, et al. reported that vacuum filtration is not economical for most dredging applications. Vacuum filtration is one of the most energy intensive of the mechanical dewatering technologies and the least effective in dewatering (EPA, 1985). Incoming feed must have a solids content of at least 3 percent in order to achieve adequate cake formation.

2.3 Active Evaporation Technologies

Active evaporation technologies are different from the evaporative drying techniques used in CDFs since artificial energy sources are used to heat the sediments, as opposed to solar radiation. Active evaporation is the most expensive dewatering technology but has been used effectively to prepare municipal sludges for incineration (EPA, 1994). Nearly all of the water is removed resulting in a solids content of

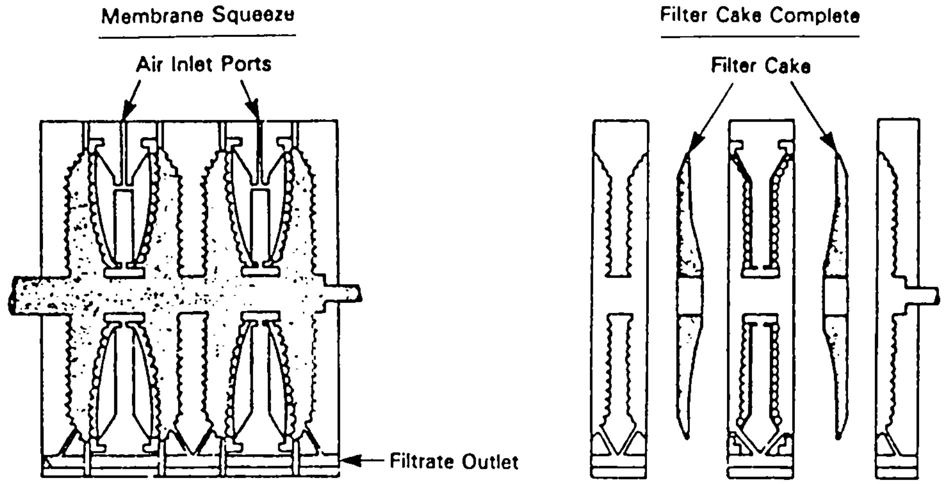


Figure 8 - Diaphragm Plate Filter

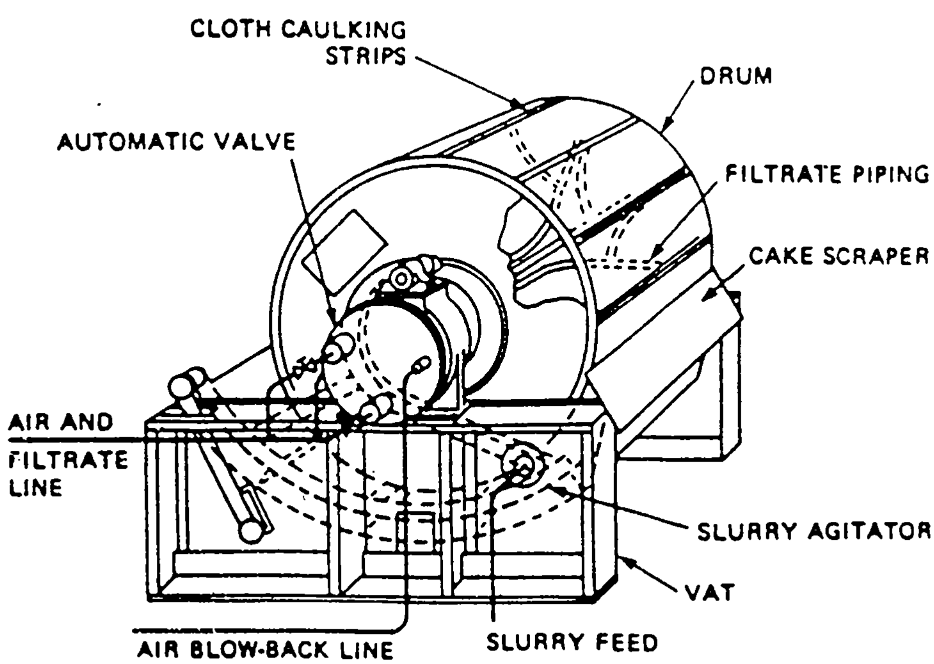


Figure 9 - Vacuum Filter

approximately 90 percent. Evaporative technologies that have been applied to sludges and may be applicable to fine-grained sediments include, (1) flash dryers, (2) rotary dryers, (3) modified multiple hearth furnaces, and (4) heated auger dryers. The most common conventional evaporation process used for waste recycling is agitated thin-film evaporation. This process is used on wastes with high solids content, viscous liquids, and slurries. The thin-film unit consists of a large surface on which a thin film of waste material is continuously applied and heated (Averett, 1990). The volatiles in the waste are vaporized.

Evaporative dewatering technologies have not been demonstrated with sediments on any scale. Most of the design and operating experience and guidance on these technologies are from municipal and industrial wastewater applications.

3.0 SELECTION OF DEWATERING ALTERNATIVES

The need for pretreatment is generally driven by the treatment and/or disposal components chosen for a remedial alternative and the physical characteristics of the sediments (EPA, 1994). A treatment technology with restrictive feed requirements may necessitate a multiunit pretreatment system. The design of a pretreatment system must be compatible with other remedial components. Sufficient land must be available at the treatment or disposal sites to operate pretreatment units and accommodate residues. Water extracted from dewatering technologies and process water from separation technologies may require a separate treatment system from the disposal site leachate system. A portion of the pretreatment water may be reusable within the process system.

The selection of a dewatering technology usually involves choosing between a passive and a mechanical approach. Active evaporation technologies would normally be employed only where subsequent processes require extremely dry material, i.e., thermal desorption and incineration units. The advantages and disadvantages of passive and mechanical dewatering are shown in Table 1 (EPA, 1994). If a permanent or temporary confined disposal facility is part of the remedial alternative, passive dewatering may be conducted within the facility. Design of the facility might accommodate a number of functions, including settling, dewatering, storage, rehandling, and disposal. Separate cells might be constructed in the disposal facility to accommodate these different functions.

Mechanical dewatering is most suitable where land is not available for a temporary or permanent diked facility. Selection of a specific type of mechanical dewatering equipment depends on the requirements of the treatment or disposal components to follow. Maximum solids content is generally achieved using a recessed plate or diaphragm plate filter. However, if lower solids content is acceptable, i.e., for transport to a landfill, less costly alternatives such as centrifugation or belt filter presses may be appropriate (EPA, 1994).

Table 1 - Advantages and Disadvantages of Passive and Mechanical Dewatering

Advantages	Disadvantages
Passive Dewatering	
Able to dewater large quantities of sediments concurrently	Land/area requirements are large
Very low operating costs	Dewatering times range from months to years
Can accommodate high flow rates and rapidly varying flows and solids concentrations, such as those produced from a hydraulic dredge	Material must be excavated if subsequent treatment and/or disposal is to take place
The site used for passive dewatering can provide intermediate storage and, in the case of confined disposal facilities, a final disposal site for dredged material	Contaminant loss by volatilization is not easily controlled
Mechanical Dewatering	
Provides a method of increasing sediment solids content quickly and efficiently	Fine-grained sediments may blind or clog filters
Requires small space	Equipment is usually housed in a building
Contaminant losses, including volatile losses, can be controlled	Operator attention is required
	Requires conditioning chemicals that may increase the weight of dry solids
	Dewatering solids must be removed on a continuous or semicontinuous basis

Active evaporation technologies, including flash dryers, rotary dryers, modified multiple hearth furnaces, and heated auger dryers, will not be considered as dewatering alternatives for the excavated Ashtabula River sediments. This technology has been described as the most expensive dewatering technology and has not been demonstrated with sediments on any scale (EPA, 1994).

It is recommended that Ashtabula River sediments that are removed with mechanical dredging equipment and disposed of in a secure licensed landfill be dewatered using passive dewatering technologies. Mechanically dredged material can be expected to contain roughly 50 percent solids and 50 percent water and normally would require little additional dewatering in order to pass the previously referenced Paint Filter Liquids Test, Method 9095, EPA Publication Number Sw-846 (EPA, 1995). It is anticipated that the fine grained Ashtabula River sediments would pass this test with a solids content of approximately 60 to 70 percent i.e., 30 to 40 percent moisture. While a single passive dewatering technology may not be appropriate for dewatering sediments in the Great Lakes region, several of these technologies used in conjunction with one another should be capable of dewatering mechanically dredged sediment in this region. Mechanically dredged sediments disposed of in an upland facility, i.e., a licensed landfill, will result in limited amounts of free water released from the sediments for possible ponding. Heavy rains may also cause ponding of water. The first technology, the use of progressive surface trenching to remove ponded surface water and precipitation and enhance evaporative dewatering of fine-grained dredged material has been described as the most cost effective dewatering alternative (USCOE, 1978). The second technology, solar evaporation of water from the surface, removes water and promotes further consolidation of the sediments, leaving a concentrated mass of solids. A solids concentration comparable with mechanical dewatering equipment may be achieved over a period of several months. The net dewatering produced from surface trenching and solar evaporation will depend on climatic conditions, dredged material engineering properties, and whether or not an aggressive and continuous surface trenching dewatering program is conducted. When a surface trenching program alone will not produce dewatering at necessary rates or it is desired to obtain enhanced dewatering rates, various forms of either gravity or vacuum assisted underdrainage may be applied. Effective underdrainage systems must be installed prior to disposal. One approach is to place perforated pipe under or around the perimeter of the disposal facility that drain into a series of sumps from which water is withdrawn. The underdrain system would aid in dewatering the dredged material contained in the facility by collecting leachate and by promoting consolidation of the solids. Several variations of subsurface drainage systems may be used. The gravity underdrain system provides free drainage at the base of the dredged material by the gravity induced downward flow of water. A vacuum assisted underdrain, which uses an induced vacuum in the underdrainage layer, improves dewatering efficiency by 50 percent over the gravity underdrain system (EPA, 1994) and could be employed on this project if additional dewatering capacity were needed. This dredging project is anticipated to take several years to complete. Therefore, it is also recommended that the dredged material be covered with an impermeable membrane during the winter shutdown period, which is also a period of increased precipitation and decreased solar evaporation. This will help

Hydraulically dredged material can be expected to contain approximately 10 to 20 percent solids or 80 to 90 percent water and would require significant dewatering in order to *pass* the Paint Filter Liquids Test. Numerous mechanical dewatering devices were considered for dewatering hydraulically dredged material. Gravity thickeners are capable of achieving a solids concentration of approximately 2 to 15 percent and generally produce the thinnest and least concentrated sludge of the mechanical dewatering technologies (Averett, 1990). Therefore, gravity thickeners will not be considered for dewatering hydraulically dredged Ashtabula River sediments. Vacuum filtration units are capable of achieving a solids concentration ranging from 20 to 40 percent and will not be considered for dewatering dredged Ashtabula River sediments since it is felt a solids content of 60 to 70 percent will be required to pass the Paint Filter Liquids Test. A disc centrifuge can achieve a 6 percent solids concentration, while a basket centrifuge can achieve a solids content ranging from 9 to 25 percent and a solid bowl centrifuge can achieve a solids content ranging from 15 to 40 percent (Averett, 1990). Centrifugation dewatering technology will not be considered further since it does not appear capable of achieving a solids content sufficient for the material to pass the Paint Filter Liquids Test.

A belt filter press was demonstrated to obtain 50 to 60 percent solids by weight while processing Ashtabula River sediment (Averett, 1990). Chamber filtration technology, plate and frame filter and diaphragm plate filter, is capable of achieving solids content ranging from approximately 50 to 60 percent (Averett, 1990), which is approaching the solids content necessary to pass the Paint Filter Liquids Test. However, belt filters and chamber filtration will not be considered for dewatering the Ashtabula River sediments due to costs and the capacity of this equipment to dewater the 696,000 cubic yards of sediment that is to be dredged and landfilled. Unit costs for belt filter press dewatering are shown in Table 2 and range from $16 to $55 per cubic yard of in place sediment for a sediment feed with 40 percent solids to $83 to $275 per cubic yards of in place sediment for a sediment feed with 10 percent solids. (EPA, 1994). At the Marathon Battery Superfund Project in Cold Springs, New York mechanical dewatering of Hudson River sediments using four belt filter presses achieved an operating capacity of 250 cubic yards per day (Taylor, 1994). To dewater 696,000 cubic yards of in place Ashtabula River sediment with a solids content of say 50 percent that was dredged hydraulically, resulting in a sediment slurry of say 20 percent solids, would require several decades assuming an operation of similar capacity that operated for 200 days per year. From personal experience it is anticipated that a plate and frame dewatering operation used to dewater 696, 000 cubic yards of hydraulically dredged Ashtabula River sediment would also be prohibitively expensive and would take a prohibitively long period of time.

For these reasons belt filter press technology and chamber filtration technology will not be considered for dewatering the dredged Ashtabula River sediments.

Table 2 - Unit Costs for Belt Filter Press Dewatering

Feed (percent solids)	\$/ton[a] Dry Solids	\$/yd[3] [b]
10	136-452	83-275
20	63-211	38-129
30	39-131	24-80
40	27-91	16-55

EPA, 1994

a English tons are used here; multiply by 1.1 for cost per dry tonne.

b Unit cost per cubic yard of sediment (in place) assumes sediments are 50 percent solids and have a dry density of 2.6-2.7 g/cm^3 (i.e., 1 yd^3 contains approximately 1,200 lbs of dry solids); multiply by 1.32 for cost per cubic meter.

Due to the size of this project, the need to achieve 60 to 70 percent solids, and the cost of dewatering per cubic yard of material, it is recommended that Ashtabula River sediments that are removed using hydraulic dredging equipment be dewatered using passive dewatering technologies. Within a disposal facility a hydraulic slurry would be dewatered by several processes, including settling, surface drainage, and evaporative drying. The containment cell would initially act as a large settling pond. The settling efficiency would be controlled by the hydraulic characteristics of the pond and the drainage mechanism. Once the majority of the ponded water has been drained off and the confined material starts to dry out, progressive surface trenching would be used to remove the remaining ponded surface water and any precipitation and enhance evaporative dewatering of the fine grained dredged material. Solar evaporation of water from the surface removes water and promotes further consolidation of the sediments, leaving a concentrated mass of solids. The net dewatering produced from draining ponded water, surface trenching and solar evaporation depends on climatic conditions, the dredged material engineering properties, and whether or not an aggressive and continuous surface trenching dewatering program is conducted. As with the mechanically dredged material, when surface trenching and solar evaporation will not produce dewatering at necessary rates or it is desired to obtain enhanced dewatering rates, gravity, or vacuum assisted underdrainage may be applied. Effective underdrainage systems must be installed prior to disposal. One approach is to place perforated pipe under or around the perimeter of the disposal facility that drain into a series of sumps from which water is withdrawn. The underdrain system would aid in dewatering the dredged material contained in the facility by collecting leachate and by promoting consolidation of the solids. A gravity underdrain system provides free drainage at the base of the dredged material by the gravity induced downward flow of water. A vacuum assisted underdrain, which uses an induced vacuum in the underdrainage layer, improves dewatering efficiency by 50 percent over the gravity underdrain system and could be employed on this project if additional dewatering capacity were needed. It is anticipated that the Ashtabula River project will take several years to complete. Therefore, it is recommended that the contained dredged material be covered with an impermeable membrane during the winter shutdown period, which is also a period of increased precipitation and decreased solar evaporation. This will help reduce the amount of precipitation infiltrating the sediments.

4.0 SUMMARY

This project involves the dredging of a total of approximately 696,000 cubic yards of contaminated sediments from the lower Ashtabula River. Approximately 150,000 cubic yards of this material may be classified as TSCA material due to elevated levels of PCBs. It is anticipated that the dredged material will be contained in an upland disposal facility. Whether the sediments are dredged mechanically or hydraulically, they will require dewatering in order to meet the legal requirement of containing no free liquid prior to being landfilled. Numerous dewatering technologies were reviewed, including passive dewatering technologies, mechanical dewatering technologies, and active evaporation.

It is recommended that the Ashtabula River sediments be dewatered using passive dewatering technologies, regardless of whether the sediments are dredged mechanically or hydraulically. Several of these technologies would be used in conjunction with one another in order to aid in the dewatering process. Advantages of passive dewatering include the ability to dewater large quantities of sediment at low cost. Disadvantages include the large land area required and the time required to achieve the dewatering. The anticipated duration of the dredging project, several years, and the expected upland disposal facility size should be sufficient to achieve dewatering using passive technologies.

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ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX K

ENVIRONMENTAL MONITORING

PREPARED BY:

Environmental Engineering Section
U.S. Army Corps of Engineers, Buffalo District
August 1997

ASHTABULA RIVER

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1 .0 MONITORING

The Ashtabula River sediment removal project consists of dredging polychlorinated biphenyl (PCB) containing sediments from the river bottom, dewatering the sediments, and disposing of the sediments. Sediments with PCB concentrations greater than or equal to 40 ppm will be dredged and disposed of separate from those containing less than 40 ppm PCBs. Water from the sediment dewatering process will be treated and discharged to the local wastewater treatment plant.

The proposed project involves dredging a total of approximately 696,000 cubic yards of contaminated sediment from the Ashtabula River. Approximately 150,000 cubic yards of this material has been classified as Toxic Substance Control Act (TSCA) material due to elevated levels of PCBs, i.e., PCB concentration equal to or greater than 50 ppm. It is anticipated that the sediment will be dredged over a 3-year period, resulting in between 200,000 and 300,000 cubic yards of sediment being dredged during each construction season.

Significant environmental monitoring will be necessary to determine environmental conditions prior to, during, and after dredging and dewatering activities. An Environmental Monitoring Plan should be prepared to address the steps to be taken during remedial activities for monitoring perimeter environmental conditions for potential adverse environmental impacts. Adverse environmental impacts associated with the project may include the release of resuspended contaminated sediments from the dredging activities to the river water column, failure of the water treatment plant to adequately remove PCBs and other contaminants from the waste water streams, and PCB releases associated with airborne particulates from the dewatering and disposal facilities. Environmental monitoring should be initiated prior to the start of any remedial activities in order to establish background conditions.

2.0 PREDREDGING DATA COLLECTION

A predredging data collection program would be used to verify the Ashtabula River bottom conditions, obtain background river water quality information, and establish baseline conditions of the ambient air. A bathymetric survey should be conducted to determine the river bottom topography within the areas to be dredged. The purpose of the bathymetric survey would be to provide information to enable quantitative measurements of the sediments removed. The predredge survey would be compared with a post dredge bathymetric survey to determine the sediment volume removed.

To perform real time monitoring that allows rapid response to changing river conditions and ensures the protection of human health and the environment, an easily measured water quality parameter that correlates with sediment resuspension during removal activities should be selected. The time required to complete the analysis for total suspended solids (TSS) in the laboratory does not allow for real time control of the dredging operation. Turbidity, however, is easily measured directly using automatic, direct readout equipment that can provide information necessary for immediate response.

Bench-scale testing could be performed to establish a site specific correlation between TSS and turbidity so that real time turbidity measurements can be used as a substitute for TSS measurements. Based on previous environmental dredging projects, an action level value should be established for TSS. This action level value should be relative to background conditions as measured upstream of any influence from the dredging operations. Once the relationship is established between turbidity and TSS, an action level for turbidity corresponding to the TSS action level can be determined. If the real time turbidity value, nephelometric turbidity units (NTUs), measured downstream of the dredging operation, outside of any silt containment equipment and away from the immediate vicinity of the dredge head, exceeds the real time turbidity value measured upstream by more than the action level value for a predetermined amount of time, water-borne remedial activities will require modification to return turbidity levels to below action levels. 'The turbidity action level, sample locations, and sample depth should be identified in the project environmental monitoring plan to be prepared prior to the remedial action.

To establish baseline conditions of the ambient air, air monitoring for PCBs will be conducted prior to sediment remediation. Sampling should be conducted in sediment stockpile areas and in the area of downwind receptors, as well as at a background or upwind location. Sampling points should be selected and shown in the project environmental monitoring plan to be prepared prior to the remedial action. The equipment and procedures to be used should also be identified in the monitoring plan. Action levels should be established and identified in the plan.

3.0 MONITORING DURING DREDGING OPERATIONS

The objective of an environmental monitoring plan would be to monitor the surrounding environment during sediment remedial activities. The audit would monitor and document conditions that could be impacted by sediment handling operations, and trigger project modifications and/or potential shut downs if predetermined action levels for environmental parameters are exceeded. The river water column, treated water effluent, and air in the vicinity of sediment stockpile and storage areas would be monitored.

Water column sampling and monitoring would be utilized to document the effects of sediment removal operations on the Ashtabula River water column. Baseline water column conditions will have been established during the predredging data collection activities. Water column turbidity monitoring conducted during sediment removal activities would be used to determine the need for corrective action.

During sediment removal turbidity measurements would be collected upstream and downstream of the currently active sediment removal area. The real time turbidity measurements would be collected at several fixed locations that would be marked using anchors and buoys. Turbidity measurements would be collected on the outside of sediment control systems when they are in use. The location of the turbidity monitoring stations would be adjusted as dredging operations proceeded to other areas of the river.

The frequency of the turbidity measurements will be determined during the preparation of the project's environmental monitoring plan.

If the measured turbidity at the downstream locations exceeds the turbidity at the upstream locations by more than the preestablished action level, measurements would be taken a second time and the cause of the exceedance investigated. If the exceedances are sustained, a sample of the river water would be collected adjacent to the downstream location and analyzed in accordance with the monitoring plan. Dredging operations would be investigated and possibly modified, i.e., reduced dredge excavation rate, or halted to perform equipment maintenance, if necessary.

Visual observation of the water column will also be performed during turbidity measurements with pertinent observations being noted in a field log.

In addition to turbidity sampling that would be performed during dredging, water column samples would be collected during normal dredging operations. The frequency of this water column sampling will be determined during preparation of the environmental monitoring plan but is likely to involve at least one sampling event per day during initial dredging startup. Analytical work to be performed will also be determined during preparation of the monitoring plan, but it is likely to involve PCB analysis at a minimum. After the initial dredging startup period the frequency of water column sampling and analysis would be reduced, assuming initial sampling and analytical results are favorable. If the analysis of downstream river water samples reveal PCB concentrations in excess of the preestablished PCB action level, a plan to modify the sediment control system, dredging operations, and/or turbidity action level would be proposed and implemented.

A temporary waste water treatment system will be established to treat liquids from sediment dewatering operations, leachate collection, surface water runoffs etc. The water will be treated to meet effluent discharge limitations established for this project. It is likely that, at a minimum, PCB, oil and grease, and TSS discharge limits will be established and monitored for this project. Samples will be collected from the finish water tank or discharge line to verify the continued effectiveness of the treatment plant. After the initial treatment plant startup period the frequency of sampling and analysis would be reduced, assuming initial sampling and analytical results are favorable. Target analytical detection limits will be established for PCBs, oil and grease, TSS and other contaminants of concern. If the concentration of any of these contaminants exceeds the action levels for the effluent water, the discharge of treated effluent will be halted or recycled back to the holding basin for further treatment. If necessary, corrective action will be taken to repair or improve the treatment plant.

Perimeter air monitoring for particulate dust, PCBs, and other contaminants of concern will be conducted on a continuous basis throughout the duration of the project. Continuous particulate dust monitoring will be performed whenever stockpiles of sediments are left exposed to the atmosphere. Monitoring will be accomplished at discrete onsite monitoring stations, on upwind of site activities and the remainder downwind of site activities. The type of equipment to be used and the location of the monitoring stations will be discussed in the environmental monitoring plan. Monitoring for airborne PCBs, and other contaminants of concern, will be performed during sediment dredging, dewatering, and stockpiling activities using procedures to be described in the monitoring plan. Air samples will be collected and sent offsite for analysis. The PCB quantity will be divided by the calibrated air volume passed through the filter to determine the 24-hour average ambient air PCB concentration. If, during an initial start up period, no detectable amounts of PCBs are found, samples will be collected and analyzed on a less frequent basis.

The action levels for particulate dust and PCBs will be determined for the monitoring plan. Corrective action will be taken if the particulate dust action level is reached at any of the monitoring stations. This may include temporarily halting grading activities or correcting the problem through dust suppression and control measures. If PCB action levels are exceeded, modifications to the dredging and/or stockpiling activities may be required. Dust suppression and control measure may be required or it may be necessary to cover stockpiled PCB contaminated sediments.

4.0 POST-DREDGING MONITORING

The objective of the post-dredging monitoring program is to determine the volume of sediments removed in the river, and whether or not the target cleanup goal has been met. A post-dredging bathymetric survey of the river bottom will be conducted.

A bathymetric survey will be conducted after the completion of sediment removal activities in each area of the river to determine the topographic conditions of the riverbed following dredging activities. The post-sediment removal bathymetric survey map will be compared to the presediment removal map, and the volume of sediments removed during the dredging operation will be computed. The survey will be conducted by obtaining elevations on the same grid spacing used in the predredging bathymetric survey. The grid spacing and the required vertical accuracy of the survey will be determined for the environmental monitoring plan.

The final decision to discontinue dredging will be made after review of the data to determine if the cleanup goals have been met.

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX L

SCREENING OF TREATMENT TECHNOLOGIES AND COST COMPARISON OF POTENTIALLY FEASIBLE ALTERNATIVES

PREPARED BY:

Environmental Engineering Section
U.S. Army Corps of Engineers, Buffalo District
August 1997

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1.0 INTRODUCTION

1.1. The Ashtabula Comprehensive Management Plan includes provisions for bank-to-bank dredging of Ashtabula River sediment and subsequent special management of the portion of dredged sediment that is regulated under the Toxic Substance Control Act (TSCA). Based upon computer modeling of polychlorinated biphenyl (PCB) sampling results, an estimated 53,000 cubic yards (cy) of sediment would be regulated under TSCA. Other organic materials and metals are below the Resource Conservation and Recovery Act (RCRA) regulatory limits. Subsequent analysis showed that between 100,000 and 150,000 cubic yards of sediment would actually have to be dredged from the river due to the location of the sediments and the limitations of proposed dredging methods. This material must be dewatered and disposed within regulatory constraints. MapInfo® was used to graphically display the horizontal distribution of PCBs in river sediment base on the results of sampling. The details of this computer modeling effort are discussed in Appendix C.

Suitable disposal of dredged Ashtabula PC-contaminated material can be accomplished in one of two ways:

1.1.1. Disposal of the dredged, dewatered toxic material in a TSCA approved landfill.

1.1.2. Treatment of the dredged, dewatered TSCA material to a lesser contamination followed by disposal of the treated residue in a solid waste landfill.

1.2. Implementation of the second option, above, is contingent upon availability of proven, technically feasible and cost effective treatment technologies for removing PCBs from dredged sediment. This technical and economic feasibility assessment must consider treatment and disposal of both process extracts and the treated residue. Accordingly, a technology screening and cost estimate has been performed, and results are reported in subsequent text. This information can be used to assess the feasibility of option 2, above, for disposing of dredged toxic material from the Ashtabula River

2.0 TECHNICAL FEASIBILITY ASSESSMENT

2.1. To assess the technical feasibility of treating PCB contaminated sediment, technologies were considered that are potentially capable of removing organic compounds from a solid matrix. These technologies were retained for further consideration if they have previously been demonstrated to successfully remove organic materials from or immobilize organic materials within solid material *on a commercial scale*. Technologies that have been demonstrated only on a bench scale were eliminated from consideration, as were processes that appear attractive on a pilot scale but are commercially unavailable as fill-scale equipment Results of the technology screening are given in Table 1.

2.2. Based upon the information presented in Table 1, incineration and thermal desorption are retained as potential treatment methods for the Ashtabula River dredged sediment. Costs for employing these technologies are presented in subsequent text. Availability of these costs will permit their comparison with the costs for depositing untreated material in a TSCA landfill, and an optimum protocol can be selected for sediment disposal.

Table 1
Technical Effectiveness Screening of Treatment Technologies
For Ashtabula Sediment

PROCESS	RESULTS	ACTION
Incineration	* Effective for destroying PCB to <1 mg/kg [1]. * May emit dioxins and dibenzofurans [1]. * Construction requires a long approval process (permitting test burn) [1].	Retain for cost analysis
Pyrolysis	* % moisture and mesh size of influent may make this impractical [1].	Drop
Supercritical Water Oxidation	* Lab studies done but demonstration scale evaluation not performed [1]. * Processing rate on available equipment is extremely slow [1].	Drop
Wet Air Oxidation	*Bench trials showed only 52 % degradation efficiency [1]. *Not demonstrated for soils or dredged materials [1].	Drop •
Alkali-Polyethylene Glycol (MEG) Process (dechlorination)	* Process design must be modified (following process studies) to be suitable for dredged material [1]. * Destruction of compounds not complete [1].	Drop
Biodegradation	* Complete mineralization not expected. *Too little known about biodegradation of complex mixtures to predict final concentration of treated sediment. * Relatively slow degradation rates [1].	Drop
Solvent extraction	* Still developmental for dredged material [1]. * Because of presence of other chemical compounds, solvent choice will be a compromise and not ideal [1].	Drop
Thermal Desorption	* Effective for PCB removal [2]. * Process equipment available from a variety of companies on large scale	Retain for cost analysis

Table 1 (continued)

TECHNOLOGY	RESULT	ACTION
Immobilization technologies	*These processes are not normally effective for attenuating the mobility of organic contaminants.	Drop
Vitrification	* Configuration applicable to dredged material is only in conceptual stage of development [1]. *Potential for thermal pollution is unknown [1].	Drop .
Asphaltic Microencapsulation	* No studies have been conducted with dredged material [1].	Drop

3.0 COST ESTIMATES FOR TREATMENT TECHNOLOGIES

3.1. Cost Constraints

Cost estimates for processing dredged, PCB-contaminated Ashtabula River sediment by incineration and by thermal desorption are developed within the following constraints:

3.1.1. The estimate applies to 100,000 cubic yards of **process feed material** (not dredged material) with a solids content of 70 %. It is assumed that some gravity dewatering has already occurred, therefore the original amount of dredged material was greater than 100,000 cubic yards.

3.1.2. It is assumed that PCBs are the only constituents of concern for this sediment.

3.1.3. The origin of the feed material is the dredged sediment classified as toxic under TSCA. Sediment with PC levels below the TSCA limit will not be subjected to treatment for PC removal.

3.1.4. Costs for dredging, debris removal, sediment drying, transportation to the processing unit arid/or treatment of removed water are considered in other report sections and are not included here. This is because each of these unit operations can be done by a number of alternative methods. Evaluation of and cost determination for these alternatives is being performed in other sections of this document.

3.1.5. It is assumed that treatment of sediment will not result in:

a. Post treatment failure of TCLP for metals or organic contaminants if the sediment passed this test before treatment.

b. Inorganic concentrations above RCRA regulatory levels because the sediment has been concentrated by a treatment process.

3.1.6. The incinerator is assumed to be off-site, but long distance transportation costs are not included for moving the sediment from the dredging site to the incinerator. Availability of potential incinerators must be researched before this cost can be included.

3.2. Incineration Unit Costs:

3.2.1. Mass Balance

3.2.1.1. 100,000 cubic yards are fed to the incinerator. Of this, 70,000 cubic yards are solids and 30,000 cubic yards are water.

3.2.1.2. Of the 70,000 cubic yards of solids, *35,000* cubic yards will burn [1], leaving 35,000 cubic yards of bottom ash, which must be deposited in a solid waste landfill.

3.2.1.3. Trapping and disposal of particulates from the air emissions control systems are assumed to be handled by the owner of the incinerator, and are therefore not estimated as a separate cost item.

3.2.2. Costs

Table 2: Unit Costs for Incineration of TSCA Sediment

Process Item	Cost per cubic yard in 1993 Dollars	Cost per cubic yard in 1996 Dollars [3]*
Charge Material to Incinerator [1]	2.17	2.36
Incinerate Material [1]	238.50	259.50
Transfer Ash to Disposal Site [1]	1.09	1.18
Deposit Ash in Disposal Site (+)	12.00	13.06
TOTAL	$253.76	$276.10

(+) $25.41/cy buried X [35,000 cy buried/70,000 feed] = $12.71 cy feed
* Cost factor (1996 $/1993 $) = 1.087

3.3 Thermal Desorption Unit Costs

3.3.1. Mass Balance

3.3.1.1. 100,000 cubic yards are fed to the desorber. Of this, 70,000 cubic yards are solids and 30,000 cubic yards are water.

3.3.1.2. Of the 70,000 cubic yards of solids 35,000 cubic yards will be desorbed from the sediment and collected [2], leaving 35,000 cubic yards of treated residue, which must be deposited in a solid waste landfill (assumed to be on site).

3.3.1.3. Thermal desorption requires combustion of removed volatile materials in an afterburner. These costs have been considered within the elements of Table3, but they do not appear as a separate line item.

3.3.2. Costs [2]

Table 3: Unit Costs for Thermal Desorption of TSCA Sediment

Process Item	Cost per cubic yard in 1993 Dollars	Cost per cubic yard. in 1996 dollars [3]*
Mobilization/Demobilization	$12.00	$13.05
Equipment Rental	149.00	161.32
Electricity	22.00	23.94
Field Labor	65.00	70.69
Maintenance	6.00	6.52
QA/QC, Management, Sample Analysis	7.00	7.61
Carbon	1.00	1.09
Transfer Treated Residual to Disposal Site [1]	1.09	1.18
Deposit Treated Residual in Disposal Site (+)	12.00	13.05
TOTAL -	$275.09	$298.45

(+) $ 25.41/cubic yards (cy) buried X [35,000 cy buried/70,000 cy feed] = $12.7l/cy feed.
* Cost factor: (1996 $/1993 $) 1.087

4.0 COST ESTIMATES FOR DISPOSAL OF UNTREATED SEDIMENT

4.1. In order to assess economic feasibility of applying incineration or thermal desorption to dredged Ashtabula sediment, it is necessary to compare the associated costs to the cost for disposal of the dredged, dewatered, untreated toxic material in an approved landfill. For disposing of untreated sediment, the entire 100,000 cubic yards of sediment must be placed in the landfill, as none of the volume has been reduced by treatment Costs for disposal in a commercially permitted TSCA chemical waste landfill are presented below for comparison purposes. The TSCA landfill is assumed to be at Model City, N. Y., and long distance transportation costs *an* included for moving the sediment from the dredging site to the disposal site.

Table 4: Unit Costs for Disposal of Untreated Sediment in TSCA Landfill

Process Item	Cost/CY in 1997 Dollars [3]*
Transfer Sediment to Disposal Site	$1.18
Deposit Sediment in TSCA Landfill [4]*	199.89
TOTAL	$201.07

* Cost provided as $13l/ton, adjusted to cost/cy by assuming a bulk density of 110 lbs/ft^3. Cost includes taxes and transportation. 1996 costs adjusted to 1997 costs by 1.0275 cost factor.

4.2. In addition to the above options, one option remains that is sometimes allowed by some regulatory agencies. On occasion, dredged material of this nature is allowed to be deposited permanently in a lakeside CDP rather than in a TSCA landfill. The TSCA section of USEPA Region 5 regulations has indicated that this scenario would likely not be approved. If this option were allowed for dredged Ashtabula River sediment, however, associated costs would be as presented in Table 5.

Table 5: Unit Costs for Disposal of Untreated Sediment in a CDF

Process Item	Cost/CY in 1997 Dollars.[3]*
Transfer Sediment to Disposal Site (+)	$1.15
Deposit Sediment in CDF	15.00
TOTAL	$16.15

(+) Transfer from storage containers to CDF, i.e., transport from dredging site to CDF site is not included.
* 1996 costs adjusted to 1997 costs by 1.0275 cost factor.

5.0 PRELIMINARY CONCLUSIONS

5.1. Based upon the above information, incineration followed by land disposal of the residue will cost $276.10/cy and thermal desorption followed by land disposal of the residue will cost $298.45/cy exclusive of costs for dredging, temporary CDF storage, debris removal, dewatering, and treatment of removed water. These costs must be added to the above costs to obtain total costs of treatment/disposal.

5.2. These costs compare to $201.07 /cy for burial of untreated sediment in a TSCA landfill and $16.59/cy for disposal of untreated sediments in a lakeside CDF. Based upon these preliminary costs, landfill disposal of untreated sediment will be more cost effective than burial of sediment treated to a lesser contamination. Disposal of TSCA regulated sediments directly in a CDF while less expensive than disposal in a TSCA landfill, likely would not receive regulatory approval

6.0 REFERENCES

[1] USACE, Chicago District, "Indiana Harbor and Canal Maintenance Dredging and Disposal Activities in Lake County, Indiana: Appendix 0, Application of Sediment Treatment Technologies to Contaminated Sediments", March 1995.

[2] USEPA, "Assessment and Remediation of Contaminated Sediments (ARCS) Program: Pilot Scale Demonstration of Thermal Desorption for the Treatment of Ashtabula River Sediment, EPA 905-R94-021, August 1994.

[3] "Construction Cost History", Engineering News Record, April, 1997.

[4] Budget cost provided by CWM Management Services Control, Inc. in Model City, N.Y. in 1996 and updated in April 1997 using Engineering News Record cost factors.

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX M

GEOTECHNICAL ENGINEERING

LANDFILL SITE

TRANSFER/DEWATERING SITE

NOTE: This appendix was updated in December 2000 to include the following sub-appendices:

SUB-APPENDIX M1 – GEOTECHNICAL EVALUATION OF RMI SODIUM (STATE ROAD) LANDFILL SITE; AND

SUB-APPENDIX M2 – GEOTECHNICAL EVALUATION OF TRANSFER/DEWATERING FACILITY SITE.

PREPARED BY:

U.S. Army Corps of Engineers, Buffalo District
December 1996
Updated December 2000

Ashtabula River Dredging
Landfill Design
Geotechnical Appendix M

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Ashtabula River Dredging
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Ashtabula River Dredging
Landfill Design

Geotechnical Appendix M

M1. REGIONAL GEOLOGY

M1.1 Physiography.

The project site is located (Figure M1) approximately 55 miles northeast of Cleveland, Ohio within the Central Lowland Physiographic Province. The Central Lowland Province is characterized by broad, flat plains which end abruptly at Lake Erie. Several ridges, parallel to the lake, cross the area and consists of sand and gravel. The Ashtabula River provides the major drainage in the area. Its lower course flows through a narrow valley cut in shale to a depth of 75 to 100 feet.

M1.2 Surficial Geology.

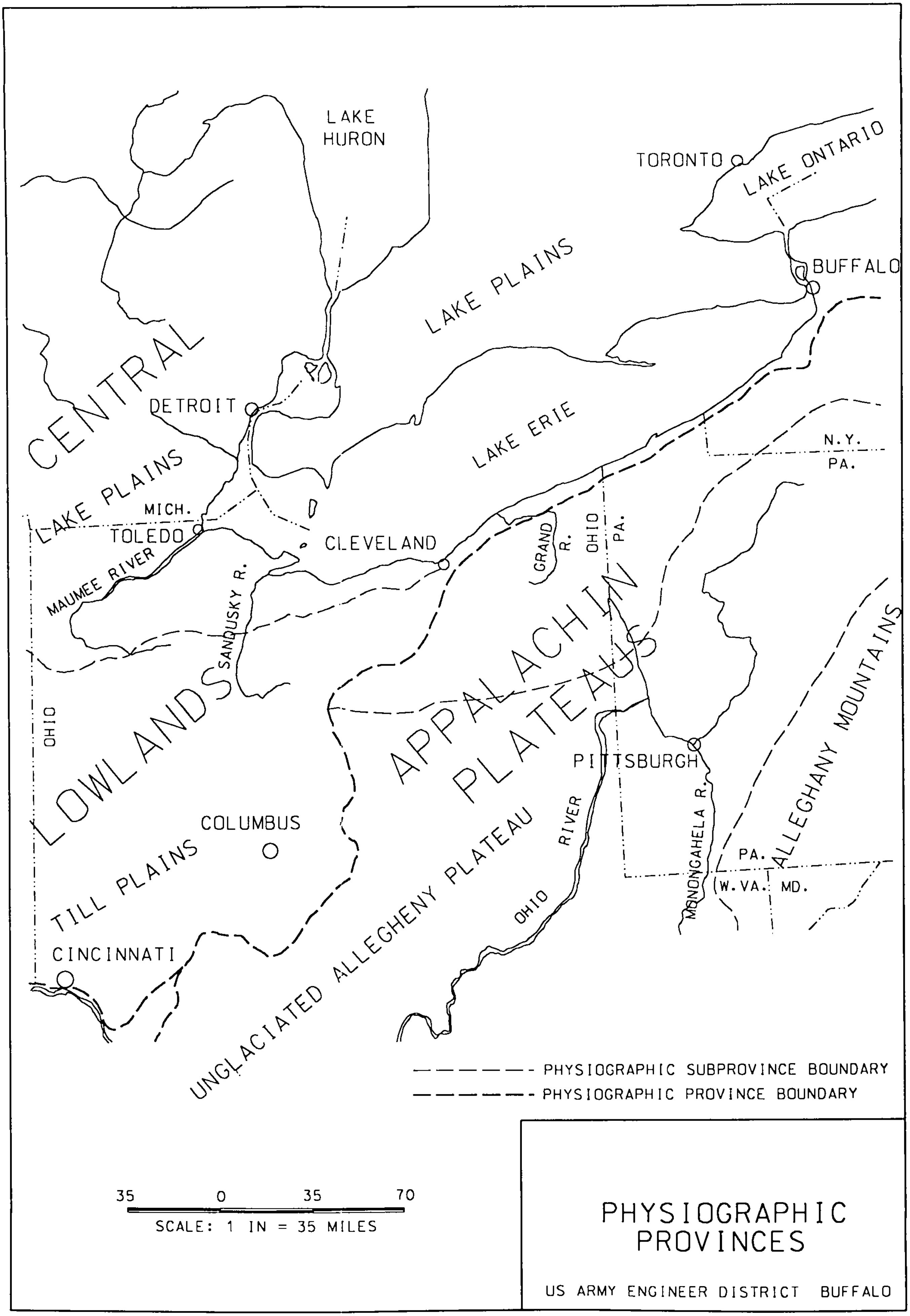
Most of northeastern Ohio consists of material deposited during the late Wisconsin glacial age. These deposits consist of glacial till and stratified gravel, sand, silt, and clay. The lake escarpment Morainic System which forms a hummocky ridge about five miles south of Lake Erie consists mostly of till deposited within the last 14,000 years. Lakeward from the moraine are several ridges representing shorelines of former glacial lakes. These ridges are about 10 feet high and consist of stratified sand and gravel. Near Ashtabula, the Whittlesey beaches reach a height of about 70 feet. Towards the lake, the soils are clayey silt which are deposits of the former high level lakes and till.

M1.3 Bedrock Geology.

Bedrock in this area consists of Upper Devonian shales (Figure M2) which were deposited as sediment in a shallow marine environment over 250 million years ago. These sediments were transformed by cementation and consolidation into the present compact shales. This is part of the Chagrin Formation of the Ohio shale group, which is up to 1,500 feet in thickness.

M1.4 Structural Geology and Seismicity..

The shale beds have experienced only one major structural change, a slight general tilting to the south. This area is considered to be relatively stable with inherently low degree of seismicity. The project site is located on the border between seismic zone No.1 and No.2 (Figure M3) which has the potential for minor to moderate damage from seismic events.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TORONTO
LAKE ONTARIO
BUFFALO
LAKE PLAINS
CENTRAL
DETROIT
LAKE ERIE
N.Y.
PA.
LAKE PLAINS
MICH.
TOLEDO
CLEVELAND
MAUMEE RIVER
SANDUSKY R.
GRAND R.
OHIO
PA.
LOWLANDS
APPALACHIAN
PLATEAUS
OHIO
PITTSBURGH
ALLEGHANY MOUNTAINS
COLUMBUS
TILL PLAINS
UNGLACIATED ALLEGHENY PLATEAU
RIVER
OHIO
MONONGAHELA R.
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W.VA.
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CINCINNATI
PHYSIOGRAPHIC SUBPROVINCE BOUNDARY
PHYSIOGRAPHIC PROVINCE BOUNDARY
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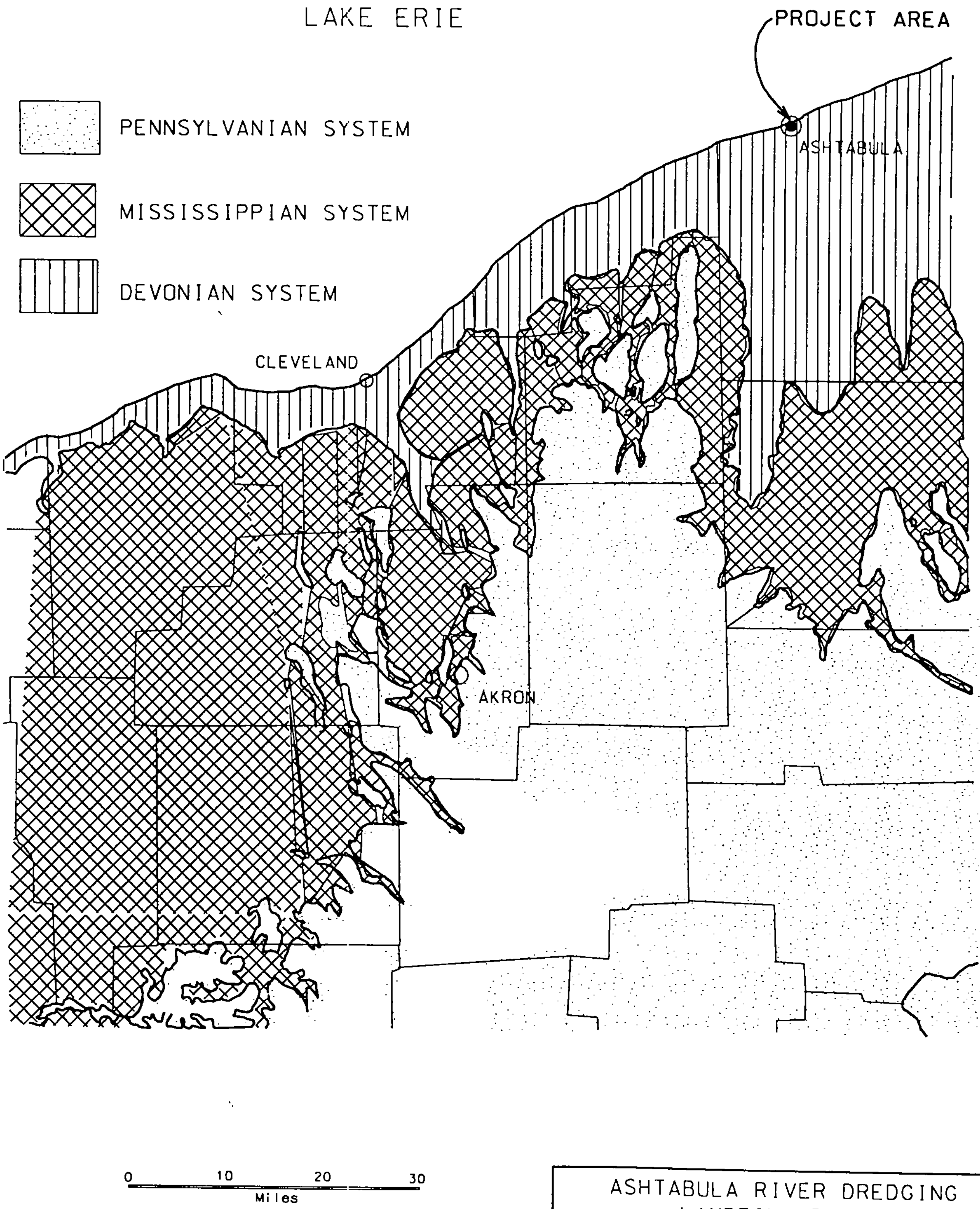
SCALE: 1 IN = 35 MILES
PHYSIOGRAPHIC PROVINCES
US ARMY ENGINEER DISTRICT BUFFALO

FIGURE M1

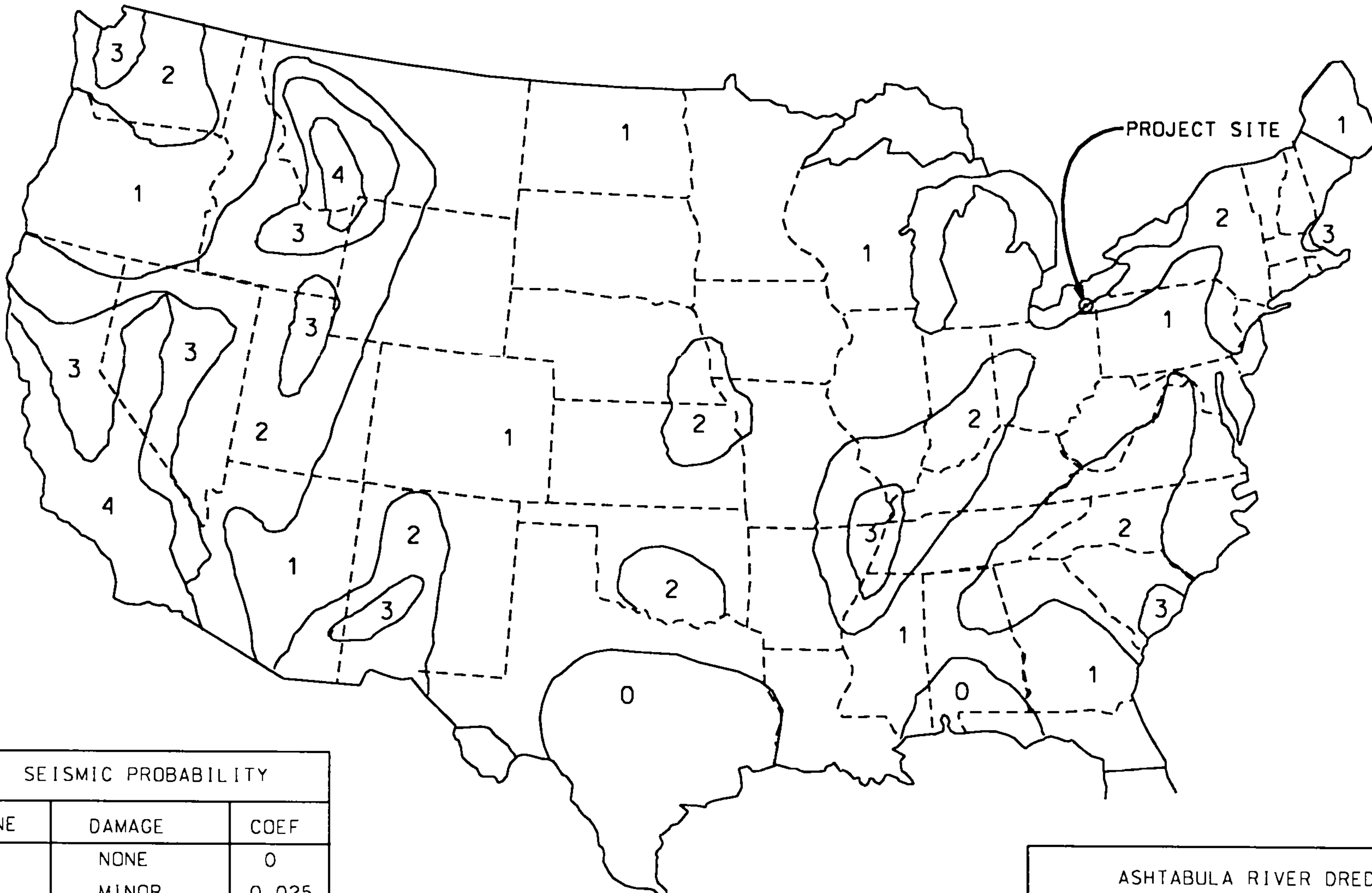


ASHTABULA RIVER DREDGING
LANDFILL DESIGN

BEDROCK GEOLOGY OF NORTHEASTERN OHIO

US ARMY ENGINEER DISTRICT BUFFALO

FIGURE M2



SEISMIC PROBABILITY		
ZONE	DAMAGE	COEF
0	NONE	0
1	MINOR	0.025
2	MODERATE	0.05
3	MAJOR	0.10
4	GREAT	0.15

ASHTABULA RIVER DREDGING
LANDFILL DESIGN

SEISMIC RISK MAP

US ARMY ENGINEER DISTRICT BUFFALO

FIGURE M3

M2.1 Subsurface Explorations.

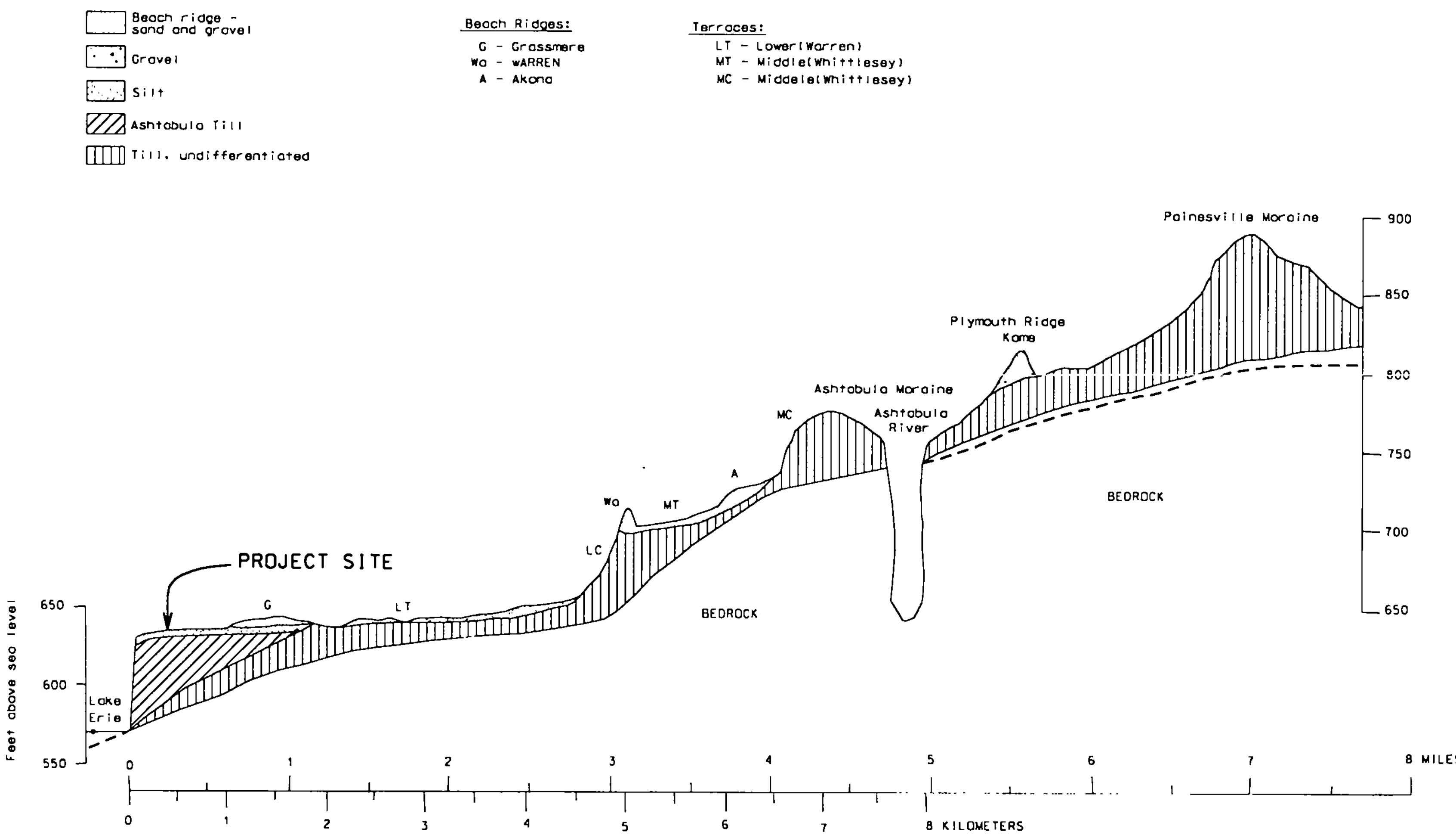
A subsurface exploration program was performed in September, 1996 in each of the two potential disposal site locations. The purpose of the exploration program was to obtain background chemical data in the soil deposits and groundwater and to obtain geotechnical information needed for the design of the disposal facility at each of the potential disposal sites. The explorations consisted of the following: (1.) Standard Drive sample borings, (2.) Undisturbed sample borings, (3.) Metal detector survey and, (4.) Installation of temporary groundwater monitoring wells. Results of the explorations are presented in Geologic profiles (Plates M1 thru M8). Results of the chemical analysis of the soil deposits and groundwater are presented in Appendix B.

M2.2 Laboratory Testing.

The focus of laboratory testing presented in this appendix is on the geotechnical data needed for the design of the containment facilities. Results of the chemical data testing of the soil deposits and groundwater is presented in Appendix B. The types of geotechnical laboratory tests performed are as follows: (1.) Soil classification tests (using the Unified Soils Classification System), (2.) Atterberg Limits tests, (3.) Unconfined Compression Tests, (4.) Triaxial Q tests (Unconsolidated Undrained) on both compacted and uncompacted samples, (5.) Triaxial Rbar Tests (Consolidated Undrained With Pore Water Pressure Measurements), (6.) Standard Compaction Tests, (7.) Permeability Tests. Results of the Geotechnical laboratory tests are available for review at the district office.

M2.3 Surficial Geology.

Surficial deposits underlying the project site consist primarily of overburden materials whose origin is directly related to the glacial and post glacial history of the region. Figure M4 provides a composite cross section showing vertical relationships between glacial deposits in northern Ashtabula County near the vicinity of the project site. Plates M2 thru M4, and M6 thru M8, show geologic profiles at each of the two alternative disposal sites. The cross section and profiles show that the surficial deposits at the alternative disposal sites are: (1.) glacial till and, (2.) glaciolacustrine deposits which overlies the till. The glacial till found at each of the two alternative disposal sites has been termed the Ashtabula Till. The Ashtabula Till is reported by White and Trotten (1979) as being the youngest till in Ohio and was deposited by the final advance of Pleistocene glaciation. The Ashtabula Till represents the surface till of the Ashtabula and Painesville Moraines. The Ashtabula Till in the Lake Plain has been more or less wave washed, so that the uppermost part of the till has been eroded and in places completely removed. The overlying silt has been at least partly derived from reworking of till. The Ashtabula Till is a calcareous silty clay till, sparingly to moderately pebbly. Unaltered Ashtabula Till is grey while altered and oxidized till is brown. The glaciolacustrine/reworked till varies in thickness from 6 to 15 feet. The underlying unaltered grey till varies in thickness from 40 to 52 feet. At alternative disposal site No.5, fill overlies the glacial deposits. The fill varies in thickness from 0 to 8 feet. The fill consists of black sandy silt and fly ash.



REF: White, G.W., Totten, S.M., "Galcial Geology of Ashtabula County, Ohio, ODNR Report No.112, 1979. Section F-F'.

ASHTABULA RIVER DREDGING
LANDFILL DESIGN

GLACIAL GEOLOGY CROSS SECTION
NORTHERN ASHTABULA COUNTY

US ARMY ENGINEER DISTRICT BUFFALO

FIGURE M4

to 15 feet. The underlying unaltered grey till varies in thickness from 40 to 52 feet. At alternative disposal site No.5, fill overlies the glacial deposits. The fill varies in thickness from 0 to 8 feet. The fill consists of black sandy silt and fly ash.

M2.4 Bedrock Geology.

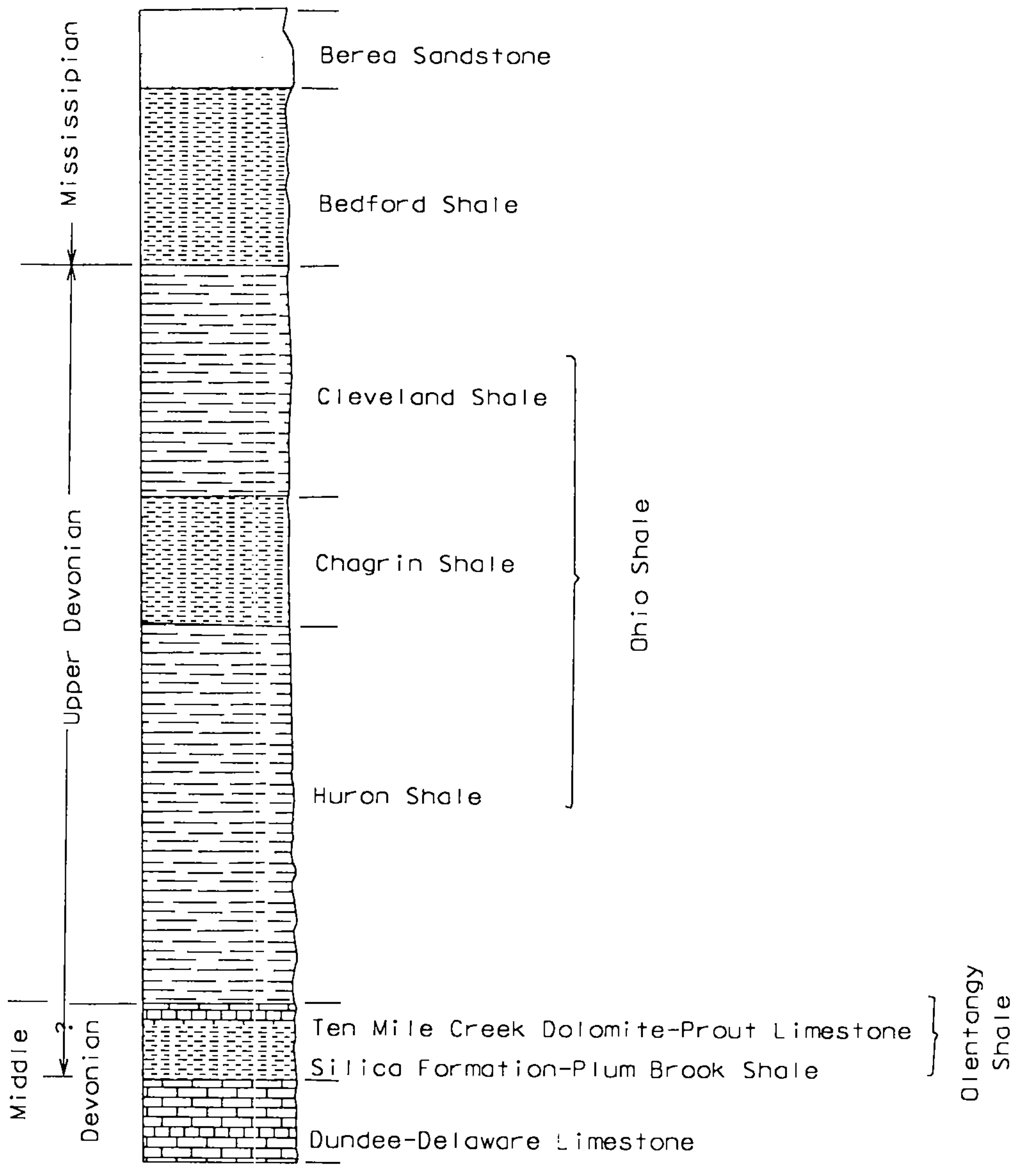
Bedrock underlying the two alternative disposal sites consists of Upper Devonian age shale of the Chagrin Formation. The Chagrin Shale has been described by Cushing (1931) and Hoover (1960) as a noncarbonaceous blue grey clay shale occupying a position between two highly carbonaceous fissile blue-black shales; the Huron and the Cleveland Shales of the Ohio Formation (Figure M5). Outcrop and well data indicate that the Chagrin Shale represents a large sedimentary wedge that thickens eastward to a maximum of 1,200 feet in Ashtabula County Ohio. Traced westward the Chagrin Formation becomes progressively thinner and eventually pinches out in Huron and Erie Counties.

The physical characteristics of the Chagrin Shale varies laterally over its region of distribution. South and east of Cleveland, the Chagrin has been described by Hoover (1960) as a sandy, greenish-grey shale of slightly calcareous nature interbedded with soft blue shale, and locally contains thin bands of impure limestone. Hoover (1960) further reports that the Chagrin Shale increases in silt and sand content eastward toward the Pennsylvania border and cross bedding and ripple marks more prevalent. In eastern Ashtabula County, Ohio and western Pennsylvania the upper beds of the Chagrin Shale consist of massive fossiliferous siltstones.

The 1996 subsurface exploration program consisted of overburden sampling and did not obtain any rock cores. However, several of the overburden borings were drilled down to bedrock at both alternative disposal sites. Bedrock was encountered at depths of 54 to 60 feet below ground surface. Samples of bedrock recovered in the bottom of the drive sample boring shoe described it as grey shale and siltstone. The geologic profiles indicates that the bedrock dips slightly to the west. This is consistent with the observations described by Cushing (1931) which states that the general dip of the rocks is to the west.

M2.5 Groundwater.

Relatively poor supplies of groundwater are found within the surficial deposits underlying the two alternative disposal sites. The depths to groundwater varied from 1 to 21 feet below the ground surface, is discontinuous and generally occurred in layers of silt or gravelly sandy clay. Laboratory permeability tests performed on samples obtained in the unaltered grey glacial till resulted in low permeabilities varying between $1x10^{-6}$ cm/sec and $3.79x10^{-8}$ cm/sec.



GENERALIZED COLUMNAR SECTION OF THE DEVONIAN-MISSISSIPPIAN SHALE SEQUENCE.

Ref: Hoover, K.V., "Devonian - Mississippian Shale Sequence in Ohio, ODNR Information Circular No.27, Columbus, 1960.

ASHTABULA RIVER DREDGING
LANDFILL DESIGN

BEDROCK STRATIGRAPHY

US ARMY ENGINEER DISTRICT BUFFALO

FIGURE M5

M3 GEOTECHNICAL DESIGN

M3.1 Stability Analysis.

M3.1(a.) Containment Dike Stability Before Facility Filled.

M3.1(a.)(1.) General.

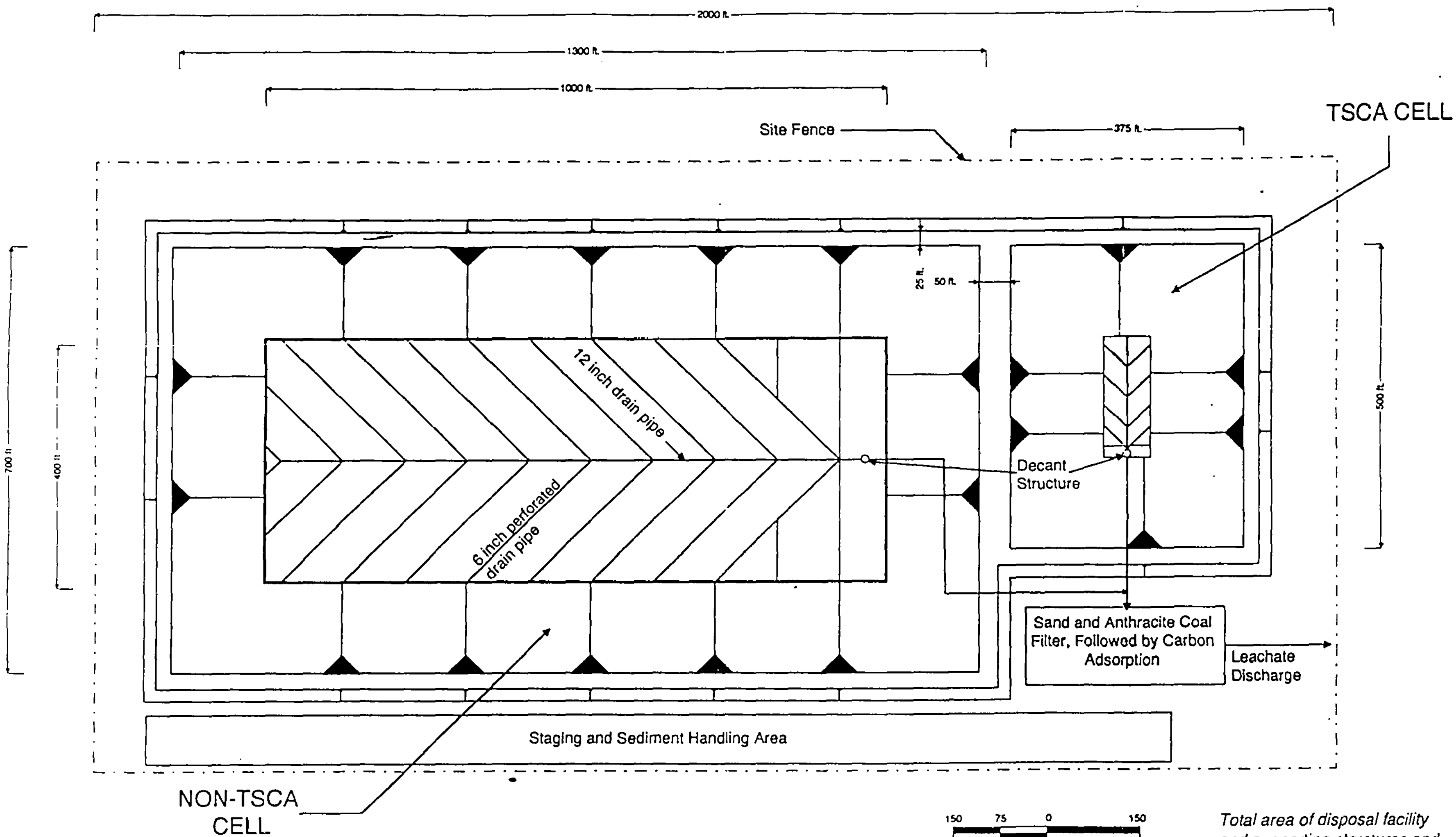
The purpose of this preliminary stability analysis is to determine wheter or not the the proposed outer dike slopes and interior excavated slopes are stable prior to the placement of dredge spoil material into the facility. The proposed design calls for a 1V on 2.5H on the outside slope and 1V on 3H on the interior slope (See Figures M6 and M7 for present dike plan and typical cross sction). In the next level of study the stability analysis will determine if a steeper (i.e. optimum) interior excavated slope can be achieved. Maintenance considerations prohibits optimizing the exterior dike slope greater than 1V on 2.5H.

M3.1(a.)(2.) Soil Design Parameters.

Laboratory strength testing was performed on samples obtained from the 1996 subsurface exploration program. Undisturbed (containment dike foundation) and remolded (excavated borrow material for containment dike) samples were tested at the Ohio River Division Laboratory Cincinnati, Ohio during the period of October thru November, 1996. The types of strength tests performed consisted of Unconsolidated Undrained (Q Test) and Consolidated Undrained With Pore Water Pressure Measurement (R - Bar).

In the Unconsolidated Undrained Test no drainage is allowed during the application of load, thus the test sample shears under conditions of maximum excess pore water pressures. Since the foundation consists of clay, the End of Construction Case using Unconsolidated Undrained shear strengths is expected to be the most critical (i.e. produce the lowest factors of safety). This is because as the embankment load is applied excess pore water pressures are developed in the foundation clay which lowers the shearing resistance and thus factors of safety.

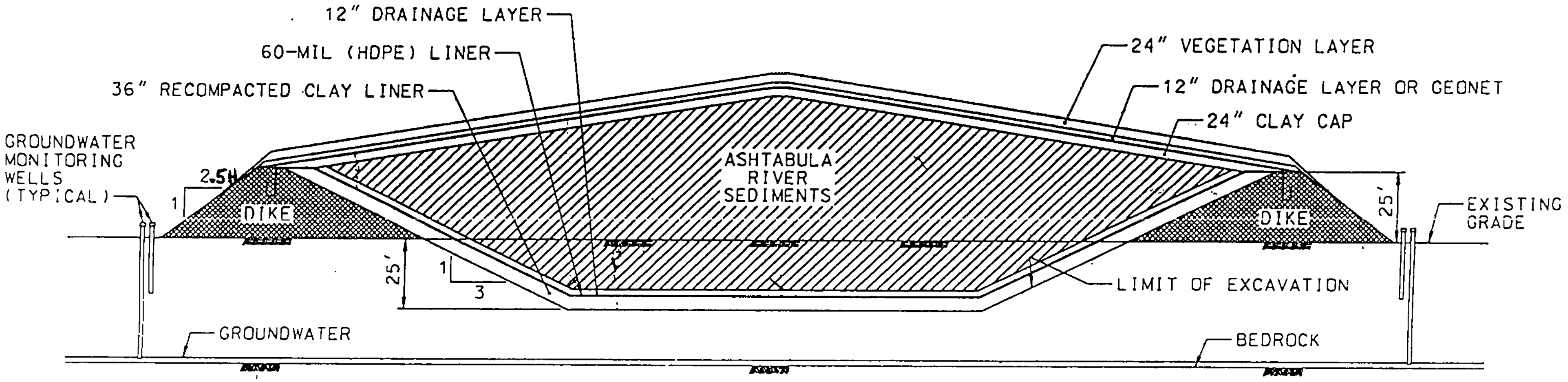
Based upon the arguments presented in the previous paragraph, Unconsolidated Undrained Shear Laboratory Shear Strengths were used for the development of the clay foundation shear strength. For the remolded clay embankment soils laboratory R Test values were used. Presented in Attachment M1 is the rationale of how the soil design values were selected. Table M1 summarizes the soil design values used in the stability analysis.



Total area of disposal facility and supporting structures and facilities is about 46 acres.

Conceptual Layout of Disposal Facility for Ashtabula River Sediments

FIGURE M6



CROSS SECTION

NOT TO SCALE

M11

DISPOSAL FACILITY
ASHTABULA, OHIO
CONCEPTUAL CROSS SECTION
OF NON-TSCA DISPOSAL FACILITY
FOR ASHTABULA RIVER SEDIMENTS
U.S. ARMY ENGINEER DISTRICT BUFFALO
JUNE 1996

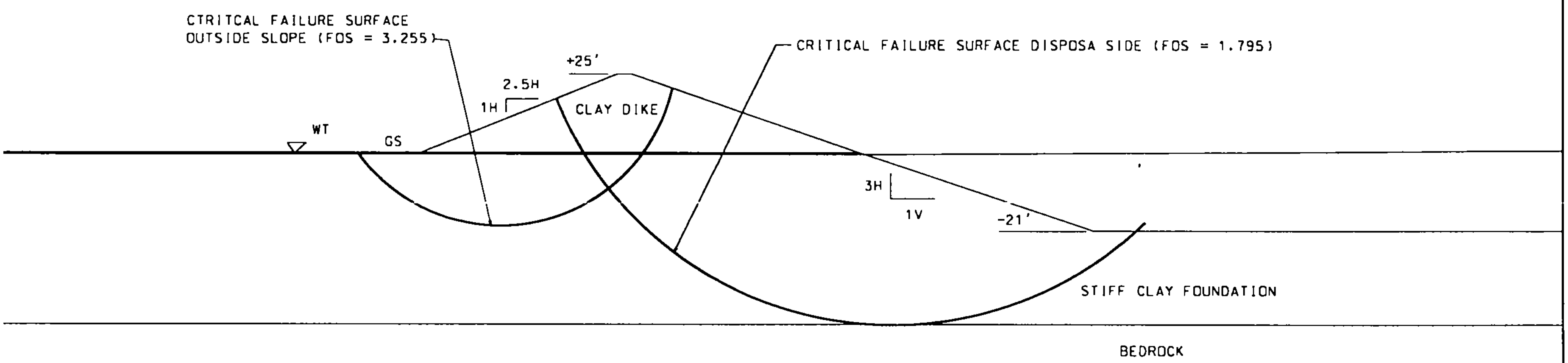
FIGURE M7

CONCLUSION

Although several parameters in soil, ground water, and surface water were detected at Site 5 at levels exceeding State of Ohio Voluntary Action Program clean-up levels or State of Ohio surface water criteria, the primary contaminant of concern is arsenic detected in soil/ash samples. The three soil/ash samples which exhibited elevated total arsenic levels were collected from the northern portion of Site 5 and immediately north of Site 5. Samples collected elsewhere at the site contained arsenic at concentrations below the proposed clean-up level.

The metal detection survey, and subsequent test pit excavations, conducted in the ash fill portion of Site 5 revealed some scrap metal. However, no buried drums or canisters were discovered.

If Site 5 is chosen as the site of an upland landfill to dispose of river sediment, ash fill material present at the site should be properly managed. No contamination was discovered at Site 7 during this investigation, so remediation is not necessary if that site is chosen for the construction of an upland landfill.



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ASHTABULA RIVER DREDGING
LANDFILL DESIGN

STABILITY BEFORE FILLING

US ARMY ENGINEER DISTRICT BUFFALO

FIGURE M8

M3.1(b.)(2.) Soil Design Parameters.

Since the facility would be filled in a relatively short period of time after initial dike construction (within 3 years of construction), the underlying clay foundation soil would not undergo any significant consolidation (i.e. drainage) . Thus, the excess pore water pressures developed during embankment construction would not have been significantly dissipated. Therefore, the same foundation shear strengths used in the End of Construction Case were used in this analysis. This analysis also includes dredge spoil which required the development of shear strength design parameters for this material. Since no laboratory strength testing of the dredge spoils were performed, presumptive design values were used. The undrained strengths for the dredge spoil was obtained from field vane shear tests performed on dregde material at the Cleveland Dike 14 and Toledo disposal sites. To obtain the presumptive consolidated drained design values of the dredged fill typical values found in literature (Bowles, 1977) was used assuming that the dredge fill was a soft clay. A summary of the material types soil design values used in the stability analysis is presented in Table M2.

Table M2 - Soil Design Parameters, Stability Analysis of Facility After Filling

Material Type\Description	Unit Weight (pcf)		Shear Strength	
	γ moist	γ sat	Cohesion, C (psf)	Friction Angle, Ø
Foundation - Very Stiff Silty Clay	138	138	1800 (UU Test) 200 (CD Test) 240 (CU Test)	0° (UU Test) 32.0° (CD Test) 28.0° (CU Test)
Embankment - Remolded Silty Clay	136	139	800 (CU Test) 560 (CD Test)	25.0° (CU Test) 31.0° (CD Test)
Dredge Spoil - Very Soft Silty Clay	110	----	0 (CD Test) 200 (CU Test)	22.0° (CD Test) 7.8° (CU Test)
Shale Bedrock	160	160	5000	0°

M3.1(b.)(3.) Results of Analysis.

Corps of Engineers Computer Program UTEXAS3 was used to search for the critical failure surface and compute the minimum factor of safety. Circular arc failure surfaces were used in the computer search . The soil design parameters presented in Table M2 were used as input data into the computer program. A graphical depiction of the critical failure surface along with its computed minimum factor of safety is presented Figures M9 and M10. Results of the stability analysis reveals that for the case without sesimic loading the containment dikes are stable on both of the containment and outside slopes with a minimum factor of safety of 4.207. When a seismic load is applied the minimum factor of safety is 2.486. Corps of Engineers ance and USEPA guidance requires a minimum factor of safety of 1.5 or greater where failure would endanger life or the environment. Ohio EPA guidance requires a minimum factor of safety of 2.0 where failure would endanger life or the environment and 1.7 for seismic conditions.

M3.1(c.) Interface Stability of Liner

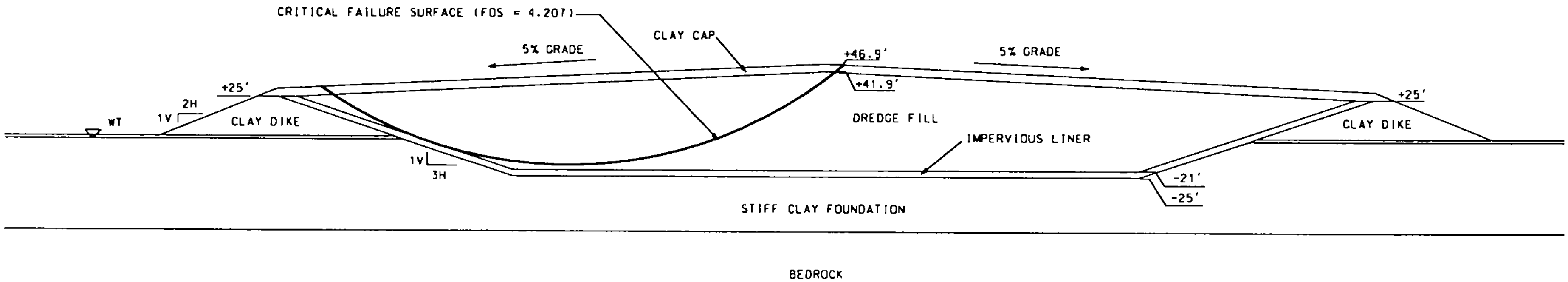
M3.1(c.)(1.) General.

Another potential failure plane is between the HDPE liner and compacted clay interface. Typically the interface friction angle between a smooth HDPE liner and compacted clay is about 9°. The present design calls for the liner to be placed at 1V on 3H slope (18.43°) . The factor of safety against sliding is computed to be 0.48 assuming that the clay is placed on top of the HDPE liner. The present design calls for the placement of a drainage layer on top of the HDPE liner. Assuming that the drainage layer consists of granular material the interface friction angle would typiclly be about 20°. The factor of safety against sliding would then be 1.09. If a textured HDPE liner is used the interface friction angle would be about 25° with a corresponding factor of safety against sliding of 1.4. To insure that the HDPE liner does not slide down the slope the liner could be anchored into a trench at the top of slope. Since the final componets of the liner may change a detailed interface stability an·lysis will be postponed until the detailed design phase. Depending upon the final components and details of the liner it may be necessary to flatten the slope in order to stabilize the interface components of the liner.

M3.2 Capacity Analysis of Facility

M3.2(a.) General.

The purpose of the capacity analysis is to determine the size of the disposal facility needed to store the dredge spoil sediments. This capacity analysis considers the volume increase of the dredge spoils after they are removed from the river (bulking) and subsequent volume reduction over time after the dredge spoils have been placed into the temporary dewatering and disposal facilities. Once the dredge spoils are placed into the facility it undergoes volume reduction from: (1.) self weight consolidation, (2.) consolidation from



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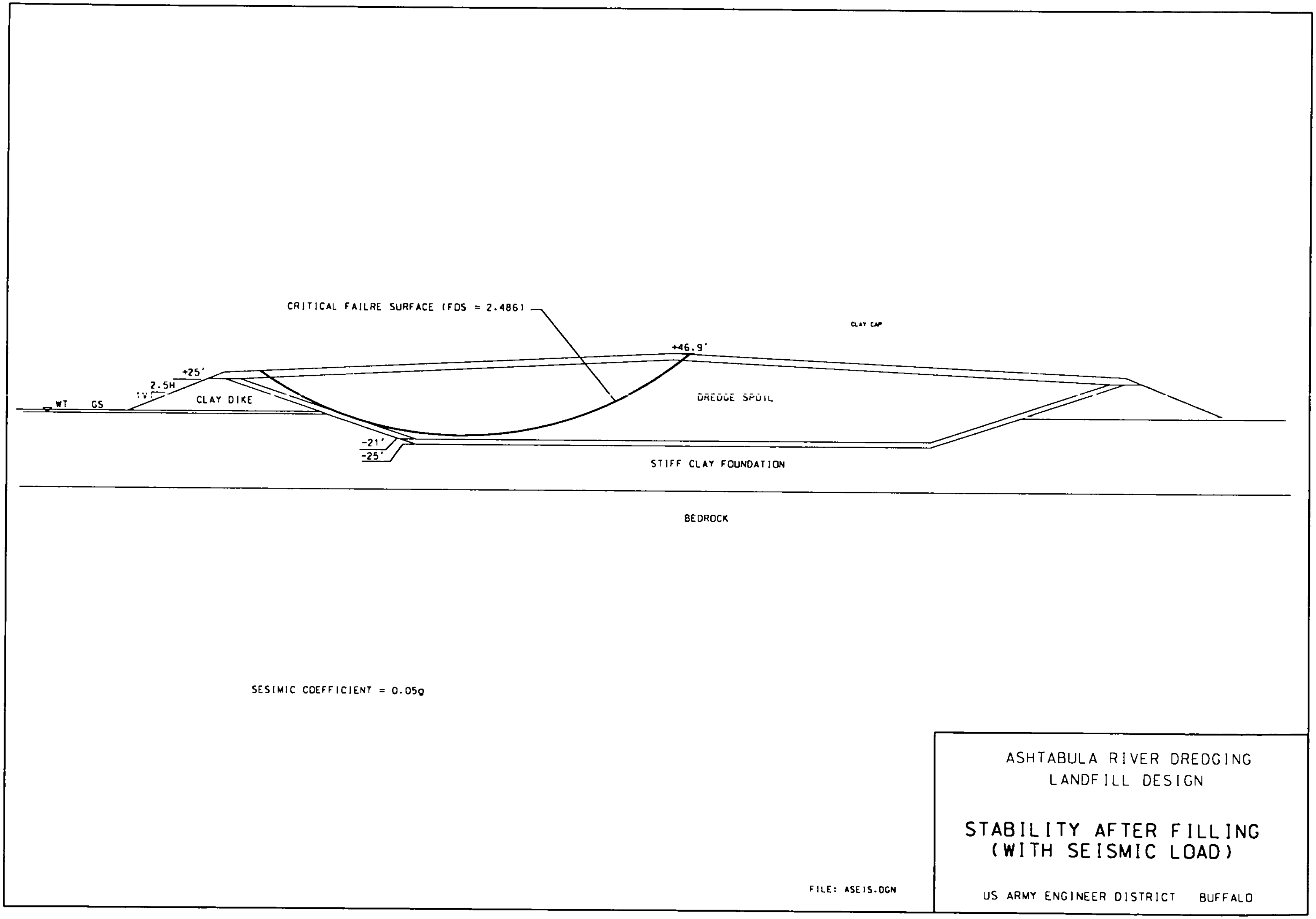
ASHTABULA RIVER DREDGING
LANDFILL DESIGN

STABILITY AFTER FILLING

US ARMY ENGINEER DISTRICT BUFFALO

FIGURE M9



CRITICAL FAILRE SURFACE (FOS = 2.486)
CLAY CAP
+46.9'
+25'
2.5H
1V
WT
GS
CLAY DIKE
DREDGE SPOIL
-21'
-25'
STIFF CLAY FOUNDATION
BEDROCK
SESIMIC COEFFICIENT = 0.05g
FILE: ASEIS.DGN
ASHTABULA RIVER DREDGING
LANDFILL DESIGN
STABILITY AFTER FILLING
(WITH SEISMIC LOAD)
US ARMY ENGINEER DISTRICT BUFFALO

FIGURE M10

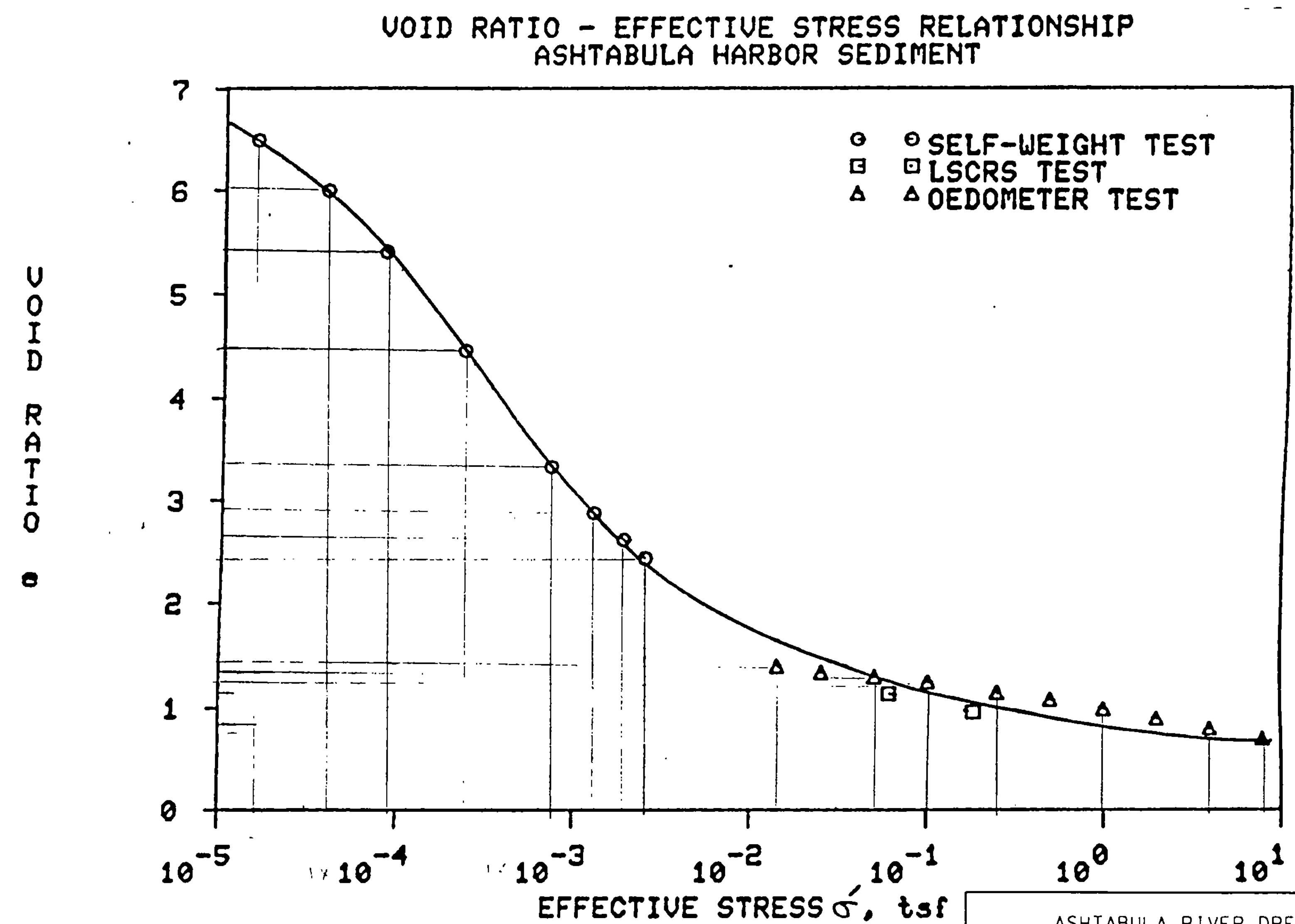
subsequent dredge fill lifts, (3.) settlement from desiccation drying processes and, (4.) foundation consolidation. Corps of Engineers Computer Program PCCDF90 was used in this analysis and incorporates all of the above processes into the computer model.

M3.2(b.) Dredge Material Properties.

Material properties needed to estimate the increase in volume of the dredge material after it has been removed from its insitu (river) conditions and volume reduction after it has been placed into the containment facility are as follows: (1.) specific gravity, (2.) insitu (i.e. in river) void ratio, (3.) insitu water content, (4.) insitu unit weight, (5.) insitu solids concentration, (6.) column settling properties, (7.) self weight consolidation properties, (8.) consolidation properties (Oedometer) and, (9.) Atterberg Limits. Laboratory testing of Ashtabula River sediment samples (See Appendix C for test results) revealed that the average insitu void ratio is about 3.0, average specific gravity of about 2.65 and, solids concentration of about 50%.

The computation of the dredge material bulking properties and material properties at the time of placement into the containment facility is contained in Appendix I (Dredge Material Dewatering). Typically dredge material is pumped out directly from a Hopper dredge or barge scow into a containment facility located along the shoreline. However, since the landfill is located inland it is more economical to truck the dredge material from a temporary dewatering facility to the landfill site. In order to transport the dredge spoils overland to the landfill the material would have to be dewatered to a point that it can be reasonably transported by truck. It was assumed in this analysis that the dredge material would be placed into a temporary off site dewatering facility, allowed to be drained, and then transported by truck to the landfill site. Under this scenario it is estimated that at the time of disposal the dredge material would have a solids concentration of about 70% and void ratio of about 1.77.

When dredge material is directly placed from a Hopper dredge water is added in order to facilitate transpiration thru dredge pipes into the facility. As a result, the dredge material is initially placed into the facility as a slurry and thus undergoes settling and self weight consolidation. Under the overland transportation scenario the dredge material will be drained prior to placement into the facility and would thus not undergo settling and self weight consolidation. However, the dredge material would still undergo settlement by consolidation by the application of overlying dredge fill lifts and desiccation (drying). Oedometer tests were performed on samples from the Ashtabula River in February, 1984 by the Corps of Engineers Waterways Experiment Station, Vicksburg Miss. These tests results are presented in Attachment M4 and shown graphically in Figures M11 and M12. Table M3 presents the void ratio corresponding effective stress and permeability relationships of the dredge spoil used in the computer simulation.

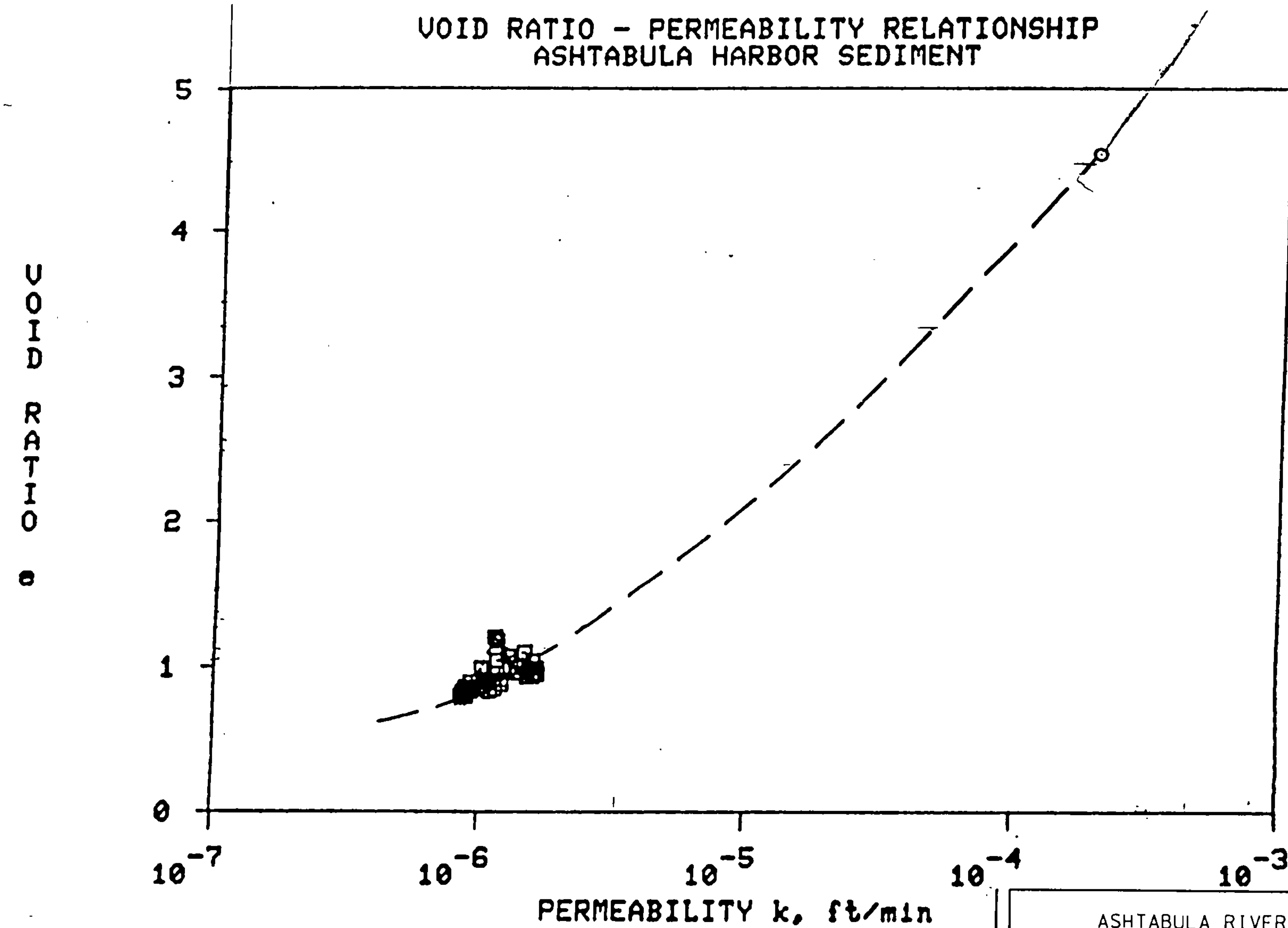


ASHTABULA RIVER DREDGING
LANDFILL DESIGN

SELF_WEIGHT AND OEDOMETER
VOID RATIO VS EFF STRESS

US ARMY ENGINEER DISTRICT BUFFALO

FIGURE M11



ASHTABULA RIVER DREDGING
LANDFILL DESIGN

VOID RATIO VS PERMEABILITY
(RIVER SEDIMENTS OEDOMETER TESTS)

US ARMY ENGINEER DISTRICT BUFFALO

FIGURE M12

Table M3 - Void Ratio, Effective Stress, Permeability of Dredge Spoil

Void Ratio	Effective Stress (psf)	Permeability (Ft/Day)
3.33	.180E+01	.940E-01
2.95	.300E+01	.600E-01
2.60	.500E+01	.360E-01
2.45	.800E+01	.220E-01
1.80	.160E+02	.100E-01
1.45	.400E+02	.720E-02
1.35	.140E+03	.580E-02
1.25	.200E+03	.430E-02
1.10	.800E+03	.360E-02
1.05	.200E+04	.290E-02
0.90	.120E+05	.220E-02
0.80	.180E+05	.140E-02

M3.2(c.) Weather Data.

Desiccation of dredged material is basically the removal of water by changing the state of the water near the surface from a liquid to a gas. This change of state results primarily from evaporation and transpiration. Evaporation is mainly controlled by such variables as radiation heating from the sun, convective heating from the earth, air temperature, ground temperature, relative humidity and wind speed. In the computer model (PCCDF90) water loss from the surface of dredged material is a function of the average class A pan evaporation rate. Municipal Solid Waste Disposal Facilities require that a dailey cover be applied over the disposed waste materials. Thus, dissication drying of the dregded material would be minimal.

The historical monthly class A pan average evaporation rate for the Ashtabula, Ohio region was determined from NOAA published reports and was input into the computer model to determine the desiccation settlement of the dredge spoil. This data is summarized in Table M4.

Other data in which the desiccation settlement is dependent upon is: (a.) rainfall, (b.) water supplied from lower consolidating dredged previously placed dredged material and, (c.) water from overland flow (excess rainfall). The computer model includes these variables in a water budget equation. Monthly historical rainfall data for the Ashtabula region was determined from published NOAA reports and was input into the computer model. Water from lower consolidating layers is obtained from consolidation equations incorporated into the computer model. Overland flow in the computer model is determined by assuming a drainage efficiency (i.e. 0.5 poorly drained, 1.0 well drained) for the containment facility, then taking a fraction of the average rainfall to obtain the amount of water lost by overland flow . The monthly average rainfall for the Ashtabula region is summarized in Table M4.

Table M4 - Summary of Monthly Rainfall and Evaporation Potential
for Ashtabula, Ohio

Month	Rainfall (inches)	Evaporation (inches)
January	2.35	.78
February	1.78	.88
March	2.63	1.63
April	3.49	2.96
May	3.40	4.45
June	3.52	5.20
July	4.07	5.19
August	3.81	4.48
September	3.63	3.22
October	3.29	2.37

November	2.55	1.38
December	2.85	0.91

M3.2(d.) Dredge Material Filling Rate and Fill Heights.

The analysis assumed that during the three year disposal period material would be placed into both the TSCA and NON-TSCA disposal facilities during a six month period (April thru October) and would be shut down for a six month winter period. Table M5 shows the dredge filling rates and fill heights into both the TSCA and NON-TSCA disposal facilities. The dredge fill heights were determined by dividing the monthly dredged fill volume (at the time of disposal) by the area of the disposal facility. The disposal facility area was adjusted for each monthly disposal period to account for changes in geometery of the facility during filling.

Table M5 - Dredge Material Filling Rates anf Fill Heights

NON-TSCA Facility		
Deep Dredging Scenario		
Year/Month	**Dredge Volume (CY)**	**Fill Heights (Feet)**
2004/April-December	197,971 (21,997 cy/month)	1.48 to 1.21
2005/April-December	207,299 (23,033 cy/month)	1.24 to 1.07
Shallow Dredging Scenario		
2004/April-December	133,570 (14,841 cy/month)	1.00 to 0.87
2005/April-December	207,299 (23,033 cy/month)	1.32 to 1.12
Bank to Bank Dredging Scenario		
2004/April-December	242,056 (26,895 cy/month)	1.82 to 1.43
2005/April-December	304,039 (33,782 cy/month)	1.75 to 1.43
2006/April-September	173,026 (28,838 cy/month)	1.20 to 1.10
TSCA Facility		
Deep Dredging Scenario		

2004/April-December	69,100 (7,678 cy/month)	13.8 to 1.87
2005/April-June	34,549 (11,517 cy/month)	2.66 to 2.27
Shallow Dredging Scenario		
2004/April-December	69,100 (7,678 cy/month)	13.8 to 1.87
2005/April-June	34,549 (11,517 cy/month)	2.66 to 2.27
Bank to Bank Scenario		
2004/April-December	69,100 (7,678 cy/month)	13.8 to 1.87
2005/April-June	34,549 (11,517 cy/month)	2.66 to 2.27

M3.2(e.) Results of Capacity Analysis.

Corps of Engineers computer model PCDDF90 was used to determine the dredge spoil consolidation (settlement) and thus determine if the configuration of both the TSCA and NON-TSCA containment facilities can contain the projected disposal volumes over a three dredging period. The computer model determines the projected dredge fill heights for subsequent time periods considering the settlement of dredge material by both consolidation and desiccation.

Table M6 shows the calculated dredge sediment volumes at different points in the disposal process including the calculated volume of the dregde material at the end of the 3 year disposal process (i.e. post settlement). Results of the analysis revealed that with the present containment area footprint and with the bottom of the facility excavated to 25 feet below the ground surface, the containment facilities are oversized. The computer model estimated that at the end of the three year dredge disposal period the dredge material would only reach a heights of -12.2 feet to +1.5 feet above ground surface for the NON-TSCA facility and to +13.6 feet for the TSCA facility. The orginal design for the disposal facilities required that the disposal dikes be constructed to +25 feet.

In order to size the containment facilities so that the dredge material could be graded to obtain a 5% cover grade and contain the estimated volume of dredge material (after consolidation), the bottom excavation depth was varied while maintaining the present design foot print dimensions. During this exercise consideration was given to the minimum depths needed to key the bottom of the facility into natural impervious material. At alternative disposal site No.5 the minimum depth to natural impervious material is 8 feet. At alternative disposal site No.7 the rooting zone for trees and shrubs occurs at depths of less than 5 feet. Thus, in order to insure that the bottom of the disposal facility was keyed into natural impervious material a

TABLE M6 - Calculation of Sediment Volumes at Different Points in Disposal Process

	In-Place			Post-Dredging			Post Dewatering			Post Settlement		
	TSCA	non-TSCA		TSCA	non-TSCA		TSCA	non-TSCA		TSCA	non-TSCA	
	Mechanical	Mechanical	Hydraulic	Mech.	Mech.	Hydr.	Mech.	Mech.	Hydr.	Mech.	Mech.	Hydr.*
BBB	150,000	1,040,753	23,446	**158,805**	**1,101,842**	**145,517**	**103,650**	**719,158**	**16,201**	**101,690**	**682,084**	**16,201**
Deep	150,000	586,519	20,084	**158,805**	**620,946**	**124,651**	**103,650**	**405,283**	**13,878**	**101,690**	**381,474**	**13,788**
Shallow	150,000	493,257	16,024	**158,805**	**522,210**	**99,453**	**103,650**	**340,839**	**11,073**	**101,690**	**322,320**	**16,201**

* Assumes hydraulic dredging occurs within last month.

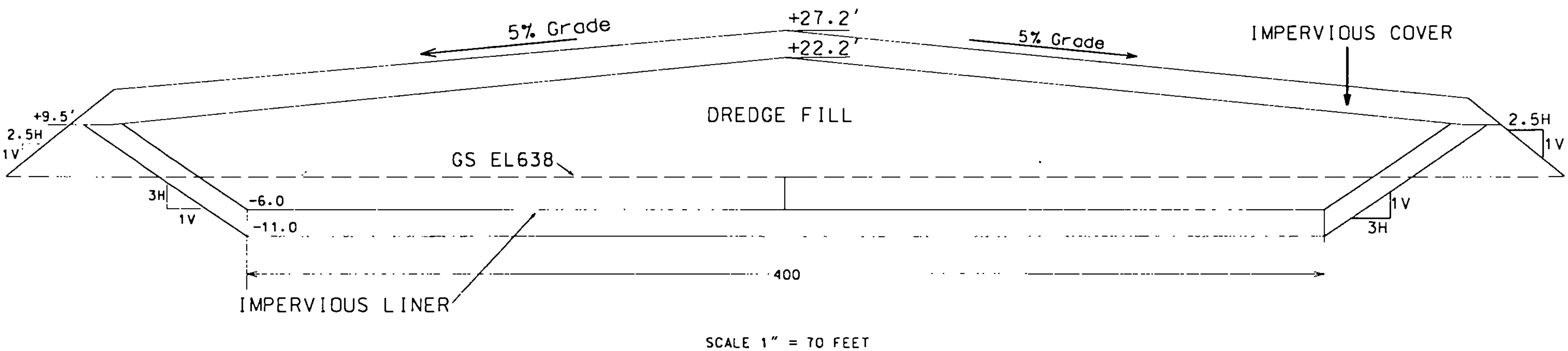
site No.7 the rooting zone for trees and shrubs occurs at depths of less than 5 feet. Thus, in order to insure that the bottom of the disposal facility was keyed into natural impervious material a minimum excavation depth of 11 feet below ground surface was selected. Due to the small foot print area for the TSCA facility the excavation depth was increased to 16 feet below the ground surface so that the height of the containment dike of the TSCA facility would more closely match the height of the containment dikes of the NON-TSCA facility. Figures M13 thru M15 show the excavation depths and typical cross section for the NON-TSCA facility for the deep, shallow and, bank to bank dredging scenarios. Figure M16 shows the excavation depth and typical cross section for the TSCA facility.

M3.3 Final Cover Settlement Analysis.
M3.3(a.) General.

Due to the very soft nature of the dredge material placed in the facility, large settlements of the final landfill cover expected. Excessive differential settlement of the final cover could lessen the effectiveness or even cause failure of the cover. Potential problems of large differential settlements include: (a.) loss of cover grade thus reducing the effectiveness water (precipitation) drainage, (b.) development of cracks in the cover, and (c.) ponding of water due to subsidence. A settlement analysis of the cover was performed in order to determine the amount of differential settlement expected to occur and to check if the minimum required grade (3% to 5%) of the cover would be maintained.

M3.3(b.) Soil Design Parameters.

The basic parameters needed to estimate the differential settlement of the cover include: (a.) distribution of dredge material void ratio with depth, (b.) unit weight of cover and dredge material, and (c.) compression index of dredge material. Computer output data from the capacity computer model PCCDF90 reveals that the void ratios in the dredge material would vary from about 1.4 at the bottom to 1.7 near the top. The average void ratio at the midpoint of the dredge fill layer is about 1.6. Figure M11 shows the void ratio vs effective stress plot for the dredge material. Table M7 shows the effective stress, void ratio and computed compression index with depth of the dredge fill material. In general the compression indices of the dredged fill vary between 0.167 to 0.33.



ASHTABULA RIVER DREDGING
LANDFILL DESIGN
NON-TSCA (DEEP SCENARIO)

FIGURE - M13

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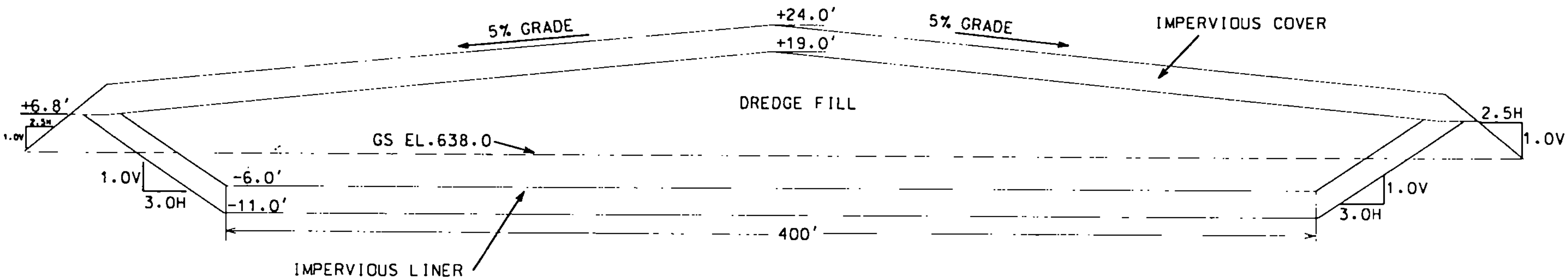

ASHTABULA RIVER DREDGING
LANDFILL DESIGN
NON-TSCA (SHALLOW SCENARIO)

FIGURE - M14

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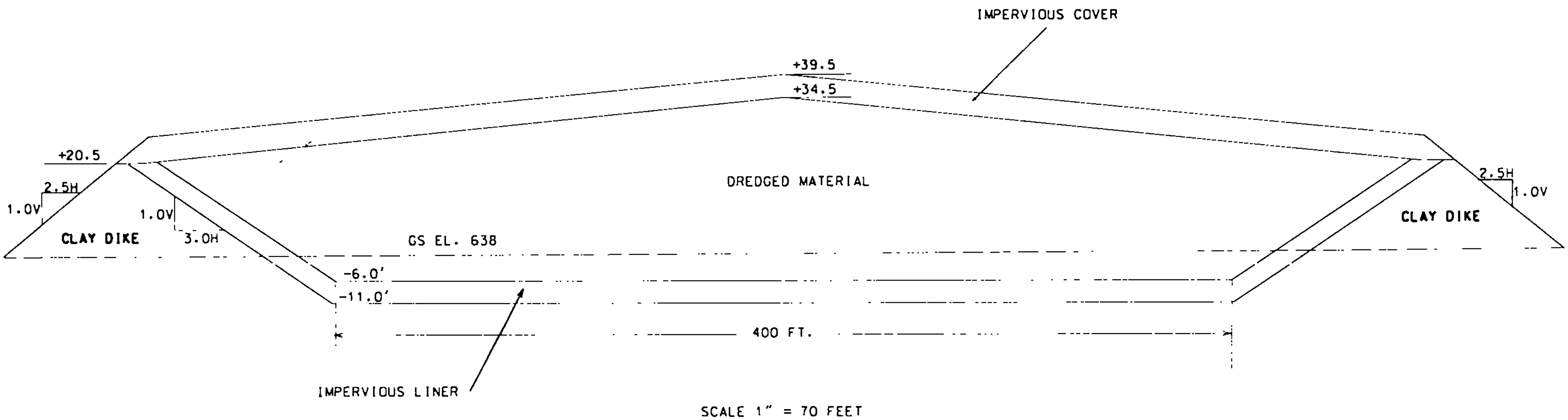
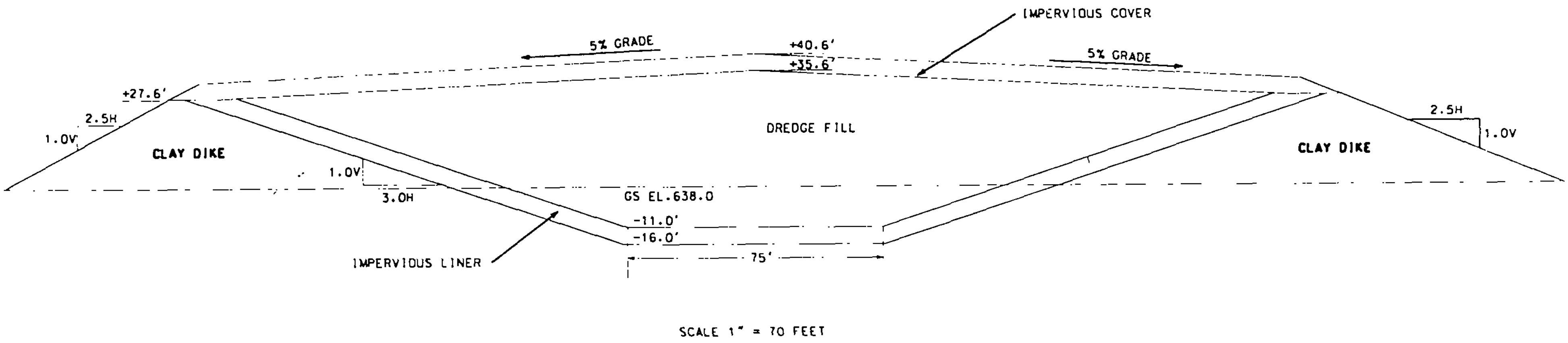


ASHTABULA RIVER DREDGING
LANDFILL DESIGN
NON-TSCA (BANK TO BANK SCENARIO)
FIGURE - M15

FILE:NTSCABB2.DGN



ASHTABULA RIVER DREDGING
LANDFILL DESIGN
TSCA FACILITY

FIGURE - M16

FILE:TSCA.DGN

Table M7 - Dredge Fill Void Ratio, Effective Stress, Computed Compression Index*

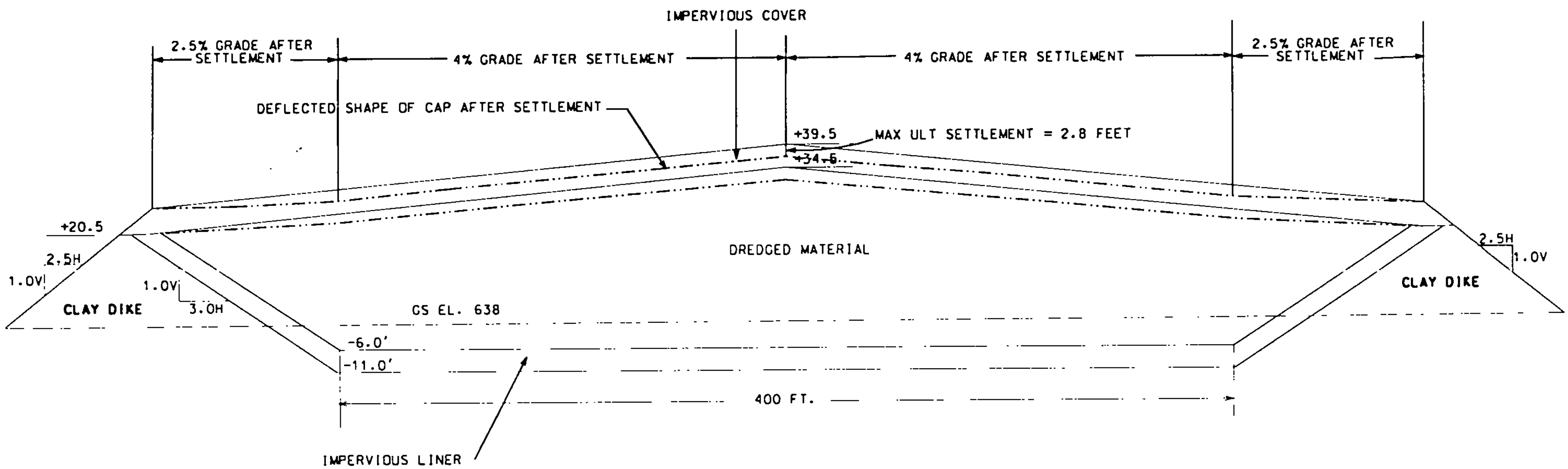
Ave Depth (FT)	Ave Eff Stress (PSF)	Void Ratio	Compression Index
0.46	16.91	1.77	1.09
2.07	75.38	1.64	0.166
6.11	89.91	1.63	0.166
12.72	96.66	1.62	0.166
19.16	117.18	1.6	0.29
23.27	155.74	1.57	0.29
25.93	190.06	1.54	0.29
28.28	249.33	1.51	0.33
30.86	335.45	1.47	0.33

* Void ratio, effective stress obtained from ADDAMS consolidation program output at end of 3 year disposal period. Compression index computed from Figure M10.

The cover is assumed to be constructed of a compacted silty clay obtained from either an offsite borrow source or from the containment facility excavation. The present design requires a 5 foot thick impervious cover. The unit weight of compacted clay cover material was assumed to be 120 pcf.

M3.3(c.) Results of Final Cover Settlement Analysis.

The computations for the cover settlement is presented in Attachment M7. The settlement was computed for the NON-TSCA facility bank to bank dredging scenario as this is expected to produce largest settlement of the scenarios investigated. Resultsof the Settlement analysis is presented on Figure M17 and reveals that a maximum ultimate settlement at the centerline of the disposal facility is computed to be 2.8 feet and about 2.0 feet at 200 feet from the centerline. This amount of settlement would effectively reduce the cover grade from it's proposed grade of 5% down to 4% over a distance of 200 feet from the centerline. From a distance of 200 feet from the centerline to the containment dike (279.5 feet from the centerline) the grade reduces to about 2.5%. A 3% grade is the minimum grade needed to maintain adequate drainage. Since the grade at the outer 79.5 feet is slightly less than the 3% minimum grade, the cover in this area would have to be monitored to insure that a 3% minimum grade is maintained.



ASHTABULA RIVER DREDGING
LANDFILL DESIGN

LANDFILL COVER SETTLEMENT

FIGURE - M17

FILE:NTSCABB.DGN

M32

M3.4 Reuse of Excavated Material.

Construction of the containment facilities for the proposed design require the excavation of native materials at either sites 5 or 7 to a depth of 25 feet. Results of the subsurface exploration program revealed that the soils in the upper 8.0 feet at Site No.5 consists of fill. This fill consists of grey fly ash and coal. Chemical testing of this material revealed the presence of arsenic (See chemical testing data, Appendix B). Thus, the composition of this fill makes it unsuitable as embankment fill and liner material. Below 8 feet at Site No.5 and below 10 feet at Site No.7 the native materials consists of very stiff, moist to dry low plasticity clay and silt. This material has ideal engineering and construction characteristics for liner and embankment material. Since this material is already compact it is unlikely that recompaction would significantly reduce the hydraulic conductivity characteristics over it's insitu hydraulic conductivity. If this material is to be used as a source of borrow for the liner, then laboratory permeability tests on compacted borrow material would have to be performed to verify that hydraulic conductivities less than $1x10^{-7}$ cm/sec can be achieved.

M3.5 Permeability of Native Soils.

Undisturbed samples obtained from the September 1996 exploration program were tested for permeability by the Ohio River Division Laboratory Cincinnati, Ohio in November 1996. The results of the permeability tests are included in the Laboratory test Report (Attachment M1). Results of the permeability tests revealed that the hydraulic conductivities of the native soils varied from $1x10^{-6}$ cm/sec to $1x10^{-8}$ cm/sec. Thus, in order to meet the minimum permeability of $1x10^{-7}$ cm/sec required by the EPA, a low permeability liner with a permeability of at least this would be required for the subject landfill site.

M3.6 Hydrostatic Uplift On Liner and Groundwater Table.

The 1996 exploration program revealed that groundwater was either not encountered or was encountered at varying depths of 1 to 21 feet below ground surface. The borings also revealed that the subsurface soils consists of silty clay glacial till having occasional seams of silt or sand. Based upon the results of the exploration program the groundwater appears to be discontinuous and occurs primarily in the silt and sand seams of the glacial till. Trotten (1979) reported that throughout the county only meager supplies of groundwater are available with a few large supplies comming from buried gravels of the moraines. The glacial till at the project site yeilds minor amounts of groundwater located in the discontinuous and isolated silt seams of the till. Assuming that the water table is at 1 foot below the ground surface, the hydrostatic pressure at the bottom of the liner for the NON-TSCA facility (-11 feet below ground surface) is computed to be 624 psf. For the TSCA facility the hydrostatic pressure at the bottom of the liner (-16 feet below ground surface) is computed to be 936 psf. For the NON-TSCA facility the minimum (i.e. shallow dredging scenario) overlying weight from the cover, dredge fill and, liner is computed to be 2,480 psf. For the TSCA facility the overlying weight of the cover, dredge fill and, liner is computed to be 3,960 psf. Since the overling weights of the cover, dredge material and cover are greater than the hydrostatic pressure at the base of the liner, uplift does not appear to be a problem. A more detailed analysis of hydrostatic uplift will be performed during the detailed design phase.

M4 REFERENCES

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Ashtabula River Dredging
Landfill Design

Geotechnical Appendix M

ATTACHMENT M1

Laboratory Test Report (Ohio River Division Laboratory)

(COPIES OF REPORT AVAILABLE AT BUFFALO DISTRICT OFFICE FOR REVIEW)

Ashtabula River Dredging
Landfill Design

Geotechnical Appendix M

ATTACHMENT M2

Soil Design Parameter Development

ASHTABULA LANDFILL SITES
SOIL DESIGN PARAMETER DEVELOPMENT

A. Slope Stability Soil Design Parameters.

(1.) Unit Weight Foundation Soils.

(a.) Saturated Density: From laboratory test data of saturated density (See test data summary Tables attached and Figure 1 of sat density vs depth) data shows some scatter varying from a low of 126 pcf to 144 pcf. Average density is 138 pcf. Use γ **= 138 pcf.**

(b.) Moist Density: From laboratory test data of moist density (See test data summary tables) the data shows that the moist unit weight is in the same range as the saturated unit weights (i.e. same natural moisture contents), therefore assume γ **= 138 pcf.**

(2.) UU Shear Strength (Q Test) of Foundation Soils.

From laboratory Q test results the undrained shear strengths for many plots are not horizontal and indicate that they are overconsolidated especially in the upper 10 feet. This is based upon: (1.) Nautral water contents much lower than the liquid limits (normally consolidated moisture contents are near liquid limit), (2.) Q test plot curves flatten as confining pressure increases. A plot of the laboratory undrained shear strengths vs depth (See Figure 2) reveals that the undrained shear strengths at depth 11' are 2 to 3 times the strengths at depths of 31 and 49 feet which is indicative of apparently high overconsolidation ratio. Since there is some scatter assume for design the use of the lowest 1/3 test values which equates to **Su = 0.9 tsf (1,800 psf).**

(3.) CU Shear Strength (R Test) of Foundation Soils.

Figure 3 shows a plot of the conslidated undrained shear strengths vs confining pressure for all of the tests. Individual test data plots show that the cohesion intercepts varied from 0.03 tsf (60 psf) to 1.18 tsf (2,360 psf) and friction angles varied from 27° to 44°. From the undrained shear strength plot (Figure 3) taking the approximate lower 1/3 of test values the adopted strength envelope has a cohesion **C = 240 psf (.12 tsf),** and friction angle **Ø = 28°** .

(4.) Effective Shear Strength (R_BAR) of Foundation Soils.

Figure 4 shows a plot of the effective shear strength at failure for all of the tests vs effective pressure. Individual plots show that the cohesion varied from 0 tsf to 0.42 tsf (840 psf) and effective friction angles varied from 25° to 47.5°. From Figure 4 and taking the approximate lower 1/3 of all test values the adopted strength envelope has a cohesion intercept **C = 200 psf (0.1 tsf)** and a friction angle **Ø = 31.8°.**

(5.) Unit Weight of Remolded Embankment Soils.

From Laboratory Standard Compaction Test Results
Wopt = 13 - 14%, γ dry (at opt W) = 113 - 123 PCF.

(a.) Moist Unit Weight.

At Wopt = 13 - 14% , **γ (mst) = 136.2 pcf** (average)

(b.) Saturated Unit Weight.

γ (sat) = 138.9 pcf (average)

(6.) Unconsolidated Undrained (Q test) Shear Strength of Remolded Embankment Soils.

Many of the samples were classified as silt or low plastic clays with plasticity indices (i.e. PI = 7 - 8) which make borderline silt/clay (CL-ML). The Q Test results do not show the typical 0 = 0° for UU Total Stress Strength Plots. This is possibly due to the fact that the samples did not become saturated before shear as a result of drainage. Thus the Q test values are not valid.

(7.) Consolidated Undrained (Rtest) Shear Strength of Remolded Embankment Soils.

From laboratory Rtest results plotted (See Figure 5) and using the lowest 1/3 of test values the adopted strength envelope has **C = 800 psf (0.34 tsf) and Ø = 25°.**

(8.) Effective Consolidated Undrained (Rbar) Strength of Remolded Embankment Soils.

From laboratory Rbar test results plotted (See Figure 6 plot) and the lowest 1/3 of the test values the effective strength plot has **C' = 560 psf (.28 tsf), Ø = 35°.**

(9.) Dredge Spoil Moist Unit Weight.

From Table 3-4, Bowles (See table below), the saturated unit weight of a soft clay is about 100 pcf to 120 pcf. Assume dredge material is moist to saturated with a unit weight of 110 pcf.

(10.) Dredge Spoil Undrained Shear Strength.

From Table 3-4, Bowles (below), the unconfined compressive strength of a very soft to soft clay is about 0.5 ksf (500 psf). The undrained shear strength is 1/2 of the unconfined compressive strength or c(undrained) = 250 psf. Assume for the soft clay spoil **c = 200 psf.**

(11.) Dredge Spoil Drained Shear Strength.

From Table 2-2 Bowles (below), The consolidated drained friction angle for a clay varies from 20° to 42°. Assume that the dredge spoil behaves as a soft clay with a friction angle of **22°.**

Table 3-3. Empirical values for ϕ, D_r, and unit weight of granular soils based on the standard penetration number with corrections for depth and for fine saturated sands

Description	Very loose	Loose	Medium	Dense	Very dense
Relative density D_r*	0	0.15	0.35	0.65	0.85 1.00
Standard penetration no. N		4	10	30	50
Approx. angle of internal friction ϕ°†	25°-30°	27-32°	30-35°	35-40°	38-43°
Approx. range of moist unit weight, (γ) pcf (kN/m³)	70-100‡ (11-16)	90-115 (14-18)	110-130 (17-20)	110-140 (17-22)	130-150 (20-23)

* USBR [Gibbs and Holtz (1957)].

† After Meyerhof (1956). $\phi = 25 + 25D_r$ with more than 5 percent fines and $\phi = 30 + 25D_r$ with less than 5 percent fines. Use larger values for granular material with 5 percent or less fine sand and silt.

‡ It should be noted that excavated material or material dumped from a truck will weigh 70 to 90 pcf. Material must be quite dense and hard to weigh much over 130 pcf. Values of 105 to 115 pcf for nonsaturated soils are common.

Table 2-2. Representative values for angle of internal friction ϕ

Soil	Type of test* Unconsolidated-undrained UU	Consolidated-undrained CU	Consolidated-drained CD
Gravel			
Medium size	40-55°		40-55°
Sandy	35-50°		35-50°
Sand			
Loose dry	28.5-34°		
Loose saturated	28.5-34°		
Dense dry	35-46°		43-50°
Dense saturated	1-2° less than dense dry		43-50°
Silt or silty sand			
Loose	20-22°		27-30°
Dense	25-30°		30-35°
Clay	0° if saturated	14-20°	20-42°

B. Settlement Design Parameters.

(1.) Compression Index (Foundation).

From laboratory consolidation test results (See consolidation summary table) the compression indices Cc varied from .02 to .15. The average compression index is 0.98571. The compression index adopted for design purposes is the upper 1/3 test value (more conservative) or **Cc = 0.14**.

(2.) Overconsolidation Ratio (Foundation).

The overconsolidation ratio has considerable scatter with a low of 0.56 to a high of 1.5. Overconsolidatio ratios of less than 1.0 are not valid and thus should be thrown out. Based upon laboratory triaxial test behavior of the soil specimens it appears that the soils in the upper 10 feet are heavily overconsolidated and at depth below 31 feet slightly to normally consolidated. Due to the lack of sufficient data assume that the soils are normally consolidated (more conservative).

(3.) Recompression Index (Foundation).

Due to the lack of sufficient data as discussed in the previous paragraph assume that the soils are normally consolidated. Thus, the compression index is not needed.

(4.) Void Ratio (Foundation).

Laboratory void ratios showed considerable scatter (See test data summary tables) but generally increased with depth again showing the highly overconsolidated nature of the soils in the upper 10 feet and the more normally consolidated nature at depths below 31 feet. Due to the scatter take the average void ratio of **Eo = 0.473** for the entire soil column.

(5.) Compression Index (Dredge Spoils at end of 3 Year Disposal Period).

From the PCCDF90 Computer program output data (Attachment A6), the void ratios of the dredged fill varied from 1.4 at the bottom to 1.7 near the top. An average void ratio of 1.6 occurs at the midpoint of the dredged fill layer. Using this information and the dredge material consolidation test data (see Figure M11 in main Appendix A and Attachment M4,lab test results), the compression index for void ratios in the range of 1.4 to 1.7 are presented in Table M7 of the main Appendix M.

ASHTABULA LANDFILL SITES
SUMMARY OF LABORATORY UNDISTURBED Q TESTS

Boring	Depth	Average Depth	Liquid Limit	Plastic Limit	Plasticity Index	Soil Class	Gs	MC	Void Ratio	Dry Density	Unit Weights Moist	Unit Weights Saturated	Confine Pressure	Max Dev Stress	Shear Stress	Cohesion Intercept	Angle of Int Friction	Adopted Moist	Adopted Unit Weight Saturated	Depth To Water Tabl	Assumed Ef Stress
5A	10.0-12.0	11	32	19	13	Sandy Clay (CL	2.776	13.5	0.381	125.4	142.329	142.6109	0.5	6.85	2.9						
								13.2	0.376	125.9	142.5188	142.9527	1	4.65	2.3	2.3	0	142.3	142.5	2	1005.5
								14.2	0.393	124.3	141.9506	141.8972	2	7.59	4						
										Ave =	142.2661	142.4869									
5A	30.0-32.0	31	27	16	11	Clay(CL)	2.816	16.5	0.507	116.6	135.839	137.593	0.5	2.02	1						
								19.4	0.529	114.9	137.1906	136.4846	1	1.67	0.82	1	0	135.4	136.3	2	2413.9
								18.4	0.561	112.5	133.2	134.9121	2	2.22	1.1						
										Ave =	135.4099	136.3299									
5A	48.0-50.0	49	25	16	9	Clay(CL)	2.761	14.5	0.445	119.2	136.484	138.4119	0.5	4.45	2	2	0	137.2	138.7	2	3860.5
								14.8	0.434	120.1	137.8748	138.9784	2	4.98	2.28						
										Ave =	137.1794	138.6952									
7A	10.0-12.0	11	26	15	11	Sandy Clay(CL)	2.758	14.3	0.405	122.5	140.0175	140.4886	0.5	6.68	3.38	3.38	0	140.6	140.7	12	1687.2
								14.5	0.396	123.3	141.1785	141.0037	2	6.64	3.35						
										Ave =	140.598	140.7461									
7A	30.0-32.0	31	26	16	10	Clay(CL)	2.785	21.8	0.642	105.9	128.9862	130.3121	0.5	1.53	0.75	0.75	0	130.9	130.9	12	2872.3
								23.2	0.612	107.8	132.8096	131.4889	2	2.62	1.3						
										Ave =	130.8979	130.9005									
7A	48.0-50.0	49	25	16	9	Clay(CL)	2.756	19.5	0.555	110.6	132.167	132.8725	0.5	1.77	0.9						
								17.8	0.511	113.8	134.0564	134.9001	1	2.34	1,18	0.9	0	132.5	133.3	12	4213.3
								20.2	0.574	109.3	131.3788	132.0642	2	3.6	1.76						
										Ave =	132.534	133.2789									

ASHTABULA LANDFILL SITES
SUMMARY OF LABORATORY UNDISTURBED R, R-BAR TESTS

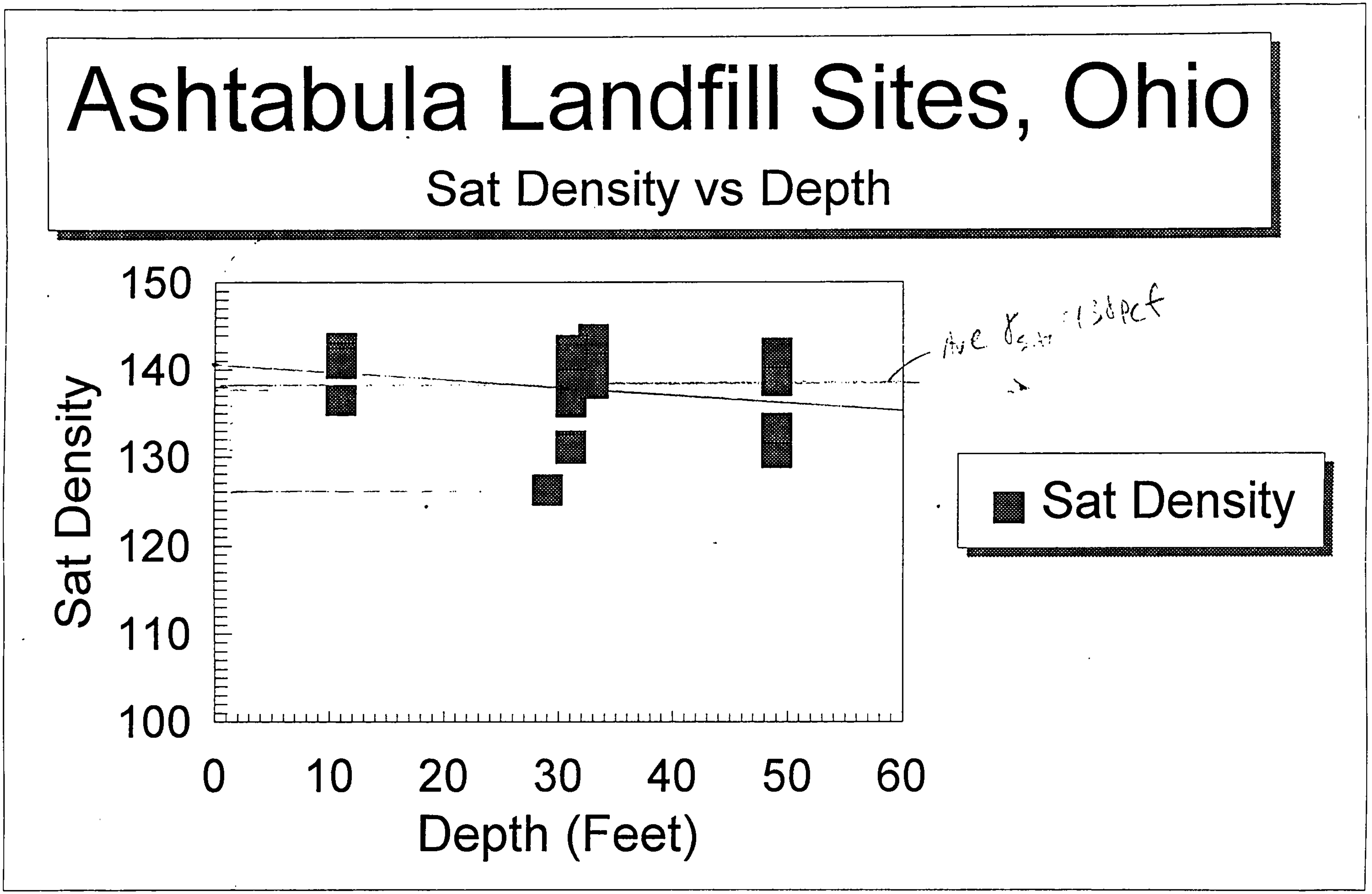
Boring	Depth	Average Depth	Liquid Limit	Plastic Limit	Plasticity Index	Soil Class	Gs	MC	Void Ratio	Dry Density	Unit Weights Moist	Unit Weights Saturated	Confine Pressure	Max Dev Stress	Shear Stress	Shear Stress Tff	Total Envelope Cohesion Intercept	Total Envelope Angle of Int Friction	Effective Normal Stress	Effective Shear Stress Tff	Effectivel Envelope Cohesion Intercept	Effectivel Envelope Angle of Int Friction	Adopted Unit Weight Moist	Adopted Unit Weight Saturated	Depth To Water Tabl	Assumed Ef Stress
5A	10.0-12.0	11	32	19	13	Sandy Clay	2.774	20.3	0.572	110.1	132.4503	132.8027	0.5	2.33	1.19	0.5			0.841	0.7						
								17.4	0.489	116.3	136.5362	136.8013	1	5.21	2.6	0.98	0.1	44	2.1	1.5	0.1	33.5	136.2	136.5	2	939.3
								15.3	0.43	121	139.513	139.7563	2	9.38	4.68	2			3.8	2.5						
										Ave =	136.1665	136.4534														
5A	30.0-32.0	31	27	16	11	Clay(CL)	2.816	16	0.44	122	141.52	141.0625	0.5	2.77	1.4	0.8			1.1	0.9						
								17.2	0.504	116.8	136.8896	137.7045	1	3.88	1.95	1.1	0.5	30	1.9	1.3	0.38	25	139.4	139.4	2	2511.8
								16.9	0.47	119.6	139.8124	139.5616	2	4.62	2.3	2.7			2.4	1.5						
										Ave =	139.4073	139.4429														
5A	48.0-50.0	49	25	16	9	Clay(CL)	2.761	14.6	0.38	124.9	143.1354	142.0901	0.5	5.96	2.8	1.45			2.6	1.8						
								14.9	0.391	123.9	142.3611	141.4461	1	6.33	2.97	1.8	1.18	32.5	2.5	1.65	0	32.5	142	142	2	4025.2
								14.8	0.377	125.1	143.8148	142.1817	2	8.56	4.25	2.4			3.5	2.4						
										Ave =	143.0371	141.906														
7A	10.0-12.0	11	26	15	11	Sandy Clay	2.758	14.6	0.393	123.5	141.531	141.0981	0.5	6.3	2.62	2			2.5	1.85						
								14.8	0.399	123.1	141.3188	140.9089	1	6.71	2.85	2.1	2	27	2.8	1.8	0.42	25	141.4	141.4	12	1555.4
								14.5	0.374	125.3	143.4685	142.2914	2	7.05	3.5	2.42			3.1	1.95						
										Ave =	142.1061	141.4328														
7A	30.0-32.0	31	26	16	10	Clay(CL)	2.785	22.2	0.628	106.7	130.3874	130.7602	0.5	1.58	0.9	0.4	0.03	36.5	0.4	0.4	0	47.5	131.2	131.3		
								22.1	0.607	108.2	132.1122	131.7825	1	3.09	1.53	0.78			0.6	0.6						
										Ave =	131.2498	131.2714														
7A	48.0-50.0	49	25	16	9	Clay(CL)	2.759	21.3	0.617	106.5	129.1845	130.3168	0.5	1.65	0.8	0.48	0.2	31	0.7	0.5	0.1	30				
								21.3	0.611	106.9	129.6697	130.5738	1	2.73	1.35	0.78			1.2	0.8						
										Ave =	129.4271	130.4453														

ASHTABULA LANDFILL SITES
SUMMARY OF LABORATORY REMOLDED R, R-BAR TESTS

Boring	Depth	Average Depth	Liquid Limit	Plastic Limit	Plasticity Index	Soil Class	Gs	MC	Void Ratio	Dry Density	Unit Weights Moist	Unit Weights Saturated	Confine Pressure	Max Dev Stress	Shear Stress	Shear Stress Tff	Total Envelope Cohesion Intercept	Total Envelope Angle of Int Friction	Effective Normal Stress	Effective Shear Stress Tff	Effectival Envelope Cohesion Intercept	Effectival Envelope Angle of Int Friction	Adopted Unit Weight Moist	Adopted Unit Weight Saturated	Depth To Water Tabl	Assumed E Stress
5A	10.0-20.0	15	25	15	10	Sandy Clay (CL)	2.798	12.9	0.426	122.5	138.3026	141.107	0.5	4.6	2.3	1.4			2.037	1.3						
								12.7	0.422	122.8	138.3956	141.3209	1	5.47	2.7	1.65	1.1	27.5	2.426	1.55	0	32	138.3	141.2	2	939.3
								12.8	0.425	122.5	138.18	141.107	2	6.37	3.2	2.2			2.765	1.9						
										Ave =	138.2927	141.1783														
5A	20.0-30.0	25	26	15	9	Clay(CL)	2.726	13	0.406	121	136.73	139.0213	0.5	2.55	1.25	0.9			0.819	0.8						
								13	0.406	121	136.73	139.0213	1	3.15	1.6	1.1	0.7	21.5	1.177	1	0.4	26.5	136.7	139	2	2611.8
								13	0.406	121	136.73	139.0213	2	6.25	3.1	1.5			3.034	1.93						
										Ave =	136.73	139.0213														
6F	3.0-18.0	10.5	24	16	8	Clay(CL)	2.768	13.9	0.424	121.3	138.1607	139.8806	0.5	3.34	1.65	1.2			1.284	1.2						
								13.9	0.42	121.6	138.5024	140.0509	1	3.9	1.9	1.38	0.3	36	1.734	1.38	0.1	31	138.7	140.2	16.5	4025.2
								13.9	0.413	122.3	139.2997	140.5478	2	6.38	3.2	1.85			2.968	2						
										Ave =	138.6543	140.1596														
6F	18.0-28.0	23	24	16	8	CLAY(CL)	2.704	12.8	0.372	123	138.744	139.9216	0.5	6.21	2.6	1.6			1.898	1.5						
								12.8	0.371	123	138.744	139.8761	1	6.77	2.9	2	1.38	26.5	2.366	1.78	0.38	30	138.7	139.8	16.5	1666.4
								12.9	0.376	122.7	138.5283	139.7165	2	7.73	3.85	2.4			3.223	2.2						
										Ave =	138.6721	139.8381														
7A	12.0-15.0	13.5	26	16	10	SANDY CLAY(CL)	2.831	13.7	0.439	122.8	139.6236	141.8425	0.5	2.91	1.45	0.7			1.321	0.82						
								13.4	0.445	122.2	138.5748	141.4084	1	4.92	2.45	1.1	0.2	41.5	2.216	1.35	0.08	30.5	138.9	141.5	12	
								13.8	0.449	121.9	138.4784	141.2336	2	6.24	3.1	2			3.034	2.85						
										Ave =	138.8923	141.4948														
7A	27.0-30.0	28.5	24	19	5	CLAYEY SILT(CL-ML)	2.771	14	0.529	113.1	128.934	134.6914	0.5	5.17	2.6	1.5			2.011	1.45						
								13.9	0.53	113	128.707	134.6131	1	6.57	3.25	1.8	1.2	31.5	2.743	1.96	0.15	31.5	128.7	134.8	12	
								13.9	0.531	112.9	128.5831	134.5348	2	8.62	4.3	2.4			3.533	2.4						
										Ave =	128.7447	134.6131														
7D	8.0-18.0	13	22	16	6	CLAYEY SILT(CL-ML)	2.7	14	0.434	117.5	133.95	136.387	0.5	2.76	1.38	0.68			0.848	0.885						
								13.9	0.437	117.2	133.4908	136.169	1	4.63	2.3	1.07	0.2	40.5	1.944	1.6	0.4	26.5	133.7	136.3	14	
								13.5	0.431	117.7	133.5895	136.4884	2	8.88	4.4	1.95			3.306	2.2						
										Ave =	133.6768	136.3482														
7D	20.0-30.0	25	24	17	7	CLAY(CL)	2.717	14.1	0.427	118.8	135.5508	137.4704	0.5	2.5	1.23	0.8			0.751	0.75						
								14.1	0.427	118.8	135.5508	137.4704	1	3.34	1.65	1	0.56	26.5	1.193	1	0.35	29	135.8	137.5	14	
								14.2	0.428	118.8	135.6696	137.5142	2	8.36	3.2	1.55			2.818	1.9						

ASHTABULA LANDFILL SITES
SUMMARY OF LABORATORY CONSOLIDATION TESTS

Boring No	Depth	Ave Depth	LL	PL	PI	Classification	Gs	WC	Void Ratio	Dry Density	Moist Density	Sat Density	Pc	Adopted Density	Depth to GWT	Po	Cc	Cr	Cv	OCR
5A	32.0-34.0	33	25	15	10		2.738	13.5	0.379	123.9	140.6265	141.05051	0.75	139.5	2	1.33455	0.14	0.053	0.011	0.561987
5C	32.0-34.0	33	25	16	9		2.733	15.1	0.377	123.6	142.2636	140.64984	1.5	140.7	1	1.32315	0.09	0.02		1.133658
5D	32.0-34.0	33	22.8	15.6	7.2		2.714	16.1	0.405	120.4	139.7844	138.36684	0.7	138.4	6	1.4412	0.11	0.022		0.485706
7A	32.0-34.0	33	24	15	9		2.751	12.8	0.342	127.6	143.9328	143.46303	1.6	139.2	12	1.6416	0.14	0.017		0.974659
7B	28.0-30.0	29	22	16	6		2.75	25.7	0.703	100.5	126.3285	126.19145	1	126.2	21	1.5803	0.02	0.006	0.0015	0.632791
7D	30.0-32.0	31	25	16	9		2.776	15.7	0.397	124	143.468	141.73343	2.5	141.7	14	1.66595	0.15	0.014	0.0033	1.500645
7C	30.0-32.0	31	23	15	8		2.737	14.5	0.359	125.8	144.041	142.30062					0.04	0.021		
																	0.098571	0.021857		



Ashtabula Landfill Sites, Ohio
Sat Density vs Depth
150
140
130
120
110
100
Sat Density
0
10
20
30
40
50
60
Depth (Feet)
Sat Density
Ave γsat = 138 pcf

FIGURE 1

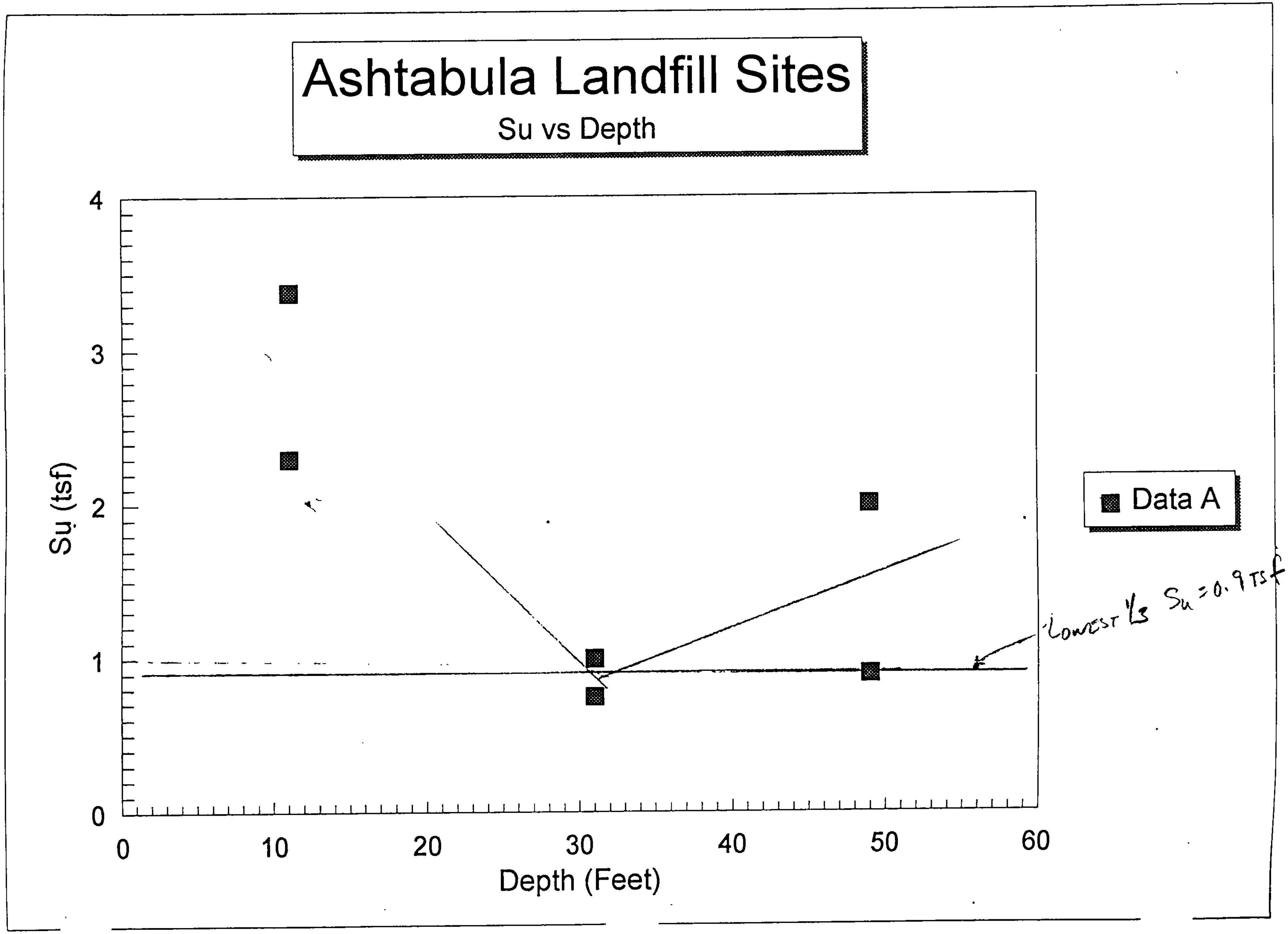
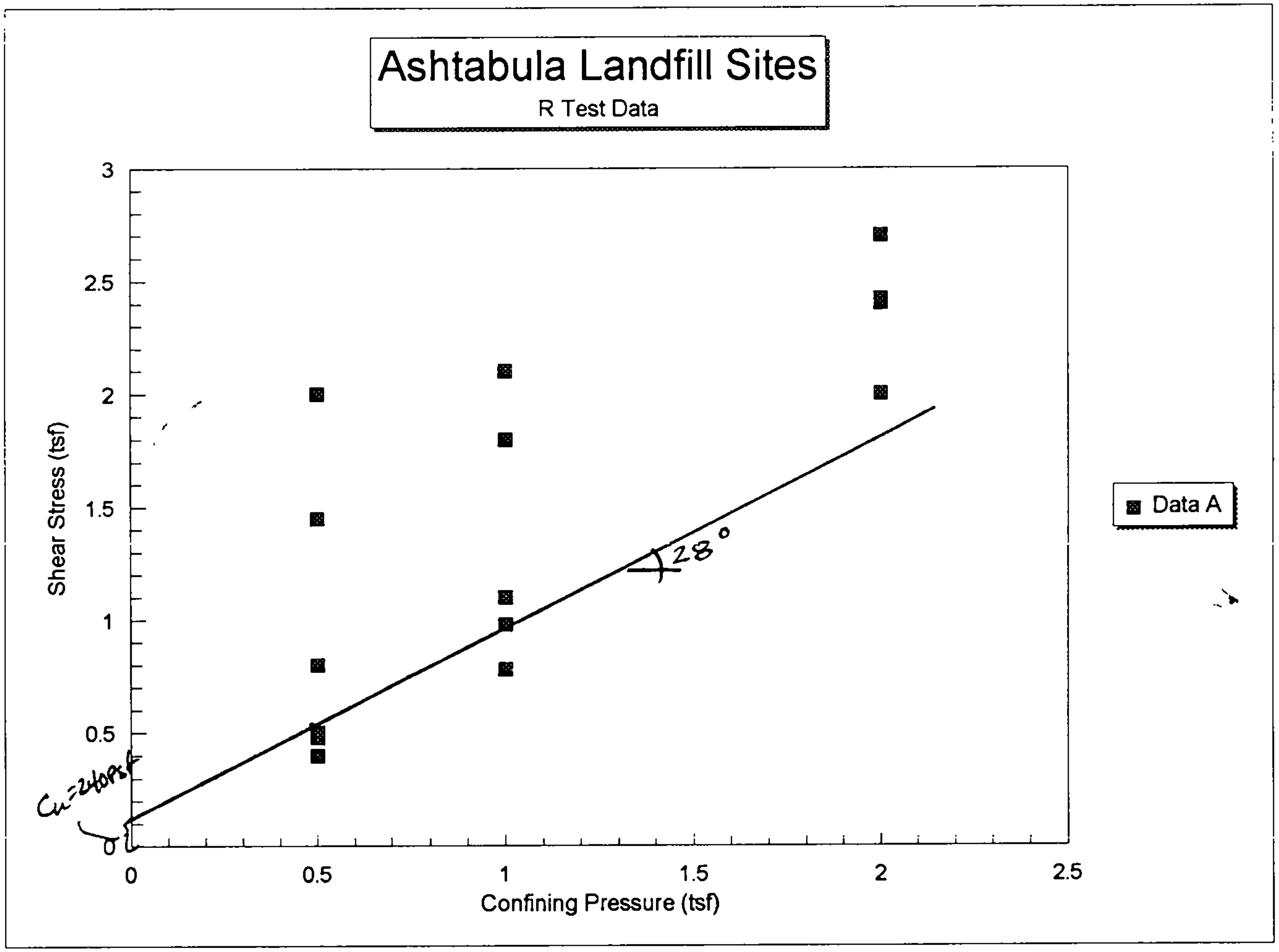

Ashtabula Landfill Sites
Su vs Depth
Su (tsf)
Depth (Feet)
0
1
2
3
4
10
20
30
40
50
60
Data A
Lowest 1/3 Su = 0.9 TSf

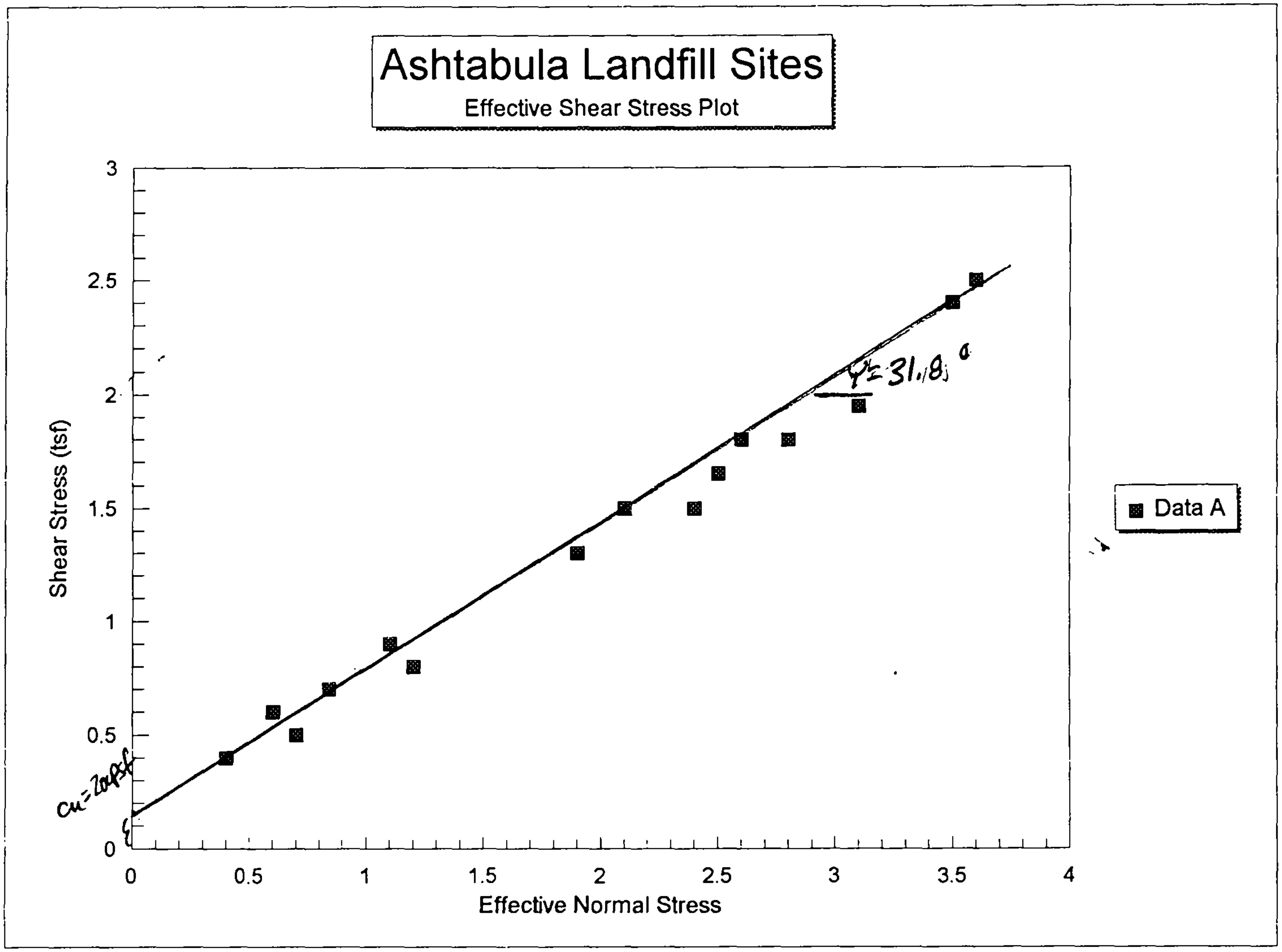
FIGURE 2



Regression Output:

Constant		0.385057
Std Err of Y Est		0.535112
R Squared		0.561841
No. of Observations		16
Degrees of Freedom		14
X Coefficient(s)	0.972299	
Std Err of Coef.	0.22948	

FIGURE 3

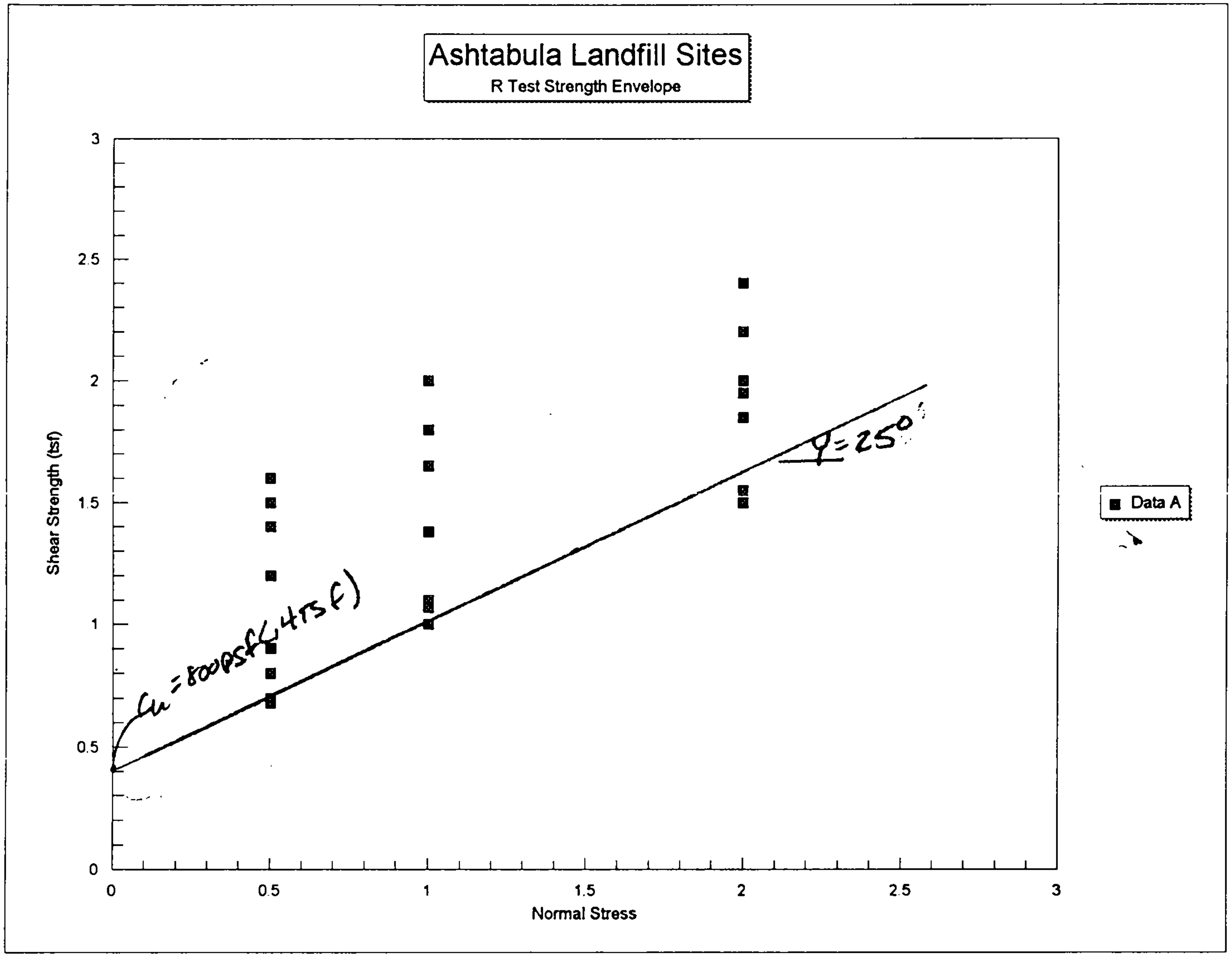


Regression Output:

Constant	0.137229
Std Err of Y Est	0.082941
R Squared	0.98524
No. of Observations	16
Degrees of Freedom	14

FIGURE 4

14



Regression Output:

Constant		0.800625
Std Err of Y Est		0.359399
R Squared		0.533281
No. of Observations		24
Degrees of Freedom		22
X Coefficient(s)	0.589821	
Std Err of Coef.	0.117641	

FIGURE 5

Table 6: Projected Tonnage Shipped Through Ashtabula Harbor

Project year	Tonnage All Commodies	Percent of initial
1	8974.0	100.0%
2	8973.4	100.0%
3	8972.9	100.0%
4	8972.0	100.0%
5	8971.1	100.0%
6	8941.6	99.6%
7	8912.2	99.3%
8	8881.3	99.0%
9	8878.3	98.9%
10	7729.1	86.1%
11	6579.9	73.3%
12	5429.9	60.5%
13	5426.4	60.5%
14	5422.3	60.4%
15	5418.2	60.4%
16	5413.5	60.3%
17	5408.8	60.3%
18	3605.8	40.2%
19	1802.9	20.1%
20	0.0	0.0%
21	0.0	0.0%
22	0.0	0.0%
23	0.0	0.0%
24	0.0	0.0%
25	0.0	0.0%
26	0.0	0.0%
27	0.0	0.0%
28	0.0	0.0%
29	0.0	0.0%
30	0.0	0.0%
31	0.0	0.0%
32	0.0	0.0%
33	0.0	0.0%
34	0.0	0.0%
35	0.0	0.0%
36	0.0	0.0%
37	0.0	0.0%
38	0.0	0.0%
39	0.0	0.0%
40	0.0	0.0%
41	0.0	0.0%
42	0.0	0.0%
43	0.0	0.0%
44	0.0	0.0%
45	0.0	0.0%
46	0.0	0.0%
47	0.0	0.0%
48	0.0	0.0%
49	0.0	0.0%
50	0.0	0.0%

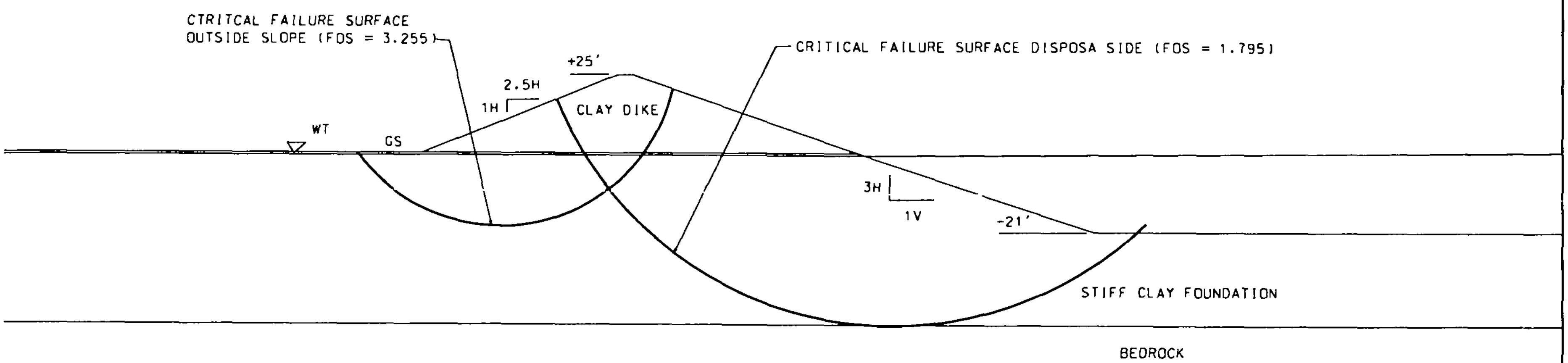
Ashtabula River Dredging
Landfill Design

Geotechnical Appendix M

ATTACHMENT M3

Computer Stability Output

1



FILE: ASHEOC2.DGN

ASHTABULA RIVER DREDGING
LANDFILL DESIGN

STABILITY BEFORE FILLING

US ARMY ENGINEER DISTRICT BUFFALO

FIGURE A8

```
HEADING
   .ASHTABULA LANDFILL SITES
   CONCEPTUAL DISPOSAL FACILITY DESIGN
   STABILITY ANALYSIS - END OF CONSTRUCTION
PROFILE LINES
  1  1  MOIST EMBANKMENT
   -65.00  0.00
   -2.50  25.00
   2.50  25.00
   75.00  0.00

  2  2  Clay Foundation (moist)
   -200.00  0.00
   -65.00  0.00
   75.00  0.00
   77.10  -0.70

  3  3  Foundation Clay (Sat)
  -200.00 -0.70
   77.10  -0.70
   150.00  -25.00
   300.00  -25.00

  4  4  Bedrock
   -200.00  -55.00
   300.00  -55.00


MATERIAL PROPERTIES
  1  Moist Embankment
    136.20 Moist Unit Weight
    Conventional Shear
     800.00  25.00
     No pore pressure
  2  Foundation Clay (moist)
    138.00 Moist Unit Weight
    Conventional Shear
     1800.00  0.00
     No pore pressure
  3  Foundation Clay (Sat)
    138.00 Sat Unit Weight
    Conventional Shear
     1800.00  0.00
     Piezometric Line
     1 Water Table
  4  Bedrock
    160.00 sat unit weight
    Conventional Shear
     5000.00  0.00
     Piezometric Line
     1 water table

PIEZOMETRIC LINE DATA
  1  62.4  Water Table
    -200.00  -0.70
    77.10  -0.70
    300.00  0.70


ANALYSIS/COMPUTATION
```

```
  Circular      Search
  90.00   30.00   0.05000   -55.00
  TANGENT
  -10.00

PLOT Output activated
COMPUTE Results
```

```
TABLE NO. 21
***** 1-STAGE FINAL CRITICAL CIRCLE INFORMATION  *****
X Coordinate of Center - - - - - - - -     86.150
Y Coordinate of Center - - - - - - - -     61.300
Radius - - - - - - - - - - - - - - - -    116.300
Factor of Safety - - - - - - - - - - -      1.795
Side Force Inclination - - - - - - - -      -7.35

Number of circles tried  - - - - - - -  509
No. of circles F calc. for - - - - - -  480


***** CAUTION ***** FACTOR OF SAFETY COULD NOT BE COMPUTED FOR SOME
                    OF GRID POINTS AROUND THE MINIMUM
***** RESULTS MAY BE ERRONEOUS *****
```

1 UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT

```
Date:  8:21:1997   Time: 16: 2:48   Input file: asheoc2
   ASHTABULA LANDFILL SITES
   CONCEPTUAL DISPOSAL FACILITY DESIGN
   STABILITY ANALYSIS - END OF CONSTRUCTION
```

```
HEADING
  ASHTABULA LANDFILL SITES
   CONCEPTUAL DISPOSAL FACILITY DESIGN
   STABILITY ANALYSIS - END OF CONSTRUCTION
PROFILE LINES
  1  1  MOIST EMBANKMENT
   -65.00  0.00
   -2.50  25.00
   2.50  25.00
   75.00  0.00

  2  2  Clay Foundation (moist)
   -200.00  0.00
   -65.00  0.00
   75.00  0.00
   77.10  -0.70

  3  3  Foundation Clay (Sat)
  -200.00 -0.70
   77.10  -0.70
   150.00  -25.00
   300.00  -25.00

  4  4  Bedrock
   -200.00  -55.00
   300.00  -55.00


MATERIAL PROPERTIES
  1  Moist Embankment
    136.20 Moist Unit Weight
    Conventional Shear
     800.00  25.00
     No pore pressure
  2  Foundation Clay (moist)
    138.00 Moist Unit Weight
    Conventional Shear
     1800.00  0.00
     No pore pressure
  3  Foundation Clay (Sat)
    138.00 Sat Unit Weight
    Conventional Shear
     1800.00  0.00
     Piezometric Line
     1 Water Table
  4  Bedrock
    160.00 sat unit weight
    Conventional Shear
     5000.00  0.00
     Piezometric Line
     1 water table

PIEZOMETRIC LINE DATA
  1  62.4  Water Table
    -200.00  -0.70
    77.10  -0.70
    300.00  0.70

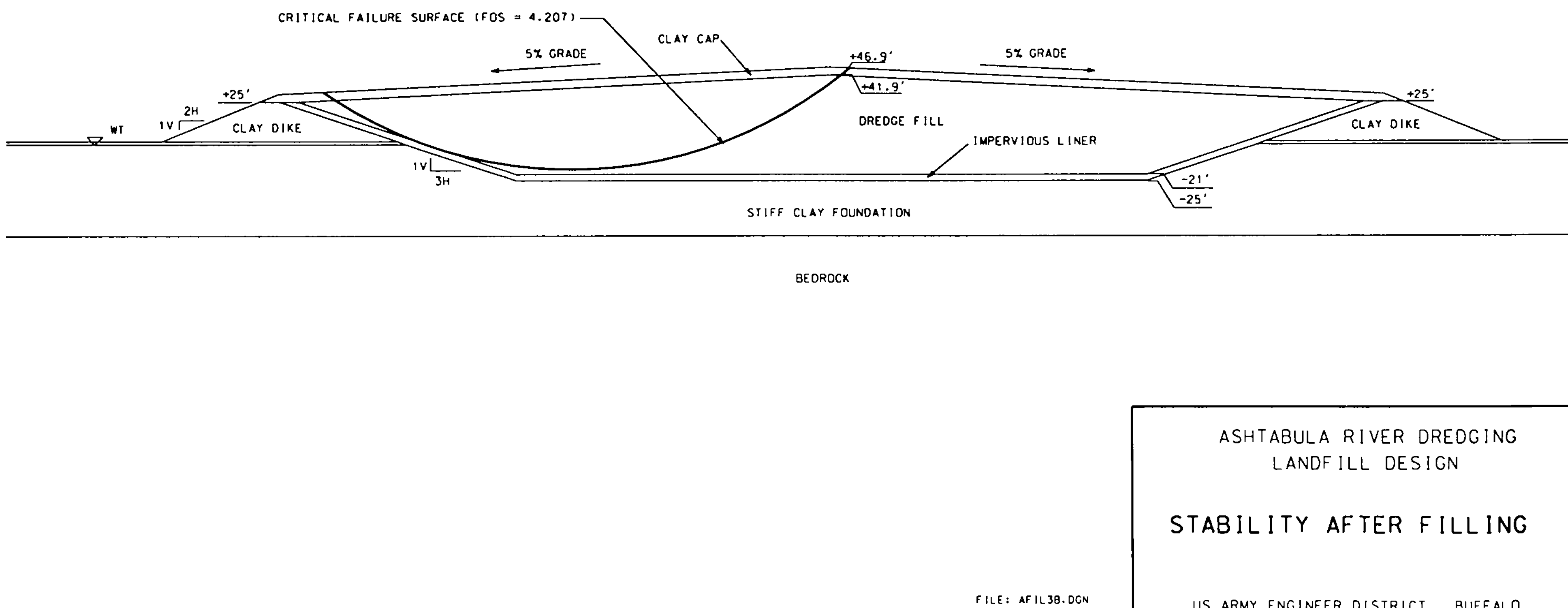

ANALYSIS/COMPUTATION
```

```
  Circular      Search
  -50.00   30.00   0.05000   -55.00
  TANGENT
  -10.00

PLOT Output activated
COMPUTE Results
```

```
TABLE NO. 21
*****  1-STAGE FINAL CRITICAL CIRCLE INFORMATION   *****
X Coordinate of Center - - - - - - - -    -39.900
Y Coordinate of Center - - - - - - - -     33.150
Radius - - - - - - - - - - - - - - - -     56.650
Factor of Safety - - - - - - - - - - -      3.255
Side Force Inclination - - - - - - - -       4.95

Number of circles tried  - - - - - - -  361
No. of circles F calc. for - - - - - -  361
1  UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
Date:  8:21:1997   Time: 14:56:15   Input file: asheoc1
   ASHTABULA LANDFILL SITES
   CONCEPTUAL DISPOSAL FACILITY DESIGN
   STABILITY ANALYSIS - END OF CONSTRUCTION
```



ASHTABULA RIVER DREDGING
LANDFILL DESIGN

STABILITY AFTER FILLING

US ARMY ENGINEER DISTRICT BUFFALO

FIGURE A9

```
HEADING
   Ashtabula Landfill Stability
   End of Construction - Facility Filled

PROFILE LINES
  1  1  Impervious Cap
   -363.00  25.00
   -350.50  30.00
   0.00  46.90
   350.50  30.00
   363.00  25.00

  2  2  Waste Fill
   -338.00  25.00
   0.00  41.90
   338.00  25.00

  3  3  Recompacted Liner
   -350.00  25.00
   -338.00  25.00
   -200.00  -21.00
   200.00  -21.00
   338.00  25.00
   350.00  25.00

  4  4  Compacted Dike
   -425.50  0.00
   -363.00  25.00
   -350.00  25.00
   -275.00  0.00

  5  4  Compacted Dike
   275.00  0.00
   350.00  25.00
   363.00  25.00
   425.50  0.00

  6  5  Moist Clay Foundation
   -1000.00  0.00
   -425.50  0.00
   -275.00  0.00
   -270.00  -2.00

  7  5  Moist Clay Foundation
   270.00  -2.00
   275.00  0.00
   425.50  0.00
   1000.00  0.00

  8  6  Sat Clay Foundation
   -1000.00  -2.00
   -270.00  -2.00
   -200.00  -25.00
   200.00  -25.00
   270.00  -2.00
   1000.00  -2.00

  9  7  Bedrock
   -1000.00  -60.00
   1000.00  -60.00
```

```
MATERIAL PROPERTIES
  1  Clay Cap
    136.00
    Conventional Shear
     800.00  25.00
     No pore pressure
  2  Waste Fill
    110.00
    Linear increase
     200.00  15.00
     No pore pressure
  3  Recompacted Clay Liner
    136.00
    Conventional Shear
     800.00  25.00
     No pore pressure
  4  Compacted Dike
    136.00
    Conventional Shear
     800.00  25.00
     No pore pressure
  5  Moist Clay Foundation
    138.00
    Conventional Shear
     1800.00  0.00
     No pore pressure
  6  Sat Clay Foundation
    138.00
    Conventional Shear
     1800.00  0.00
     Piezometric Line
     1 water table
  7  Bedrock
    160.00
    Conventional Shear
     6000.00  0.00
     Piezometric Line
     1 water table

PIEZOMETRIC LINE DATA
  1  62.4
    -1000.00  -2.00
    -270.00  -2.00
    -200.00  -25.00
    200.00  -25.00
    270.00  -2.00
    1000.00  -2.00


ANALYSIS/COMPUTATION
  Circular      Search
  -79.00   242.00   0.05000   -60.00
  TANGENT
  25.00

PLOT Output activated
COMPUTE Results
```

Table 4.- Schedule Of Sources and Uses of Non-Federal Funds

Feasibility, Design/PED Costs

Fiscal Year	**Beginning Balance**	**Required Contribution**	**Balance**
Thru 2002 (Cash)	$600,000	$600,000	$0

Construction Expenditures

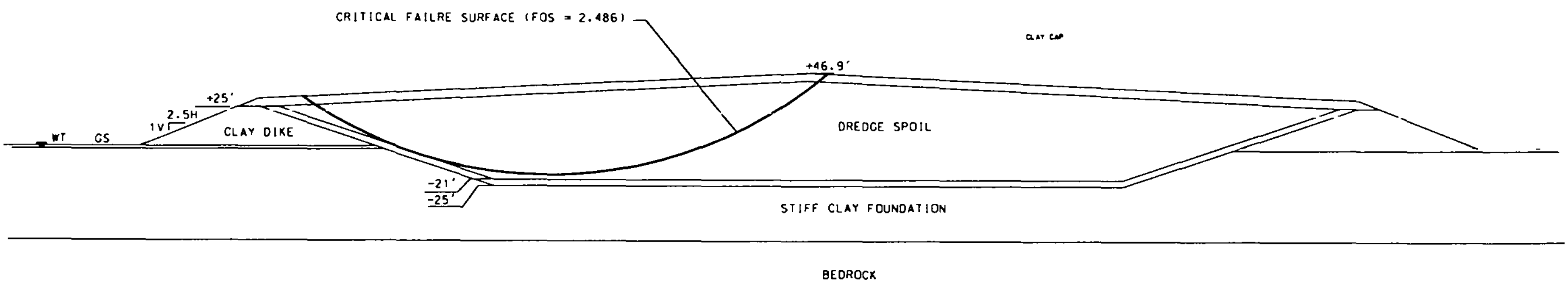
Fiscal Year	**Beginning Balance**	**Required Contribution**	**Balance**
2003 (Cash)	$4,595,000	$ 4,595,000	$ 0
2004 (Cash)	$3,900,000	$ 3,900,000	$ 0
2005 (Cash)	$3,700,000	$ 3,700,000	$ 0
2006 (Cash)	$1,200,000	$ 1,200,000	$ 0
	$13,395,000	$13,395,000	$ 0

Total Feasibility And Construction Expenditures

Beginning Balance	**Required Contribution**	**Balance**
$13,995,000	$13,995,000	$ 0

Annual Monitoring And Maintenance Costs

	Beginning Balance	**Required Contribution**	**Balance**
2007-2056	$47,500	$47,500	$ 0



SESIMIC COEFFICIENT = 0.05g

FILE: ASEIS.DGN

ASHTABULA RIVER DREDGING
LANDFILL DESIGN

STABILITY AFTER FILLING
(WITH SEISMIC LOAD)

US ARMY ENGINEER DISTRICT BUFFALO

FIGURE A10

```
HEADING
  Ashtabula Landfill Stability
  End of Construction - Facility Filled

PROFILE LINES
 1  1  Impervious Cap
  -363.00  25.00
  -350.50  30.00
  0.00  46.90
  350.50  30.00
  363.00  25.00

 2  2  Waste Fill
  -338.00  25.00
  0.00  41.90
  338.00  25.00

 3  3  Recompacted Liner
  -350.00  25.00
  -338.00  25.00
  -200.00  -21.00
  200.00  -21.00
  338.00  25.00
  350.00  25.00

 4  4  Compacted Dike
  -425.50  0.00
  -363.00  25.00
  -350.00  25.00
  -275.00  0.00

 5  4  Compacted Dike
  275.00  0.00
  350.00  25.00
  363.00  25.00
  425.50  0.00

 6  5  Moist Clay Foundation
  -1000.00  0.00
  -425.50  0.00
  -275.00  0.00
  -270.00  -2.00

 7  5  Moist Clay Foundation
  270.00  -2.00
  275.00  0.00
  425.50  0.00
  1000.00  0.00

 8  6  Sat Clay Foundation
  -1000.00  -2.00
  -270.00  -2.00
  -200.00  -25.00
  200.00  -25.00
  270.00  -2.00
  1000.00  -2.00

 9  7  Bedrock
  -1000.00  -60.00
  1000.00  -60.00
```

```
MATERIAL PROPERTIES
  1  Clay Cap
    136.00
    Conventional Shear
     560.00  31.00
     No pore pressure
  2  Waste Fill
    110.00
    Conventional Shear
     0.00  22.00
     No pore pressure
  3  Recompacted Clay Liner
    136.00
    Conventional Shear
     560.00  31.00
     No pore pressure
  4  Compacted Dike
    136.00
    Conventional Shear
     560.00  31.00
     No pore pressure
  5  Moist Clay Foundation
    138.00
    Conventional Shear
     200.00  32.00
     No pore pressure
  6  Sat Clay Foundation
    138.00
    Conventional Shear
     200.00  32.00
     Piezometric Line
     1 water table
  7  Bedrock
    160.00
    Conventional Shear
     1500.00  50.00
     Piezometric Line
     1 water table

PIEZOMETRIC LINE DATA
  1  62.4
    -1000.00  -2.00
    -270.00  -2.00
    -200.00  -25.00
    200.00  -25.00
    270.00  -2.00
    1000.00  -2.00


SECond-Stage Data Activated
MATERIAL PROPERTIES
  1
    136.00
    2-stage Linear
     800.00  25.00   560.00   31.C0
     No pore pressure
  2
    110.00
```

```
    2-stage Linear
     200.00  7.8   0.00   18.00
     No pore pressure
  3
    136.00
    2-stage Linear
     800.00  25.00   560.00   31.00
     No pore pressure
  4
    136.00
    2-stage Linear
     800.00  25.00   560.00   31.00
     No pore pressure
  5
    138.00
    2-stage Linear
     240.00  28.00   200.00   32.00
     No pore pressure
  6
    138.00
    2-stage Linear
     240.00  28.00   200.00   32.00
     Piezometric Line
     1 water table
  7
    160.00
    Conventional Shear
     6000.00  0.00
     Piezometric Line
     1 water table

PIEZOMETRIC LINE DATA
  1  62.4
    -1000.00  -2.00
    -270.00  -2.00
    -200.00  -25.00
    200.00  -25.00
    270.00  -2.00
    1000.00  -2.00


ANALYSIS/COMPUTATION
  Circular      Search
  -79.00   242.00   0.05000   -60.00
  TANGENT
  25.00
  TWO-STAGE COMPUTATIONS To Be Performed
   SEISMIC COEFFICIENT
    0.05

PLOT Output activated
COMPUTE Results
```

```
TABLE NO. 21
*****  2-STAGE FINAL CRITICAL CIRCLE INFORMATION   *****
X Coordinate of Center - - - - - - - -  -164.800
Y Coordinate of Center - - - - - - - -   258.150
Radius - - - - - - - - - - - - - - - -   276.050
Factor of Safety - - - - - - - - - - -     2.486
Side Force Inclination - - - - - - - -      4.36

Number of circles tried  - - - - - - -  692
No. of circles F calc. for - - - - - -  692
1  UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
Date:  8:21:1997   Time: 13: 2:34   Input file: AFIL3C.IN
   Ashtabula Landfill Stability
   End of Construction - Facility Filled
```

Ashtabula River Dredging
Landfill Design

Geotechnical Appendix M

ATTACHMENT M4

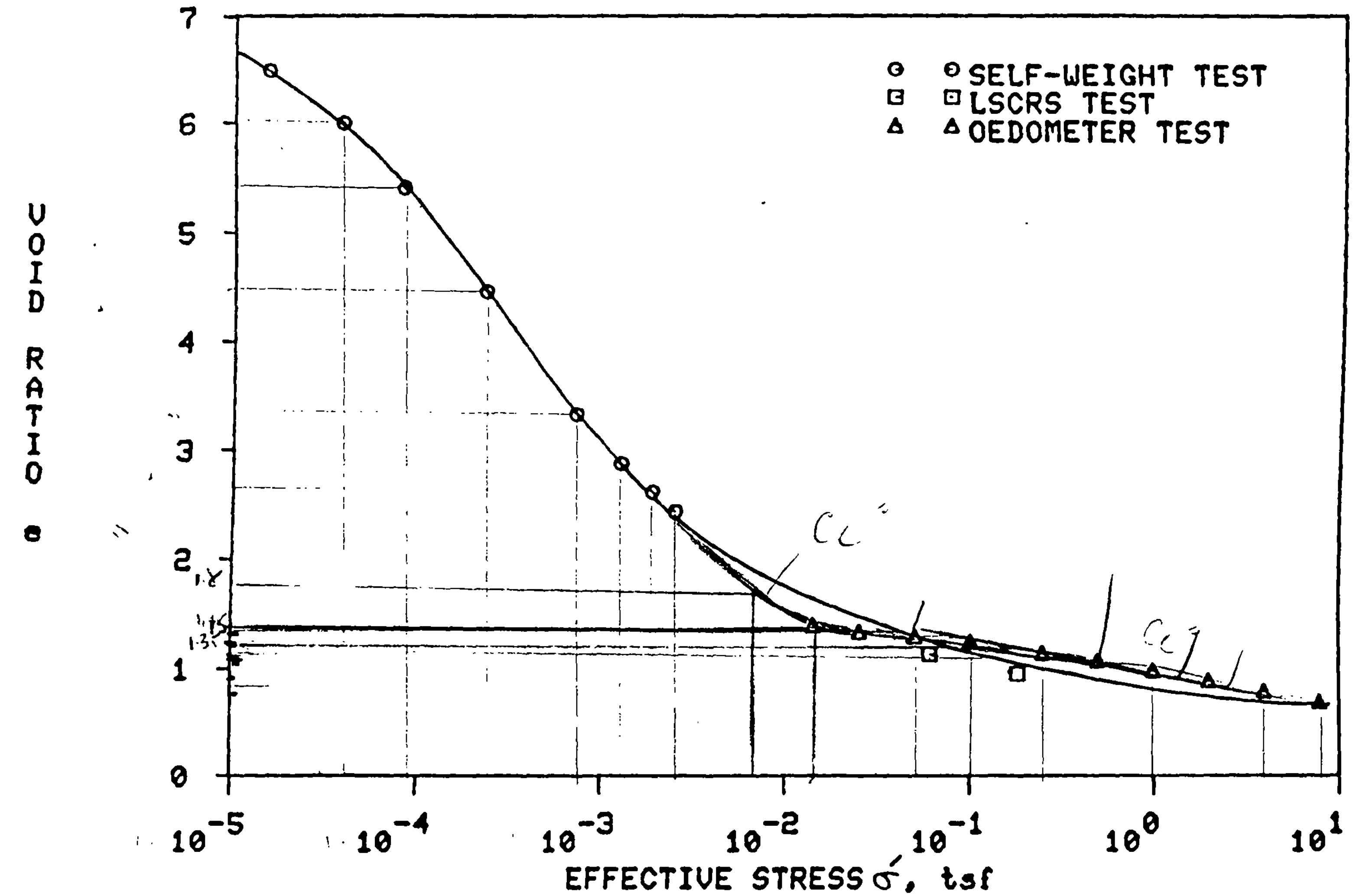
Ashtabula River Sediment Self Weight and Oedometer Consolidation Test Report (Waterways Experiment Station)

Dredge Material Properties

(A.) Void Ratio vs Stress Data (From Consolidation Self wt and Gedanken tests fr. Ashtabula Dike attached)

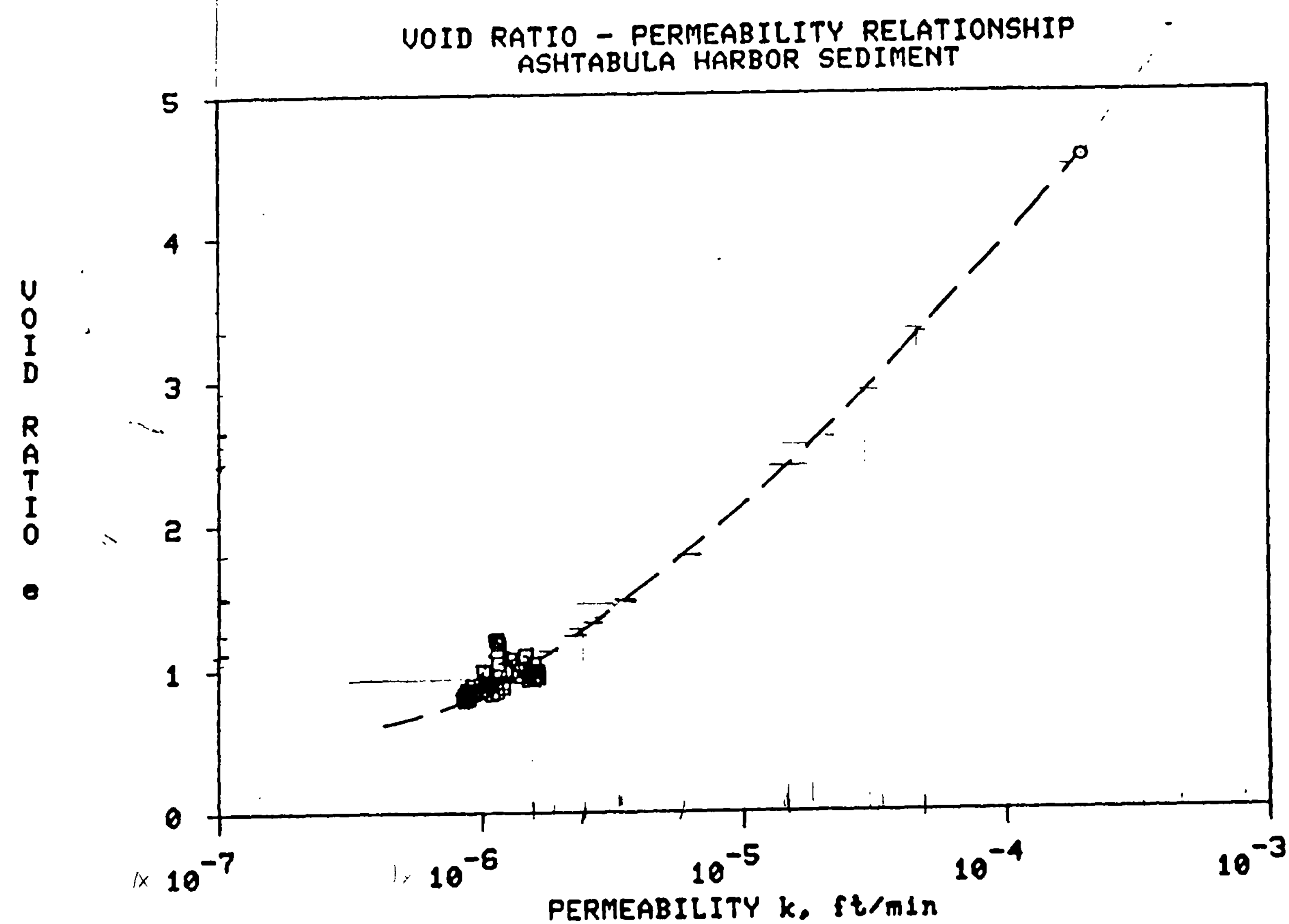
e	σ'
6.5	2×10^{-5} TSF = .04 PSF
6.0	6×10^{-5} TSF = .12 PSF
5.45	9.5×10^{-5} TSF = .19 PSF
4.50	4×10^{-4} TSF = .80 PSF
3.3	9×10^{-4} TSF = 1.8 PSF
2.95	1.5×10^{-3} TSF = 3.0 PSF
2.60	2.5×10^{-3} TSF = 5.0 PSF
2.45	4×10^{-3} TSF = 8.0 PSF
1.60	8×10^{-3} TSF = 16.0 PSF
1.45	2×10^{-2} TSF = ~~40.0 PSF~~ 32 PSF
1.35	~~7x10 TSF~~ = ~~140 PSF~~
1.25	1×10^{-1} TSF = 200 PSF
1.10	~~4~~ 7×10^{-1} TSF = ~~800 PSF~~ 1,400
1.05	~~1~~ 1.5 TSF = ~~2000 PSF~~ 3,000
0.90	~~6~~ 3.0 TSF = ~~12000 PSF~~ 6,000
0.80	9 TSF = 18,000 PSF

VOID RATIO - EFFECTIVE STRESS RELATIONSHIP
ASHTABULA HARBOR SEDIMENT



(B.) Void Ratio vs Permeability Data
(From Consolidation Self weight and oedometer tests for Ashtabula Dike)

e	K
6.5	9×10^{-4} ft/min = 1.296 ft/day
6.0	8×10^{-4} ft/min = 1.152 ft/day
5.45	6×10^{-4} ft/min = 0.864 ft/day
4.50	2.5×10^{-4} ft/min = .36 ft/day
3.3	6.5×10^{-5} ft/min = .094 ft/day
2.95	4.5×10^{-5} ft/min = [illegible] ft/day
2.60	2.5×10^{-5} ft/min = .036 ft/day
2.45	~~1.5×10^{-5} ft/min~~ = .022 ft/day
1.80	7.5×10^{-6} ft/min = .01 ft/day
1.45	5×10^{-6} ft/min = .0072 ft/day
1.35	4×10^{-6} ft/min = ~~.0058~~ ft/day
1.25	3×10^{-6} ft/min = .0043 ft/day
1.10	2.5×10^{-6} ft/min = .0036 ft/day
1.05	2.0×10^{-6} ft/min = .0029 ft/day
0.9	1.5×10^{-6} ft/min = .0022 ft/day
0.8	1.0×10^{-6} ft/min = .0014 ft/day


VOID RATIO - PERMEABILITY RELATIONSHIP
ASHTABULA HARBOR SEDIMENT
VOID RATIO e
PERMEABILITY k, ft/min
0
1
2
3
4
5
10^-7
10^-6
10^-5
10^-4
10^-3

Ashtabula River Dredging
Landfill Design

Geotechnical Appendix M

ATTACHMENT M5

NOAA Weather Data

RAINFALL VS EVAPORATION DATA OF DREDGE FILL
(FROM CLIMATOLOGICAL DATA ATTACHED)

ASSUME PAN COEFF = .76

MONTH	EVAP. (Cleveland station)	PRECIP (Ashtabula Station)
JAN	.76 x (1.02) = .78"	2.35"
FEB	.76 x (1.16) = .88"	1.78"
MAR	.76 x (2.15) = 1.63"	2.63"
APR	.76 x (3.89) = 2.96"	3.49"
MAY	.76 x (5.86) = 4.45"	3.40"
JUNE	.76 x (6.84) = 5.20"	3.52"
JULY	.76 x (6.83) = 5.19"	4.07"
AUG	.76 x (5.89) = 4.48"	3.61"
SEPT	.76 x (4.24) = 3.22"	3.63"
OCT	.76 x (3.12) = 2.37"	3.29"
NOV.	.76 x (1.82) = 1.38"	2.55"
DEC.	.76 x (1.20) = 0.9"	2.85"

TABLE II -- MONTHLY MEANS OF ESTIMATED "PAN EVAPORATION" COMPUTED FROM METEOROLOGICAL MEASUREMENTS USING A FORM OF THE PENMAN EQUATION*

	State No.	Station Index No.**	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	May-Oct***	Nov-Apr***	Annual***	Record Began Mo/Yr	Last Data Mo/Yr
NORTH CAROLINA (continued)																			
Raleigh Durham WB Airport	31	7069	2.01	2.44	4.07	5.81	6.38	6.87	6.89	6.25	4.88	3.56	2.71	2.15	34.90	19.18	54.29	1/56	12/70
35° 52', 78° 46'			15	15	15	15	15	14	15	15	15	15	15	15					
			19	12	22	12	16	12	12	14	12	16	12	13	6	7	5		
Wilmington WSO	31	9457	2.10	2.64	4.21	6.35	7.31	7.24	7.53	6.40	5.34	4.00	2.86	2.39	37.81	20.55	58.35	1/56	12/70
34° 16', 77° 55'			15	15	15	15	15	15	15	15	15	15	15	15					
			18	12	18	8	12	8	14	11	10	14	12	10	5	8	5		
Winston-Salem WB Airport	31	9539	2.14	2.44	4	6	7	7	7	6	5	4	3	2	36	20	56	1/56	2/65
36° 7', 80° 13'			10	10	9	9	9	9	9	9	9	9	9	9					
			16	7	****	****	****	****	****	****	****	****	****	****	****	****	****		
NORTH DAKOTA																			
Bismarck WSO	32	819	0.55	0.71	1.95	4.07	6.49	7.28	8.68	8.11	4.82	3.27	1.33	0.68	38.65	9.37	47.48	1/56	12/70
46° 46', 100° 45'			15	14	14	15	15	15	15	15	15	15	14	15					
			38	24	31	17	16	18	16	17	18	20	26	35	8	11	7		
Fargo WSO	32	2859	0.50	0.68	1.63	3.64	5.91	6.54	7.77	7.08	4.21	2.92	1.13	0.56	34.42	8.28	43.39	2/56	12/70
46° 53', 96° 48'			13	14	15	14	15	15	15	15	15	15	15	14					
			44	25	37	19	24	13	16	12	18	25	31	36	6	19	5		
Williston WSO	32	9425	0	1	1.53	3.56	6.19	6.93	9	7.72	5	3	1	1	38	8	46	1/56	12/70
48° 10', 103° 37'			9	9	10	10	10	10	9	10	9	9	9	9					
			****	****	31	19	13	13	****	14	****	****	****	****	****	****	****		
OHIO																			
Akron Canton WSO	33	58	0.95	1.12	2.10	3.70	5.09	5.99	6.10	5.63	4.19	3.27	1.81	1.00	30.28	10.67	40.94	1/56	12/70
40° 55', 81° 25'			15	15	15	15	15	15	15	15	15	15	15	15					
			33	23	20	18	12	16	12	7	12	17	13	26	6	12	5		
Cleveland WSFO	33	1657	~~1.02~~	~~1.16~~	~~2.15~~	~~3.89~~	~~5.86~~	~~6.84~~	~~6.83~~	~~5.89~~	~~4.24~~	~~3.12~~	~~1.87~~	~~1.20~~	~~32.78~~	~~11.29~~	~~44.07~~	~~1/56~~	~~12/70~~
41° 23', 81° 51'			15	15	15	15	15	15	15	15	15	15	15	15					
			32	22	22	16	12	8	8	11	11	18	12	25	5	10	5		
Columbus WSO	33	1786	1.06	1.23	2.55	3.92	5.73	6.59	6.79	5.90	4.10	3.01	1.71	1.08	32.13	11.56	43.69	1/56	12/70
40° 0', 82° 52'			15	15	15	15	15	15	15	15	15	15	15	15					
			41	18	20	17	16	12	12	13	20	18	14	24	7	12	6		
Dayton WSO	33	2075	1.14	1.38	2.58	4.35	6.34	7.58	7.46	6.81	5.04	3.54	1.90	1.22	36.77	12.56	49.34	1/56	12/70
39° 53', 84° 13'			15	15	15	15	15	15	15	15	15	15	15	15					
			35	16	20	17	16	11	14	10	10	16	14	19	6	8	6		

* First line of data in the table for each station is mean evaporation in inches; second line is the number of years of record per month; and third line is the coefficient of variation in percent (computed only when there are 10 years or more of record during 1956-1970).

** Climatological Data (NOAA-EDIS)

*** Sum of monthly means.

**** Insufficient data between 1956-70 to compute the coefficient of variation.

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JAN PRECIP.	JAN DEPARTURE	FEB PRECIP.	FEB DEPARTURE	MAR PRECIP.	MAR DEPARTURE	APR PRECIP.	APR DEPARTURE	MAY PRECIP.	MAY DEPARTURE	JUN PRECIP.	JUN DEPARTURE
OHIO												
NORTHWEST 01												
BOWLING GREEN WWTP	1.73	-.18	.57	-.96	2.55	.04	3.38	.13	6.29	3.03	4.19	.60
DEFIANCE	1.74	-.27	.84	-.88	2.16	-.51	3.14	-.27	4.27	.82	4.49	1.06
FINDLAY FAA AIRPORT	2.94	.92	.82	-.77	2.40	-.45	2.75	-.71	5.12	1.57	3.54	.13
FINDLAY WPCC R	2.57	.33	1.14	-.79	2.71	-.28	2.91	-.63	5.48	1.76	2.73	-.76
GROVER HILL	2.19		.79		2.36		3.00		5.18		3.40	
HOYTVILLE 2 NE	1.97	-.01	.80	-.81	2.42	-.24	3.62	.39	5.64	2.30	4.68	1.20
LIMA WWTP	2.61	.16	1.48	-.38	2.03	-1.11	3.81	.10	4.98	1.33	2.84	-.83
MONTPELIER	1.90	.08	.81	-.95	1.78	-1.03	3.72	.27	5.26	2.10	3.99	.59
NAPOLEON	M		.72	-1.14	2.02	-.84	3.44	-.03	5.14	[illegible]	5.63	2.24
OTTAWA	2.04		.94		2.17		3.98		4.79		3.03	
PANDORA	2.61	.33	1.20	-.75	2.55	-.49	3.43	-.03	5.39	[illegible]	3.66	.38
PAULDING	2.07	.04	.81	-.90	1.67	-1.15	3.04	-.50	4.61	1.01	4.24	.39
TOLEDO EXPRESS WSO AP R	1.80	-.19	.74	-1.06	2.03	-.61	3.50	.46	4.87	1.97	6.74	3.25
TOLEDO BLADE	1.52	-.53	1.04	-.77	2.09	-.58	2.71	-.39	4.58	1.69	6.77	3.27
VAN WERT	3.87	.51	1.09	-.98	2.24	-1.03	4.55	.73	5.43	1.69	3.77	-.17
WAUSEON WATER PLANT	1.62	-.53	.68	-1.25	1.28	-1.60	3.46	-.07	4.76	1.41	5.39	1.99
DIVISIONAL DATA------->	2.15	.07	.91	-.88	2.14	-.68	3.39	.00	5.13	1.72	4.48	.95
NORTH CENTRAL 02												
BUCYRUS	1.68	-.75	1.73	-.21	2.74	-.16	2.76	-.94	6.92	2.95	4.70	.89
ELYRIA 3 E	1.92	-.44	1.50	-.52	2.67	-.16	2.80	-.43	7.99	4.55	5.09	1.41
FREMONT	2.41	.31	.98	-.67	2.24	-.50	3.72	.65	6.12	2.87	3.43	-.11
GALION WATER WORKS	2.10	-.43	2.07	.03	3.24	.18	3.12	-.49	7.13	3.17	5.72	1.71
NORWALK WWTP	1.56	-.70	1.09	-.74	2.26	-.66	3.44	-.04	6.34	2.83	4.57	.62
OBERLIN	1.85	-.36	1.51	-.46	2.61	-.15	4.02	.81	7.85	4.41	4.73	1.23
OTTAWA WWR	1.93		M .46		2.78		4.25					
PUT-IN-BAY	1.17	-.87	.57	-.99	2.67	.14	3.24	.14	5.23	2.26	3.44	.21
SANDUSKY	2.12	-.07	.77	-1.01	2.13	-.61	3.40	.22	5.01	1.82	3.39	-.33
TIFFIN	2.15	-.29	1.18	-.80	2.04	-1.08	3.33	-.21	5.93	2.38	3.39	-.07
UPPER SANDUSKY	1.22	-1.27	1.37	-.59	1.93	-1.26	2.18	-1.34	5.78	2.07	5.02	1.89
DIVISIONAL DATA------->	1.80	-.48	1.19	-.60	2.41	-.44	3.31	-.06	6.31	2.85	4.20	.67
NORTHEAST 03												
AKRON CANTON WSO AP R	2.23	-.33	2.11	-.07	3.86	.49	2.46	-.80	5.98	2.43	8.42	5.15
AKRON	1.98		1.77		3.38		2.00		4.72		6.78	
ANDOVER 2 NE	3.03		3.67		3.98		4.17		10.77		12.46	
ASHTABULA	2.18	-.17	1.48	-.30	3.83	1.20	2.80	-.69	5.50	2.09	4.80	1.28
CHARDON	3.43	.10	1.98	-.71	3.19	-.55	2.98	-1.28	9.67	5.93	5.41	1.40
CHIPPEWA LAKE	2.34	-.04	1.85	-.15	3.20	.10	3.19	-.25	5.04	1.37	6.72	2.99
CLEVELAND WSFO AP R	2.07	-.40	1.73	-.47	3.46	.47	3.73	.41	9.14	5.84	5.22	1.73
DORSET	1.65		M 1.36		2.64		2.23		8.33		6.44	
HIRAM	2.03	-.70	1.92	-.49	3.36	-.26	2.42	-1.49	7.00	3.32	6.70	2.78
KIRTLAND-HOLDEN	2.38		1.72		3.76		3.23		9.64		4.52	
MINERAL RIDGE WTR WKS	1.11	-1.30	1.58	-.35	2.34	-.67	2.20	-1.03	5.70	2.55	8.73	5.15
MOSQUITO CREEK LAKE	1.62	-.70	1.51	-.36	3.29	.34	2.40	-1.13	6.30	3.06	7.45	3.88
PAINESVILLE 4 NW	1.83	.50	1.20	-.62	3.41	.79	2.10	-1.10	7.39	4.33	3.53	.16
RAVENNA 2 S	1.52	-1.04	1.63	-.47	2.48	-.74	1.89	-1.65	[illegible]	2.48	8.86	4.98
WARREN	1.83		1.86		3.32		2.36		6.40		7.63	
WARREN 3 S	1.50	-.96	M 1.72		3.65	.58	2.23	-1.01	6.54	3.32	9.93	6.37
YOUNGSTOWN WSO AP R	1.96	-.73	1.90	-.33	3.64	.35	1.56	-1.90	6.24	2.95	10.09	6.56
DIVISIONAL DATA------->	2.05	-.52	1.75	-.36	3.36	.24	2.55	-.93	6.99	3.58	6.71	3.08

SEE REFERENCE NOTES FOLLOWING STATION INDEX

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION JUL AUG SEP OCT

OHIO

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

OHIO
1989

STATION	JUL PRECIP.	JUL DEPARTURE	AUG PRECIP.	AUG DEPARTURE	SEP PRECIP.	SEP DEPARTURE	OCT PRECIP.	OCT DEPARTURE	NOV PRECIP.	NOV DEPARTURE	DEC PRECIP.	DEC DEPARTURE	ANNUAL PRECIP.	ANNUAL DEPARTURE
OHIO														
NORTHWEST 01														
BOWLING GREEN WWTP	8.62	4.53	2.12	-.67	4.16	1.56	1.59	-.48	2.19	-.28	.93	-1.30	38.32	6.12
DEFIANCE	3.85	.30	1.36	-1.74	4.15	1.50	1.06	-1.18	2.45	-.16	1.20	-1.19	30.71	-2.53
FINDLAY FAA AIRPORT	3.38	-.52	1.42	-1.76	3.22	.42	2.17	.24	2.05	-.35	1.45	-.77	31.26	-2.05
FINDLAY WPCC R	5.52	1.44	1.90	-1.58	2.88	-.09	2.50	.48	1.77	-.86	1.87	-.64	33.98	-1.62
GROVER HILL	3.52		1.11		2.96		1.11		1.63		1.85		29.10	
HOYTVILLE 2 NE	2.78	-1.16	1.63	-1.46	3.07	.23	2.03	-.02	2.08	-.37	.84	-1.41	31.56	-1.36
LIMA WWTP	3.16	-.47	2.52	-.51	3.13	.27	1.89	-.26	2.66	-.02	1.42	-1.13	32.53	-2.85
MONTPELIER	5.17	1.70	3.96	.88	4.38	1.70	1.32	-.89	2.37	-.22	1.33	-1.09	35.99	3.14
NAPOLEON	3.89	-.17	2.73	-.57	4.58	2.08	1.45	-.79	2.55	-.09	1.33	-1.20		
OTTAWA	2.43		1.58		3.71		1.59		1.94		1.37		29.57	
PANDORA	3.20	-.36	2.23	-.65	3.55	.66	1.66	-.37	1.95	-.58	1.72	-.85	33.15	-.79
PAULDING	2.71	-.83	1.28	-1.47	2.79	.07	1.73	-.53	1.57	-1.04	1.11	-1.32	27.63	-6.23
TOLEDO EXPRESS WSO AP R	6.31	3.05	3.59	.40	3.30	.77	1.36	-.58	1.89	-.52	1.29	-1.30	37.42	5.64
TOLEDO BLADE	4.27	.89	2.03	-1.29	3.22	.68	2.04	.00	2.10	-.33	.73	-1.83	33.10	.81
VAN WERT	4.37	.93	4.24	1.41	3.91	.93	1.41	-1.00	2.12	-.62	1.37	-1.23	37.37	1.17
WAUSEON WATER PLANT	4.63	.88	2.16	-.85	4.49	1.85	1.21	-.97	2.01	-.69	.44	-2.24	32.13	-2.07
--DIVISIONAL DATA------->	4.42	.76	2.37	-.73	3.63	.93	1.67	-.46	2.13	-.42	1.22	-1.24	33.64	.02
NORTH CENTRAL 02														
BUCYRUS	3.09	-.89	1.29	-1.80	2.29	-.79	2.08	.03	2.26	-.40	1.38	-1.11	32.52	-3.18
ELYRIA 3 E	4.13	.96	.89	-2.62	3.80	.79	3.52	1.10	3.30	.53	1.84	-.80	39.45	4.37
FREMONT	1.06	-2.69	1.30	-2.07	3.65	.97	3.02	1.10	3.07	.65	1.37	-.92	32.37	-.41
GALION WATER WORKS	2.68	-1.40	1.39	-2.19	3.15	.06	2.24	.16	3.55	.71	1.72	-.87	38.11	.64
NORWALK WWTP	2.27	-2.05	1.21	-2.09	3.96	1.02	2.56	.49	2.99	.39	1.21	-1.21	33.46	-2.14
OBERLIN	4.70	1.08	.91	-2.33	4.00	1.12	3.11	.99	2.91	.28	1.52	-.85	39.72	5.77
OTTAWA NWR														
PUT-IN-BAY	2.99	-.07	1.64	-1.77	4.48	1.93	2.24	.24	2.76	.50	.87	-1.38	31.30	.34
SANDUSKY	3.26	-.55	.73	-2.95	2.95	.10	2.26	.34	2.62	.18	1.14	-1.26	29.78	-4.12
TIFFIN	2.72	-1.16	1.44	-1.78M			2.37	.32	3.31	.66	1.65	-.97		
UPPER SANDUSKY	4.95	1.15M	.46		2.75	-.27	2.35	.38	2.43	-.19	.93	-1.69M	31.37	
--DIVISIONAL DATA------->	3.24	-.45	1.18	-2.11	3.49	.66	2.61	.55	2.85	.27	1.32	-1.14	33.91	-.28
NORTHEAST 03														
AKRON CANTON WSO AP R	2.83	-1.18	1.13	-2.18	3.38	.42	2.45	.21	2.49	-.05	1.98	-.67	39.32	3.42
AKRON	3.80		2.51		3.94		3.29		2.51		1.30		37.98	
ANDOVER 2 NE	4.77		3.13		5.43		4.24		5.44		4.33		65.42	
ASHTABULA	1.60	-2.47	2.50	-1.31	3.30	-.33	2.80	-.49M	2.55		2.14	-.71M	35.48	
CHARDON	3.55	-.33	2.12	-2.27	4.74	1.06	4.32	.57	5.11	1.05	3.12	-.57	49.62	4.40
CHIPPEWA LAKE	2.77	-1.19	2.94	-.12	6.13	2.96	2.66	.36	3.49	.74	1.67	-.89	42.00	5.88
CLEVELAND WSFO AP R	3.02	-.35	1.09	-2.29	4.61	1.69	4.50	2.05	3.61	.85	1.72	-1.03	43.90	8.50
DORSET M			1.63		4.23		3.83		3.61		2.10			
HIRAM	2.48	-1.45	1.49	-2.12	5.14	1.51	3.62	.55M			2.07	-1.21	[illegible]	
KIRTLAND-HOLDEN	2.57		1.94		4.59		4.12		4.82		2.66		45.[illegible]	
MINERAL RIDGE WTR WKS	3.36	-.45	1.37	-1.83	5.45	2.33	2.31	-.22	2.93	.49M				
MOSQUITO CREEK LAKE	2.08	-1.83	2.00	-1.26	5.87	2.78	2.96	.16	2.62	.02	1.26	-1.14	39.36	3.82
PAINESVILLE 4 NW	2.97	-.34	1.31	-2.13	4.96	1.66	3.69	.65	3.75	.31	2.20	-.57	38.34	2.64
RAVENNA 2 S	2.28	-2.05	2.21	-1.26	4.99	1.60	3.10	.47	2.60	-.32	1.41	-1.32	39.07	.68
WARREN	2.41		1.94		5.48									
WARREN 3 S	3.61	-.09	1.41	-1.75	6.07	3.00	3.42	.84	2.31	-.30M	1.57	M	43.96	
YOUNGSTOWN WSO AP R	3.33	-.71	1.68	-1.79	6.11	3.01	2.90	.25	2.47	-.35	1.45	-1.31	43.33	6.00
--DIVISIONAL DATA------->	2.99	-.80	1.78	-1.72	4.87	1.59	3.35	.52	3.30	.24	2.04	-.77	41.74	4.15

4

Ashtabula River Dredging
Landfill Design

Geotechnical Appendix M

ATTACHMENT M6

PCCDF90 Computer Output

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CONSOLIDATION AND DESICCATION OF SOFT LAYERS---DREDGED FILL

****

PROBLEM ashtabula simulation - month apr 2005

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.48	2.65	1.77	2.15	.93

MATERIAL TYPE 1

I	VOID RATIO	EFFECTIVE STRESS	PERM-EABILITY	K/1+E PK	BETA	DSDE	ALPHA
1	3.330	.748E+00	.150E+00	.346E-01	.129E+00	-.378E+01	-.131E+00
2	3.200	.124E+01	.750E-01	.179E-01	.933E-01	-.433E+01	-.773E-01
3	3.110	.170E+01	.580E-01	.141E-01	.218E-01	-.540E+01	-.762E-01
4	3.000	.232E+01	.540E-01	.135E-01	.355E-01	-.728E+01	-.983E-01
5	2.948	.288E+01	.330E-01	.836E-02	.735E-01	-.108E+02	-.903E-01
6	2.900	.340E+01	.240E-01	.615E-02	.573E-02	-.558E+01	-.344E-01
7	2.640	.460E+01	.240E-01	.659E-02	-.172E-02	-.562E+01	-.371E-01
8	2.580	.520E+01	.240E-01	.670E-02	-.188E-02	-.923E+01	-.619E-01
9	2.510	.580E+01	.240E-01	.684E-02	-.194E-02	-.100E+02	-.684E-01
10	2.460	.640E+01	.240E-01	.694E-02	-.200E-02	-.133E+02	-.925E-01
11	2.420	.700E+01	.240E-01	.702E-02	.377E-02	-.337E+02	-.236E+00
12	1.700	.320E+02	.110E-01	.407E-02	.883E-02	-.572E+02	-.233E+00
13	1.668	.500E+02	.100E-02	.375E-03	.450E-01	-.829E+03	-.311E+00
14	1.618	.100E+03	.100E-02	.382E-03	-.148E-03	-.109E+04	-.415E+00
15	1.530	.200E+03	.100E-02	.395E-03	.529E-03	-.183E+04	-.725E+00
16	1.400	.500E+03	.640E-03	.267E-03	.932E-03	-.320E+04	-.853E+00
17	1.280	.100E+04	.370E-03	.162E-03	.676E-03	-.600E+04	-.974E+00
18	1.150	.200E+04	.210E-03	.977E-04	.497E-03	-.769E+04	-.751E+00

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.44	2.65	1.77	2.15	.93

MATERIAL TYPE 1

***********************SOIL DATA FOR DREDGED FILL***********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.40	2.65	1.77	2.15	.93
	MATERIAL TYPE	1		

***********************SOIL DATA FOR DREDGED FILL***********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.36	2.65	1.77	2.15	.93
	MATERIAL TYPE	1		

***********************SOIL DATA FOR DREDGED FILL***********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.33	2.65	1.77	2.15	.93
	MATERIAL TYPE	1		

***********************SOIL DATA FOR DREDGED FILL***********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.30	2.65	1.77	2.15	.93
	MATERIAL TYPE	1		

***********************SOIL DATA FOR DREDGED FILL***********************

LAYER SPECIFIC GRAVITY INITIAL SATURATION DESICCATION

THICKNESS	OF SOLIDS	VOID RATIO	LIMIT	LIMIT
1.27	2.65	1.77	2.15	.93

MATERIAL TYPE 1

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.24	2.65	1.77	2.15	.93

MATERIAL TYPE 1

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.21	2.65	1.77	2.15	.93

MATERIAL TYPE 1

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.24	2.65	1.77	2.15	.93

MATERIAL TYPE 1

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.22	2.65	1.77	2.15	.93

MATERIAL TYPE 1

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.19	2.65	1.77	2.15	.93

MATERIAL TYPE 1

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.17	2.65	1.77	2.15	.93

MATERIAL TYPE 1

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.15	2.65	1.77	2.15	.93

MATERIAL TYPE 1

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.13	2.65	1.77	2.15	.93

MATERIAL TYPE 1

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.10	2.65	1.77	2.15	.93

MATERIAL TYPE 1

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.09	2.65	1.77	2.15	.93

MATERIAL TYPE 1

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
1.07	2.65	1.77	2.15	.93

MATERIAL TYPE 1

**********************SOIL DATA FOR DREDGED FILL**********************

LAYER THICKNESS	SPECIFIC GRAVITY OF SOLIDS	INITIAL VOID RATIO	SATURATION LIMIT	DESICCATION LIMIT
.63	2.65	1.77	2.15	.93

MATERIAL TYPE 2

I	VOID RATIO	EFFECTIVE STRESS	PERM-EABILITY	K/1+E PK	BETA	DSDE	ALPHA
1	3.330	.748E+00	.150E+00	.346E-01	.129E+00	-.378E+01	-.131E+00
2	3.200	.124E+01	.750E-01	.179E-01	.933E-01	-.433E+01	-.773E-01
3	3.110	.170E+01	.580E-01	.141E-01	.218E-01	-.540E+01	-.762E-01

4	3.000	.232E+01	.540E-01	.135E-01	.355E-01	-.728E+01	-.983E-01
5	2.948	.288E+01	.330E-01	.836E-02	.735E-01	-.108E+02	-.903E-01
6	2.900	.340E+01	.240E-01	.615E-02	.573E-02	-.558E+01	-.344E-01
7	2.640	.460E+01	.240E-01	.659E-02	-.172E-02	-.562E+01	-.371E-01
8	2.580	.520E+01	.240E-01	.670E-02	-.188E-02	-.923E+01	-.619E-01
9	2.510	.580E+01	.240E-01	.684E-02	-.194E-02	-.100E+02	-.684E-01
10	2.460	.640E+01	.240E-01	.694E-02	-.200E-02	-.133E+02	-.925E-01
11	2.420	.700E+01	.240E-01	.702E-02	.377E-02	-.337E+02	-.236E+00
12	1.700	.320E+02	.110E-01	.407E-02	.883E-02	-.572E+02	-.233E+00
13	1.668	.500E+02	.100E-02	.375E-03	.450E-01	-.829E+03	-.311E+00
14	1.618	.100E+03	.100E-02	.382E-03	-.148E-03	-.109E+04	-.415E+00
15	1.530	.200E+03	.100E-02	.395E-03	.529E-03	-.183E+04	-.725E+00
16	1.400	.500E+03	.640E-03	.267E-03	.932E-03	-.320E+04	-.853E+00
17	1.280	.100E+04	.370E-03	.162E-03	.676E-03	-.600E+04	-.974E+00
18	1.150	.200E+04	.210E-03	.977E-04	.497E-03	-.769E+04	-.751E+00

SUMMARY OF MONTHLY RAINFALL AND EVAPORATION POTENTIAL

MONTH	RAINFALL	EVAPORATION
1	2.350	.780
2	1.780	.880
3	2.630	1.630
4	3.490	2.960
5	3.400	4.450
6	3.520	5.200
7	4.070	5.190
8	3.810	4.480
9	3.630	3.220
10	3.290	2.370
11	2.550	1.380
12	2.850	.910

****************************CALCULATION DATA*****************************

TAU	LOWER LAYER VOID RATIO	LOWER LAYER PERMEABILITY	DRAINAGE PATH LENGTH
.126	.400	.10000E-07	Z = 14.29

SUMMARY OF DESICCATION PARAMETERS

PARAMETER	VALUE
SURFACE DRAINAGE EFFICIENCY	1.00
MAXIMUM EVAPORATION EFFICIENCY	1.00
SATURATION AT DESICCATION LIMIT	.75
MAXIMUM CRUST THICKNESS	.60
TIME TO DESIC. AFTER INITIAL FILL	120.00
MONTH OF INITIAL DESICCATION	7
ELEVATION OF FIXED WATER TABLE	618.00
ELEVATION OF TOP OF INCOMPRES. FOUND.	618.00

SUMMARY OF ADDITIONAL LIFTS AND PRINT DETAIL

TIME DAYS	FILL HEIGHT FEET	START DESICCATION DAY	MONTH	PRINT DETAIL
30.00	1.44	90.00	7	1
60.00	1.40	120.00	8	1
90.00	1.36	150.00	9	1
120.00	1.33	180.00	10	1
150.00	1.30	240.00	12	1
180.00	1.27	360.00	4	1
210.00	1.24	390.00	5	1
240.00	1.21	420.00	6	1
270.00	.00	420.00	6	1
300.00	.00	420.00	6	1
330.00	.00	450.00	7	1
360.00	1.24	450.00	7	1
390.00	1.22	480.00	8	1
420.00	1.19	480.00	8	1
450.00	1.17	510.00	9	1
480.00	1.15	540.00	10	1
510.00	1.13	600.00	12	1
540.00	1.10	720.00	4	1
570.00	1.09	750.00	5	1
600.00	1.07	780.00	6	1
630.00	.63	780.00	6	0
660.00	.00	780.00	6	1
690.00	.00	810.00	7	1

*******************INITIAL CONDITIONS IN DREDGED FILL*******************

***** COORDINATES *****   ***** VOID RATIOS *****

A	XI	Z	EINITIAL	E	EFINAL	MATERIAL
1.48	1.48	.53	1.77	1.77	1.77	1
1.23	1.23	.45	1.77	1.77	2.36	1
.99	.99	.36	1.77	1.77	2.09	1
.74	.74	.27	1.77	1.77	1.83	1
.49	.49	.18	1.77	1.77	1.69	1
.25	.25	.09	1.77	1.77	1.68	1
.00	.00	.00	1.77	1.77	1.66	1

	***** STRESSES *****		***** PORE PRESSURES *****			
XI	TOTAL	EFFECTIVE	TOTAL	STATIC	EXCESS	MATERIAL
1.48	.00	.00	.00	.00	.00	1
1.23	24.56	.00	24.56	15.39	9.17	1
.99	49.12	.00	49.12	30.78	18.34	1
.74	73.68	.00	73.68	46.18	27.51	1
.49	98.24	.00	98.24	61.57	36.67	1
.25	122.80	.00	122.80	76.96	45.84	1
.00	147.36	.00	147.36	92.35	55.01	1

TIME = .00 DEGREE OF CONSOLIDATION = .0000

SETTLEMENT = .00 FINAL SETTLEMENT = -.08

BOTTOM BOUNDARY GRADIENT = .00

9.62	8.80	3.47	1.77	1.59	1.40	1
9.37	8.57	3.38	1.77	1.59	1.40	1
9.13	8.34	3.29	1.77	1.58	1.40	1
8.88	8.11	3.21	1.77	1.58	1.39	1
8.63	7.88	3.12	1.77	1.58	1.39	1
8.39	7.65	3.03	1.77	1.58	1.39	1
8.14	7.42	2.94	1.77	1.57	1.39	1
7.89	7.19	2.85	1.77	1.57	1.39	1
7.65	6.96	2.76	1.77	1.57	1.38	1
7.40	6.73	2.67	1.77	1.57	1.38	1
7.15	6.50	2.58	1.77	1.56	1.38	1
6.91	6.27	2.49	1.77	1.56	1.38	1
6.66	6.05	2.40	1.77	1.56	1.37	1
6.41	5.82	2.32	1.77	1.55	1.37	1
6.17	5.59	2.23	1.77	1.55	1.37	1
5.92	5.36	2.14	1.77	1.55	1.37	1
5.67	5.14	2.05	1.77	1.55	1.37	1
5.43	4.91	1.96	1.77	1.54	1.36	1
5.18	4.68	1.87	1.77	1.54	1.36	1
4.93	4.46	1.78	1.77	1.54	1.36	1
4.69	4.23	1.69	1.77	1.53	1.36	1
4.44	4.01	1.60	1.77	1.53	1.35	1
4.19	3.78	1.51	1.77	1.53	1.35	1
3.95	3.56	1.42	1.77	1.52	1.35	1
3.70	3.33	1.34	1.77	1.52	1.35	1
3.45	3.11	1.25	1.77	1.52	1.35	1
3.21	2.88	1.16	1.77	1.51	1.34	1
2.96	2.66	1.07	1.77	1.51	1.34	1
2.71	2.44	.98	1.77	1.51	1.34	1
2.47	2.21	.89	1.77	1.50	1.34	1
2.22	1.99	.80	1.77	1.50	1.34	1
1.97	1.77	.71	1.77	1.50	1.33	1
1.73	1.55	.62	1.77	1.49	1.33	1
1.48	1.32	.53	1.77	1.49	1.33	1
1.23	1.10	.45	1.77	1.49	1.33	1
.99	.88	.36	1.77	1.48	1.32	1
.74	.66	.27	1.77	1.48	1.32	1
.49	.44	.18	1.77	1.48	1.32	1
.25	.22	.09	1.77	1.47	1.32	1
.00	.00	.00	1.77	1.47	1.32	1

	***** STRESSES *****		***** PORE PRESSURES *****			
XI	TOTAL	EFFECTIVE	TOTAL	STATIC	EXCESS	MATERIAL
21.45	.00	.00	.00	.00	.00	2
21.21	24.56	9.17	15.39	15.39	.00	2
20.96	49.08	18.34	30.74	30.74	.00	1
20.71	73.68	27.51	46.18	46.18	.00	1
20.47	98.07	31.60	66.47	61.40	5.07	1
20.23	122.19	45.84	76.35	76.35	.00	1
19.99	146.19	55.01	91.18	91.18	.00	1
19.75	170.13	64.18	105.95	105.95	.00	1
19.52	194.02	73.35	120.67	120.67	.00	1
19.28	217.87	79.02	138.84	135.35	3.49	1
19.05	241.69	82.48	159.21	150.00	9.21	1
18.81	265.49	84.81	180.68	164.64	16.04	1
18.58	289.29	86.51	202.78	179.27	23.52	1
18.34	313.08	87.80	225.28	193.89	31.39	1
18.11	336.86	88.83	248.03	208.50	39.53	1

17.88	360.63	89.68	270.96	223.11	47.85	1
17.64	384.40	90.40	294.00	237.71	56.29	1
17.41	408.17	91.04	317.13	252.31	64.82	1
17.17	431.94	91.62	340.32	266.90	73.42	1
16.94	455.70	92.15	363.55	281.50	82.05	1
16.71	479.46	92.65	386.81	296.09	90.72	1
16.47	503.21	93.12	410.09	310.67	99.41	1
16.24	526.96	93.59	433.38	325.26	108.12	1
16.01	550.71	94.04	456.67	339.84	116.83	1
15.77	574.46	94.49	479.97	354.42	125.55	1
15.54	598.21	94.95	503.26	368.99	134.27	1
15.31	621.95	95.41	526.54	383.57	142.98	1
15.07	645.69	95.87	549.82	398.14	151.68	1
14.84	669.43	96.35	573.07	412.71	160.37	1
14.60	693.16	96.85	596.31	427.28	169.04	1
14.37	716.89	97.37	619.53	441.84	177.69	1
14.14	740.62	97.91	642.71	456.40	186.31	1
13.90	764.35	98.49	665.86	470.96	194.90	1
13.67	788.07	99.11	688.97	485.51	203.46	1
13.44	811.79	99.77	712.02	500.06	211.96	1
13.21	835.51	100.56	734.94	514.61	220.34	1
12.97	859.22	101.46	757.76	529.15	228.61	1
12.74	882.92	102.43	780.49	543.69	236.80	1
12.51	906.62	103.49	803.14	558.22	244.92	1
12.27	930.32	104.62	825.70	572.75	252.95	1
12.04	954.01	105.85	848.16	587.27	260.89	1
11.81	977.70	107.16	870.54	601.79	268.75	1
11.58	1001.37	108.56	892.81	616.30	276.52	1
11.34	1025.04	110.05	914.99	630.80	284.19	1
11.11	1048.71	111.64	937.07	645.29	291.78	1
10.88	1072.36	113.32	959.04	659.78	299.26	1
10.65	1096.01	115.10	980.91	674.26	306.65	1
10.41	1119.65	116.97	1002.67	688.72	313.95	1
10.18	1143.27	118.94	1024.33	703.18	321.15	1
9.95	1166.89	121.00	1045.89	717.63	328.25	1
9.72	1190.50	123.16	1067.34	732.07	335.26	1
9.49	1214.10	125.41	1088.68	746.50	342.18	1
9.26	1237.68	127.76	1109.93	760.92	349.01	1
9.03	1261.26	130.19	1131.07	775.33	355.74	1
8.80	1284.82	132.71	1152.11	789.72	362.39	1
8.57	1308.37	135.31	1173.06	804.10	368.96	1
8.34	1331.91	138.00	1193.91	818.47	375.44	1
8.11	1355.43	140.76	1214.66	832.82	381.84	1
7.88	1378.94	143.61	1235.33	847.16	388.17	1
7.65	1402.43	146.52	1255.92	861.49	394.42	1
7.42	1425.92	149.50	1276.41	875.80	400.61	1
7.19	1449.38	152.55	1296.83	890.10	406.73	1
6.96	1472.83	155.66	1317.18	904.38	412.79	1
6.73	1496.27	158.82	1337.45	918.65	418.79	1
6.50	1519.69	162.04	1357.65	932.90	424.74	1
6.27	1543.09	165.31	1377.78	947.14	430.64	1
6.05	1566.48	168.63	1397.85	961.36	436.49	1
5.82	1589.85	171.99	1417.87	975.56	442.30	1
5.59	1613.21	175.38	1437.83	989.75	448.07	1
5.36	1636.55	178.82	1457.73	1003.92	453.81	1
5.14	1659.87	182.28	1477.59	1018.07	459.52	1
4.91	1683.18	185.77	1497.41	1032.21	465.20	1
4.68	1706.46	189.28	1517.18	1046.33	470.85	1
4.46	1729.73	192.82	1536.91	1060.43	476.48	1
4.23	1752.99	196.37	1556.61	1074.52	482.10	1

4.01	1776.22	199.94	1576.28	1088.59	487.70	1
3.78	1799.44	207.20	1592.25	1102.64	489.61	1
3.56	1822.64	214.61	1608.04	1116.67	491.37	1
3.33	1845.83	222.11	1623.71	1130.68	493.03	1
3.11	1868.99	229.71	1639.28	1144.68	494.60	1
2.88	1892.14	237.40	1654.74	1158.66	496.08	1
2.66	1915.26	245.18	1670.09	1172.61	497.48	1
2.44	1938.37	253.03	1685.34	1186.55	498.79	1
2.21	1961.46	260.96	1700.50	1200.48	500.02	1
1.99	1984.53	268.97	1715.56	1214.38	501.18	1
1.77	2007.58	277.05	1730.54	1228.26	502.28	1
1.55	2030.62	285.19	1745.43	1242.12	503.30	1
1.32	2053.63	293.39	1760.23	1255.97	504.27	1
1.10	2076.62	301.65	1774.96	1269.79	505.17	1
.88	2099.59	309.97	1789.62	1283.59	506.03	1
.66	2122.54	318.33	1804.21	1297.38	506.83	1
.44	2145.48	326.74	1818.73	1311.14	507.59	1
.22	2168.39	335.19	1833.20	1324.88	508.31	1
.00	2191.28	343.68	1847.60	1338.51	509.00	1

TIME = 690.02 DEGREE OF CONSOLIDATION = .1091

SETTLEMENT = 1.49 FINAL SETTLEMENT = 13.64

BOTTOM BOUNDARY GRADIENT = .00

SURFACE ELEVATION = 639.45

*** A CUMULATIVE MASS ERROR OF .39% WAS DETECTED. ***

Ashtabula River Dredging
Landfill Design

Geotechnical Appendix M

ATTACHMENT M7

Cover Settlement Analysis

II. OUTPUT SUMMARY.

1. TITLE- ASHTABULA CAP SETTLEMENT - BANK TO BANK

PROGRAM CSETT - VERTICAL STRESS INDUCTION AND SETTLEMENT PROGRAM
DATE: 97/08/11 TIME: 10.17.43

I. INPUT DATA

1. TITLE - ASHTABULA CAP SETTLEMENT - BANK TO BANK

2. BOUSSINESQ SOLUTION WILL BE USED TO COMPUTE INDUCED STRESSES.
THE MAXIMUM DEPTH TO WHICH THE ANALYSIS WILL BE EXTENDED
IS 33.39 FEET.

3. 2-DIMENSIONAL PRESSURE LOAD DATA

LOAD NUMBER 1 : NUMBER OF POINTS= 5
BEGINNING TIME OF APPLICATION = .0000 YRS.
ENDING TIME OF APPLICATION = .1670 YRS.

POINT NO.	X (FT.)	PRESSURE (PSF)
1	-400.00	600.00
2	-128.80	600.00
3	.00	1244.00
4	128.80	600.00
5	400.00	600.00

4. 2-DIMENSIONAL SOIL LOAD DATA
NONE

5. 3-DIMENSIONAL RECTANGULAR LOAD DATA
NONE

6. 3-DIMENSIONAL IRREGULAR LOAD DATA
NONE

7. EXCAVATION DATA
NONE

8. SOIL DATA

STRATA NO.	EL. OF TOP OF STRATUM (FEET NGVD)	DRAINAGE CONDITION	EFF UNIT WEIGHT (PCF)	RECOMPR. INDEX	COEF.OF CONSOL. (SQFT/YR)	POISSON'S RATIO
1	665.39	S	38.60	.09000	46.50000	.50000
2	664.72	C	14.00	.09000	46.50000	.50000
3	650.65	C	7.60	.09000	46.50000	.50000

9. STRESS-STRAIN DATA

STRATUM NO. 1

COMPRESSION INDEX= .43000
RECOMPRESSION INDEX= .09000
INSITU VOID RATIO= .93000
INSITU OVERBURDEN= 12.92 PSF

STRATUM NO. 2

COMPRESSION INDEX= .17000
RECOMPRESSION INDEX= .09000
INSITU VOID RATIO= 1.62000
INSITU OVERBURDEN= 94.92 PSF

STRATUM NO. 3

COMPRESSION INDEX= .30000
RECOMPRESSION INDEX= .09000
INSITU VOID RATIO= 1.55000
INSITU OVERBURDEN= 173.67 PSF

10. TIME SEQUENCE FOR CONSOLIDATION CALCULATIONS

TIME RATE OF CONSOLIDATION CALCULATIONS WILL BE MADE

```
     AT TIMES (YRS):
                          10.00
                          20.00
                          30.00
                          40.00
                          50.00
                          60.00
                          70.00
                          80.00
                          90.00
                         100.00
```

11. OUTPUT CONTROL DATA

```
      XXL= -400.0000 FT.
      XUL=  400.0000 FT.
     DELX=   20.0000 FT.
```

AWARE INCORPORATED

TEST BORING LOG

NO. PZ-14

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	Pennsylvania Drilling Company
DRILLER:	Peter Martin
EQUIPMENT:	Truck Mounted Rig
METHOD:	6"OD Solid Stem Auger

SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE	NONE		
DIAMETER			
OTHER			

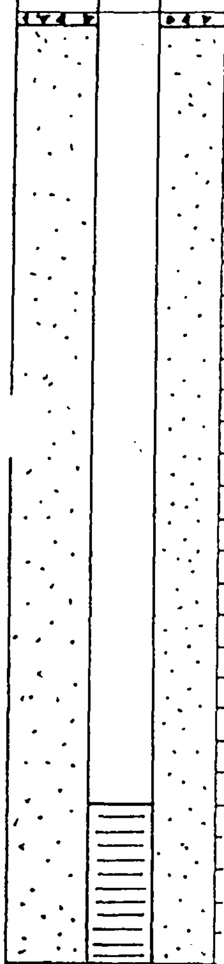
WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC (S-40)	PVC
DIAMETER	1.5"	1.5"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT	
METHOD:	NONE
DURATION:	
YIELD:	
OTHER:	

	GROUND	WELL	PROT CSG.
ELEV			

DATE STARTED: 8-17-88
DATE COMPLETED: 8-17-88
INSPECTOR: ROB GUIDRY

WELL CONSTRUCTION



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–13.5				BROWN SILT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
13.5–30				GREY TILL	
30				30' END OF BORING	

POSITION: X= -120.0
****

2. SUMMARY OF ULTIMATE SETTLEMENTS.

STRATA NO.	MID-DEPTH OF STRATA (FEET)	IN-SITU OVERBURDEN (LB/SQ FT)	DELTA SIGMA (LB/SQ FT)	ULTIMATE SETTLEMENT (FEET)
1	.33	12.93	644.00	.255
2	7.70	124.35	646.92	.743
3	24.07	293.71	664.30	1.165

3. TIME-SETTLEMENT SUMMARY.

(SETTLEMENT IN FEET AT SPECIFIED TIMES)

STRATA NO	ULT	10.00 (YRS.)	20.00 (YRS.)	30.00 (YRS.)	40.00 (YRS.)	50.00 (YRS.)	60.00 (YRS.)
1	.255	.181	.228	.245	.251	.253	.255
2	.743	.529	.667	.715	.734	.739	.743
3	1.165	.827	1.044	1.121	1.149	1.159	1.165
TOTALS:	2.163	1.537	1.939	2.081	2.134	2.151	2.163

(SETTLEMENT IN FEET AT SPECIFIED TIMES)

STRATA NO	70.00 (YRS.)	80.00 (YRS.)	90.00 (YRS.)	100.00 (YRS.)
1	.255	.255	.255	.255
2	.743	.743	.743	.743
3	1.165	1.165	1.165	1.165
TOTALS:	2.163	2.163	2.163	2.163

POSITION: X= .0
****

2. SUMMARY OF ULTIMATE SETTLEMENTS.

STRATA NO.	MID-DEPTH OF STRATA (FEET)	IN-SITU OVERBURDEN (LB/SQ FT)	DELTA SIGMA (LB/SQ FT)	ULTIMATE SETTLEMENT (FEET)
1	.33	12.93	1242.90	.297
2	7.70	124.35	1219.52	.966
3	24.07	293.71	1168.34	1.579

3. TIME-SETTLEMENT SUMMARY.

(SETTLEMENT IN FEET AT SPECIFIED TIMES)

STRATA NO	ULT	10.00 (YRS.)	20.00 (YRS.)	30.00 (YRS.)	40.00 (YRS.)	50.00 (YRS.)	60.00 (YRS.)
1	.297	.211	.266	.286	.293	.295	.297
2	.966	.686	.866	.930	.954	.962	.966
3	1.579	1.121	1.415	1.520	1.558	1.571	1.579
TOTALS:	2.842	2.018	2.547	2.736	2.805	2.828	2.842

(SETTLEMENT IN FEET AT SPECIFIED TIMES)

STRATA NO	70.00 (YRS.)	80.00 (YRS.)	90.00 (YRS.)	100.00 (YRS.)
1	.297	.297	.297	.297
2	.966	.966	.966	.966
3	1.579	1.579	1.579	1.579
TOTALS:	2.842	2.842	2.842	2.842

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX M

GEOTECHNICAL ENGINEERING

SUB-APPENDIX M-1

GEOTECHNICAL EVALUATION OF RMI SODIUM (STATE ROAD) LANDFILL SITE

PREPARED BY:

U.S. Army Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, New York 14207
December 2000

ASHTABULA RIVER PARTNERSHIP
SITE SELECTION FOR AN UPLAND DISPOSAL FACILITY
ASHTABULA, OHIO

SUB APPENDIX M-1

GEOTECHNICAL EVALUATION OF RMI SODIUM LANDFILL SITE

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Figures

Attachments

ASHTABULA RIVER PARTNERSHIP
SITE SELECTION FOR AN UPLAND DISPOSAL FACILITY
ASHTABULA, OHIO

SUB APPENDIX M-1

GEOTECHNICAL EVALUATION OF RMI SODIUM LANDFILL SITE

M1-1. REGIONAL GEOLOGY

The regional geology for the previously proposed Project Site #7, as discussed in Appendix M, is also applicable to the RMI site.

M1-2. LOCAL GEOLOGY

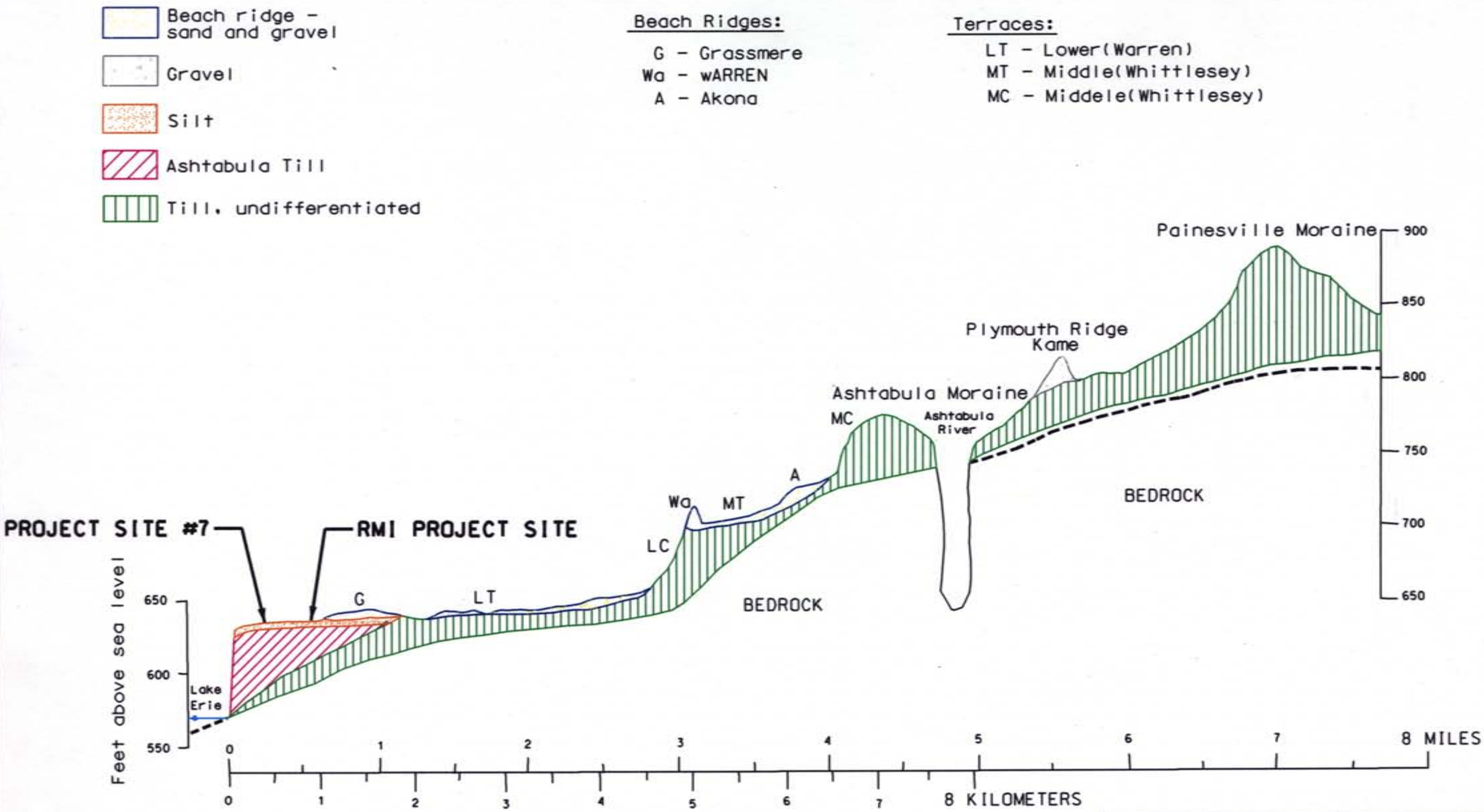
Overburden deposits beneath the project site primarily consist of soils whose origin is directly related to the glacial and post-glacial history of the region. Figure M1-1 illustrates the location of the RMI site relative to glacial deposits in northern Ashtabula County. As depicted in Figure M1-1, the site is primarily underlain by the Ashtabula Till. White and Trotten (1979) describe the Ashtabula Till as a calcareous silty clay till, which is sparingly to moderately pebbly. Ashtabula Till tends to be brown when altered and oxidized, and gray when unaltered. Fifteen monitoring wells, seven soil borings, and twenty piezometers were drilled/installed at the RMI site in 1988. The boring locations are illustrated in Figure M1-2. Subsurface conditions encountered at the boring/well/piezometer locations are described in the boring logs, which are included in Attachment M1-1. General subsurface cross sections through the site are included in Figures M1-3, M1-4, and M1-5. Zero to eight feet of fill was encountered below the ground surface. The fill consists of various materials including silt, gravel, and sand. Some concrete rubble and wood debris was also encountered within the fill. Till was encountered below the fill. The till primarily consists of brown to gray silty clay with a trace of gravel. Relatively thin, discontinuous layers of sand were encountered within the till strata. The Chagrin Shale bedrock unit was encountered at elevations ranging from 581 feet to 592 feet, generally dipping from south to north. Shallow groundwater was encountered within the upper ten feet of soil across the site.

M1-3. GEOTECHNICAL DESIGN

The local geology at the RMI site is similar to the geology at the previously proposed Project Site #7. Therefore, the stability analyses, capacity analyses, and settlement analyses described in Appendix M are also applicable to the RMI site. In order to ensure a stable foundation for proposed perimeter dikes, all fill within the footprint of dikes should be removed down to stiff till prior to constructing the dikes. Shallow groundwater encountered during the 1988 subsurface exploration is likely associated with water trapped in the fill above the glacial till, which has relatively low permeability. A drainage system around the perimeter of the landfill may be required to prevent seepage into the waste containment area, and to prevent uplift pressures on the liner system.

M1-4. REFERENCE

White, G.W. and Totten, S.M., "Glacial Geology of Ashtabula County, Ohio", Report of Investigations No. 112, Ohio Department of Natural Resources, 1979.



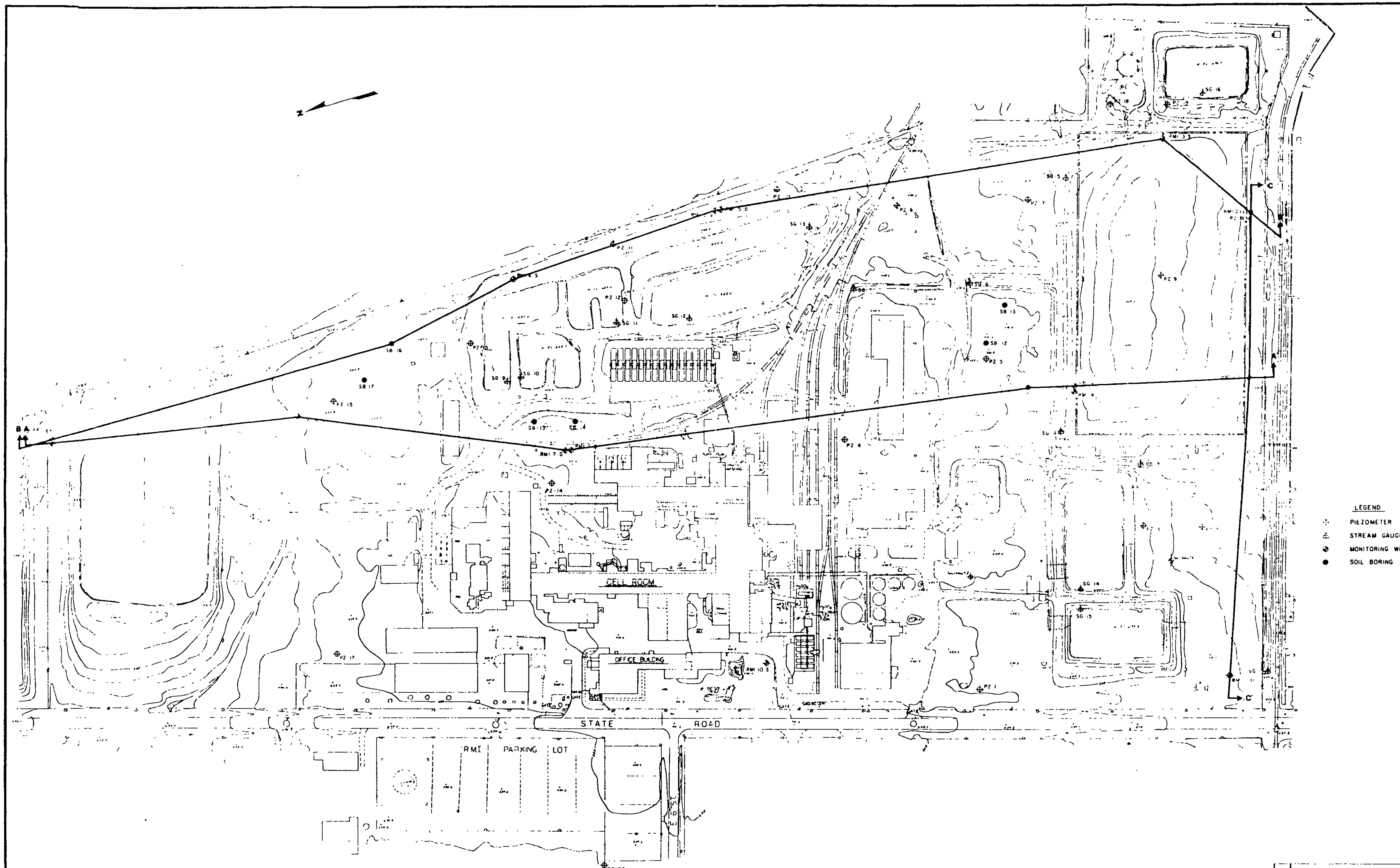
REF: White, G.W., Totten, S.M., "Galcial Geologiy of Ashtabula County, Ohio, ODNR Report No.112, 1979. Section F-F'.

ASHTABULA RIVER DREDGING
LANDFILL DESIGN

GLACIAL GEOLOGY CROSS SECTION
NORTHERN ASHTABULA COUNTY
SITE #7 AND RMI SITE

US ARMY ENGINEER DISTRICT BUFFALO

Figure M1-1



NO.	REVISIONS	REV'D BY	DATE	APPR'D BY

AWARE INCORPORATED

NASHVILLE, TENNESSEE
MAHWAH, NEW JERSEY

RMI SODIUM PLANT
Ashtabula, Ohio

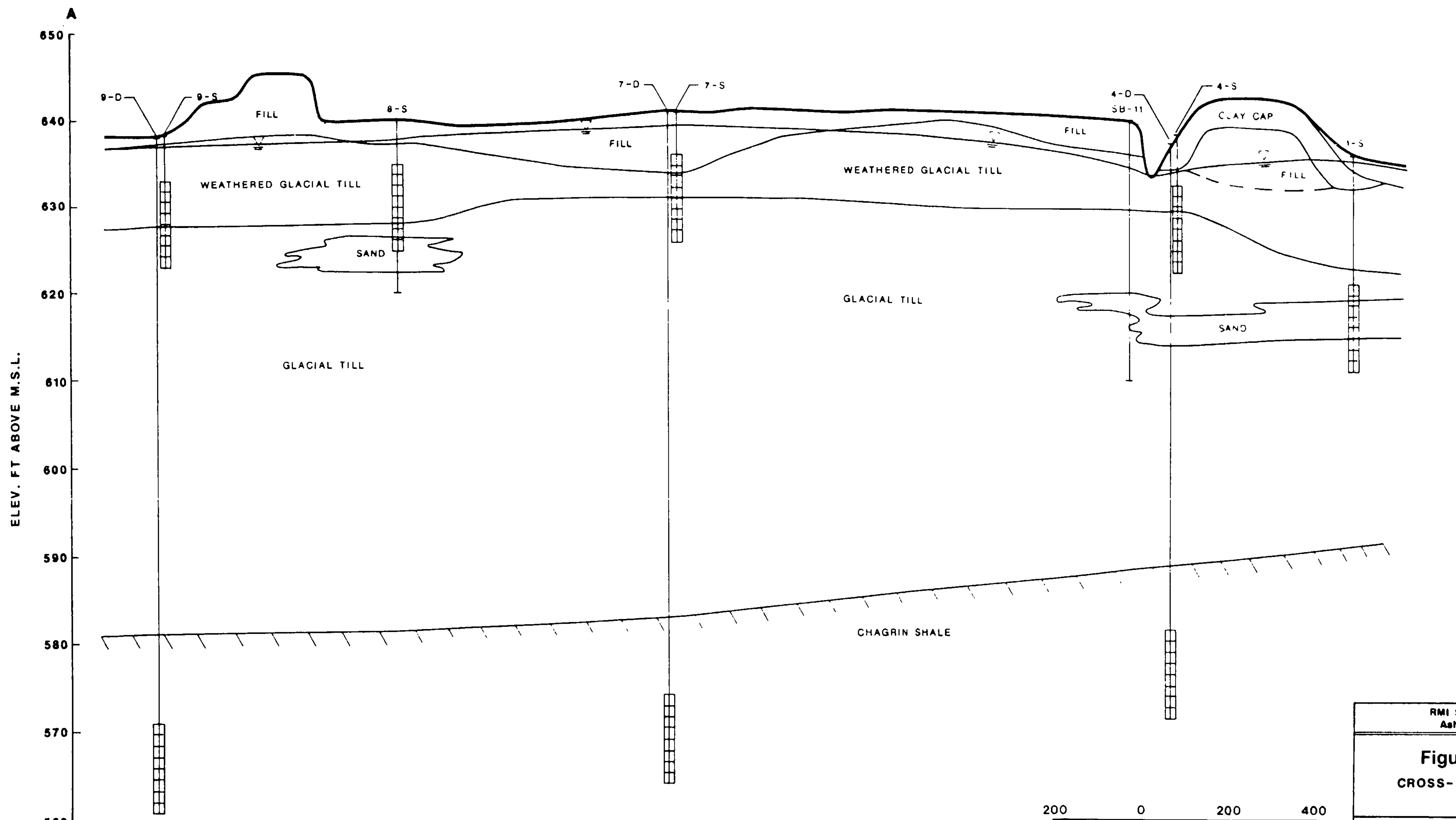
FIGURE M1-2

LOCATIONS OF GEOLOGIC CROSS SECTIONS

SCALE: 1" = 100'

100 0 100 200
scale feet

DRAWN BY	DATE	CHECKED BY	APPROVED BY	DRAWING NUMBER



RMI SODIUM PLANT
Ashtabula, Ohio

Figure 3 (M-1)

CROSS-SECTION A-A'

AWARE INCORPORATED
NASHVILLE, TENNESSEE
MAHWAH, NEW JERSEY

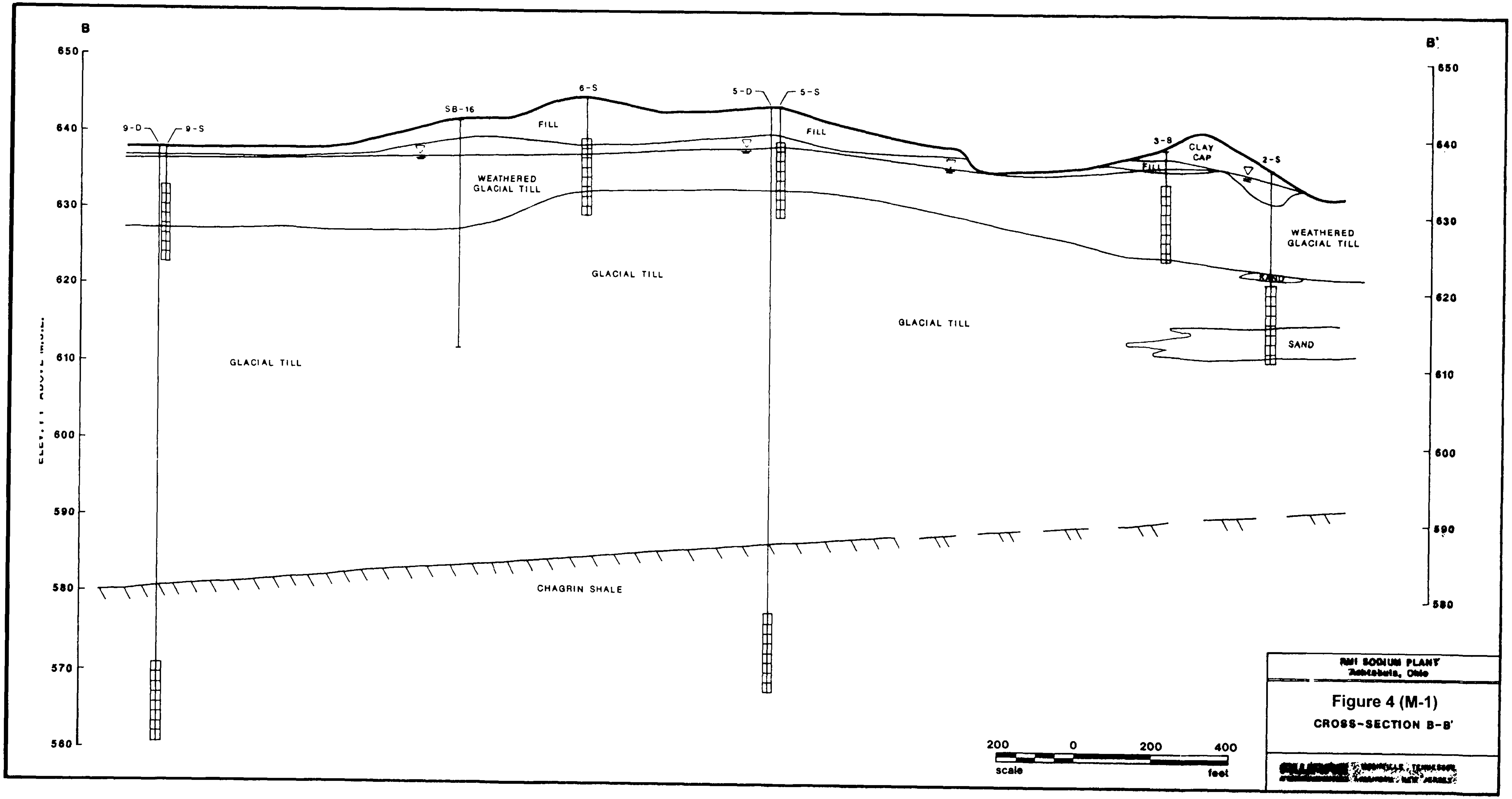
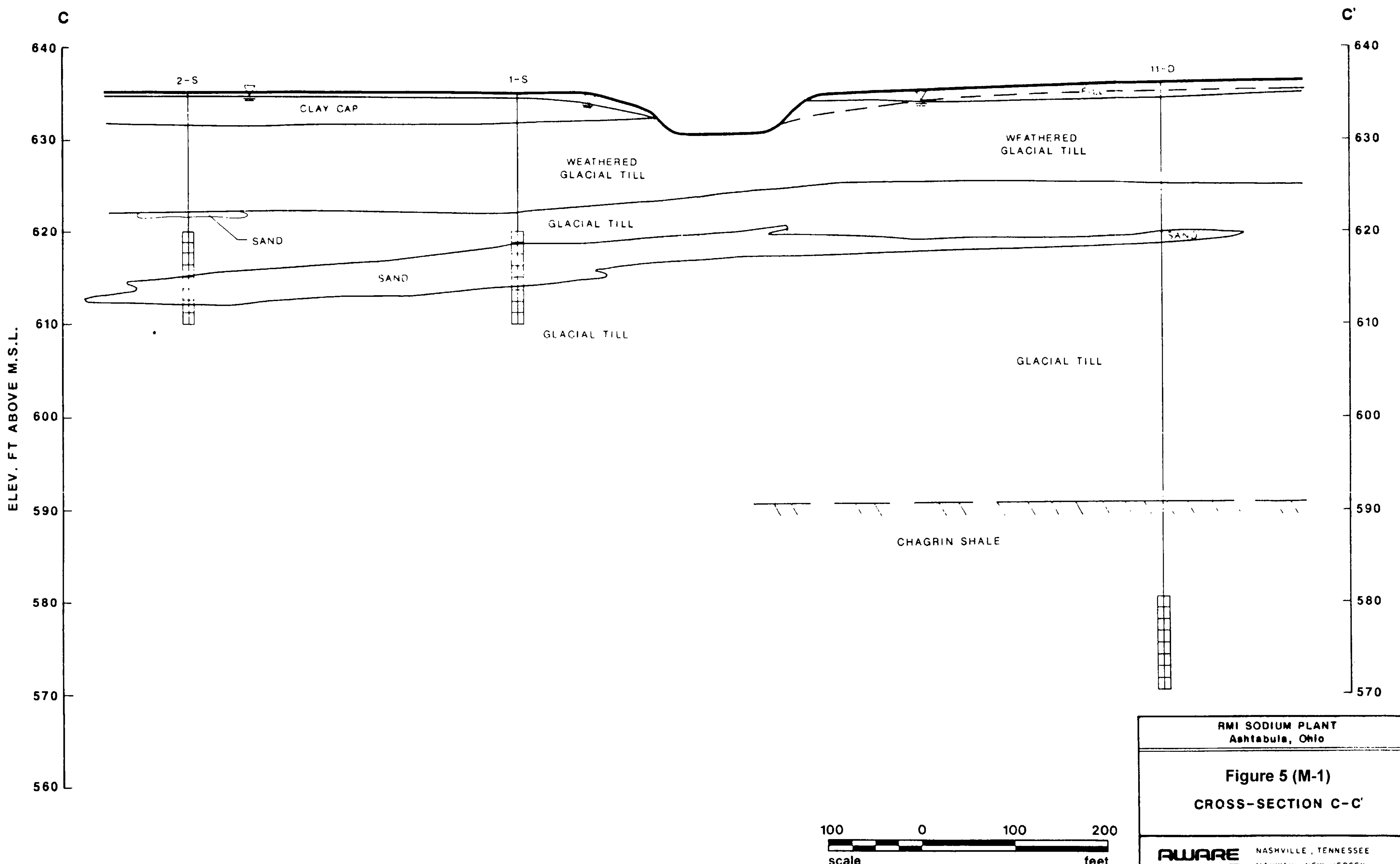


Figure 4 (M-1)

CROSS-SECTION B-B'



RMI SODIUM PLANT
Ashtabula, Ohio

Figure 5 (M-1)

CROSS-SECTION C-C'

AWARE INCORPORATED NASHVILLE, TENNESSEE MAHWAH, NEW JERSEY

ASHTABULA RIVER PARTNERSHIP
SITE SELECTION FOR AN UPLAND DISPOSAL FACILITY
ASHTABULA, OHIO

SUB APPENDIX M-1

GEOTECHNICAL EVALUATION OF RMI SODIUM LANDFILL SITE

Attachment M1-1

Monitoring Well / Boring / Piezometer Logs

AWARE INCORPORATED

TEST BORING LOG

NO. RMI - 1S

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 1
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING CO.
DRILLER:	BURNIE GOLLIHUE
EQUIPMENT:	ROTARY 8" OD AUGER
METHOD:	

SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE		5' cont. split tube	
DIAMETER		4"	
OTHER			

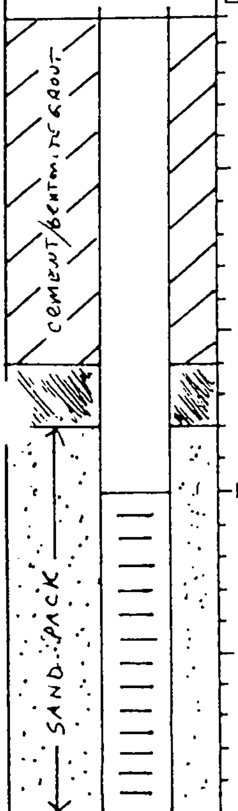
WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	TEFLON	TEFLON
DIAMETER	2"	2"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT	
METHOD:	
DURATION:	
YIELD:	
OTHER:	

	GROUND	WELL	PROT CSG
ELEV	636.0	638.78	

DATE STARTED: 10-24-88
DATE COMPLETED: 10-25-88
INSPECTOR: ROB GUIDRY

WELL CONSTRUCTION



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS	HNU
0–3.05	1			BROWN, ORANGE, AND GREY CLAY + SILT, trace(-) fine Gravel; OXIDATION PRESENT 3.05'	CLAY CAP	0.0 ppm
3.05–9.95	2			Mottled Orange, Brown, + Grey CLAY grades to BROWN CLAY + SILT trace(-) fine Gravel; fine Sand-filled oxidized fractures near base 9.95'	WEATHERED TILL	37 ppm; 16 ppm
9.95–13.0	3			Grey CLAY and BROWN SILT laminations trace fine Sand 13.0'	UNWEATHERED TILL	22 ppm
13.0–16.7				Grey CLAY + SILT grades to Grey SILT + CLAY 16.7'		
16.7–20.8	4			fine SAND, some Silt; fine SAND, SILT, and CLAY laminations near base 20.8'		108 ppm
20.8–25	5			Grey Silty CLAY; trace Gravel near base 25'		
25				END OF BORING		

AWARE INCORPORATED

TEST BORING LOG

NO. RMI-2S

PROJECT: RCRA FACILITY INVESTIGATION
CLIENT: RMI SODIUM PLANT

SHEET NO. 1 of 1
PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING CO.
DRILLER:	BURNIE GOLLIHUE
EQUIPMENT:	ROTARY 8"OD AUGER
METHOD:	

SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE		5' cont. split tube	
DIAMETER		4"	
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	Teflon	Teflon
DIAMETER	2"	2"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT
METHOD:
DURATION:
YIELD:
OTHER:

	GROUND	WELL	PROT CSG
ELEV	636.3	638.64	

DATE STARTED: 10-19-88
DATE COMPLETED: 10-19-88
INSPECTOR: ROB GUIDRY

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS	HNU
Cement/Bentonite grout	0–3.5	1			Gray Silty Clay, trace(+) Sand 3.5'	CLAY CAP	6ppm
	3.5–12.9	2, 3			Mottled Brown and Gray Silty CLAY grades to Gray CLAY + SILT, trace fine Gravel. Large oxidized fracture planes throughout. Thin fine Sand lense @12.8–12.9' 12.9'	WEATHERED TILL	11ppm
Sand pack	12.9–15.9				Gray Silty CLAY. Oxidized fractures present 15.9	UNWEATHERED TILL	150ppm
	15.9–21.6	4			Gray Clayey SILT, trace(+) fine Sand, trace(−) fine Gravel. SILT and fine Sand laminations increase from 20' to 21.6'. Small pink clay inclusions 18-21' 21.6'		
	21.6–23.7	5			Gray Silty CLAY with fine Sand-filled fractures 23.7'		130ppm
	23.7–25				Gray Silty CLAY 25'		
	25				END OF BORING		

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

AWARE INCORPORATED

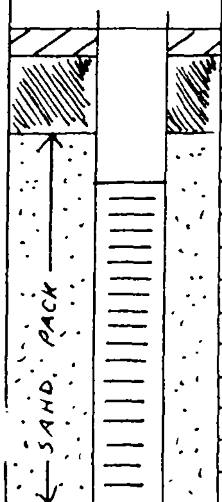
TEST BORING LOG

NO. RM1 - 3S

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 1
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS	SAMPLER	TUBE	CORE
CONTRACTOR: PENNSYLVANIA DRILLING CO.				
DRILLER: BURNIE GOLLIHUE	TYPE		5' cont. split tube	
EQUIPMENT: ROTARY 8" OD Auger	DIAMETER		4"	
METHOD:	OTHER			

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT		GROUND	WELL	PROT CSG.
			METHOD: Compressed Air	ELEV	639.6	642.2	
MATERIAL	PVC	PVC	DURATION: ~1.5 hrs	DATE STARTED: 10-12-88			
DIAMETER	2"	2"	YIELD:	DATE COMPLETED: 10-12-88			
COUPLING	THREADED	THREADED	OTHER: SILTY wtr	INSPECTOR: ROB GUIDRY			



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
0–1.4'				Gray and Brown CLAY + SILT, trace Gravel 1.4'	CLAY CAP
1.4–3'	1			coarse Sand and fine Gravel 3'	Water pipe bed
3–14.9'	1, 2, 3			Mottled Brown, Orange, and Gray Silty CLAY oxidized fractures present Silt and CLAY laminations @ 14.1-14.9'	WEATHERED TILL
14.9–15.2'	3			Gray CLAY, trace(-) fine Gravel 14.9' 15.2'	UNWEATHERED TILL
				END OF BORING	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

AWARE INCORPORATED

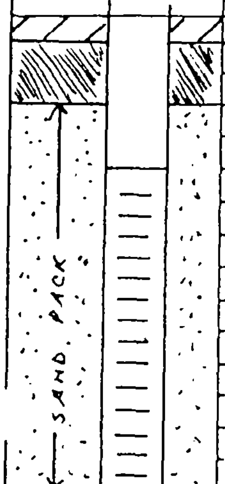
TEST BORING LOG

NO. RMI-4S

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 1
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS			
CONTRACTOR: PENNSYLVANIA DRILLING CO.		SAMPLER	TUBE	CORE
DRILLER: BURNIE GOLLIHUE	TYPE		5' cont. SPLIT TUBE	
EQUIPMENT: ROTARY	DIAMETER		4"	
METHOD:	OTHER			

WELL CONSTRUCTION			WELL DEVELOPMENT		GROUND	WELL	PROT CSG
	RISER	INTAKE	METHOD: COMPRESSED AIR	ELEV	637.2	639.99	
MATERIAL	PVC	PVC	DURATION: 1.5 hrs	DATE STARTED: 10-13-88			
DIAMETER	2"	2"	YIELD:	DATE COMPLETED: 10-13-88			
COUPLING	THREADED	THREADED	OTHER: wtr clear	INSPECTOR: ROB GUIDRY			



WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
	0				SEE RMI-4D FOR GEOLOGIC DESCRIPTION	1.7' CLAY CAP
		1				WEATHERED TILL
	5	—				
		2				8.1
	10	—				UNWEATHERED TILL
		3				
	15				15'	
					END OF BORING	
	20					
	25					
	30					
	35					
	40					

AWARE INCORPORATED — TEST BORING LOG

NO. RMI-4D

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 2
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS	SAMPLER	TUBE	CORE
CONTRACTOR: PENNSYLVANIA DRILLING CO.				
DRILLER: BURNIE GOLLIHUE	TYPE		5' cont. split tube	
EQUIPMENT: ROTARY 13" OD Augers to 48.8'	DIAMETER		4"	
METHOD: 5 7/8" BIT to 64.35'	OTHER			

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT		GROUND	WELL	PROT CSG
			METHOD: COMPRESSED AIR	ELEV	637.4	639.59	
MATERIAL	PVC	PVC	DURATION: 1.5 hrs	DATE STARTED: 10-4-88			
DIAMETER	2"	2"	YIELD:	DATE COMPLETED: 10-18-88			
COUPLING	THREADED	THREADED	OTHER: wtr silty	INSPECTOR: ROB GUIDRY			

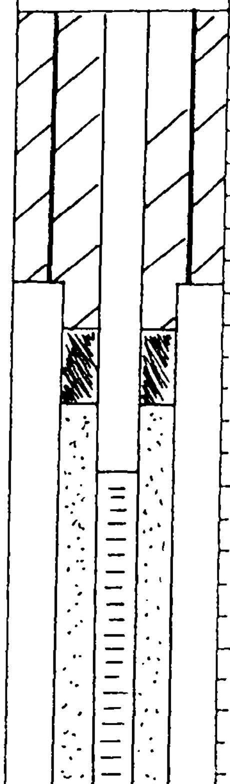
DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
0				BROWN SILTY CLAY 1.7'	CLAY CAP
	1			BLACK PEAT 2'	
				Mottled Brown and Gray Silty CLAY, OXIDIZED FRACTURES PRESENT 5.4'	WEATHERED TILL
5				BROWN SILT 6.4'	
	2			Mottled Brown and Gray Silty CLAY, trace(-) fine Gravel, oxidized fractures 8.1'	
				Gray Silty CLAY, trace(-) fine Gravel	
10					
	3			14.4'	UNWEATHERED TILL
15				Gray Clayey SILT, trace fine Sand 15.3	
	4			Gray CLAY grades to Gray Silty CLAY, trace fine Sand 20'	
20				Gray fine SAND 21'	
	5			LAMINATED fine SAND, CLAY, and SILTY CLAY. BLACK, & Gray in color 23.7	
25				Grey Silty CLAY, trace fine Sand	
	6				
30					
	7			35'	
35				Gray Silty CLAY, trace(+) Gravel	
	8				
40					

AWARE INCORPORATED

TEST BORING LOG

NO. RMI-4D

PROJECT: RCRA FACILITY INVESTIGATION | SHEET NO. 2 of 2
CLIENT: RMI SODIUM PLANT | PROJECT NO. 6120

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
	40					
		9				
	45	10				
					46.7'	
					GRAY SHALE BEDROCK	CHAGRIN SHALE
	50					
	55					
	60					
					64.35'	
	65				END OF BORING	
	70					

AWARE INCORPORATED

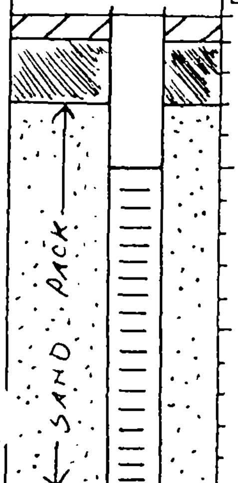
TEST BORING LOG

NO. RMI-5S

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 1
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS			
		SAMPLER	TUBE	CORE
CONTRACTOR: PENNSYLVANIA DRILLING CO.	TYPE		5' cont. split tube	
DRILLER: BURNIE GOLLIHUE	DIAMETER		4"	
EQUIPMENT: ROTARY 8" OD AUGERS	OTHER			
METHOD:				

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT		GROUND	WELL	PROT CSG
			METHOD: COMPRESSED AIR	ELEV	642.9	645.67	
MATERIAL	PVC	PVC	DURATION: ~1 hr	DATE STARTED: 10-12-88			
DIAMETER	2"	2"	YIELD:	DATE COMPLETED: 10-12-88			
COUPLING	THREADED	THREADED	OTHER: wtr ~ clear	INSPECTOR: ROB GUIDRY			



WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
	0				SEE RMI-5D FOR GEOLOGIC DESCRIPTION	COVER AND FILL
		1				3.6'
	5					WEATHERED TILL
		2				
	10					11.1
		3				UNWEATHERED TILL
	15				15' END OF BORING	
	20					
	25					
	30					
	35					
	40					

AWARE INCORPORATED

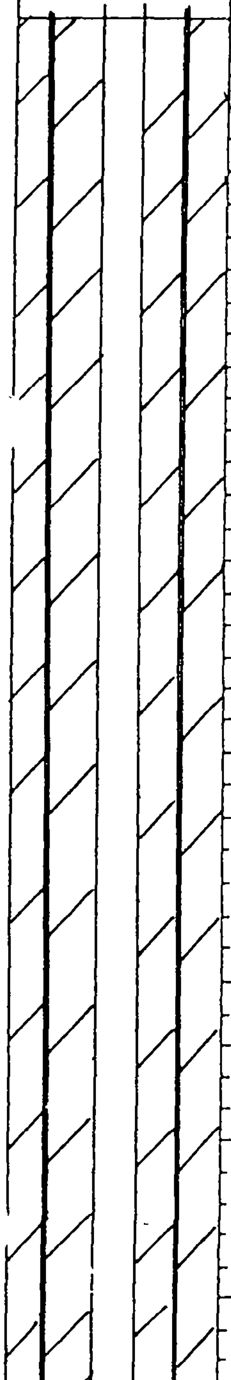
TEST BORING LOG

NO. RMI - 5D

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 2
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA		SAMPLING METHODS		
CONTRACTOR: PENNSYLVANIA DRILLING CO.		SAMPLER	TUBE	CORE
DRILLER: BURNIE GOLLIHUE	TYPE		5' cont. split tube	
EQUIPMENT: ROTARY 13"OD AUGER to 57.60'	DIAMETER		4"	
METHOD: 5 7/8" BIT to 75.70'	OTHER			

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT		GROUND	WELL	PROT CSG
			METHOD: COMPRESSED AIR	ELEV	642.9	645.17	
MATERIAL	PVC	PVC	DURATION: ~1 hr	DATE STARTED: 9-28-88			
DIAMETER	2"	2"	YIELD:	DATE COMPLETED: 10-17-88			
COUPLING	THREADED	THREADED	OTHER: SILTY	INSPECTOR: ROB GUIDRY			



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
0	1			Gravel, SILT, CLAY, CINDERS, BRICK FRAGMENTS — 3.6'	COVER AND FILL
5	2			Mottled ORANGE AND BROWN CLAY + SILT, trace(–) fine Gravel. OXIDIZED FRACTURES — 9.2'	WEATHERED TILL
10				BROWN SILT, trace(–) fine Gravel — 11.1'	
	3			GRAY CLAYEY SILT, trace(–) fine Gravel, trace(–) fine Sand — 14.9'	UNWEATHERED TILL
15	4			GRAY SILTY CLAY, trace fine Gravel	
20	5			— 25.3'	
25	6			GRAY SILT + CLAY — 28.8'	
30	7			GRAY SILT + CLAY, trace(+) fine Sand grades to GRAY SILT, some(+) fine Sand — 34.1'	
35	8			GRAY CLAY, trace fine Gravel	
40					

AWARE INCORPORATED

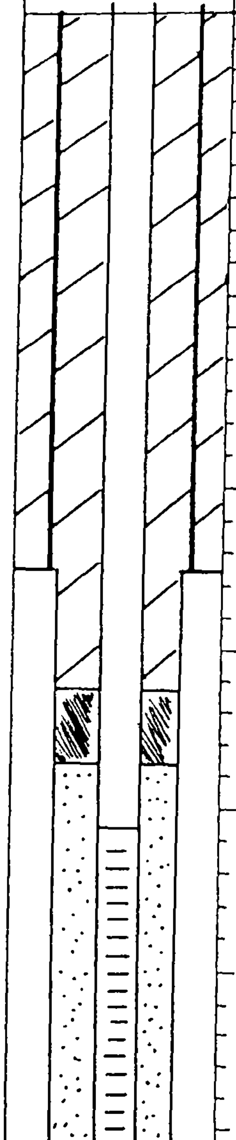
TEST BORING LOG

NO. RMI - 5D

PROJECT: RCRA FACILITY INVESTIGATION | SHEET NO. 2 of 2

CLIENT: RMI SODIUM PLANT | PROJECT NO. 6120

WELL CONSTRUCTION



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
40	9				
45				45'	
	10			GRAY CLAY, little Gravel Gravel is poorly sorted	
50	11				
55	12			Gravel angularity increases	
				56.95'	
				GRAY SHALE BEDROCK	CHAGRIN SHALE
60					
65					
70					
75				75.7'	
				END OF BORING	
80					

AWARE INCORPORATED

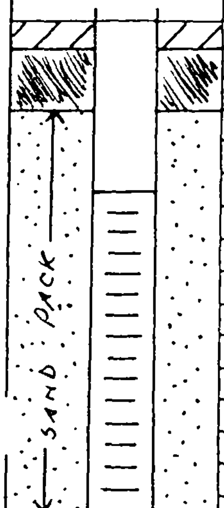
TEST BORING LOG

NO. RMI - 6S

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 1
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS	SAMPLER	TUBE	CORE
CONTRACTOR: PENNSYLVANIA DRILLING CO.				
DRILLER: BURNIE GOLLIHUE	TYPE		5' cont. split tube	
EQUIPMENT: ROTARY 8" OD AUGERS	DIAMETER		4"	
METHOD:	OTHER			

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT		GROUND	WELL	PROT CSG
			METHOD: Compressed Air	ELEV	645.1	647.95	
MATERIAL	PVC	PVC	DURATION: 40 min.	DATE STARTED: 10-12-88			
DIAMETER	2"	2"	YIELD:	DATE COMPLETED: 10-12-88			
COUPLING	THREADED	THREADED	OTHER: wtr clear	INSPECTOR: ROB GUIDRY			



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
0–6'	1			UNCONSOLIDATED SAND, SILT, CLAY, GRAVEL, BRICK, WOOD, CONCRETE, ASPHALT, AND ROCK FRAGMENTS 6'	COVER AND FILL
6'–12.5'	2			mottled GRAY AND BROWN CLAY + SILT, trace fine Gravel OXIDIZED FRACTURES 12.5'	WEATHERED TILL
12.5'–15.5'	3			GRAY SILTY CLAY, trace(-) fine Gravel 15.5'	UNWEATHERED TILL
				END OF BORING	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

AWARE INCORPORATED

TEST BORING LOG

NO. RMI-7D

PROJECT: RCRA FACILITY INVESTIGATION		SHEET NO. 1 of 2	
CLIENT: RMI SODIUM PLANT		PROJECT NO. 6120	

DRILLING DATA		SAMPLING METHODS	SAMPLER	TUBE	CORE
CONTRACTOR:	Pennsylvania Drilling Co.				
DRILLER:	BURNIE GOLLIHUE	TYPE		5' cont. split tube	
EQUIPMENT:	ROTARY 13" OD Auger to 59'	DIAMETER		4"	
METHOD:	5 7/8" bit to 76.65'	OTHER			

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT		GROUND	WELL	PROT CSG
MATERIAL	PVC	PVC	METHOD: Compressed Air	ELEV	641.3	642.41	
DIAMETER	2"	2"	DURATION: 45 min	DATE STARTED: 9-30-88			
COUPLING	THREADED	THREADED	YIELD: went DRY	DATE COMPLETED: 10-17-88			
			OTHER:	INSPECTOR: ROB GUIDRY			

DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
0–5	1			Cobbles, Gravel, SILT, CLAY, concrete, fine Sand. UNCONSOLIDATED	COVER and FILL
5–10	2			7.1'	
				GRAY SILTY CLAY, trace(–) poorly sorted GRAVEL. oxidized fractures present	WEATHERED TILL
10–15	3			10.3'	
				GRAY CLAY, trace(–) Gravel	UNWEATHERED TILL
15–20	4				
20–25	5			grades to	
25–30	6			GREY CLAY + SILT, trace(–) fine Sand	
30–35	7			33–37.3' small red clay inclusions and BLACK laminae present	
35–40	8			37.3'	
				GRAY SILTY CLAY, trace fine Gravel	
40					

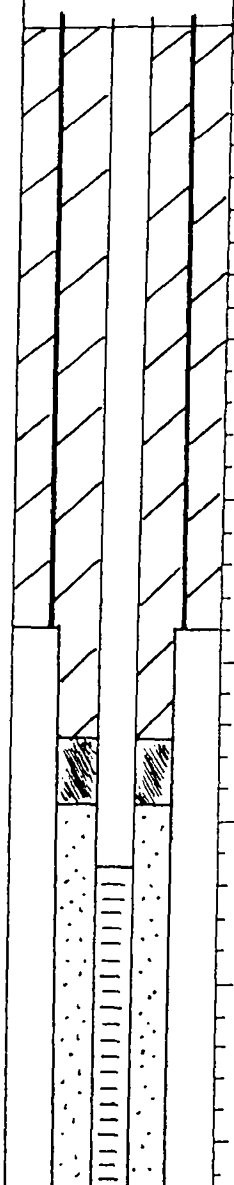
AWARE INCORPORATED

TEST BORING LOG

NO. RMI - 7D

PROJECT: RCRA FACILITY INVESTIGATION | SHEET NO. 2 of 2

CLIENT: RMI SODIUM PLANT | PROJECT NO. 6120



DEPTH (FEET)	SAMPLE NO	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
40–45	9			Gray Silty CLAY, trace fine Gravel	
45–50	10			Angular shale fragments increase in size and frequency	
51.6'					
50–55	11			Medium to Coarse SAND, little Clayey SILT, trace Gravel	
52.3'					
55–58	12			Gray Silty CLAY, trace fine Gravel	
58.1'					
				Gray Shale Bedrock	CHAGRIN SHALE
60.0'–60.5'				Soft drilling	
66.0'–66.3'				Soft drilling	
76.65'				END OF BORING	

Depth scale: 40, 45, 50, 55, 60, 65, 70, 75, 80

AWARE INCORPORATED

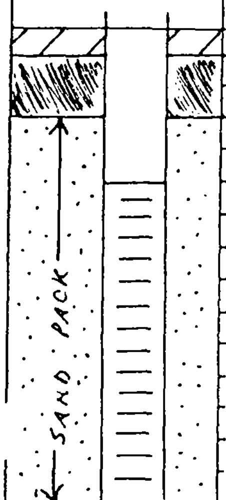
TEST BORING LOG

NO. RMI-7S

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 1
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA		SAMPLING METHODS		
		SAMPLER	TUBE	CORE
CONTRACTOR:	PENNSYLVANIA DRILLING CO.			
DRILLER:	BURNIE GOLLIHUE	TYPE	5' cont. split tube	
EQUIPMENT:	ROTARY 8" OD AUGERS	DIAMETER	4"	
METHOD:		OTHER		

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT		GROUND	WELL	PROT CSG
			METHOD: Compressed Air	ELEV	641.2	643.61	
MATERIAL	PVC	PVC	DURATION: 1 hr.	DATE STARTED: 10-13-88			
DIAMETER	2"	2"	YIELD:	DATE COMPLETED: 10-13-88			
COUPLING	THREADED	THREADED	OTHER: wtr clear	INSPECTOR: ROB GUIDRY			



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
0	1			SEE RMI-7D FOR GEOLOGIC DESCRIPTION	Cover and Fill
5					7.1'
	2				WEATHERED TILL
10					10.3
	3				UNWEATHERED TILL
15				15' END OF BORING	
20					
25					
30					
35					
40					

AWARE INCORPORATED

TEST BORING LOG

NO. RMI - 8S

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 1
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

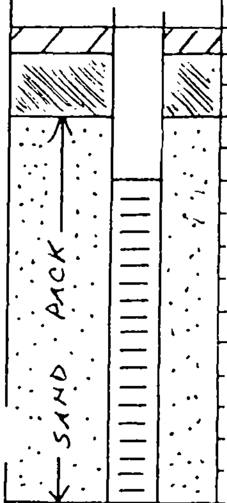
DRILLING DATA		SAMPLING METHODS			
			SAMPLER	TUBE	CORE
CONTRACTOR:	Pennsylvania Drilling Co.	TYPE		5' cont. split tube	
DRILLER:	Burnie Gollihue	DIAMETER		4"	
EQUIPMENT:	Rotary 8" OD Augers	OTHER			
METHOD:					

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC	PVC
DIAMETER	2"	2"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT	
METHOD:	Compressed Air
DURATION:	~1 hr 15 min
YIELD:	
OTHER:	wtr sl. silty

	GROUND	WELL	PROT CSG
ELEV	640.7	643.50	

DATE STARTED: 10-11-88
DATE COMPLETED: 10-11-88
INSPECTOR: Rob Guidry



Original boring loc. 6' east of well.

DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
0 – 2.5'	1			Gravel, Sand, Silt, Clay, Brick, Metal, 2.5'	FILL
2.5' – 8.9'	2			Mottled Brown and Gray CLAY + SILT, trace (–) fine to medium Gravel. Oxidized fractures	Weathered TILL
8.9' – 12'	3			8.9' Same as above except - no gravel 12'	
12' – 17.9'	3, 4			Gray Silty CLAY, trace fine Gravel. Oxidized fractures @ top. 13.5' Gray fine SAND. 17.9'	UNWEATHERED TILL
17.9' – 20'	4			Gray CLAY + SILT, trace (–) fine Gravel, thin fine Sand laminations present 20'	
20'				END OF BORING	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

AWARE INCORPORATED

TEST BORING LOG

NO. RMI-9S

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 1
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING CO.
DRILLER:	BURNIE GOLLIHUE
EQUIPMENT:	ROTARY 8" OD AUGERS
METHOD:	

SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE		5' cont. split tube	
DIAMETER		4"	
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC	PVC
DIAMETER	2"	2"
COUPLING	THREADED	THREADED

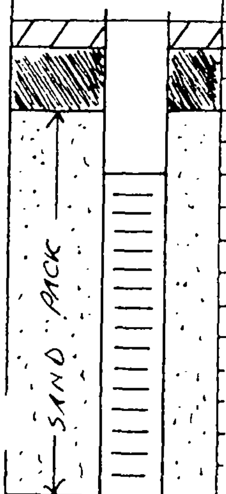
WELL DEVELOPMENT	
METHOD:	Compressed Air
DURATION:	~1 hr
YIELD:	
OTHER:	wtr clear

	GROUND	WELL	PROT CSG.
ELEV	638.1	640.82	

DATE STARTED: 10-14-88

DATE COMPLETED: 10-14-88

INSPECTOR: ROB GUIDRY



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
0				SEE RMI-9D FOR GEOLOGIC DESCRIPTION	0.8' Top soil and Fill
	1				WEATHERED TILL
5					
	2				
10					10.5'
	3				UNWEATHERED TILL
15				15' END OF BORING	
20					
25					
30					
35					
40					

AWARE INCORPORATED

TEST BORING LOG

NO. RMI-9D

PROJECT: RCRA FACILITY INVESTIGATION — SHEET NO. 1 of 2
CLIENT: RMI SODIUM PLANT — PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING CO.
DRILLER:	BURNIE GOLLIHUE
EQUIPMENT:	ROTARY 13" OD AUGER to 58.8'
METHOD:	

SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE		5' cont. split tube	
DIAMETER		4"	
OTHER	2"x2" split spoon from 35'-57.5'		

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC	PVC
DIAMETER	2"	2"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT
METHOD: Compressed Air
DURATION: 1 hr.
YIELD:
OTHER: wtr silty

	GROUND	WELL	PROT CSG
ELEV	638.4	640.29	

DATE STARTED: 9-26-88
DATE COMPLETED: 10-17-88
INSPECTOR: ROB GUIDRY

DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
0				BROWN CLAY + SILT, BRICK FRAGMENTS (0-1.8')	TOP SOIL AND FILL
	1			Mottled ORANGE, BROWN, AND GREY SILTY CLAY, OXIDIZED FRACTURES	WEATHERED TILL
5	2				
10				10.5	
	3			GRAY CLAY, trace fine Gravel, oxidized fractures near top	UNWEATHERED TILL
15	4			19'	
20	5			GRAY SILTY CLAY, trace fine Gravel	
25				25'	
	6			grades to GRAY SILT + CLAY	
30	7		3-16		
			23-27		
	8			35'	
35	9		21-36	Grades to GRAY Clayey SILT, trace(+) fine SAND	
			26-26		
	10		12-18		
			18-26		
40	11		16-18	39-43' same w/orange and black colored laminae	

AWARE INCORPORATED

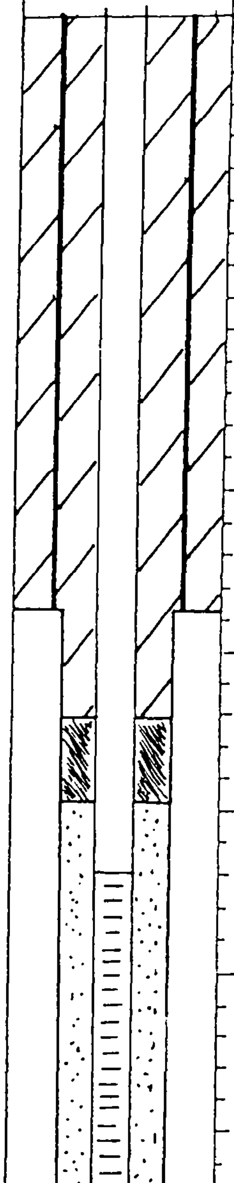
TEST BORING LOG

NO. RMI-9D

PROJECT: RCRA FACILITY INVESTIGATION | SHEET NO. 2 of 2

CLIENT: RMI SODIUM PLANT | PROJECT NO. 6120

WELL CONSTRUCTION



Depth (feet)	Sample No	Type	Blows per 6 inches	Classification (after Burmister, 1959)	Remarks
40	11		26-27		
	12		19-21		
			26-27	43'	
	13		15-15	Gray Silty CLAY, little (–) medium to fine Gravel	
45			30-26		
	14		13-16		
			18-24		
	15		12-12		
			18-26		
50	16		12-15		
			19-25		
	17		16-17		
			21-29		
	18		23-26		
55			45-61	angular shale fragments increase in size and frequency	
	19		25-30		
			60-78	57.04'	
				Gray Shale Bedrock	Chagrin Shale
60					
65					
70					
75				76.95'	
				End of Boring	
80					

AWARE INCORPORATED — TEST BORING LOG

NO. RMI-10S

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 1
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING CO.
DRILLER:	BURNIE GOLLIHUE
EQUIPMENT:	ROTARY
METHOD:	

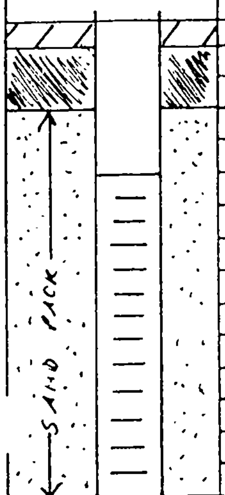
SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE		5' cont. split tube	
DIAMETER		4"	
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC	PVC
DIAMETER	2"	2"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT	
METHOD:	COMPRESSED AIR
DURATION:	~1 hr.
YIELD:	
OTHER:	wtr sl. silty

	GROUND	WELL	PROT CSG.
ELEV	641.8	644.57	

DATE STARTED: 10-12-88
DATE COMPLETED: 10-12-88
INSPECTOR: ROB GUIDRY



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
0–2.6'	1			Brown medium to coarse SAND, some silt, little (+) gravel. Below 1.6' – brown + black silty CLAY. 2.6'	LAWN COVER
2.6'–10'	2			Mottled brown, orange, and gray silty CLAY. Oxidized fractures present. 10'	weathered TILL
10'–15'	3			Gray silty CLAY, trace (–) gravel. Oxidized fractures in upper ~2'. 15'	unweathered TILL
15'				END OF BORING	

AWARE INCORPORATED

TEST BORING LOG

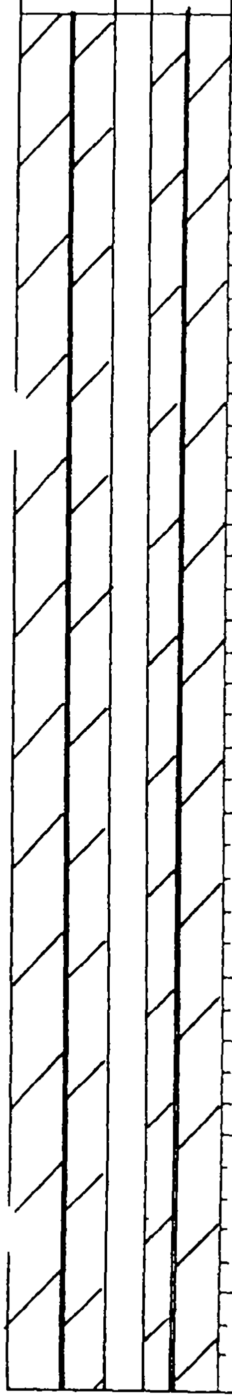
NO. RMI -11D

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 2
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA		SAMPLING METHODS	SAMPLER	TUBE	CORE
CONTRACTOR:	PENNSYLVANIA DRILLING CO.				
DRILLER:	BURNIE GOLLIHUE	TYPE		5' cont. split tube	
EQUIPMENT:	ROTARY	DIAMETER		4"	
METHOD:		OTHER			

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT		GROUND	WELL	PROT CSG
			METHOD:	ELEV	636.7	639.23	
MATERIAL	PVC	PVC	DURATION:	DATE STARTED: 10-25-88			
DIAMETER	2"	2"	YIELD:	DATE COMPLETED: 10-27-88			
COUPLING	THREADED	THREADED	OTHER:	INSPECTOR: ROB GUIDRY			

WELL CONSTRUCTION



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
0				GRAVEL, SAND, SILT, CINDER 1.6'	cover and FILL
	1			Mottled GRAY and BROWN SILTY CLAY, trace(–) gravel. OXIDIZED FRACTURES. 2.2 to 3.6' – sand gravel and silt-rich LAYERS	WEATHERED TILL
5	2			10.95	
10	3			GRAY SILTY CLAY, trace(–) Gravel. OXIDIZED SILT-filled fractures near top 13'	UNWEATHERED TILL
				Gray SILT, trace(+) fine Sand 15.7'	
15	4			GRAY CLAY 16.7	
				GRAY fine Sand 17.2'	
				GRAY CLAY + SILT, trace fine Sand 18.9'	
20	5			Mottled Gray and PINK CLAY, trace fine sand in upper 1.5' 23.7'	
25	6			GRAY SILTY CLAY, trace(–) fine Gravel	
30	7				
35	8			35' Angular SHALE FRAGMENTS	
40					

AWARE INCORPORATED

TEST BORING LOG

NO. RMI-11D

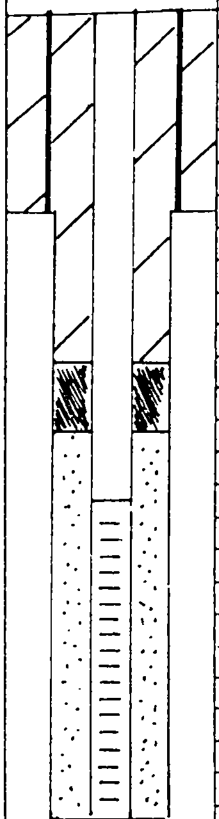
PROJECT: RCRA FACILITY INVESTIGATION

CLIENT: RMI SODIUM PLANT

SHEET NO. 2 of 2

PROJECT NO. 6120

WELL CONSTRUCTION



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
40	9			Gray Silty CLAY, trace (-) fine Gravel Angular shale fragments increase in frequency 45.2'	
45				GRAY SHALE BEDROCK	CHAGRIN SHALE
50					
55					
60					
65				65.5' END OF BORING	
70					

AWARE INCORPORATED

TEST BORING LOG

NO. SB-11

PROJECT: RCRA FACILITY INVESTIGATION
CLIENT: RMI SODIUM PLANT

SHEET NO. 1 of 1
PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING CO.
DRILLER:	BURNIE GOLLIHUE
EQUIPMENT:	ROTARY 8" OD AUGER
METHOD:	

SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE		5' cont. split tube	
DIAMETER		4"	
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL		
DIAMETER		
COUPLING		

WELL DEVELOPMENT
METHOD:
DURATION:
YIELD:
OTHER:

	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED: 10-7-88
DATE COMPLETED: 10-7-88
INSPECTOR: ROB GUIDRY

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
BACK FILLED WITH CEMENT-BENTONITE GROUT (0–30')	0	1			BLACK SAND AND GRAVEL (POSS. CINDER) 1.7' DARK GREEN to BROWN Sand, Gravel and Clayey SILT 3.65'	FILL
	5	2			Mottled GRAY AND BROWN CLAY OXIDIZED FRACTURES 5.6' BROWN CLAYEY SILT grades to BROWN SILT + CLAY (OXIDIZED FRACTURES) 8.2' BROWN CLAY + SILT OXIDIZED FRACTURES 11.8'	WEATHERED TILL
	10	3			Alternating GRADED layers of GRAY SILT and GRAY CLAY trace (–) fine Gravel 20'	UNWEATHERED TILL
	15	4				
	20	5			GRAY fine SAND AND SILT 21.9' grades to GRAY CLAY, trace (–) Gravel BLACK and PINK Mottling present 28.85'	
	25	6			GRAY SILTY CLAY, trace fine Gravel 30'	
	30				END OF BORING	
	35					
	40					

AWARE INCORPORATED

TEST BORING LOG

NO. SB-12

PROJECT: RCRA FACILITY INVESTIGATION

CLIENT: RMI SODIUM PLANT

SHEET NO. 1 of 1

PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING CO.
DRILLER:	BURNIE GOLLIHUE
EQUIPMENT:	ROTARY 8" OD AUGER
METHOD:	

SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE		5' cont. split tube	
DIAMETER		4"	
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL		
DIAMETER		
COUPLING		

WELL DEVELOPMENT	
METHOD:	
DURATION:	
YIELD:	
OTHER:	

	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED: 10-10-88

DATE COMPLETED: 10-10-88

INSPECTOR: ROB GUIDRY

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
BACKFILLED WITH CEMENT-BENTONITE GROUT	0 – 2.3	1			UNCONSOLIDATED GRAVEL, SAND, SILT, ASPHALT, CONCRETE, CHARCOAL 2.3	FILL
	2.3 – 5.7	1			Mottled Brown and Gray CLAY, trace Gravel; OXIDIZED FRACTURES 5.7	WEATHERED TILL
	5.7 – 11.5	2			BROWN SILT, some (–) fine Sand; OXIDIZED FRACTURES; GRADES TO GREY COLOR @ BASE 11.5'	WEATHERED TILL
	11.5 – 17.2	3			GRAY Silty CLAY, trace fine Gravel 17.2'	UNWEATHERED TILL
	17.2 – 22.5	4, 5			GRAY SILT + CLAY 22.5'	UNWEATHERED TILL
	22.5 – 25	5			GRAY Clayey SILT, some fine Sand, trace (–) fine Gravel 25'	UNWEATHERED TILL
	25 – 26.8	6			GRAY fine SAND 26.8'	UNWEATHERED TILL
	26.8 – 30.2	6			GRAY fine SAND AND SILT 30.2'	UNWEATHERED TILL
	30.2 – 35	7			GRAY SILTY CLAY, trace Gravel 35'	UNWEATHERED TILL
	35				END OF BORING	

AWARE INCORPORATED

TEST BORING LOG

NO. SB-13

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 1
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING CO.
DRILLER:	BURNIE GOLLIHUE
EQUIPMENT:	ROTARY 8" OD AUGER
METHOD:	

SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE		5' cont. split tube	
DIAMETER		4"	
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL		
DIAMETER		
COUPLING		

WELL DEVELOPMENT	
METHOD:	
DURATION:	
YIELD:	
OTHER:	

	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED: 10-10-88
DATE COMPLETED: 10-10-88
INSPECTOR: ROB GUIDRY

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
BACKFILLED WITH CEMENT-BENTONITE GROUT	0–3.5	1			UNCONSOLIDATED SILT, SAND, GRAVEL, CONCRETE, ASPHALT, CHARCOAL 3.5'	FILL
	3.5–5.8				BROWN Clayey SILT AND SAND some (–) Gravel 5.8'	WEATHERED TILL
	5.8–10.6	2			BROWN Silty CLAY, trace Gravel; OXIDIZED FRACTURES; BROWN AND GRAY MOTTLING @ BASE 10.6	WEATHERED TILL
	10.6–20	3, 4			GRAY SILTY CLAY, trace fine Gravel; OXIDIZED FRACTURES @ TOP 20'	UNWEATHERED TILL
	20–22.1	5			GRAY SILT + CLAY 22.1'	UNWEATHERED TILL
	22.1–24.2				Alternating Laminae of fine SAND, AND BLACK OR RED CLAY 24.2'	UNWEATHERED TILL
	24.2–26.2				Gray fine SAND, some (–) SILT 26.2	UNWEATHERED TILL
	26.2–30	6			Gray fine SAND, some Clayey SILT 30'	UNWEATHERED TILL
	30				END OF BORING	

AWARE INCORPORATED

TEST BORING LOG

NO. SB-14

PROJECT: RCRA FACILITY INVESTIGATION
CLIENT: RMI SODIUM PLANT
SHEET NO. 1 of 1
PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING CO.
DRILLER:	BURNIE GOLLIHUE
EQUIPMENT:	ROTARY 8" OD AUGER
METHOD:	

SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE		5' cont. SPLIT TUBE	
DIAMETER		4"	
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL		
DIAMETER		
COUPLING		

WELL DEVELOPMENT
METHOD:
DURATION:
YIELD:
OTHER:

	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED: 10-7-88
DATE COMPLETED: 10-7-88
INSPECTOR: ROB GUIDRY

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
BACKFILLED WITH CEMENT-BENTONITE GROUT	0				UNCONSOLIDATED SAND, SILT, CLAY, AND GRAVEL 1.7'	FILL
		1			Mottled Brown and Gray SILTY CLAY, trace (-) fine Gravel	
	5				OXIDIZED FRACTURES	WEATHERED TILL
		2			8.5'	
	10				Mottled Gray and Brown CLAY + SILT, trace (-) fine Gravel 10'	
		3			Gray SILTY CLAY, trace (-) fine to medium Gravel	
	15					UNWEATHERED TILL
		4				
	20					
		5				
	25				25'	
		6			GRADES TO GRAY CLAY + SILT 27'	
					GRADES TO GRAY CLAYEY SILT	
	30				30'	
					END OF BORING	
	35					
	40					

AWARE INCORPORATED

TEST BORING LOG

NO. SB-15

PROJECT: RCRA FACILITY INVESTIGATION
CLIENT: RMI SODIUM PLANT

SHEET NO. 1 of 1
PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING CO.
DRILLER:	BURNIE GOLLIHUE
EQUIPMENT:	ROTARY 8" OD AUGER
METHOD:	

SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE		5' cont. SPLIT TUBE	
DIAMETER		4"	
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL		
DIAMETER		
COUPLING		

WELL DEVELOPMENT
METHOD:
DURATION:
YIELD:
OTHER:

	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED: 10-6-88
DATE COMPLETED: 10-6-88
INSPECTOR: ROB GUIDRY

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
BACK FILLED WITH CEMENT-BENTONITE GROUT	0–2.95	1			DARK BROWN to BLACK SILT, little SAND, trace fine-medium Gravel; GREY CLAY NEAR BASE (2.95')	FILL
	2.95–10.4	2			Mottled BROWN AND GRAY SILTY CLAY, trace (−) Gravel; OXIDIZED FRACTURES (10.4)	WEATHERED TILL
	10.4–11.4				BROWN OXIDIZED SILT (11.4)	
	11.4–15	3			GRAY SILTY CLAY, trace Gravel (15')	UNWEATHERED TILL
	15–25	4, 5			GRAY CLAY, trace Gravel (25')	
	25–30	6			GRAY CLAY + SILT (30')	
	30				END OF BORING	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

AWARE INCORPORATED

TEST BORING LOG

NO. SB-16

PROJECT: RCRA FACILITY INVESTIGATION — SHEET NO. 1 of 1

CLIENT: RMI SODIUM PLANT — PROJECT NO. 6120

DRILLING DATA		SAMPLING METHODS	SAMPLER	TUBE	CORE
CONTRACTOR:	Pennsylvania Drilling Co.				
DRILLER:	BURNIE GOLLIHUE	TYPE		5' cont. split tube	
EQUIPMENT:	ROTARY 8" OD AUGER	DIAMETER		4"	
METHOD:		OTHER			

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT			GROUND	WELL	PROT CSG.
			METHOD:		ELEV			
MATERIAL			DURATION:		DATE STARTED: 10-5-88			
DIAMETER			YIELD:		DATE COMPLETED: 10-5-88			
COUPLING			OTHER:		INSPECTOR: ROB GUIDRY			

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
BACKFILLED WITH CEMENT-BENTONITE GROUT	0				UNCONSOLIDATED SILT, GRAVEL, METAL, SAND, CONCRETE, BRICK, WOOD	FILL
		1			Mottled Brown and Gray CLAY, trace Gravel	
	5	—			OXIDIZED FRACTURES	WEATHERED TILL
		2				
	10	—				
		3			14.4'	
	15	—			Gray Silty CLAY, trace fine Gravel. SILT LAMINATIONS PRESENT 17.4'	
		4			Gray Silty CLAY, trace fine Gravel	UNWEATHERED TILL
	20	—				
		5				
	25	—				
		6			30'	
	30				END OF BORING	
	35					
	40					

AWARE INCORPORATED

TEST BORING LOG

NO. SB-17

PROJECT: RCRA FACILITY INVESTIGATION	SHEET NO. 1 of 1
CLIENT: RMI SODIUM PLANT	PROJECT NO. 6120

DRILLING DATA

CONTRACTOR:	PENNSYLVANIA DRILLING CO.
DRILLER:	BURNIE GOLLIHUE
EQUIPMENT:	ROTARY 8" OD AUGER
METHOD:	

SAMPLING METHODS

	SAMPLER	TUBE	CORE
TYPE		5' cont. SPLIT TUBE	
DIAMETER		4"	
OTHER			

WELL CONSTRUCTION

	RISER	INTAKE
MATERIAL		
DIAMETER		
COUPLING		

WELL DEVELOPMENT

METHOD:
DURATION:
YIELD:
OTHER:

	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED: 10-6-88
DATE COMPLETED: 10-6-88
INSPECTOR: ROB GUIDRY

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS
BACKFILLED WITH CEMENT-BENTONITE GROUT	0–5.5'	1			CLAYEY SILT, GRAVEL, BRICK, WOOD, SAND — 5.5'	FILL
	5.5'–14.2'	2, 3			Mottled Gray and Brown SILTY CLAY, trace (–) Gravel; OXIDIZED FRACTURES — 14.2'	WEATHERED TILL
	14.2'–18.3'	3, 4			Alternating LAYERS OF GRAY AND BROWN SILTY CLAY; HEAVILY OXIDIZED FRACTURES PRESENT — 18.3'	
	18.3'–30'	4, 5, 6			GRAY CLAY + SILT, trace (–) Gravel, LARGE OXIDIZED FRACTURES NEAR TOP; GRADES TO GRAY SILTY CLAY, trace (–) Gravel — 30'	UNWEATHERED TILL
	30'				END OF BORING	

AWARE INCORPORATED

TEST BORING LOG

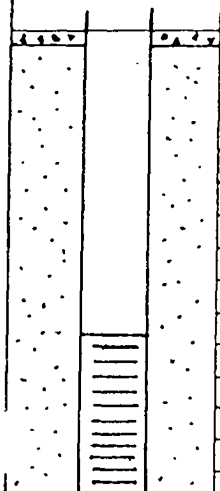
NO. PZ-1

PROJECT: HYDROGEOLOGIC INVESTIGATION | SHEET NO. 1 of 20

CLIENT: RMI SODIUM PLANT ASHTABULA, OH | PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS			
		SAMPLER	TUBE	CORE
CONTRACTOR: PENNSYLVANIA DRILLING COMPANY	TYPE	NONE		
DRILLER: PETER MARTIN	DIAMETER			
EQUIPMENT: TRUCK MOUNTED RIG	OTHER			
METHOD: 6"OD SOLID STEM AUGER				

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT		GROUND	WELL	PROT CSG
MATERIAL	PVC (S-40)	PVC	METHOD: NONE	ELEV			
DIAMETER	1.5"	1.5"	DURATION:	DATE STARTED: 8-16-88			
COUPLING	THREADED	THREADED	YIELD:	DATE COMPLETED: 8-16-88			
			OTHER:	INSPECTOR: ROB GUIDRY			

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0–14.8				GREY TILL	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
	14.8				14.8' END OF BORING	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

AWARE INCORPORATED	TEST BORING LOG	NO. PZ-2

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING COMPANY
DRILLER:	PETER MARTIN
EQUIPMENT:	TRUCK MOUNTED RIG
METHOD:	6" OD SOLID STEM AUGER

SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE	NONE		
DIAMETER			
OTHER			

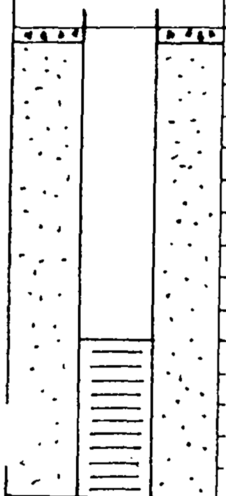
WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC (S-40)	PVC
DIAMETER	1.5"	1.5"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT	
METHOD:	NONE
DURATION:	
YIELD:	
OTHER:	

	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED:	8-16-88
DATE COMPLETED:	8-16-88
INSPECTOR:	ROB GUIDRY

WELL CONSTRUCTION



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–10				BROWN SILT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
10–15				GREY TILL	
15				15' END OF BORING	
20					
25					
30					
35					
40					

AWARE INCORPORATED — TEST BORING LOG

NO. PZ-3

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	Pennsylvania Drilling Company
DRILLER:	Peter Martin
EQUIPMENT:	Truck Mounted Rig
METHOD:	6" OD Solid Stem Auger

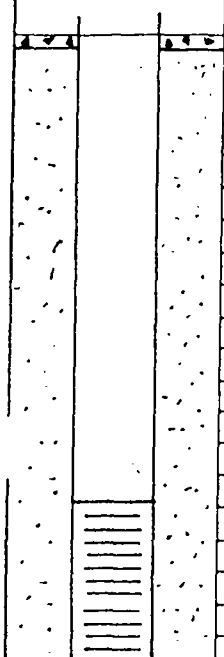
SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE	NONE		
DIAMETER			
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC (S-40)	PVC
DIAMETER	1.5"	1.5"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT	
METHOD:	NONE
DURATION:	
YIELD:	
OTHER:	

	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED: 8-18-88
DATE COMPLETED: 8-18-88
INSPECTOR: ROB GUIDRY



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–9				BROWN SILT	NO SAMPLES COLLECTED. DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
9–19.9				GREY TILL	
19.9				19.9' END OF BORING	

AWARE INCORPORATED — TEST BORING LOG

NO. PZ-4

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	Pennsylvania Drilling Company
DRILLER:	Peter Martin
EQUIPMENT:	Truck Mounted Rig
METHOD:	6"OD SOLID STEM AUGER

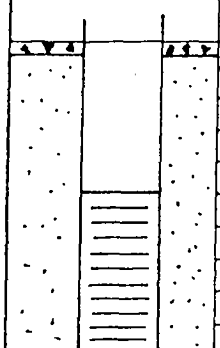
SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE	NONE		
DIAMETER			
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC (S-40)	PVC
DIAMETER	1.5"	1.5"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT	
METHOD:	NONE
DURATION:	
YIELD:	
OTHER:	

	GROUND	WELL	PROT CSG.
ELEV			

DATE STARTED: 8-17-88
DATE COMPLETED: 8-17-88
INSPECTOR: ROB GUIDRY



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0				ASPHALT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
				BROWN SANDY SILT	
5					
				BROWN SILT	
10				10' END OF BORING	
15					
20					
25					
30					
35					
40					

AWARE INCORPORATED

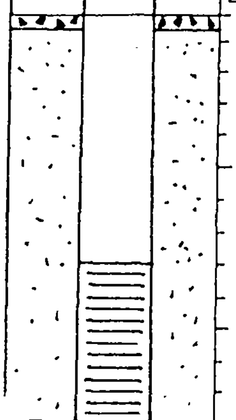
TEST BORING LOG

NO. PZ-5

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA		SAMPLING METHODS			
			SAMPLER	TUBE	CORE
CONTRACTOR:	PENNSYLVANIA DRILLING COMPANY	TYPE	NONE		
DRILLER:	PETER MARTIN	DIAMETER			
EQUIPMENT:	TRUCK MOUNTED RIG	OTHER			
METHOD:	6"OD SOLID STEM AUGER				

WELL CONSTRUCTION			WELL DEVELOPMENT		GROUND	WELL	PROT CSG
	RISER	INTAKE	METHOD: NONE	ELEV			
MATERIAL	PVC (S-40)	PVC	DURATION:	DATE STARTED: 8-17-88			
DIAMETER	1.5"	1.5"	YIELD:	DATE COMPLETED: 8-17-88			
COUPLING	THREADED	THREADED	OTHER:	INSPECTOR: ROB GUIDRY			



DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0				ASPHALT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
5				BROWN SILT	
10					
				GREY TILL	
				13' END OF BORING	
15					
20					
25					
30					
35					
40					

AWARE INCORPORATED

TEST BORING LOG

NO. PZ-6

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	Pennsylvania Drilling Company
DRILLER:	Peter Martin
EQUIPMENT:	Truck Mounted Rig
METHOD:	6"OD Solid Stem Auger

SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE	NONE		
DIAMETER			
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC (S-40)	PVC
DIAMETER	1.5"	1.5"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT	
METHOD:	NONE
DURATION:	
YIELD:	
OTHER:	

	GROUND	WELL	PROT CSG
ELEV			
DATE STARTED: 8-17-88			
DATE COMPLETED: 8-17-88			
INSPECTOR: ROB GUIDRY			

DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0				BLACK SOIL AND GRAVEL	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
0–7				BROWN SILT	
7–10				GREY TILL	
10				10' END OF BORING	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

AWARE INCORPORATED

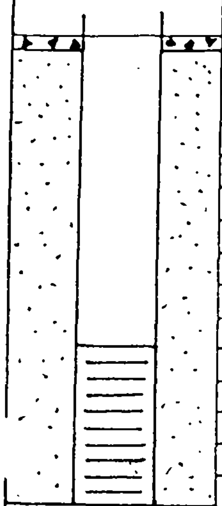
TEST BORING LOG

NO. PZ-7

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS			
CONTRACTOR: PENNSYLVANIA DRILLING COMPANY		SAMPLER	TUBE	CORE
DRILLER: PETER MARTIN	TYPE	NONE		
EQUIPMENT: TRUCK MOUNTED RIG	DIAMETER			
METHOD: 6"OD SOLID STEM AUGER	OTHER			

WELL CONSTRUCTION			WELL DEVELOPMENT		GROUND	WELL	PROT CSG
	RISER	INTAKE	METHOD: NONE	ELEV			
MATERIAL	PVC (S-40)	PVC	DURATION:	DATE STARTED: 8-17-88			
DIAMETER	1.5"	1.5"	YIELD:	DATE COMPLETED: 8-17-88			
COUPLING	THREADED	THREADED	OTHER:	INSPECTOR: ROB GUIDRY			

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0–8				BROWN SILT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
	8–15				GREY TILL	
	15				15' END OF BORING	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

AWARE INCORPORATED

TEST BORING LOG

NO. PZ - 8

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO.

DRILLING DATA	SAMPLING METHODS			
CONTRACTOR: PENNSYLVANIA DRILLING COMPANY		SAMPLER	TUBE	CORE
DRILLER: PETER MARTIN	TYPE	NONE		
EQUIPMENT: TRUCK MOUNTED RIG	DIAMETER			
METHOD: 6" OD SOLID STEM AUGER	OTHER			

WELL CONSTRUCTION			WELL DEVELOPMENT		GROUND	WELL	PROT CSG
	RISER	INTAKE	METHOD: NONE	ELEV			
MATERIAL	PVC (S-40)	PVC	DURATION:	DATE STARTED: 8- -88			
DIAMETER	1.5"	1.5"	YIELD:	DATE COMPLETED: 8- -88			
COUPLING	THREADED	THREADED	OTHER:	INSPECTOR: ROB GUIDRY			

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0–10				BROWN SILT	NO SAMPLES COLLECTED. DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
	10				10' END OF BORING	
	15					
	20					
	25					
	30					
	35					
	40					

AWARE INCORPORATED

TEST BORING LOG

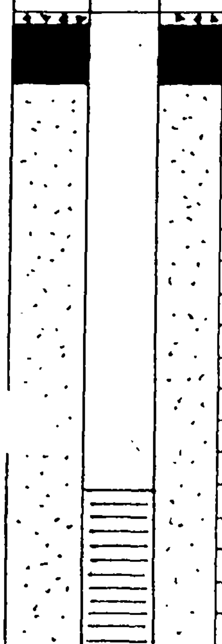
NO. PZ-9

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS			
CONTRACTOR: Pennsylvania Drilling Company		SAMPLER	TUBE	CORE
DRILLER: Peter Martin	TYPE	NONE		
EQUIPMENT: TRUCK MOUNTED RIG	DIAMETER			
METHOD: 6"OD SOLID STEM AUGER	OTHER			

WELL CONSTRUCTION			WELL DEVELOPMENT		GROUND	WELL	PROT CSG
	RISER	INTAKE	METHOD: NONE	ELEV			
MATERIAL	PVC (S-40)	PVC	DURATION:	DATE STARTED: 8-18-88			
DIAMETER	1.5"	1.5"	YIELD:	DATE COMPLETED: 8-18-88			
COUPLING	THREADED	THREADED	OTHER:	INSPECTOR: ROB GUIDRY			

WELL CONSTRUCTION



DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–3.5				CLAY CAP	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
3.5–19				GRAVEL @ 5' FILL AND BROWN SILT	
19–20.2				BROWN SILT	
20.2				20.2' END OF BORING	

AWARE INCORPORATED

TEST BORING LOG

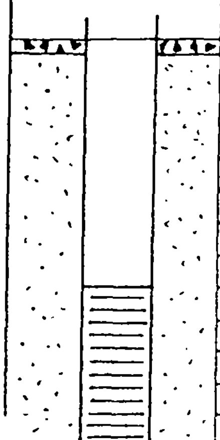
NO. PZ-10

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA		SAMPLING METHODS			
			SAMPLER	TUBE	CORE
CONTRACTOR: PENNSYLVANIA DRILLING COMPANY		TYPE	NONE		
DRILLER: PETER MARTIN		DIAMETER			
EQUIPMENT: TRUCK MOUNTED RIG		OTHER			
METHOD: 6" OD SOLID STEM AUGER					

WELL CONSTRUCTION			WELL DEVELOPMENT		GROUND	WELL	PROT CSG
	RISER	INTAKE	METHOD: NONE	ELEV			
MATERIAL	PVC (S-40)	PVC	DURATION:	DATE STARTED: 8-18-88			
DIAMETER	1.5"	1.5"	YIELD:	DATE COMPLETED: 8-18-88			
COUPLING	THREADED	THREADED	OTHER:	INSPECTOR: ROB GUIDRY			

WELL CONSTRUCTION



DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–3				BLACK SANDY SILT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
3–10				BROWN SILT	
10–13				GREY TILL	
13				13' END OF BORING	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

AWARE INCORPORATED

TEST BORING LOG

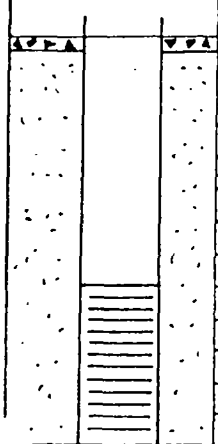
NO. PZ-11

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS			
		SAMPLER	TUBE	CORE
CONTRACTOR: Pennsylvania Drilling Company	TYPE	NONE		
DRILLER: Peter Martin	DIAMETER			
EQUIPMENT: Truck Mounted Rig	OTHER			
METHOD: 6"OD SOLID STEM AUGER				

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT		GROUND	WELL	PROT CSG
			METHOD: NONE	ELEV			
MATERIAL	PVC (S-40)	PVC	DURATION:	DATE STARTED: 8-18-88			
DIAMETER	1.5"	1.5"	YIELD:	DATE COMPLETED: 8-18-88			
COUPLING	THREADED	THREADED	OTHER:	INSPECTOR: ROB GUIDRY			

WELL CONSTRUCTION



DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–3.5				DARK BROWN SILT	NO SAMPLES COLLECTED. DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
3.5–11				BROWN SILT	
11–13				GREY TILL	
13				13' END OF BORING	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

AWARE INCORPORATED

TEST BORING LOG

NO. PZ-12

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING COMPANY
DRILLER:	PETER MARTIN
EQUIPMENT:	TRUCK MOUNTED RIG
METHOD:	6"OD SOLID STEM AUGER

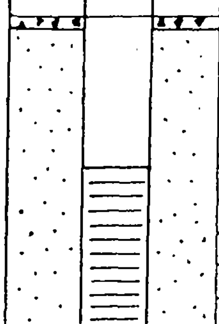
SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE	NONE		
DIAMETER			
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC (S-40)	PVC
DIAMETER	1.5"	1.5"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT	
METHOD:	NONE
DURATION:	
YIELD:	
OTHER:	

	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED:	8-18-88
DATE COMPLETED:	8-18-88
INSPECTOR:	ROB GUIDRY

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0–10				BROWN SILT	NO SAMPLES COLLECTED. DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
	10				10' END OF BORING	
	15					
	20					
	25					
	30					
	35					
	40					

AWARE INCORPORATED

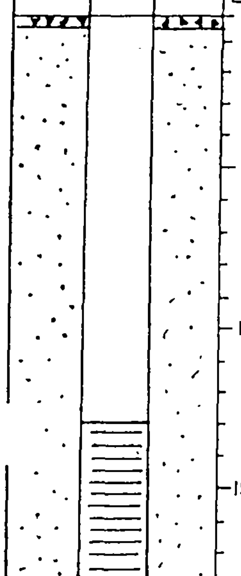
TEST BORING LOG

NO. PZ - 13

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS			
		SAMPLER	TUBE	CORE
CONTRACTOR: PENNSYLVANIA DRILLING COMPANY	TYPE	NONE		
DRILLER: PETER MARTIN	DIAMETER			
EQUIPMENT: TRUCK MOUNTED RIG	OTHER			
METHOD: 6"OD SOLID STEM AUGER				

WELL CONSTRUCTION			WELL DEVELOPMENT		GROUND	WELL	PROT CSG
	RISER	INTAKE	METHOD: NONE	ELEV			
MATERIAL	PVC (S-40)	PVC	DURATION:	DATE STARTED: 8-17-88			
DIAMETER	1.5"	1.5"	YIELD:	DATE COMPLETED: 8-17-88			
COUPLING	THREADED	THREADED	OTHER:	INSPECTOR: ROB GUIDRY			



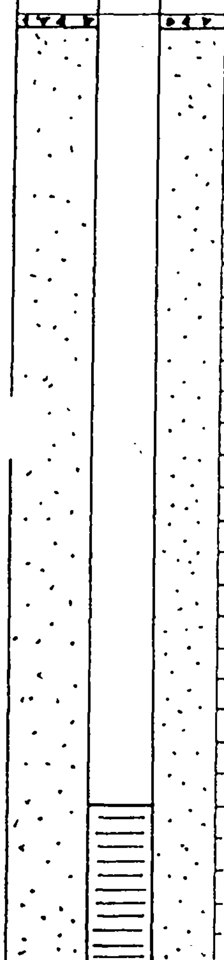
DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–17				BROWN SILT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
17–18				GREY TILL	
18				18' END OF BORING	

AWARE INCORPORATED	TEST BORING LOG	NO. PZ-14

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS			
		SAMPLER	TUBE	CORE
CONTRACTOR: Pennsylvania Drilling Company	TYPE	NONE		
DRILLER: PETER MARTIN	DIAMETER			
EQUIPMENT: TRUCK MOUNTED RIG	OTHER			
METHOD: 6"OD SOLID STEM AUGER				

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT		GROUND	WELL	PROT CSG.
			METHOD: NONE	ELEV			
MATERIAL	PVC (S-40)	PVC	DURATION:	DATE STARTED: 8-17-88			
DIAMETER	1.5"	1.5"	YIELD:	DATE COMPLETED: 8-17-88			
COUPLING	THREADED	THREADED	OTHER:	INSPECTOR: ROB GUIDRY			



DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–13.5				BROWN SILT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
13.5–30				GREY TILL	
30				30' END OF BORING	

AWARE INCORPORATED

TEST BORING LOG

NO. PZ-15

PROJECT: HYDROGEOLOGIC INVESTIGATION

CLIENT: RMI SODIUM PLANT ASHTABULA, OH

SHEET NO. 1 of 20

PROJECT NO. 6120

DRILLING DATA

CONTRACTOR: PENNSYLVANIA DRILLING COMPANY

DRILLER: PETER MARTIN

EQUIPMENT: TRUCK MOUNTED RIG

METHOD: 6"OD SOLID STEM AUGER

SAMPLING METHODS

	SAMPLER	TUBE	CORE
TYPE	NONE		
DIAMETER			
OTHER			

WELL CONSTRUCTION

	RISER	INTAKE
MATERIAL	PVC (S-40)	PVC
DIAMETER	1.5"	1.5"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT

METHOD: NONE

DURATION:

YIELD:

OTHER:

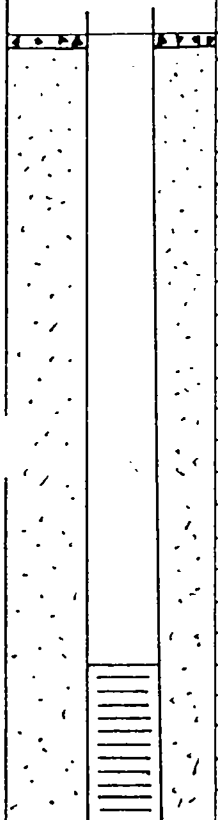
	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED: 8-17-88

DATE COMPLETED: 8-17-88

INSPECTOR: ROB GUIDRY

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0				FILL	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
	5					
	10				BROWN SILT	
	15					
	20				GREY TILL	
	25				25' END OF BORING	
	30					
	35					
	40					



AWARE INCORPORATED

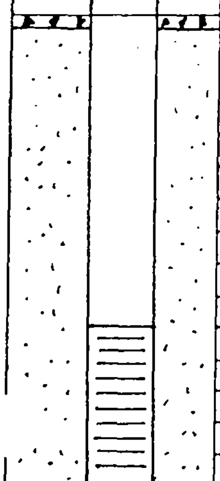
TEST BORING LOG

NO. PZ-16

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS			
		SAMPLER	TUBE	CORE
CONTRACTOR: PENNSYLVANIA DRILLING COMPANY				
DRILLER: PETER MARTIN	TYPE	NONE		
EQUIPMENT: TRUCK MOUNTED RIG	DIAMETER			
METHOD: 6"OD SOLID STEM AUGER	OTHER			

WELL CONSTRUCTION			WELL DEVELOPMENT		GROUND	WELL	PROT CSG
	RISER	INTAKE	METHOD: NONE	ELEV			
MATERIAL	PVC (S-40)	PVC	DURATION:	DATE STARTED: 8-16-88			
DIAMETER	1.5"	1.5"	YIELD:	DATE COMPLETED: 8-16-88			
COUPLING	THREADED	THREADED	OTHER:	INSPECTOR: ROB GUIDRY			

WELL CONSTRUCTION	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0–12				BROWN SILT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
	12–15				GREY TILL	
	15				15' END OF BORING	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

AWARE INCORPORATED

TEST BORING LOG

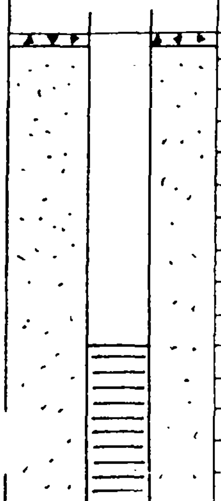
NO. PZ-17

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	SAMPLING METHODS			
CONTRACTOR: PENNSYLVANIA DRILLING COMPANY		SAMPLER	TUBE	CORE
DRILLER: PETER MARTIN	TYPE	NONE		
EQUIPMENT: TRUCK MOUNTED RIG	DIAMETER			
METHOD: 6"OD SOLID STEM AUGER	OTHER			

WELL CONSTRUCTION			WELL DEVELOPMENT				
	RISER	INTAKE	METHOD: NONE		GROUND	WELL	PROT CSG
				ELEV			
MATERIAL	PVC (S-40)	PVC	DURATION:	DATE STARTED: 8-16-88			
DIAMETER	1.5"	1.5"	YIELD:	DATE COMPLETED: 8-16-88			
COUPLING	THREADED	THREADED	OTHER:	INSPECTOR: ROB GUIDRY			

DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–12				BROWN SILT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
12–15				GREY TILL	
15				15' END OF BORING	



AWARE INCORPORATED

TEST BORING LOG

NO. PZ-18

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

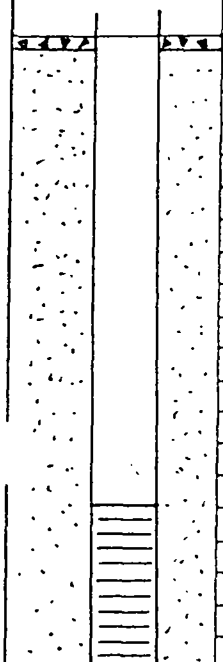
DRILLING DATA		SAMPLING METHODS		
CONTRACTOR: Pennsylvania Drilling Company		SAMPLER	TUBE	CORE
DRILLER: PETER MARTIN	TYPE	NONE		
EQUIPMENT: TRUCK MOUNTED RIG	DIAMETER			
METHOD: 6" OD SOLID STEM AUGER	OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC (S-40)	PVC
DIAMETER	1.5"	1.5"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT	
METHOD:	NONE
DURATION:	
YIELD:	
OTHER:	

	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED: 8-17-88
DATE COMPLETED: 8-17-88
INSPECTOR: ROB GUIDRY



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–10				BROWN SILT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
10–20				GREY TILL	
20				20' END OF BORING	

AWARE INCORPORATED

TEST BORING LOG

NO. PZ-19

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR: PENNSYLVANIA DRILLING COMPANY	
DRILLER: PETER MARTIN	
EQUIPMENT: TRUCK MOUNTED RIG	
METHOD: 6"OD SOLID STEM AUGER	

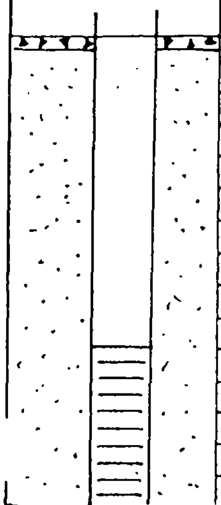
SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE	NONE		
DIAMETER			
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC (S-40)	PVC
DIAMETER	1.5"	1.5"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT	
METHOD:	NONE
DURATION:	
YIELD:	
OTHER:	

	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED: 8-18-88
DATE COMPLETED: 8-18-88
INSPECTOR: ROB GUIDRY



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–15				BROWN SILT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
15				15' END OF BORING	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

AWARE INCORPORATED

TEST BORING LOG

NO. PZ-20

PROJECT: HYDROGEOLOGIC INVESTIGATION	SHEET NO. 1 of 20
CLIENT: RMI SODIUM PLANT ASHTABULA, OH	PROJECT NO. 6120

DRILLING DATA	
CONTRACTOR:	PENNSYLVANIA DRILLING COMPANY
DRILLER:	PETER MARTIN
EQUIPMENT:	TRUCK MOUNTED RIG
METHOD:	6"OD SOLID STEM AUGER

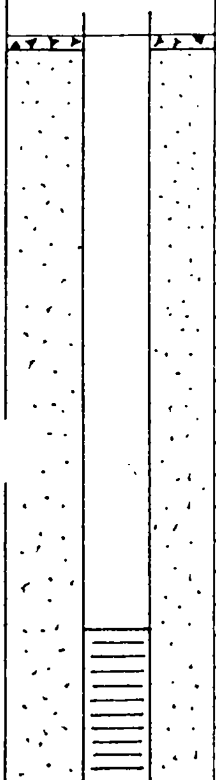
SAMPLING METHODS	SAMPLER	TUBE	CORE
TYPE	NONE		
DIAMETER			
OTHER			

WELL CONSTRUCTION	RISER	INTAKE
MATERIAL	PVC (S-40)	PVC
DIAMETER	1.5"	1.5"
COUPLING	THREADED	THREADED

WELL DEVELOPMENT	
METHOD:	NONE
DURATION:	
YIELD:	
OTHER:	

	GROUND	WELL	PROT CSG
ELEV			

DATE STARTED: 8-17-88
DATE COMPLETED: 8-17-88
INSPECTOR: ROB GUIDRY



DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–8.5				BROWN SILT	NO SAMPLES COLLECTED DRILLED MATERIALS WERE VISUALLY DESCRIBED FROM AUGER CUTTINGS
8.5–23.8				GREY TILL	
23.8				23.8' END OF BORING	

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX M

GEOTECHNICAL ENGINEERING

SUB-APPENDIX M-2

GEOTECHNICAL EVALUATION OF THE TRANSFER/DEWATERING FACILITY SITE.

PREPARED BY:

U.S. Army Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, New York 14207
December 2000

ASHTABULA RIVER PARTNERSHIP
SITE SELECTION FOR AN UPLAND DISPOSAL FACILITY
ASHTABULA, OHIO

SUB APPENDIX M-2
GEOTECHNICAL EVALUATION OF TRANSFER/DEWATERING FACILITY

M2-1. LOCATION OF PROPOSED TRANSFER/DEWATERING FACILITY

The location of the proposed transfer/dewatering facility encompass 8.31 acres located on the banks of the Ashtabula River on Conrail Corporation property, 1.25 miles upstream of the mouth of the river, south of the 5th street bridge, City of Ashtabula, Ashtabula County, Ohio (See Figures 1(M-2) and 2(M-2)). In the past the site was used for material handling and storage. Dredged material from operation and maintenance dredging of the Harbor in 1993 was deposited at the site. Railroad tracks exist immediately to the east of the site.

M2-2. REGIONAL AND LOCAL GEOLOGY

In general, the regional geology is the same as discussed in Appendix M and Sub Appendix M-1 in which the unconsolidated surficial deposits overlying bedrock In northeastern Ohio are glacial in origin. The surficial glacial deposits consists of till and reworked till which consists of stratified gravel, sand, silt, and clay. Bedrock underlying northeastern Ohio consists of Paleozoic age sedimentary rocks consisting of sandstone and shale. The youngest (upper) rock type in northeastern Ohio are Devonian age shales which consists of fine clastic sediments that were deposited in the western portion of the Appalachian Basin, a subsiding shallow sea through.

The most recent surficial deposits in the region around the proposed transfer facility are alluvium in origin, which fills many of the major river valleys in Ashtabula County. The alluvium generally consists of poorly sorted, poorly bedded silts and sands.

M2-3. SITE HISTORY AND EXISTING SITE INVESTIGATIONS

In the past the site was used for material handling and storage. In 1993 the City of Ashtabula was issued a permit by the U.S. Army Corps of Engineers to construct a temporary dike disposal facility to contain dredging from the upper Ashtabula River. The surface area of the facility, as defined by the inside toes of the containment dikes, was 2.75 acres. The containment dikes had the following dimensions: height of approximately 10 feet, crest width of 4 feet, side slopes of 1V on 2H. The dikes were constructed of compacted fill having a maximum permeability of 1×10^{-7} cm/sec. The interior of the disposal facility had a 1-ft thick low permeability clay liner, which had a maximum permeability of 1×10^{-7} cm/sec. The permit required that the toe of the

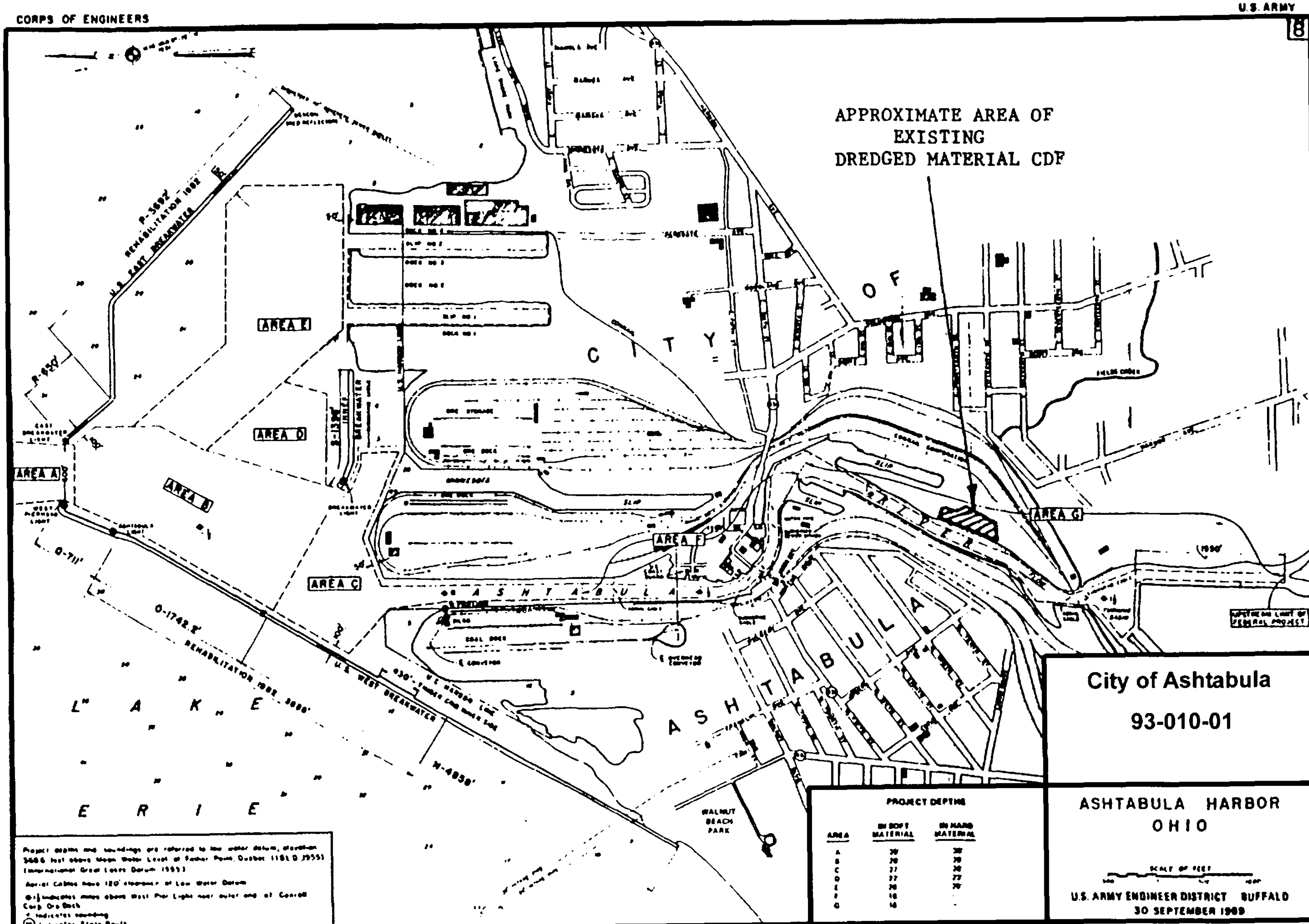
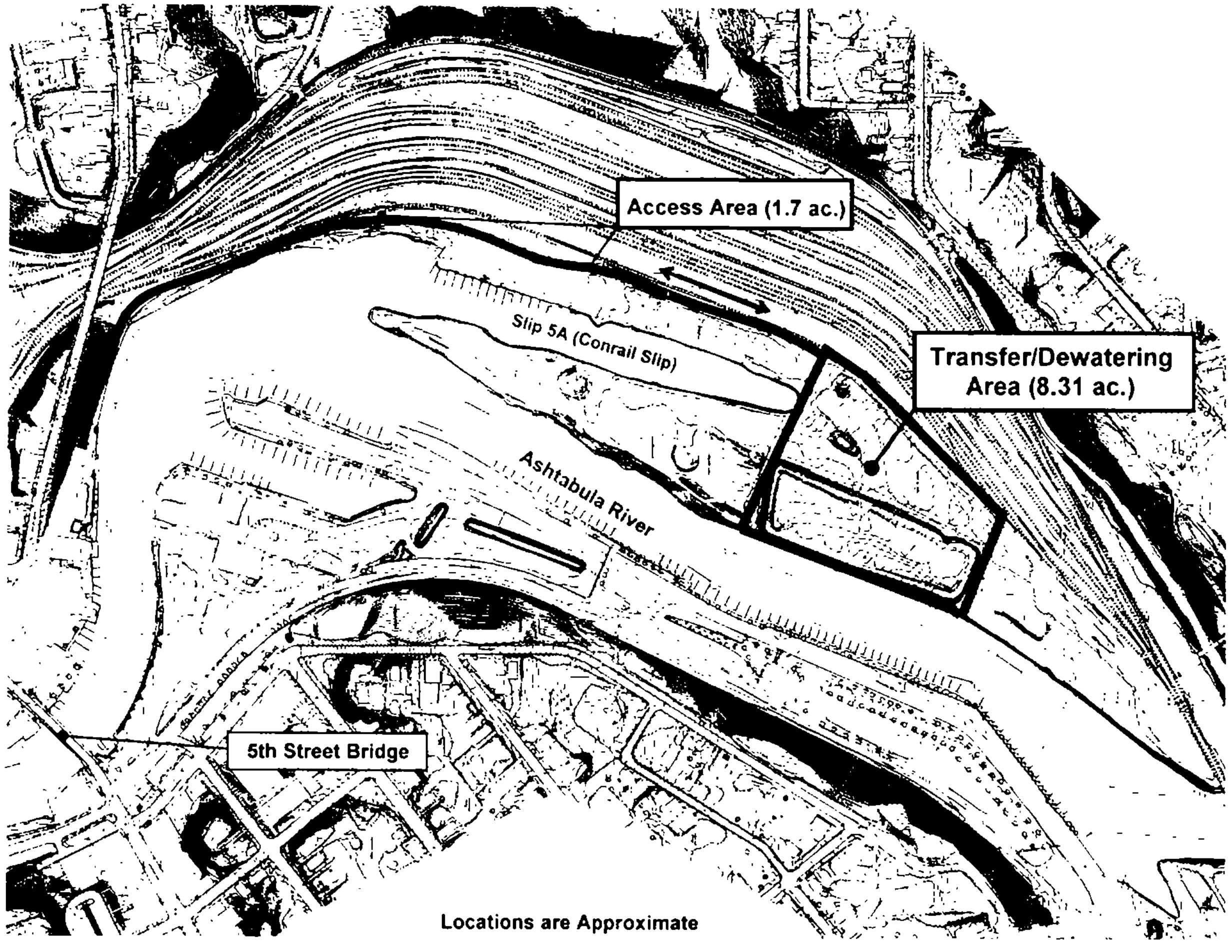

CORPS OF ENGINEERS
U.S. ARMY
8
APPROXIMATE AREA OF
EXISTING
DREDGED MATERIAL CDF
CITY OF
ASHTABULA
LAKE ERIE
AREA A
AREA B
AREA C
AREA D
AREA E
AREA F
AREA G
RIVER
REHABILITATION 1982
U.S. EAST BREAKWATER
U.S. WEST BREAKWATER
WALNUT BEACH PARK
City of Ashtabula
93-010-01
PROJECT DEPTHS
ASHTABULA HARBOR
OHIO
U.S. ARMY ENGINEER DISTRICT BUFFALO
30 SEPTEMBER 1969

Figure 1 (M-2)



Map Not To Scale

: Transfer/Dewatering Area

: Access Area

: Federal Authorized Channel

EXHIBIT A

SITE ONE

Transfer/Dewatering

Figure 2 (M-2)

containment dikes were to be maintained at a distance of 15 feet landward of the Riverbank. However, a site visit by Army Corps personnel revealed that the toe of the dikes were constructed at the riverbank in violation of the permit.

In July 1993 prior to construction of the dike dredge disposal facility four drive sample borings were drilled by the Marine Dredging Contractor in the interior of the disposal facility. The purpose of the explorations were to determine if a clay liner was needed on the interior floor of the facility. The borings were drilled to depths of 2 to 3 feet below the ground surface. Boring logs (Copies included in Attachment No.1(M-2)) show that the surficial material (upper 1 to 3 feet) is described as fill consisting of clayey silt, with sand, gravel, shale, slag, cinders, iron ore pellets, organics, and brick. In two borings pervious material consisting of cinders, slag, or sand underlay the thin surficial material. Based upon the composition of disposal area floor, the Marine Contractor was required to place a low permeability clay liner.

M2-4. GEOTECHNICAL DESIGN

The available subsurface information discussed in the previous section are not sufficient to support the design of this facility. The final design of the transfer facility must be preceded by additional geotechnical subsurface explorations and laboratory testing program. The in-situ soil conditions must be established for a number of purposes, including the design of the treatment facilities, basin embankment, and basin liners. The following types of geotechnical data is required for the design:

- Foundation soil properties are needed to establish that any facilities for the site will be stable for the duration of the project. A grid of standard drive sample borings and undisturbed (Shelby Tubes) borings should be taken over the proposed area to obtain information on the site subsurface conditions and to obtain samples for laboratory geotechnical testing. The samples obtained would be tested to determine the in-situ shear strength and consolidation characteristics of the soil.

- The transfer/dewatering facility is expected to make extensive use of earth berms. The site soils should be evaluated for their potential use as borrow material to construct the containment dikes. Bulk samples would be tested for compaction characteristics, remolded shear strength, and remolded permeability.

- The shore side of the transfer facility will have to support access roads and vehicle wash facilities. The soil investigation and testing should obtain data needed for the design of pavements and slabs.

- Mooring facilities would be required to secure the barges during transfer. The soil investigation should obtain data needed for the design of these facilities, which may include sheetpile structures and retaining walls.

- The existing dike disposal facility should be evaluated for the possibility of re-using this feature in the transfer/dewatering facility or if it should be removed. The existing dredged material contained in the facility is classified as being polluted and should be removed from the site either before or after this facility has performed its function. In either event these sediments would not be suitable for construction borrow material for the transfer/dewatering facility.

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX N

HTRW EVALUATION OF POTENTIAL LANDFILL AND TRASNFER/DEWATERING SITES

LANDFILL SITES

TRANSFER/DEWATERING FACILITY SITE

NOTE: This appendix was updated in December 2000 to include the following sub-appendices:

SUB-APPENDIX N1 – HTRW EVALUATION OF RMI SODIUM (STATE ROAD) LANDFILL DISPOSAL SITE; AND

SUB-APPENDIX N2 – HTRW EVALUATION OF TRANSFER/DEWATERING FACILITY SITE.

PREPARED BY:

Environmental Analysis Section,
Coastal/Geotechnical Section
U.S. Army Corps of Engineers, Buffalo District
December 1996/Updated December 2000

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Sub-Appendices

SUB-APPENDIX N1 – HTRW EVALUATION OF RMI SODIUM (STATE ROAD) LANDFILL DISPOSAL SITE; AND

SUB-APPENDIX N2 – HTRW EVALUATION OF TRANSFER/DEWATERING FACILITY SITE.

AUTHORITY

The Water Resources policies and Authorities ER 1165-2-132, Hazardous, Toxic and Radioactive Waste (HTRW) Guidance for Civil Works projects, requires that a site investigation be conducted as early as possible to identify and evaluate potential HTRW problems. This report documents the work performed during the HTRW investigations of two potential upland landfill sites in Ashtabula, Ohio.

OBJECTIVE

The purpose of the HTRW evaluation is to determine if contamination is present at two potential upland landfill sites and to help in the selection of the most suitable site for construction of a landfill. The landfill will be used for the disposal of sediment dredged from the Ashtabula River. This assessment relied primarily on coordination with the U.S. Environmental Protection Agency (USEPA), the Ohio Environmental Protection Agency (OEPA), the property owner of the potential landfill sites, Ashtabula County Engineer's Office, and the Farm Service Agency, USDA.

PROJECT DESCRIPTION

The Ashtabula River Partnership (ARP) is currently conducting a search for a site to construct a landfill. The landfill will be used to properly dispose of PCB-contaminated (50-500 ppm) and possibly less contaminated sediment dredged from the Ashtabula River. A total quantity of approximately 1,200,000 cubic yards of sediment will be dredged from the river after completion of the landfill, with additional amounts to be dredged in subsequent years for operation and maintenance purposes. In order to provide enough landfill capacity for the disposal of the anticipated quantity of sediment, a land size requirement of approximately 50 acres is envisioned.

A map showing the locations of the two potential upland landfill sites, Site 5 and Site 7, is provided in Figure 1.

SITE VISITS

Initial site visits were conducted at both of the potential landfill sites in March 1995 by U.S. Army Corps of Engineers personnel. Personnel met with property owner representatives and visited public agencies to collect background information. Site reconnaissances at Sites 5 and 7 were also conducted.

Site 5 is owned by Reserve Environmental Services, Inc. (4633 Middle Road, Ashtabula, OH). The site is 32 acres in size and is located approximately 350 feet south of Lake Road (Rt. 531) and 2,800 feet west of Labounty Road. The site visit

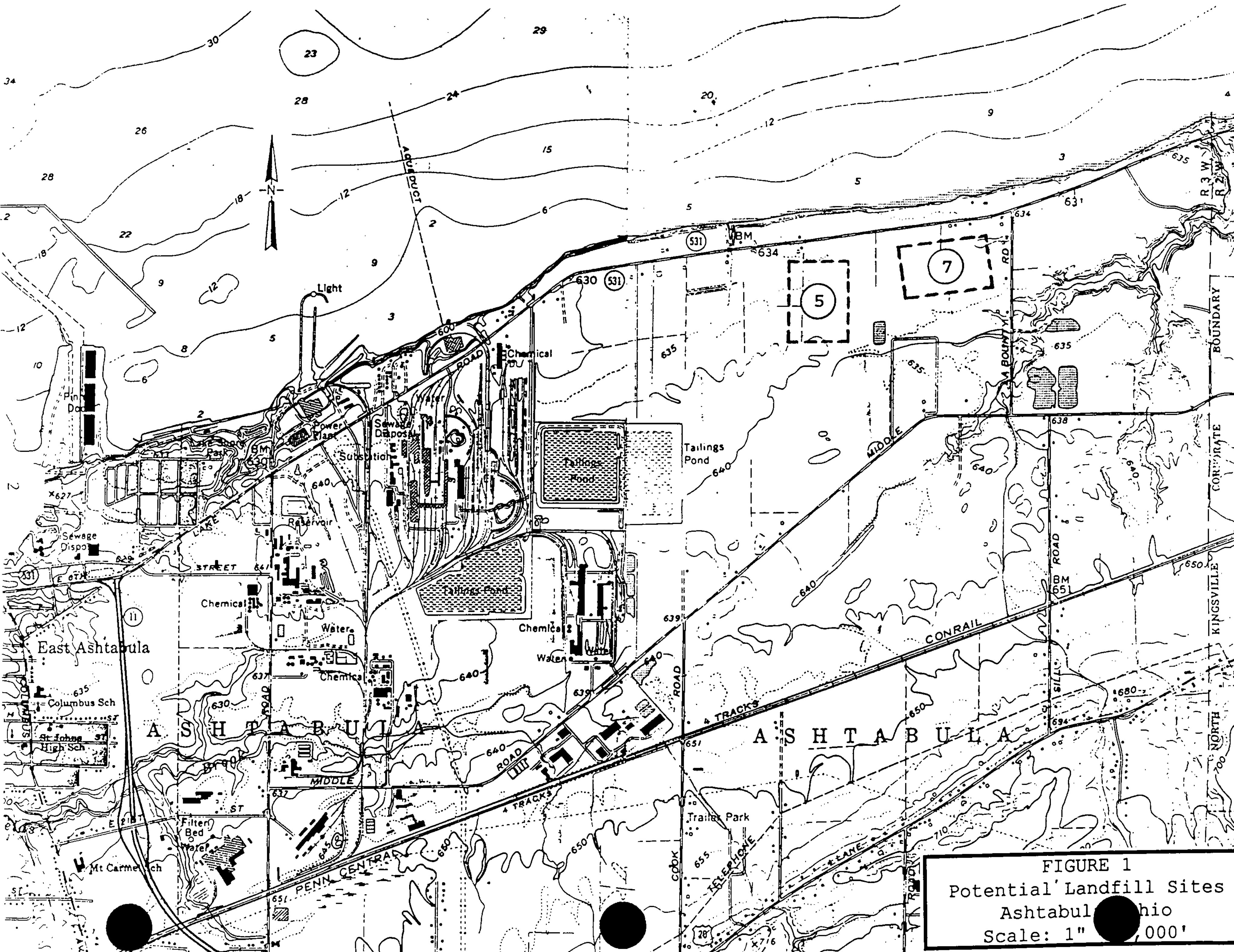


FIGURE 1
Potential Landfill Sites
Ashtabul [illegible]hio
Scale: 1" [illegible],000'

revealed the presence of fill material deposited at this location. Site 5 was previously owned by a power company (Centerior Energy Corporation) and was used to dispose of cinders and ash generated by a coal-burning operation. The surface of this site consists primarily of scrub brush and bare areas in the northern portion of the site and trees in the remaining areas of the site.

Site 7 is also owned by Reserve Environmental Services (RES). The site occupies an area of 31 acres and is located approximately 300 feet south of Lake Road and 360 feet west of Labounty Road. The site is forested with tall deciduous trees.

DATABASE INFORMATION

U.S. Army Corps of Engineers personnel reviewed the USEPA Facilities Index Database Sytem (FINDS) to identify which sites in the City of Ashtabula have been included on the USEPA's Resource Conservation and Recovery Information System (RCRIS) and the Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) databases. The RCRIS database provides pertinent information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act. The CERCLIS database provides information on sites identified by the USEPA as abandoned, inactive, or uncontrolled hazardous waste sites which may require cleanup. Approximately 120 sites in Ashtabula are listed in the RCRIS and/or CERCLIS databases.

RES is located approximately 250 feet south of Site 7 and is the nearest facility to either Site 5 or Site 7. RES is listed on the RCRIS database and is also listed on the CERCLIS database. RES officials informed U.S. Army Corps of Engineers personnel that corrective action is being taken at inactive sites, with appropriate approvals from Ohio EPA and U.S. EPA. In addition, a RCRA Facility Investigation has been completed and approved by U.S. EPA, and a Corrective Measures Study has been completed and conditionally approved.

To the southwest of RES, and located along Middle Road, are Ashta Chemicals, Inc., ESAB Welding Products, Inc., and SCM Ashtabula Plant 1 all of which are listed on the RCRIS and CERCLIS databases.

AERIAL PHOTOGRAPHS AND MAPS

An examination of aerial photographs taken in 1972, 1979, 1989, 1991, and 1995 shows Site 7 thickly forested, as expected based on field observations. Site 5 is shown as forested in the southern portion of the site, but deforested in the northern portion of the site where previous filling has occurred. A dirt access road leading from Lake Road to the disposal area in Site 5 is readily discernible in the photographs. The photographs also show a depressional area located adjacent to the northeast corner of Site 5. The depression contains standing water and measures approximately 150' wide by 380' long.

PRIOR LAND USE

A portion of Site 5 was previously used by a local power plant to dispose of ash generated by a coal-burning process. Prior land use in the area encompassing Sites 5 and 7 was probably limited to farming, as evidenced by the ground surface tilling pattern observed in some of the aerial photographs.

PHASE I SITE INVESTIGATIONS

Phase I of the investigations of potential landfill sites was conducted in Ashtabula August 19 - 23, 1996. Phase I consisted of the following tasks:

- Clearing access paths to boring locations at Site 5 and Site 7,
- Clearing approximately 11 acres of phragmites and brush at Site 5,
- Establishing a grid and performing a metal detection survey at Site 5, and
- Excavation of test pits in areas at Site 5 where the metal detection survey identified anomalies.

Maps showing the approximate sampling locations at Sites 5 and 7 are provided in Figures 2 and 3.

Mobilization of field personnel occurred on August 19, 1996. A bull dozer was used to clear very dense phragmites and brush over an 11-acre area at Site 5 where fill material had apparently been placed in the past. The clearing of dense vegetation allowed the placement of metal detection survey grid markers and facilitated access during the metal detection survey. Paths were cleared to boring locations a, b, c, d, e, and f as well as the 10 fill material delineation borings at Site 5. Paths were also cleared to boring locations a, b, c, and d at Site 7. All of the boring locations were then marked with red flagging. As directed, Parratt-Wolff avoided clearing or damaging large trees.

Metal Detection Survey Grid

A land surveyor and assistant set the northern-most row of survey grid markers. The Parratt-Wolff field crew used a compass and tape measure to set the remaining metal detection survey grid markers.

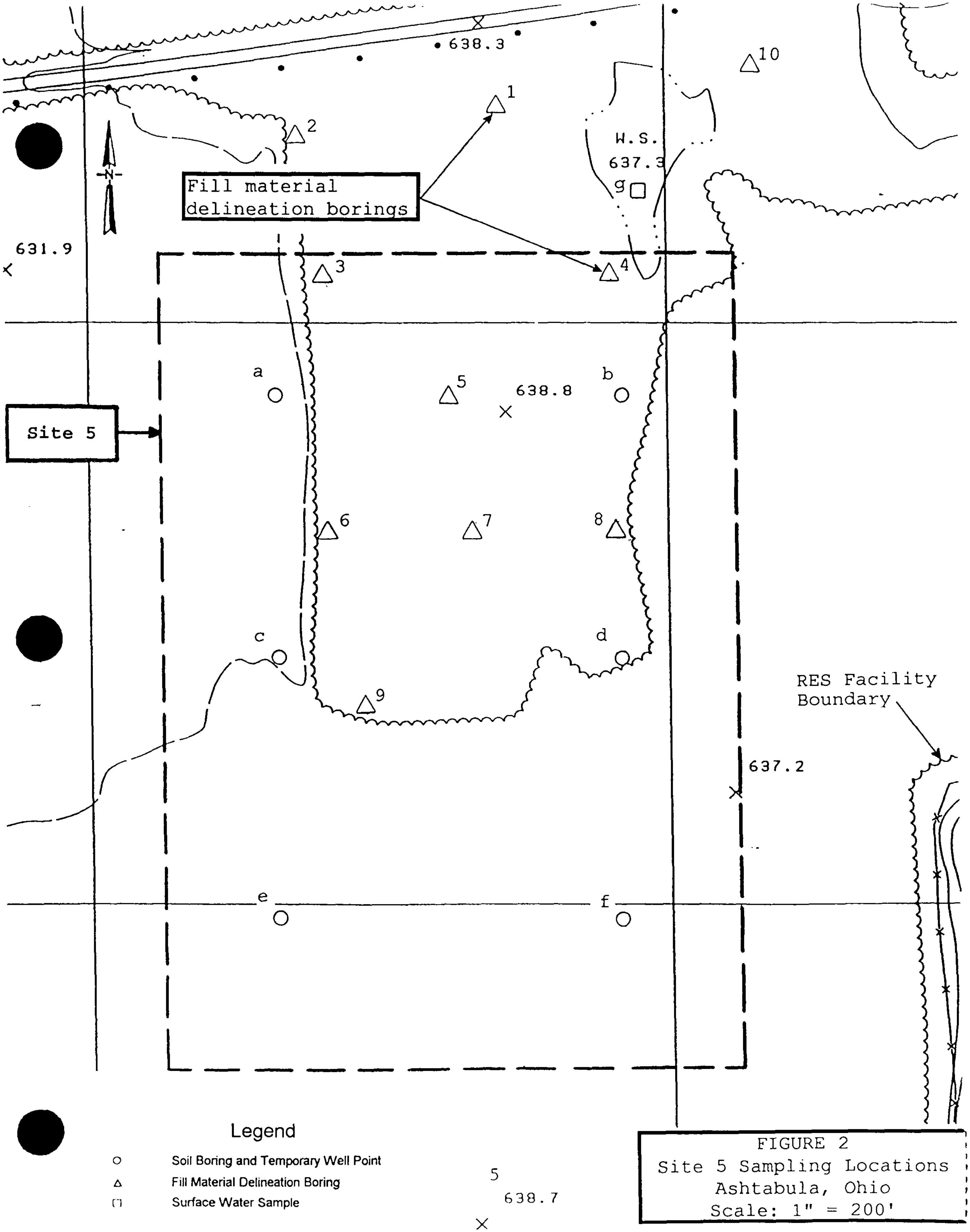


FIGURE 2
Site 5 Sampling Locations
Ashtabula, Ohio
Scale: 1" = 200'

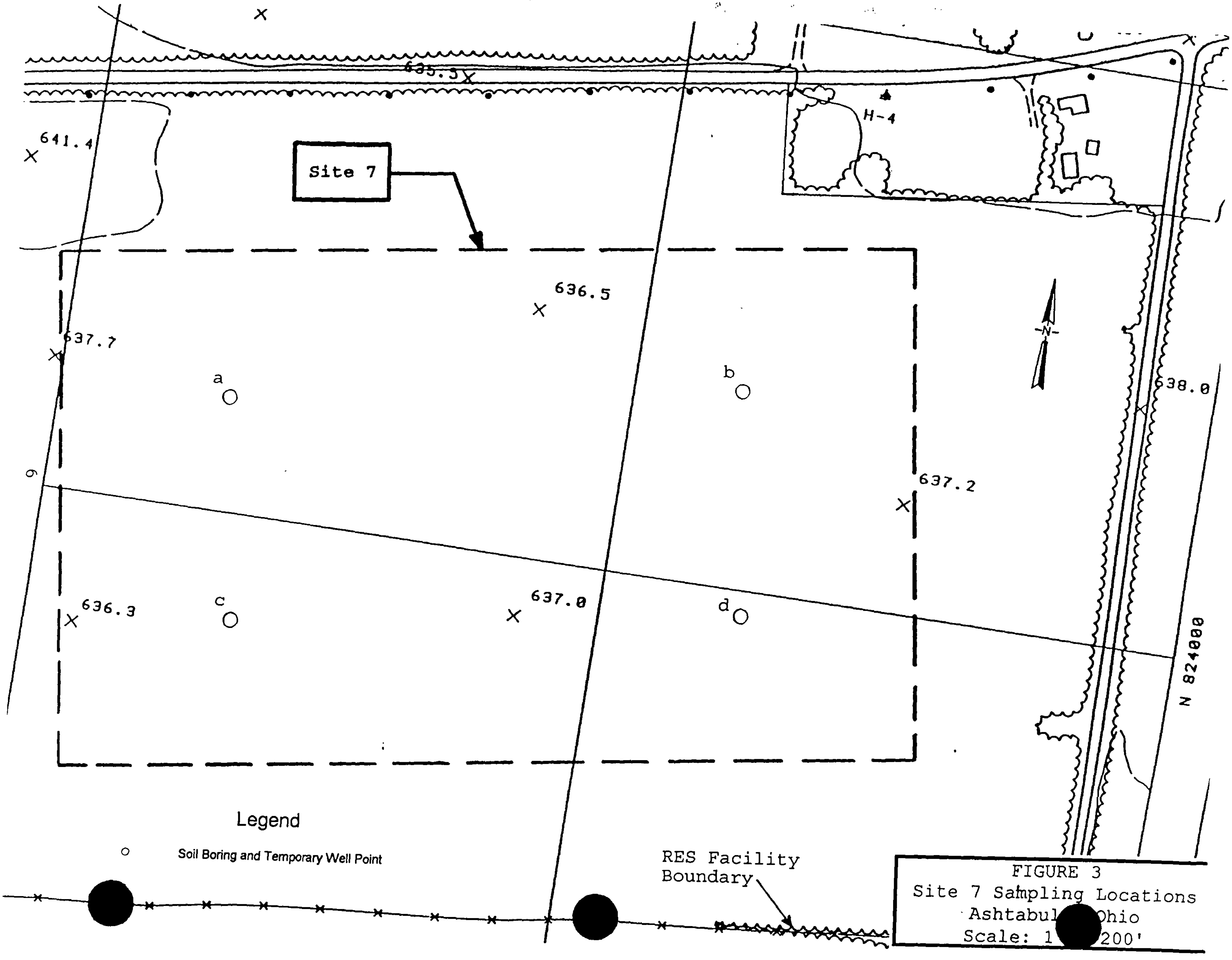


FIGURE 3
Site 7 Sampling Locations
Ashtabul Ohio
Scale: 1 200'

Metal Detection Survey

A metal detection survey was conducted over the previously filled portion of Site 5 to determine if environmental concerns posed by drums, canisters, and other containers are present. No metal detection survey was conducted at Site 7 since there has been no documented history of waste disposal at the site and a site reconnaisance revealed no evidence of previous waste disposal in the area of Site 7.

The metal detection survey at Site 5 was conducted using a Heliflux Magnetic Locator, Model GA - 52Cx manufactured by Schonstedt Instrument Co. The metal detector model and survey methodology used in the field were in agreement with the Metal Detection Survey Work Plan submitted by Parratt-Wolff prior to the start of field work. A grid system measuring 600 feet wide by 800 feet long with 100-foot grid spacings was established for metal detector survey horizontal control. The metal detector was left on continuously while the operator traversed each grid. Traverses were spaced at 12.5-foot intervals on the western side of the site where the most obvious fill areas were found and at 25-foot intervals over the remaining survey area.

According to product literature, the metal detector used during this site investigation is capable of detecting a fifty-five gallon metal drum at a depth of 8 feet or less.

Test Pit Excavations

A total of 11 anomalies were discovered during the metal detection survey metal detector in the filled portion of Site 5. Each anomaly was marked with a stake and red flagging for subsequent excavation with a backhoe. Level C Personal Protective Equipment was used initially during the test pit excavations, but was subsequently downgraded to Level D. A map showing the approximate locations of the test pits is provided in Figure 4 at the back of this report. Observations recorded during the test pit excavations are provided below.

Test Pit A2

From 0 to 1 foot below ground level (bgl) light brown soil was observed. From 1 to 7 feet bgl, is black material resembling ash. From 7 to 8 feet bgl is light brown clay.

Test Pit A1

From 0 to 1 foot bgl, orange-colored soil was observed. From 1 to 7 feet bgl, black material resembling ash is present. A metal plate measuring approximately 2 feet long x 4 inches wide x 1inch thick was discovered at a depth of 3 feet. The excavation sidewall was very wet beginning at a depth of about 5-1/2 feet bgl. Excavation stopped at a depth of 7 feet. The bottom 6 to 8 inches contained ponded water where water flowed quickly into the pit. The last two buckets of soil removed from the excavation contained light-colored clay, so a depth of approximately 7 feet may be the vertical limit of ash at this location.

Test Pit A3

Light brown and some gray-colored soil was observed from 0 to 2 feet bgl. At 2 feet bgl, a distinct gray layer resembling ash and extending to a depth of 7 feet was apparent. From 7 to 8 feet bgl is light brown clay.

Test Pit A8

A metal object resembling a drum was discoverd with the metal detector near the ground surface at A8. A8 is located on top of a small mound of vegetated soil approximately 2 to 3 feet high. Upon cautious excavation of this area the metal object was identified as an open metal pail with a handle. A piece of plastic material resembling a portion of a plastic bag was uncovered at a depth of approximately 1 foot. Additional plastic debris was discovered at a depth of about 1 to 2 feet. From 0 to 4-1/2 feet bgl is gray and black material resembling ash. The excavated material caused a signal on the metal detector, indicating the presence of metal(s) in the material. From 4-1/2 to 5-1/2 feet bgl ponded water was observed.

Test Pit A7

From 0 to 1 foot bgl is orange/brown-colored soil. Gray-colored material resembling ash was observed below a depth of 1 foot. Water was observed flowing into the pit from the excavation sidewall at a depth of 5 feet. The excavation was stopped at 7 feet bgl.

Test Pit A4

Orange-colored soil is present from 0 to 1-1/2 feet bgl. From 1-1/2 feet to 5 feet-4 inches bgl is gray material. At 3 feet-4 inches bgl water was noticed flowing into the pit. From 5 feet-4 inches to 6 feet bgl is light gray-colored clay. The orange-colored soil registered a much stronger signal on the metal detector than the gray material at this location.

Test Pit A5

Anomaly A5 was eliminated from the backhoe test pit excavation phase after the area was manually dug with a spade to a depth of about 1 foot, revealing black-colored material resembling ash and two rusted, cylindrical, metal objects approximately 1 inch in diameter and 6 inches long. Both the black material and the metal objects gave strong metal detector readings. Another area, A4, which was located approximately 10 feet from A5 was excavated with a backhoe allowing observation of the soil profile to a greater depth than at A5.

Test Pit A6

From 0 to 2 feet bgl is grayish-black topsoil. Two metal bars approximately 1/2-inch in diameter were uncovered near the ground surface. Below a depth of 2 feet is light brown clay. A small amount of water was observed seeping into the pit at a depth of approximately 3 feet. The excavation was stopped after a depth of 7 feet was achieved. The excavation sidewall material appeared to be relatively undisturbed native soil. The light brown clay registered a stronger signal on the metal detector than the gray material at this location.

Test Pit A11

From ground surface to a depth ranging from 2 - 14 inches is light brown-colored soil. Below the top layer of soil and extending to a depth of 5 feet-10 inches is dark gray, fine-grained, moldable material. This material didn't register a high reading on the metal detector. From 5 feet-10 inches to 6 feet-10 inches bgl is light brown-colored clay. The excavation was stopped at a depth of 6 feet-10 inches. Water was observed seeping slowly into the pit from the excavation sidewall below a depth of approximately 5 feet. A railroad tie was observed near the test pit.

Test Pit A10

From 0 to approximately 2-1/2 feet bgl is light brown-colored soil. From 2-1/2 to 6 feet-2 inches bgl is gray-colored material. The gray material has a silty-sand texture. From 6 feet-2 inches to 7 feet bgl is grayish-brown clay. The excavation was stopped at a depth of 7 feet.

Test Pit A9

From 0 to 10 inches bgl is light brownish-orange soil. At a depth of 3 feet is a 4 to 6 inch-thick layer of black material. At this same depth, a metal object was discovered measuring approximately 18 inches long x 4 inches wide x 1-1/2 to 2 inches thick. The top surface of the metal object was rounded creating the appearance of a metal ingot. From 5 feet-6 inches to 7 feet bgl is light brown-colored soil. The excavation was stopped at a depth of 7 feet.

All of the test pits were backfilled following observations, depth measurements, and photographs. No drums were discovered during Phase I of the site investigations.

A sheen was observed in several locations on the south side of the pond at Site 5. A pile of granular fill material measuring approximately 8 feet wide x 12 feet long x 3 feet high is present on the west side of Site 5 near metal detection grid marker #21.

PHASE II SITE INVESTIGATIONS

Phase II of the investigations of potential landfill sites was conducted in Ashtabula, Ohio September 3 - 10, 1996. Phase II consisted of the collection of soil, ground water, and surface water samples for environmental testing and the collection of soil samples for geotechnical testing at the two potential upland landfill sites.

Parratt-Wolff, Inc. (based in Syracuse, NY) and Engineering and Environment, Inc. (based in Virginia Beach, VA) were contracted to complete the sampling. An ATV-mounted drill rig was used to collect soil samples and provide boreholes to establish temporary well points.

Soil Profile Characterization

The following provides a summary of the soil profile from 0'-6' below ground level (bgl) for each of the boring locations at Sites 5 and 7. Soil samples for environmental testing were collected from the 0'-6' interval. Particular emphasis is placed on the locations and thicknesses of ash fill material at Site 5.

Descriptions of soil profiles below a depth of 6' are provided on boring logs prepared during augering by Parratt-Wolff. A boring log was completed for each deep boring at Sites 5 and 7 as well as each fill material delineation boring at Site 5. Generally, soil below a depth of 6' is glacial till consisting of stiff to very stiff gray sandy clay. The sandy clay contained some silt and fine gravel in several soil samples.

Site 5

Boring a

0'-2' Clay with a thin layer of ash, wet
2'-4' Dark gray clay, possible ash, wet
Sample collected from 2'-4' interval
4'-6' Gray and brown clay, moist

Boring b

0'-2' Brown and orangish clay
2'-4' Light brown and orangish soil, wet
Sample collected from 2'-4' interval
4'-6' Brown, gray, and orangish soil, dry

Boring c

0'-2' Brown and orangish clay with a small amount of ash, moist
Sample collected from 0'-2' interval
2'-4'
2'-3.5' Brownish-orange soil, moist 2"-thick layer of sand at 2.5' depth
3.5'-4' Dark gray and black clay
4'-6' Brown and gray clay

Boring d

0'-2' Brown clay with some black material
Sample collected from 0'-2' interval
2'-4' Brown clay
4'-6'
4'-4.7' Gray clay
4.7'-6' Brown and gray clay

Boring e

0'-2' Brown and orange mottled soil
2'-4' Brown and orange mottled soil
Sample collected from 2'-4' interval
4'-6' Brown and orange mottled soil

Boring f

0'-2'
0'-1' Grayish-brown clay
1'-2' Brown, gray, and orange clay
Sample collected from 0'-2' interval
2'-4' Orangish-brown and gray clay
4'-6' Orangish-brown and gray clay

The depth of each ash fill material delineation boring was determined in the field based on visual observations of the split spoon samples. Each boring continued until undisturbed, native soil was reached.

Fill Material Delineation Boring 1

0'-2' Possible ash
Sample collected from 0'-2' interval
2'-4' No recovery in split spoon
4'-6' Brown clay
6'-8' Gray clay

Fill Material Delineation Boring 2

0'-7' Ash and rust-colored soil
Sample collected from 0'-2' interval
7'-8' Gray clay

Fill Material Delineation Boring 3

0'-1' Clay
1'-6' Ash
Sample collected from 2'-4' interval, tests will include TCLP
6'-8' Gray clay
8' 3"-thick layer of clay and sand
8'-10' Split spoon contained ash, but was probably slough material from above
10'-12' Light brown and orange mottled clay

Fill Material Delineation Boring 4

0'-1' Vegetation and muck, ground water level at 6" below ground level (bgl)
1'-3'
1'-2' Appears as muck and ash (found pieces of coal)
2'-3' Brown clay, appears to be native soil
Sample collected from 1'-3' interval
3'-5' Light brown clay, appears to be native soil

Fill Material Delineation Boring 5

0'-2'
0'-1.8' Brown and gray clay
1.8'-2' Black ash
2'-4' Light brown clay/ash
4'-6'
4'-4.5' Light brown clay
4.5'-6' Black ash
Sample collected from 4'-6' interval, tests will include TCLP
6'-8' Brown and gray clay

Fill Material Delineation Boring 6

0'-2' Brown clay, small amount of coal
2'-4' Brown and gray clay, pieces of coal observed at 4' depth
4'-6'
  4'-5.5' Gray clay
  5.5'-6' Coal and ash
  Sample collected from 4'-6' interval
6'-8'
  6'-6.3' Gray material, possibly ash
  6.3'-8' Brown clay

Fill Material Delineation Boring 7

0'-2' Light brown clay
2'-4'
  2'-2.5' Light brown clay
  2.5'-4' Gray and black ash
  Sample collected from 2'-4' interval
4'-6'
  4'-5.5' Gray and black ash
  5.5'-6' Light brown clay
6'-8' Light brown and gray clay

Fill Material Delineation Boring 8

0'-2'
  0'-1.5' Brown clay
  1.5'-2' Gray ash
  Sample collected from 1.5'-2.5' interval
2'-4'
  2'-2.5' Gray ash
  2.5'-3' Brown clay, appears to be native soil
4'-6' Brown clay, appears to be native soil

Fill Material Delineation Boring 9

0'-2' Dark brown and gray clay and black ash
Sample collected from 0'-2' interval, tests will include TCLP
2'-4' Light brown clay
4'-6' Medium brown clay

Fill Material Delineation Boring 10

0'-2' Muck
2'-4' Brown and orange mottled soil, small amount of black specks
Sample collected from 2'-4' interval
4'-6' Gray clay

Site 7

Boring a

0'-2' Brown clay
2'-4' Brown clay
Sample collected from 2'-4' interval
4'-6' Orange clay

Boring b

0'-6' Clay
Sample collected from 4'-6' interval

Boring c

0'-6' Clay
Sample collected from 0'-2' interval

Boring d

0'-6' Clay
Sample collected from 2'-4' interval

Depth to Bedrock

Depths to the gray, shale bedrock were determined at Sites 5 and 7. Borings b and c at Site 7 were terminated before bedrock was encountered because Borings a and d were deeper than the estimated 55-foot depth to bedrock. However, the depth to bedrock data at Site 7 is augmented by two borings completed previously by RES. Tables 1 and 2 show the depth to bedrock for each boring at Sites 5 and 7, respectively.

Table 1
Depth to Bedrock at Site 5

Boring ID	Depth to Bedrock (Feet Below Ground Level)
a	55.4
b	55.5
c	*
d	*
e	57.3
f	54.0

* Note: Borings c and d were augered to a depth of only 17.0 feet since no geotechnical samples were required from these locations and because ground water for environmental testing was available in the upper soil layers.

Table 2
Depth to Bedrock at Site 7

Boring ID	Depth to Bedrock (Feet Below Ground Level)
a	60.2
b	> 52.0 [1]
c	> 50.0 [1]
d	56.9
SB4 [2]	55
SB5 [2]	59

[1]Boring terminated before bedrock encountered.

[2]Borings SB4 and SB5 were completed by RES during a previous, unrelated investigation in December 1994. SB4 was augered along the western boundary of Site 7; SB5 was augered within Site 7.

Collection of Soil Samples for Environmental Testing

Soil samples for environmental testing were collected in split spoons during augering of boreholes at Sites 5 and 7. Sixteen borings (four deep borings, two shallow borings, and ten fill material delineation borings) were completed at Site 5 and four deep borings were completed at Site 7. Most of the deep borings extended to bedrock. As expected, bedrock was encountered at depths of approximately 55-60 feet below ground level.

Split spoon soil samples were collected in the 0'-2', 2'-4', and 4'-6' intervals. Upon opening the split spoons, the soil was field-screened with a photo-ionization detector (PID) to determine if organic vapors were emitted from the samples. EEI personnel used a "Mini RAE Photo-Ionization Detector" for this purpose. From each of the three sampling intervals, two samples were collected. One sample was immediately sealed in a sample jar; the second sample was placed in a sample jar and covered with aluminum foil. After the soil was allowed to warm slightly, the PID probe was placed beneath the aluminum foil and the organic vapor concentration determined.

The results of PID testing and visual observations determined which interval a sample would be collected from for subsequent laboratory testing. If organic vapors were detected at concentrations above background from a sample in the field, the sample would be tested in the laboratory (Laboratory Resources, Inc.) for all of the parameters (23 metals, cyanide, VOC's, SVOC's, pesticides, PCB's, pH, and conductivity) specified in the Statement of Work. If no organic vapors were detected from a sample in the field, the sample would be tested in the laboratory for all of the above parameters except VOC's and SVOC's. Three soil samples collected from fill material delineation borings at Site 5 (Borings 3, 5, and 9) underwent the TCLP metals test to determine if the ash is classified as a hazardous waste. The three most contaminated (based on visual observations and PID readings) soil samples collected were chosen to undergo the TCLP metals test.

One soil split sample was collected from Boring c at Site 5 and one soil split sample was collected from Boring d at Site 7. Split samples were sent to the Missouri River/Omaha Laboratory for Quality Assurance testing.

Applicable or Relevant and Appropriate Requirements

In June 1994, a law was passed by the State of Ohio to encourage voluntary real estate reuse and cleanup. The law became effective in September 1994 and was called the Voluntary Action Program. This law is found in Chapter 3746 of the Ohio Revised Code.

Ohio EPA has proposed two sets of rules to implement the Voluntary Action Program. The first set of rules were filed on October 6, 1995 and includes provisions for general definitions, certified laboratories, certified professionals, program fees, variances, no further action letter scope and content, audits, and interim certified laboratories' standards during their phase-out. The first set of rules were approved on November 14, 1995.

The second set of proposed rules were filed by Ohio EPA on July 31, 1996 and includes technical provisions for the eligibility of a property to partcipate in the program, Phase I and Phase II property assessments, generic numeric standards, site specific risk assessments, ground water classification, case-by-case ground water standards, and consolidated standards permits. The public comment period for the second set of proposed rules extended until October 15, 1996. Based on a telephone conversation with Ms. Amy Yersavich, Supervisor of the Ohio EPA Voluntary Action Program Coordination Unit, on November 1, 1996, the second set of proposed rules is expected to be finalized at the end of 1996 or the beginning of 1997.

Although the program is voluntary, if a property is remediated according to the guidelines, Ohio EPA will release the owner from future liability. The Voluntary Action Program provides financial relief to people undertaking voluntary actions by

- Offering low-interest State loans,
- Abating real estate taxes for ten years, and
- Allowing people engaged in voluntary actions to make agreements with local governments for ten year tax abatements for development projects.

The second set of proposed rules contain Generic Direct Contact soil cleanup standards for Residential, Commercial, and Industrial Land-Use Categories. Since Sites 5 and 7 are located in an area that is zoned for heavy manufacturing and the proposed use of Site 5 or 7 is landfill disposal of dredged sediment, the Proposed Generic Industrial, Direct Contact Standards were compared to soil test results. The proposed rule also contains Generic Unrestricted Potable Use Standards for ground water. These standards were compared to ground water test results to determine if any parameters exceed cleanup criteria.

Three soil/ash samples collected at Site 5 underwent the TCLP test for metals. The test results were compared to TCLP Regulatory Levels as promulgated in 40 CFR 261.24, "Toxicity Characteristic", to determine if the ash is classified as a hazardous waste.

Test results of the surface water sample collected from the small pond at Site 5 were compared to the State of Ohio Water Quality Standards contained in Chapter 3745-1-07 of the Administrative Code (effective October 1, 1996).

Site 5 Soil Sample Test Results

Laboratory test results of soil samples collected from Site 5 are shown in Tables 3 through 15. A total of 16 soil samples were collected (Soil Profile Borings a through f and Fill Material Delineation Borings 1 through 10) at Site 5 for laboratory testing. Contaminant levels which exceed standards have been shaded. The qualifier "J" denotes an estimated result less than the quantitation limit. The qualifier "B" denotes the parameter was detected in the method blank.

Table 3
Site 5 Soil Sample Results
Inorganics

	Boring a	Boring b	Boring c	Boring d	Boring e	Boring f	Proposed Single Chemical Generic Industrial Direct Contact Standard (mg/kg)
Sampling Date	9/8/96	9/9/96	9/8/96	9/8/96	9/7/96	9/9/96	
Sample Depth (ft)	2-4	2-4	0-2	0-2	2-4	0-2	
Aluminum[1]	14,000	14,000	11,000	11,000	12,000	9,900	
Antimony	<0.62	<0.60	<0.69	<0.64	<0.60	<0.66	
Arsenic	100	9.9	12	16	11	4.9	86
Barium	120	44	84	87	70	46	140,000
Beryllium	2.6	0.54	0.59	0.73	0.65	0.42	
Cadmium	<0.19	<0.18	<0.21	<0.19	<0.36	0.20	300
Calcium	3,700	1,200	9,900	640	2,300	710	
Chromium	31	16	16	15	16	11	2,800 (Cr VI)
Cobalt	6.3	6.8	11	4.9	10	5.3	
Copper	25	13	27	14	26	13	
Iron	28,000	27,000	27,000	27,000	30,000	16,000	
Lead	20	8.5	13	15	12	11	2,800
Magnesium	1,000	2,900	5,900	1,500	4,100	1,700	
Manganese	70	190	400	140	270	110	
Mercury	0.28	<0.12	<0.14	<0.13	<0.12	<0.13	230
Nickel	19	18	27	13	31	12	3,700
Potassium	2,200	1,100	1,700	920	940	810	
Selenium	9.7	1.4	1.5	2.6	1.3	0.86	
Silver	<0.31	<0.30	<0.34	<0.32	<0.30	<0.33	
Sodium	280	45	71	39	58	34	
Thallium	4.6	<0.60	<0.69	0.67	<0.60	<0.66	
Vanadium	46	24	20	24	16	13	
Zinc	37	70	64	55	68	39	370,000
Cyanide	<0.62	<0.60	<0.69	<0.64	<0.60	<0.66	

[1]Units of all parameters are in mg/kg.

Table 4
Site 5 Soil Sample Results
Inorganics

	Boring 1	Boring 2	Boring 3	Boring 4	Boring 5[1]	Proposed Single Chemical Generic Industrial Direct Contact Standard
Sampling Date	9/7/96	9/7/96	9/7/96	9/6/96	9/6/96	(mg/kg)
Sample Depth (ft)	0-2	2-4	2-4	1-3	4-6	
Aluminum[2]	10,000	7,800	8,700	11,000	–	
Antimony	1.1	<0.64	<0.59	<0.67	–	
Arsenic	180	5.1	9.5	89	–	86
Barium	160	37	180	190	–	140,000
Beryllium	5.7	0.4	1.3	3.1	–	
Cadmium	<0.20	<0.19	<0.18	<0.20	–	300
Calcium	2,300	410	1,200	2,800	–	
Chromium	26	9.1	12	28	–	2,800 (Cr VI)
Cobalt	9.1	3.5	7.8	7.2	–	
Copper	32	9.5	11	26	–	
Iron	32,000	13,000	27,000	49,000	–	
Lead	29	8	3	22	–	2,800
Magnesium	420	1,200	350	780	–	
Manganese	60	76	26	85	–	
Mercury	0.19	<0.13	<0.12	0.18	–	230
Nickel	26	9.7	15	19	–	3,700
Potassium	1,000	480	800	1,200	–	
Selenium	11	0.7	1.8	6.9	–	
Silver	<0.33	<0.32	<0.29	<0.33	–	
Sodium	92	<32	<29	94	–	
Thallium	6.2	<0.64	0.98	2.2	–	
Vanadium	47	16	16	39	–	
Zinc	66	37	11	50	–	370,000
Cyanide	<0.66	<0.64	<0.59	<0.67	<0.63	

[1]Sample collected from Boring 5 was tested for TCLP metals instead of total metals. See Table 15.
[2]Units of all parameters are in mg/kg.

Table 5
Site 5 Soil Sample Results
Inorganics

	Boring 6	Boring 7	Boring 8	Boring 9[1]	Boring 10	Proposed Single Chemical Generic Industrial Direct Contact Standard (mg/kg)
Sampling Date	9/6/96	9/6/96	9/6/96	9/6/96	9/7/96	
Sample Depth (ft)	4-6	2-4	1.5-2.5	0-2	2-4	
Aluminum[2]	11,000	16,000	10,000	--	6,600	
Antimony	<0.59	0.89	0.84	--	<0.60	
Arsenic	12	77	72	--	5.9	86
Barium	64	300	290	--	68	140,000
Beryllium	0.59	5.2	3.2	--	0.37	
Cadmium	<0.88	<0.95	<0.91	--	<0.18	300
Calcium	12,000	4,900	1,800	--	920	
Chromium	16	36	24	--	8.6	2,800 (Cr VI)
Cobalt	11	9.3	9.7	--	6.1	
Copper	24	35	22	--	10	
Iron	35,000	53,000	56,000	--	15,000	
Lead	12	24	14	--	7.2	2,800
Magnesium	7,100	580	630	--	1,500	
Manganese	390	44	150	--	410	
Mercury	<0.12	0.26	0.22	--	<0.12	230
Nickel	27	24	23	--	14	3,700
Potassium	2,200	1,800	1,000	--	460	
Selenium	1.5	8.4	4.1	--	0.85	
Silver	<0.29	<0.32	0.35	--	<0.30	
Sodium	92	58	<30	--	55	
Thallium	<0.59	3.9	1.9	--	<0.60	
Vanadium	16	65	39	--	14	
Zinc	59	60	49	--	43	370,000
Cyanide	<0.59	<0.63	<0.61	<0.63	<0.60	

[1]Sample collected from Boring 9 was tested for TCLP metals instead of total metals. See Table 15.
[2]Units of all parameters are in mg/kg.

Table 6
Site 5 Soil Sample Results
Volatile Organic Compounds

	Boring a	Boring b[1]	Boring c[1]	Boring d[1]	Boring e	Boring f	Proposed Single Chemical Generic Industrial Direct Contact Standard (mg/kg)
Sampling Date	9/8/96	9/9/96	9/8/96	9/8/96	9/7/96	9/9/96	
Sampling Depth (ft)	2-4	2-4	0-2	0-2	2-4	0-2	
Chloromethane[2]	<0.012	--	--	--	<0.012	<0.013	
Bromomethane	<0.012	--	--	--	<0.012	<0.013	
Vinyl Chloride	<0.012	--	--	--	<0.012	<0.013	2.5
Chloroethane	<0.012	--	--	--	<0.012	<0.013	
Methylene Chloride	<0.0062	--	--	--	<0.006	<0.0066	990
Acetone	<0.012	--	--	--	<0.012	<0.013	55,000
Carbon Disulfide	<0.0062	--	--	--	<0.006	<0.0066	
1,1-Dichloroethene	<0.0062	--	--	--	<0.006	<0.0066	6.3
1,1-Dichloroethane	<0.0062	--	--	--	<0.006	<0.0066	2,300
trans-1,2-Dichloroethene	<0.0062	--	--	--	<0.006	<0.0066	2,500
Chloroform	<0.0062	--	--	--	<0.006	<0.0066	
1,2-Dichloroethane	<0.0062	--	--	--	<0.006	<0.0066	41
2-Butanone (MEK)	<0.012	--	--	--	<0.012	<0.013	27,000
1,1,1-Trichloroethane	<0.0062	--	--	--	<0.006	<0.0066	1,400
Carbon Tetrachloride	<0.0062	--	--	--	<0.006	<0.0066	15
Bromodichloro-methane	<0.0062	--	--	--	<0.006	<0.0066	
1,2-Dichloropropane	<0.0062	--	--	--	<0.006	<0.0066	
cis-1,3-Dichloropropene	<0.0062	--	--	--	<0.006	<0.0066	
Trichloroethene (TCE)	0.009	--	--	--	<0.006	<0.0066	330
Dibromochloro-methane	<0.0062	--	--	--	<0.006	<0.0066	
1,1,2-Trichloroethane	<0.0062	--	--	--	<0.006	<0.0066	
Benzene	<0.0062	--	--	--	<0.006	<0.0066	68

trans-1,3-Dichloropropene	<0.0062	--	--	--	<0.006	<0.0066	
Bromoform	<0.0062	--	--	--	<0.006	<0.0066	
4-Methyl-2-pentanone (MIBK)	<0.012	--	--	--	<0.012	<0.013	3,800
2-Hexanone	<0.012	--	--	--	<0.012	<0.013	
Tetrachloroethene	<0.0062	--	--	--	<0.006	<0.0066	370
Toluene	<0.0062	--	--	--	<0.006	<0.0066	520
1,1,2,2-Tetrachloroethane	<0.0062	--	--	--	<0.006	<0.0066	
Chlorobenzene	<0.0062	--	--	--	<0.006	<0.0066	
Ethyl Benzene	<0.0062	--	--	--	<0.006	<0.0066	230
2-Chloroethyl Vinyl Ether	<0.0062	--	--	--	<0.006	<0.0066	
Vinyl Acetate	<0.012	--	--	--	<0.012	<0.013	
Styrene	<0.0062	--	--	--	<0.006	<0.0066	1,700
Xylenes (Total)	<0.012	--	--	--	<0.012	<0.012	1,500

[1]Samples collected from Borings b, c, and d were not tested for VOC's since no vapors were detected by the PID.
[2]Units of all parameters are in mg/kg.

Table 7
Site 5 Soil Sample Results
Volatile Organic Compounds

	Boring 1	Boring 2	Boring 3	Boring 4	Boring 5	Proposed Single Chemical Generic Industrial Direct Contact Standard (mg/kg)
Sampling Date	9/7/96	9/7/96	9/7/96	9/6/96	9/6/96	
Sample Depth (ft)	0-2	2-4	2-4	1-3	4-6	
Chloromethane[1]	<0.013	<0.013	<0.012	<0.013	<0.013	
Bromomethane	<0.013	<0.013	<0.012	<0.013	<0.013	
Vinyl Chloride	<0.013	<0.013	<0.012	<0.013	<0.013	2.5
Chloroethane	<0.013	<0.013	<0.012	<0.013	<0.013	
Methylene Chloride	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	990
Acetone	<0.013	<0.013	<0.012	<0.013	<0.013	55,000
Carbon Disulfide	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
1,1-Dichloroethene	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	6.3
1,1-Dichloroethane	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	2,300
trans-1,2-Dichloroethene	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	2,500
Chloroform	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
1,2-Dichloroethane	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	41
2-Butanone (MEK)	<0.013	<0.013	<0.012	<0.013	<0.013	27,000
1,1,1-Trichloroethane	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	1,400
Carbon Tetrachloride	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	15
Bromodichloro-methane	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
1,2-Dichloropropane	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
cis-1,3-Dichloropropene	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
Trichloroethene (TCE)	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	330
Dibromochloro-methane	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
1,1,2-Trichloroethane	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
Benzene	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	68

trans-1,3-Dichloropropene	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
Bromoform	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
4-Methyl-2-pentanone (MIBK)	<0.013	<0.013	<0.012	<0.013	<0.013	3,800
2-Hexanone	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
Tetrachloroethene	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	370
Toluene	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	520
1,1,2,2-Tetrachloroethane	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
Chlorobenzene	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
Ethyl Benzene	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	230
2-Chloroethyl Vinyl Ether	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	
Vinyl Acetate	<0.013	<0.013	<0.012	<0.013	<0.013	
Styrene	<0.0066	<0.0064	<0.0059	<0.0067	<0.0063	1,700
Xylenes (Total)	<0.013	<0.013	<0.012	0.0029J	<0.013	1,500

[1]Units of all parameters are in mg/kg.

Table 8
Site 5 Soil Sample Results
Volatile Organic Compounds

	Boring 6	Boring 7[1]	Boring 8	Boring 9	Boring 10	Proposed Single Chemical Generic Industrial Direct Contact Standard (mg/kg)
Sampling Date	9/6/96	9/6/96	9/6/96	9/6/96	9/7/96	
Sample Depth (ft)	4-6	2-4	1.5-2.5	0-2	2-4	
Chloromethane[2]	<0.012	–	<0.012	<0.013	<0.012	
Bromomethane	<0.012	–	<0.012	<0.013	<0.012	
Vinyl Chloride	<0.012	–	<0.012	<0.013	<0.012	2.5
Chloroethane	<0.012	–	<0.012	<0.013	<0.012	
Methylene Chloride	<0.0059	–	<0.006	0.027B	<0.006	990
Acetone	0.058	–	<0.012	<0.013	<0.012	55,000
Carbon Disulfide	<0.0059	–	<0.006	<0.0063	<0.006	
1,1-Dichloroethene	<0.0059	–	<0.006	<0.0063	<0.006	6.3
1,1-Dichloroethane	<0.0059	–	<0.006	<0.0063	<0.006	2,300
trans-1,2-Dichloroethene	<0.0059	–	<0.006	<0.0063	<0.006	2,500
Chloroform	<0.0059	–	<0.006	<0.0063	<0.006	
1,2-Dichloroethane	<0.0059	–	<0.006	<0.0063	<0.006	41
2-Butanone (MEK)	0.015	–	<0.012	<0.013	<0.012	27,000
1,1,1-Trichloroethane	<0.0059	–	<0.006	<0.0063	<0.006	1,400
Carbon Tetrachloride	<0.0059	–	<0.006	<0.0063	<0.006	15
Bromodichloro-methane	<0.0059	–	<0.006	<0.0063	<0.006	
1,2-Dichloropropane	<0.0059	–	<0.006	<0.0063	<0.006	
cis-1,3-Dichloropropene	<0.0059	–	<0.006	<0.0063	<0.006	
Trichloroethene (TCE)	<0.0059	–	<0.006	<0.0063	<0.006	330
Dibromochloro-methane	<0.0059	–	<0.006	<0.0063	<0.006	
1,1,2-Trichloroethane	<0.0059	–	<0.006	<0.0063	<0.006	
Benzene	<0.0059	–	<0.006	<0.0063	<0.006	68

trans-1,3-Dichloropropene	<0.0059	--	<0.006	<0.0063	<0.006	
Bromoform	<0.0059	--	<0.006	<0.0063	<0.006	
4-Methyl-2-pentanone (MIBK)	<0.012	--	<0.012	<0.013	<0.012	3,800
2-Hexanone	<0.012	--	<0.012	<0.013	<0.012	
Tetrachloroethene	<0.0059	--	<0.006	<0.0063	<0.006	370
Toluene	0.012	--	<0.006	<0.0063	<0.006	520
1,1,2,2-Tetrachloroethane	<0.0059	--	<0.006	<0.0063	<0.006	
Chlorobenzene	<0.0059	--	<0.006	<0.0063	<0.006	
Ethyl Benzene	<0.0059	--	<0.006	<0.0063	<0.006	230
2-Chloroethyl Vinyl Ether	<0.0059	--	<0.006	<0.0063	<0.006	
Vinyl Acetate	<0.012	--	<0.012	<0.013	<0.012	
Styrene	<0.0059	--	<0.006	<0.0063	<0.006	1,700
Xylenes (Total)	<0.012	--	<0.012	<0.013	<0.012	1,500

[1]Sample collected from Boring 7 was not tested for VOC's since no vapors were detected by the PID.
[2]Units of all parameters are in mg/kg.

Table 9
Site 5 Soil Sample Results
Semi-Volatile Organic Compounds

	Boring a	Boring b[1]	Boring c[1]	Boring d[1]	Boring e	Boring f	Proposed Single Chemical Generic Industrial Direct Contact Standard
Sampling Date	9/8/96	9/9/96	9/8/96	9/8/96	9/7/96	9/9/96	(mg/kg)
Sample Depth (ft)	2-4	2-4	0-2	0-2	2-4	0-2	
Phenol[2]	<0.41	--	--	--	<0.40	<0.44	300,000
bis(2-Chloroethyl) ether	<0.41	--	--	--	<0.40	<0.44	
2-Chlorophenol	<0.41	--	--	--	<0.40	<0.44	
1,3-Dichlorobenzene	<0.41	--	--	--	<0.40	<0.44	
1,4-Dichlorobenzene	<0.41	--	--	--	<0.40	<0.44	
1,2-Dichlorobenzene	<0.41	--	--	--	<0.40	<0.44	
2-Methylphenol	<0.41	--	--	--	<0.40	<0.44	
4-Methylphenol	<0.41	--	--	--	<0.40	<0.44	
N-Nitroso-di-n-propylamine	<0.41	--	--	--	<0.40	<0.44	
Hexachloroethane	<0.41	--	--	--	<0.40	<0.44	
Nitrobenzene	<0.41	--	--	--	<0.40	<0.44	
Isophorone	<0.41	--	--	--	<0.40	<0.44	
2-Nitrophenol	<0.41	--	--	--	<0.40	<0.44	
2,4-Dimethylphenol	<0.41	--	--	--	<0.40	<0.44	
bis(2-Chloroethoxy) methane	<0.41	--	--	--	<0.40	<0.44	
2,4-Dichlorophenol	<0.41	--	--	--	<0.40	<0.44	
1,2,4-Trichloro-benzene	<0.41	--	--	--	<0.40	<0.44	
Naphthalene	0.074J	--	--	--	<0.40	<0.44	22,000
4-Chloroaniline	<0.41	--	--	--	<0.40	<0.44	
Hexachlorobutadiene	<0.41	--	--	--	<0.40	<0.44	
4-Chloro-3-methylphenol	<0.41	--	--	--	<0.40	<0.44	
2-Methylnaphthalene	<0.41	--	--	--	<0.40	<0.44	

Hexachlorocyclo-pentadiene	<0.41	--	--	--	<0.40	<0.44	
2,4,6-Trichlorophenol	<0.41	--	--	--	<0.40	<0.44	
2,4,5-Trichloro-phenol	<1.0	--	--	--	<1.0	<1.1	
2-Chloronaphthalene	<0.41	--	--	--	<0.40	<0.44	
2-Nitroaniline	<1.0	--	--	--	<1.0	<1.1	
Dimethylphthalate	<0.41	--	--	--	<0.40	<0.44	
Acenaphthylene	<0.41	--	--	--	<0.40	<0.44	
2,6-Dinitrotoluene	<0.41	--	--	--	<0.40	<0.44	
3-Nitroaniline	<1.0	--	--	--	<1.0	<1.1	
Acenaphthene	<0.41	--	--	--	<0.40	<0.44	18,000
2,4-Dinitrophenol	<1.0	--	--	--	<1.0	<1.1	
4-Nitrophenol	<1.0	--	--	--	<1.0	<1.1	
Dibenzofuran	<0.41	--	--	--	<0.40	<0.44	
2,4-Dinitrotoluene	<0.41	--	--	--	<0.40	<0.44	
Diethylphthalate	<0.41	--	--	--	<0.40	<0.44	
4-Chlorophenyl-phenyl ether	<0.41	--	--	--	<0.40	<0.44	
Fluorene	<0.41	--	--	--	<0.40	<0.44	12,000
4-Nitroaniline	<1.0	--	--	--	<1.0	<1.1	
4,6-Dinitro-2-methylphenol	<1.0	--	--	--	<1.0	<1.1	
N-nitrosodiphenyl-amine	<0.41	--	--	--	<0.40	<0.44	
4-Bromophenyl-phenylether	<0.41	--	--	--	<0.40	<0.44	
Hexachlorobenzene	<0.41	--	--	--	<0.40	<0.44	
Pentachlorophenol	<1.0	--	--	--	<1.0	<1.1	
Phenanthrene	<0.41	--	--	--	<0.40	<0.44	
Anthracene	<0.41	--	--	--	<0.40	<0.44	89,000
Carbazole	<0.41	--	--	--	<0.40	<0.44	
Di-n-butylphthalate	<0.41	--	--	--	<0.40	<0.44	
Fluoranthene	<0.41	--	--	--	<0.40	<0.44	12,000
Pyrene	<0.41	--	--	--	<0.40	<0.44	8,900

Butylbenzylphthalate	<0.41	--	--	--	<0.40	<0.44	
3,3'-Dichloro-benzidine	<0.41	--	--	--	<0.40	<0.44	
Benzo(a)anthracene	<0.41	--	--	--	<0.40	<0.44	31
Chrysene	<0.41	--	--	--	<0.40	<0.44	3,100
bis(2-Ethylhexyl)-phthalate	0.044J	--	--	--	0.049J	0.059J	860
Di-n-octylphthalate	<0.41	--	--	--	<0.40	<0.44	
Benzo(b)fluoranthene	<0.41	--	--	--	<0.40	<0.44	31
Benzo(k)fluoranthene	<0.41	--	--	--	<0.40	<0.44	310
Benzo(a)pyrene	<0.41	--	--	--	<0.40	<0.44	3.1
Indeno-(1,2,3-cd)pyrene	<0.41	--	--	--	<0.40	<0.44	31
Dibenzo(a,h)-anthracene	<0.41	--	--	--	<0.40	<0.44	3.1
Benzo(g,h,i)perylene	<0.41	--	--	--	<0.40	<0.44	
Aniline	<0.41	--	--	--	<0.40	<0.44	
Azobenzene	<0.41	--	--	--	<0.40	<0.44	
Benzidine	<1.0	--	--	--	<1.0	<1.1	
Benzoic Acid	<0.41	--	--	--	<0.40	<0.44	
Benzyl Alcohol	<0.41	--	--	--	<0.40	<0.44	
bis(2-Chloro-isopropyl) ether	<0.41	--	--	--	<0.40	<0.44	
N-Nitrosodimethyl-amine	<0.41	--	--	--	<0.40	<0.44	

[1]Samples collected from Borings b, c, and d were not tested for SVOC's since no vapors were detected by the PID.
[2]Units of all parameters are in mg/kg.

Table 10
Site 5 Soil Sample Results
Semi-Volatile Organic Compounds

	Boring 1	Boring 2	Boring 3	Boring 4	Boring 5	Proposed Single Chemical Generic Industrial Direct Contact Standard (mg/kg)
Sampling Date	9/7/96	9/7/96	9/7/96	9/6/96	9/6/96	
Sample Depth (ft)	0-2	2-4	2-4	1-3	4-6	
Phenol[1]	<0.44	<0.43	<0.39	<0.44	<0.42	300,000
bis(2-Chloroethyl) ether	<0.44	<0.43	<0.39	<0.44	<0.42	
2-Chlorophenol	<0.44	<0.43	<0.39	<0.44	<0.42	
1,3-Dichlorobenzene	<0.44	<0.43	<0.39	<0.44	<0.42	
1,4-Dichlorobenzene	<0.44	<0.43	<0.39	<0.44	<0.42	
1,2-Dichlorobenzene	<0.44	<0.43	<0.39	<0.44	<0.42	
2-Methylphenol	<0.44	<0.43	<0.39	<0.44	<0.42	
4-Methylphenol	<0.44	<0.43	<0.39	<0.44	<0.42	
N-Nitroso-di-n-propylamine	<0.44	<0.43	<0.39	<0.44	<0.42	
Hexachloroethane	<0.44	<0.43	<0.39	<0.44	<0.42	
Nitrobenzene	<0.44	<0.43	<0.39	<0.44	<0.42	
Isophorone	<0.44	<0.43	<0.39	<0.44	<0.42	
2-Nitrophenol	<0.44	<0.43	<0.39	<0.44	<0.42	
2,4-Dimethylphenol	<0.44	<0.43	<0.39	<0.44	<0.42	
bis(2-Chloroethoxy) methane	<0.44	<0.43	<0.39	<0.44	<0.42	
2,4-Dichlorophenol	<0.44	<0.43	<0.39	<0.44	<0.42	
1,2,4-Trichloro-benzene	<0.44	<0.43	<0.39	<0.44	<0.42	
Naphthalene	<0.44	<0.43	<0.39	0.071J	<0.42	22,000
4-Chloroaniline	<0.44	<0.43	<0.39	<0.44	<0.42	
Hexachlorobutadiene	<0.44	<0.43	<0.39	<0.44	<0.42	
4-Chloro-3-methylphenol	<0.44	<0.43	<0.39	<0.44	<0.42	
2-Methylnaphthalene	<0.44	<0.43	<0.39	0.12J	<0.42	

Hexachlorocyclo-pentadiene	<0.44	<0.43	<0.39	<0.44	<0.42	
2,4,6-Trichlorophenol	<0.44	<0.43	<0.39	<0.44	<0.42	
2,4,5-Trichlorophenol	<0.44	<0.43	<0.39	<0.44	<0.42	
2-Chloronaphthalene	<0.44	<0.43	<0.39	<0.44	<0.42	
2-Nitroaniline	<1.1	<1.1	<0.98	<1.1	<1.0	
Dimethylphthalate	<0.44	<0.43	<0.39	<0.44	<0.42	
Acenaphthylene	<0.44	<0.43	<0.39	<0.44	<0.42	
2,6-Dinitrotoluene	<0.44	<0.43	<0.39	<0.44	<0.42	
3-Nitroaniline	<1.1	<1.1	<0.98	<1.1	<1.0	
Acenaphthene	<0.44	<0.43	<0.39	<0.44	<0.42	18,000
2,4-Dinitrophenol	<1.1	<1.1	<0.98	<1.1	<1.0	
4-Nitrophenol	<1.1	<1.1	<0.98	<1.1	<1.0	
Dibenzofuran	<0.44	<0.43	<0.39	0.052J	<0.42	
2,4-Dinitrotoluene	<0.44	<0.43	<0.39	<0.44	<0.42	
Diethylphthalate	<0.44	<0.43	<0.39	<0.44	<0.42	
4-Chlorophenyl-phenyl ether	<0.44	<0.43	<0.39	<0.44	<0.42	
Fluorene	<0.44	<0.43	<0.39	<0.44	<0.42	12,000
4-Nitroaniline	<1.1	<1.1	<0.98	<1.1	<1.0	
4,6-Dinitro-2-methylphenol	<1.1	<1.1	<0.98	<1.1	<1.0	
N-nitrosodiphenyl-amine	<0.44	<0.43	<0.39	<0.44	<0.42	
4-Bromophenyl-phenylether	<0.44	<0.43	<0.39	<0.44	<0.42	
Hexachlorobenzene	<0.44	<0.43	<0.39	<0.44	<0.42	
Pentachlorophenol	<1.1	<1.1	<0.98	<1.1	<1.0	
Phenanthrene	<0.44	<0.43	<0.39	0.19J	<0.42	
Anthracene	<0.44	<0.43	<0.39	<0.44	<0.42	89,000
Carbazole	<0.44	<0.43	<0.39	<0.44	<0.42	
Di-n-butylphthalate	<0.44	<0.43	<0.39	<0.44	<0.42	
Fluoranthene	<0.44	0.051J	<0.39	0.15J	<0.42	12,000
Pyrene	<0.44	<0.43	<0.39	0.13J	<0.42	8,900

Butylbenzylphthalate	<0.44	<0.43	<0.39	<0.44	<0.42	
3,3'-Dichloro-benzidine	<0.44	<0.43	<0.39	<0.44	<0.42	
Benzo(a)anthracene	<0.44	<0.43	<0.39	0.064J	<0.42	31
Chrysene	<0.44	<0.43	<0.39	0.084J	<0.42	3,100
bis(2-Ethylhexyl)-phthalate	<0.44	0.071J	0.075J	0.063J	0.09J	860
Di-n-octylphthalate	<0.44	<0.43	<0.39	<0.44	<0.42	
Benzo(b)fluoranthene	<0.44	<0.43	<0.39	0.057J	<0.42	31
Benzo(k)fluoranthene	<0.44	<0.43	<0.39	<0.44	<0.42	310
Benzo(a)pyrene	<0.44	<0.43	<0.39	<0.44	<0.42	3.1
Indeno-(1,2,3-cd)pyrene	<0.44	<0.43	<0.39	<0.44	<0.42	31
Dibenzo(a,h)-anthracene	<0.44	<0.43	<0.39	<0.44	<0.42	3.1
Benzo(g,h,i)perylene	<0.44	<0.43	<0.39	<0.44	<0.42	
Aniline	<0.44	<0.43	<0.39	<0.44	<0.42	
Azobenzene	<0.44	<0.43	<0.39	<0.44	<0.42	
Benzidine	<1.1	<1.1	<0.98	<1.1	<1.0	
Benzoic Acid	<0.44	<0.43	<0.39	<0.44	<0.42	
Benzyl Alcohol	<0.44	<0.43	<0.39	<0.44	<0.42	
bis(2-Chloroiso-propyl) ether	<0.44	<0.43	<0.39	<0.44	<0.42	
N-nitrosodimethyl-amine	<0.44	<0.43	<0.39	<0.44	<0.42	

[1]Units of all parameters are in mg/kg.

Table 11
Site 5 Soil Sample Results
Semi-Volatile Organic Compounds

	Boring 6	Boring 7[1]	Boring 8	Boring 9	Boring 10	Proposed Single Chemical Generic Industrial Direct Contact Standard
Sampling Date	9/6/96	9/6/96	9/6/96	9/6/96	9/7/96	(mg/kg)
Sample Depth (ft)	4-6	2-4	1.5-2.5	0-2	2-4	
Phenol[2]	<0.39	--	<0.40	<0.42	<0.40	300,000
bis(2-Chloroethyl) ether	<0.39	--	<0.40	<0.42	<0.40	
2-Chlorophenol	<0.39	--	<0.40	<0.42	<0.40	
1,3-Dichlorobenzene	<0.39	--	<0.40	<0.42	<0.40	
1,4-Dichlorobenzene	<0.39	--	<0.40	<0.42	<0.40	
1,2-Dichlorobenzene	<0.39	--	<0.40	<0.42	<0.40	
2-Methylphenol	<0.39	--	<0.40	<0.42	<0.40	
4-Methylphenol	<0.39	--	<0.40	<0.42	<0.40	
N-Nitroso-di-n-propylamine	<0.39	--	<0.40	<0.42	<0.40	
Hexachloroethane	<0.39	--	<0.40	<0.42	<0.40	
Nitrobenzene	<0.39	--	<0.40	<0.42	<0.40	
Isophorone	<0.39	--	<0.40	<0.42	<0.40	
2-Nitrophenol	<0.39	--	<0.40	<0.42	<0.40	
2,4-Dimethylphenol	<0.39	--	<0.40	<0.42	<0.40	
bis(2-Chloroethoxy) methane	<0.39	--	<0.40	<0.42	<0.40	
2,4-Dichlorophenol	<0.39	--	<0.40	<0.42	<0.40	
1,2,4-Trichloro-benzene	<0.39	--	<0.40	<0.42	<0.40	
Naphthalene	0.13J	--	<0.40	<0.42	<0.40	22,000
4-Chloroaniline	<0.39	--	<0.40	<0.42	<0.40	
Hexachlorobutadiene	<0.39	--	<0.40	<0.42	<0.40	
4-Chloro-3-methylphenol	<0.39	--	<0.40	<0.42	<0.40	
2-Methylnaphthalene	0.29J	--	<0.40	<0.42	<0.40	

Hexachlorocyclo-pentadiene	<0.39	--	<0.40	<0.42	<0.40	
2,4,6-Trichlorophenol	<0.39	--	<0.40	<0.42	<0.40	
2,4,5-Trichlorophenol	<0.98	--	<1.0	<1.0	<1.0	
2-Chloronaphthalene	<0.39	--	<0.40	<0.42	<0.40	
2-Nitroaniline	<0.98	--	<1.0	<1.0	<1.0	
Dimethylphthalate	<0.39	--	<0.40	<0.42	<0.40	
Acenaphthylene	<0.39	--	<0.40	<0.42	<0.40	
2,6-Dinitrotoluene	<0.39	--	<0.40	<0.42	<0.40	
3-Nitroaniline	<0.98	--	<1.0	<1.0	<1.0	
Acenaphthene	<0.39	--	<0.40	<0.42	<0.40	18,000
2,4-Dinitrophenol	<0.98	--	<1.0	<1.0	<1.0	
4-Nitrophenol	<0.98	--	<1.0	<1.0	<1.0	
Dibenzofuran	0.087J	--	<0.40	<0.42	<0.40	
2,4-Dinitrotoluene	<0.39	--	<0.40	<0.42	<0.40	
Diethylphthalate	<0.39	--	<0.40	<0.42	<0.40	
4-Chlorophenyl-phenyl ether	<0.39	--	<0.40	<0.42	<0.40	
Fluorene	<0.39	--	<0.40	<0.42	<0.40	12,000
4-Nitroaniline	<0.98	--	<1.0	<1.0	<1.0	
4,6-Dinitro-2-methylphenol	<0.98	--	<1.0	<1.0	<1.0	
N-nitrosodiphenyl-amine	<0.39	--	<0.40	<0.42	<0.40	
4-Bromophenyl-phenylether	<0.39	--	<0.40	<0.42	<0.40	
Hexachlorobenzene	<0.39	--	<0.40	<0.42	<0.40	
Pentachlorophenol	<0.98	--	<1.0	<1.0	<1.0	
Phenanthrene	0.22J	--	<0.40	<0.42	<0.40	
Anthracene	<0.39	--	<0.40	<0.42	<0.40	89,000
Carbazole	<0.39	--	<0.40	<0.42	<0.40	
Di-n-butylphthalate	<0.39	--	<0.40	<0.42	<0.40	
Fluoranthene	<0.39	--	<0.40	<0.42	<0.40	12,000
Pyrene	0.049J	--	<0.40	<0.42	<0.40	8,900

Butylbenzylphthalate	<0.39	--	<0.40	<0.42	<0.40	
3,3'-Dichloro-benzidine	<0.39	--	<0.40	<0.42	<0.40	
Benzo(a)anthracene	<0.39	--	<0.40	<0.42	<0.40	31
Chrysene	0.066J	--	<0.40	<0.42	<0.40	3,100
bis(2-Ethylhexyl)-phthalate	0.14J	--	0.043J	0.053J	<0.40	860
Di-n-octylphthalate	<0.39	--	<0.40	<0.42	<0.40	
Benzo(b)fluoranthene	<0.39	--	<0.40	<0.42	<0.40	31
Benzo(k)fluoranthene	<0.39	--	<0.40	<0.42	<0.40	310
Benzo(a)pyrene	<0.39	--	<0.40	<0.42	<0.40	3.1
Indeno-(1,2,3-cd)pyrene	<0.39	--	<0.40	<0.42	<0.40	31
Dibenzo(a,h)-anthracene	<0.39	--	<0.40	<0.42	<0.40	3.1
Benzo(g,h,i)perylene	<0.39	--	<0.40	<0.42	<0.40	
Aniline	<0.39	--	<0.40	<0.42	<0.40	
Azobenzene	<0.39	--	<0.40	<0.42	<0.40	
Benzidine	<0.98	--	<1.0	<1.0	<1.0	
Benzoic Acid	<0.39	--	0.34J	<0.42	<0.40	
Benzyl Alcohol	<0.39	--	<0.40	<0.42	<0.40	
bis(2-Chloroiso-propyl)ether	<0.39	--	<0.40	<0.42	<0.40	
N-nitrosodimethyl-amine	<0.39	--	<0.40	<0.42	<0.40	

[1]Sample collected from Boring 7 was not tested for SVOC's since no vapors were detected by the PID.
[2]Units of all parameters are in mg/kg.

Table 12
Site 5 Soil Sample Results
Pesticides and PCB's

	Boring a	Boring b	Boring c	Boring d	Boring e	Boring f	Proposed Single Chemical Generic Industrial Direct Contact Standard (mg/kg)
Sampling Date	9/8/96	9/9/96	9/8/96	9/8/96	9/7/96	9/9/96	
Sample Depth (ft)	2-4	2-4	0-2	0-2	2-4	0-2	
alpha-BHC[1]	<0.0012	<0.0012	<0.021	<0.0013	<0.0012	<0.0013	
beta-BHC	<0.0021	<0.002	<0.0013	<0.0021	<0.002	<0.0022	
delta-BHC	<0.0021	<0.002	<0.0021	<0.0021	<0.002	<0.0022	
gamma-BHC (Lindane)	<0.0016	<0.0016	<0.0021	<0.0017	<0.0016	<0.0018	
Heptachlor	<0.0012	<0.0012	<0.0014	<0.0013	<0.0012	<0.0013	
Aldrin	<0.0016	<0.0016	<0.0018	<0.0017	<0.0016	<0.0018	
Heptachlor epoxide	<0.0041	<0.004	<0.0046	<0.0043	<0.004	<0.0044	
Endosulfan I	<0.0021	<0.002	<0.0023	<0.0021	<0.002	<0.0022	
Endosulfan II	<0.0016	<0.0016	<0.0018	<0.0017	<0.0016	<0.0018	
Dieldrin	<0.0008	<0.0008	<0.0009	<0.0009	<0.0008	0.0004J	
4,4'-DDE	<0.0021	<0.002	<0.0023	<0.0021	<0.002	<0.0022	
Endrin	<0.0021	<0.002	<0.0023	<0.0021	<0.002	<0.0022	
Endosulfan sulfate	<0.0041	<0.004	<0.0046	<0.0043	<0.004	<0.0044	
4,4'-DDD	<0.0021	<0.002	<0.0023	<0.0021	<0.002	<0.0022	
4,4'-DDT	<0.0041	0.0008J	<0.0046	<0.0043	<0.004	0.0009J	
Methoxychlor	<0.016	<0.016	<0.018	<0.017	<0.016	<0.018	
Endrin ketone	<0.0021	<0.002	<0.0023	<0.0021	<0.002	<0.0022	
Endrin aldehyde	<0.0021	<0.002	<0.0023	<0.0021	<0.002	<0.0022	
alpha-Chlordane	<0.0021	<0.002	<0.0017	<0.0021	<0.002	<0.0022	
gamma-Chlordane	<0.0021	<0.002	<0.0021	<0.0021	<0.002	<0.0022	
Toxaphene	<0.01	<0.01	<0.011	<0.011	<0.01	<0.011	
Aroclor-1016	<0.021	<0.02	<0.0017	<0.021	<0.02	<0.022	25[2]
Aroclor-1221	<0.021	<0.02	<0.021	<0.021	<0.02	<0.022	25[2]
Aroclor-1232	<0.021	<0.02	<0.021	<0.021	<0.02	<0.022	25[2]

Aroclor-1242	<0.021	<0.02	<0.021	<0.021	<0.02	<0.022	25[2]
Aroclor-1248	<0.021	<0.02	<0.021	<0.021	<0.02	<0.022	25[2]
Aroclor-1254	<0.021	<0.02	<0.021	<0.021	<0.02	<0.022	25[2]
Aroclor-1260	<0.021	<0.02	<0.021	<0.021	<0.02	<0.022	25[2]

[1]Units of all parameters are in mg/kg.
[2]The Proposed Generic Industrial Land-Use, Direct Contact Standard for Total PCB's is 25 mg/kg.

Table 13
Site 5 Soil Sample Results
Pesticides and PCB's

	Boring 1	Boring 2	Boring 3	Boring 4	Boring 5	Proposed Single Chemical Generic Industrial Direct Contact Standard (mg/kg)
Sampling Date	9/7/96	9/7/96	9/7/96	9/6/96	9/6/96	
Sample Depth (ft)	0-2	2-4	2-4	1-3	4-6	
alpha-BHC[1]	<0.0013	<0.0013	<0.0012	<0.0013	<0.0013	
beta-BHC	<0.0022	<0.0021	<0.002	<0.0022	<0.0021	
delta-BHC	<0.0022	<0.0021	<0.002	<0.0022	<0.0021	
gamma-BHC (Lindane)	<0.0018	<0.0017	<0.0016	<0.0018	<0.0017	
Heptachlor	<0.0013	<0.0013	<0.0012	<0.0013	<0.0013	
Aldrin	<0.0018	<0.0017	<0.0016	<0.0018	<0.0017	
Heptachlor epoxide	<0.0044	<0.0043	<0.0039	<0.0044	<0.0042	
Endosulfan I	<0.0022	<0.0021	<0.002	<0.0022	<0.0021	
Endosulfan II	<0.0018	<0.0017	<0.0016	<0.0018	<0.0017	
Dieldrin	<0.0009	<0.0009	<0.0008	<0.0009	<0.0008	
4,4'-DDE	<0.0022	<0.0021	<0.002	<0.0022	<0.0021	
Endrin	<0.0022	<0.0021	<0.002	<0.0022	<0.0021	
Endosulfan sulfate	<0.0044	<0.0043	<0.0039	<0.0044	<0.0042	
4,4'-DDD	<0.0022	<0.0021	<0.002	<0.0022	<0.0021	
4,4'-DDT	<0.0044	<0.0043	<0.0039	<0.0044	<0.0042	
Methoxychlor	<0.018	<0.017	<0.016	<0.018	<0.017	
Endrin ketone	<0.0022	<0.0021	<0.002	<0.0022	<0.0021	
Endrin aldehyde	<0.0022	<0.0021	<0.002	<0.0022	<0.0021	
alpha-Chlordane	<0.0022	<0.0021	<0.002	<0.0022	<0.0021	
gamma-Chlordane	<0.0022	<0.0021	<0.002	<0.0022	<0.0021	
Toxaphene	<0.011	<0.011	<0.0098	<0.011	<0.010	
Aroclor-1016	<0.022	<0.021	<0.020	<0.022	<0.021	25[2]
Aroclor-1221	<0.022	<0.021	<0.020	<0.022	<0.021	25[2]
Aroclor-1232	<0.022	<0.021	<0.020	<0.022	<0.021	25[2]

Aroclor-1242	<0.022	<0.021	<0.020	<0.022	<0.021	25[2]
Aroclor-1248	<0.022	<0.021	<0.020	<0.022	<0.021	25[2]
Aroclor-1254	<0.022	<0.021	<0.020	<0.022	<0.021	25[2]
Aroclor-1260	<0.022	<0.021	<0.020	<0.022	<0.021	25[2]

[1]Units of all parameters are in mg/kg.
[2]The Proposed Generic Industrial Land-Use, Direct Contact Standard for Total PCB's is 25 mg/kg.

Table 14
Site 5 Soil Sample Results
Pesticides and PCB's

	Boring 6	Boring 7	Boring 8	Boring 9	Boring 10	Proposed Single Chemical Generic Industrial Direct Contact Standard (mg/kg)
Sampling Date	9/6/96	9/6/96	9/6/96	9/6/96	9/7/96	
Sample Depth (ft)	4-6	2-4	1.5-2.5	0-2	2-4	
alpha-BHC[1]	<0.0012	<0.0013	<0.0012	<0.0013	<0.0012	
beta-BHC	<0.002	<0.0021	<0.002	<0.0021	<0.002	
delta-BHC	<0.002	<0.0021	<0.002	<0.0021	<0.002	
gamma-BHC (Lindane)	<0.0016	<0.0017	<0.0016	<0.0017	<0.0016	
Heptachlor	<0.0012	<0.0013	<0.0012	<0.0013	<0.0012	
Aldrin	<0.0016	<0.0017	<0.0016	<0.0017	<0.0016	
Heptachlor epoxide	<0.0039	<0.0042	<0.004	<0.0042	<0.004	
Endosulfan I	<0.002	<0.0021	<0.002	<0.0021	<0.002	
Endosulfan II	<0.0016	<0.0017	<0.0016	<0.0017	<0.0016	
Dieldrin	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	
4,4'-DDE	<0.002	<0.0021	<0.002	<0.0021	<0.002	
Endrin	<0.002	<0.0021	<0.002	<0.0021	<0.002	
Endosulfan sulfate	<0.0039	<0.0042	<0.004	<0.0042	<0.004	
4,4'-DDD	<0.002	<0.0021	<0.002	<0.0021	<0.002	
4,4'-DDT	<0.0039	<0.0042	<0.004	<0.0042	<0.004	
Methoxychlor	<0.016	<0.017	<0.016	<0.017	<0.016	
Endrin ketone	<0.002	<0.0021	<0.002	<0.0021	<0.002	
Endrin aldehyde	<0.002	<0.0021	<0.002	<0.0021	<0.002	
alpha-Chlordane	<0.002	<0.0021	<0.002	<0.0021	<0.002	
gamma-Chlordane	<0.002	<0.0021	<0.002	<0.0021	<0.002	
Toxaphene	<0.0098	<0.011	<0.01	<0.01	<0.01	
Aroclor-1016	<0.02	<0.021	<0.02	<0.021	<0.02	25[2]
Aroclor-1221	<0.02	<0.021	<0.02	<0.021	<0.02	25[2]
Aroclor-1232	<0.02	<0.021	<0.02	<0.021	<0.02	25[2]

Aroclor-1242	<0.02	<0.021	<0.02	<0.021	<0.02	25[2]
Aroclor-1248	<0.02	<0.021	<0.02	<0.021	<0.02	25[2]
Aroclor-1254	<0.02	<0.021	<0.02	<0.021	<0.02	25[2]
Aroclor-1260	<0.02	<0.021	<0.02	<0.021	<0.02	25[2]

[1]Units of all parameters are in mg/kg.
[2]The Proposed Generic Industrial Land-Use, Direct Contact Standard for Total PCB's is 25 mg/kg.

Table 15
Site 5 Soil Sample Results
TCLP Metals

	Boring 3	Boring 5	Boring 9	TCLP Regulatory Level
Sampling Date	9/7/96	9/6/96	9/6/96	(mg/l)
Sample Depth (ft)	2-4	4-6	0-2	
Arsenic[1]	<0.06	<0.06	<0.06	5.0
Barium	0.50	1.9	2.0	100.0
Cadmium	<0.03	<0.03	<0.03	1.0
Chromium	<0.1	<0.1	<0.1	5.0
Lead	<0.03	<0.03	<0.03	5.0
Mercury	<0.005	<0.005	<0.005	0.2
Selenium	<0.05	<0.05	<0.05	1.0
Silver	<0.05	<0.05	<0.05	5.0

[1]Units of all parameters are in mg/l.

Site 7 Soil Sample Test Results

A total of four soil samples were collected (Borings a, b, c, and d) at Site 7 for laboratory testing. Laboratory test results of soil samples collected from Site 7 are shown in Tables 16 through 19. The qualifier "J" denotes an estimated result less than the quantitation limit.

Table 16
Site 7 Soil Sample Results
Inorganics

	Boring a	Boring b	Boring c	Boring d	Proposed Single Chemical Generic Industrial Direct Contact Standard (mg/kg)
Sampling Date	9/4/96	9/6/96	9/4/96	9/5/96	
Sample Depth (ft)	2-4	4-6	0-2	2-4	
Aluminum[1]	12,000	12,000	15,000	13,000	
Antimony	<0.59	<0.59	<0.60	<0.58	
Arsenic	13	12	3.5	6.3	86
Barium	74	61	56	91	140,000
Beryllium	0.61	0.57	0.60	0.69	
Cadmium	<0.18	<0.36	<0.18	<0.17	300
Calcium	2,200	2,400	2,200	2,100	
Chromium	18	17	19	18	2,800 (Cr VI)
Cobalt	13	12	6.4	9.4	
Copper	28	28	13	23	
Iron	35,000	34,000	20,000	25,000	
Lead	15	14	9.4	12	2,800
Magnesium	4,600	4,900	2,900	4,700	
Manganese	370	380	91	150	
Mercury	<0.00024	<0.00012	<0.00024	0.00029	230
Nickel	32	31	21	28	3,700
Potassium	1,300	1,600	1,100	1,100	
Selenium	1.3	1.3	0.70	0.79	
Silver	<0.29	<0.30	<0.30	<0.29	
Sodium	44	50	48	56	
Thallium	<0.59	<0.59	<0.60	<0.58	
Vanadium	17	16	19	18	
Zinc	74	75	64	72	370,000
Cyanide	<0.59	<0.59	<0.60	<0.58	

[1]Units of all parameters are in mg/kg.

trans-1,3-Dichloropropene	<0.0059	<0.0059	--	--	
Bromoform	<0.0059	<0.0059	--	--	
4-Methyl-2-pentanone (MIBK)	<0.012	<0.012	--	--	3,800
2-Hexanone	<0.012	<0.012	--	--	
Tetrachloroethene	<0.0059	<0.0059	--	--	370
Toluene	<0.0059	<0.0059	--	--	520
1,1,2,2-Tetrachloroethane	<0.0059	<0.0059	--	--	
Chlorobenzene	<0.0059	<0.0059	--	--	
Ethyl Benzene	<0.0059	<0.0059	--	--	230
2-Chloroethyl Vinyl Ether	<0.0059	<0.0059	--	--	
Vinyl Acetate	<0.012	<0.012	--	--	
Styrene	<0.0059	<0.0059	--	--	1,700
Xylenes (Total)	<0.012	<0.012	--	--	1,500

[1]Samples collected from Borings c and d were not tested for VOC's since no vapors were detected by the PID.
[2]Units of all parameters are in mg/kg.

Table 18
Site 7 Soil Sample Results
Semi-Volatile Organic Compounds

	Boring a	Boring b	Boring c[1]	Boring d[1]	Proposed Single Chemical Generic Industrial Direct Contact Standard (mg/kg)
Sampling Date	9/4/96	9/6/96	9/4/96	9/5/96	
Sample Depth (ft)	2-4	4-6	0-2	2-4	
Phenol[2]	<0.39	<0.39	--	--	300,000
bis(2-Chloroethyl) ether	<0.39	<0.39	--	--	
2-Chlorophenol	<0.39	<0.39	--	--	
1,3-Dichlorobenzene	<0.39	<0.39	--	--	
1,4-Dichlorobenzene	<0.39	<0.39	--	--	
1,2-Dichlorobenzene	<0.39	<0.39	--	--	
2-Methylphenol	<0.39	<0.39	--	--	
4-Methylphenol	<0.39	<0.39	--	--	
N-Nitroso-di-n-propylamine	<0.39	<0.39	--	--	
Hexachloroethane	<0.39	<0.39	--	--	
Nitrobenzene	<0.39	<0.39	--	--	
Isophorone	<0.39	<0.39	--	--	
2-Nitrophenol	<0.39	<0.39	--	--	
2,4-Dimethylphenol	<0.39	<0.39	--	--	
bis(2-Chloroethoxy) methane	<0.39	<0.39	--	--	
2,4-Dichlorophenol	<0.39	<0.39	--	--	
1,2,4-Trichloro-benzene	<0.39	<0.39	--	--	
Naphthalene	<0.39	<0.39	--	--	22,000
4-Chloroaniline	<0.39	<0.39	--	--	
Hexachlorobutadiene	<0.39	<0.39	--	--	
4-Chloro-3-methylphenol	<0.39	<0.39	--	--	
2-Methylnaphthalene	<0.39	<0.39	--	--	

Hexachlorocyclo-pentadiene	<0.39	<0.39	–	–	
2,4,6-Trichlorophenol	<0.39	<0.39	–	–	
2,4,5-Trichlorophenol	<0.98	<0.98	–	–	
2-Chloronaphthalene	<0.39	<0.39	–	–	
2-Nitroaniline	<0.98	<0.98	–	–	
Dimethylphthalate	<0.39	<0.39	–	–	
Acenaphthylene	<0.39	<0.39	–	–	
2,6-Dinitrotoluene	<0.39	<0.39	–	–	
3-Nitroaniline	<0.98	<0.98	–	–	
Acenaphthene	<0.39	<0.39	–	–	18,000
2,4-Dinitrophenol	<0.98	<0.98	–	–	
4-Nitrophenol	<0.98	<0.98	–	–	
Dibenzofuran	<0.39	<0.39	–	–	
2,4-Dinitrotoluene	<0.39	<0.39	–	–	
Diethylphthalate	<0.39	<0.39	–	–	
4-Chlorophenyl-phenyl ether	<0.39	<0.39	–	–	
Fluorene	<0.39	<0.39	–	–	12,000
4-Nitroaniline	<0.98	<0.98	–	–	
4,6-Dinitro-2-methylphenol	<0.98	<0.98	–	–	
N-nitrosodiphenyl-amine	<0.39	<0.39	–	–	
4-Bromophenyl-phenylether	<0.39	<0.39	–	–	
Hexachlorobenzene	<0.39	<0.39	–	–	
Pentachlorophenol	<0.98	<0.98	–	–	
Phenanthrene	<0.39	<0.39	–	–	
Anthracene	<0.39	<0.39	–	–	89,000
Carbazole	<0.39	<0.39	–	–	
Di-n-butylphthalate	<0.39	<0.39	–	–	
Fluoranthene	<0.39	<0.39	–	–	12,000
Pyrene	<0.39	<0.39	–	–	8,900

Butylbenzylphthalate	<0.39	<0.39	--	--	
3,3'-Dichloro-benzidine	<0.39	<0.39	--	--	
Benzo(a)anthracene	<0.39	<0.39	--	--	31
Chrysene	<0.39	<0.39	--	--	3,100
bis(2-Ethylhexyl)-phthalate	0.11J	0.19J	--	--	860
Di-n-octylphthalate	<0.39	<0.39	--	--	
Benzo(b)fluoranthene	<0.39	<0.39	--	--	31
Benzo(k)fluoranthene	<0.39	<0.39	--	--	310
Benzo(a)pyrene	<0.39	<0.39	--	--	3.1
Indeno-(1,2,3-cd)pyrene	<0.39	<0.39	--	--	31
Dibenzo(a,h)-anthracene	<0.39	<0.39	--	--	3.1
Benzo(g,h,i)perylene	<0.39	<0.39	--	--	
Aniline	<0.39	<0.39	--	--	
Azobenzene	<0.39	<0.39	--	--	
Benzidine	<0.98	<0.98	--	--	
Benzoic Acid	<0.39	<0.39	--	--	
Benzyl Alcohol	<0.39	<0.39	--	--	
bis(2-Chloroiso-propyl)ether	<0.39	<0.39	--	--	
N-nitrosodimethyl-amine	<0.39	<0.39	--	--	

[1]Samples collected from Borings c and d were not tested for SVOC's since no vapors were detected by the PID.
[2]Units of all parameters are in mg/kg.

Table 19
Site 7 Soil Sample Results
Pesticides and PCB's

	Boring a	Boring b	Boring c	Boring d	Proposed Single Chemical Generic Industrial Direct Contact Standard (mg/kg)
Sampling Date	9/4/96	9/6/96	9/4/96	9/5/96	
Sample Depth (ft)	2-4	4-6	0-2	2-4	
alpha-BHC[1]	<0.0012	<0.0012	<0.0012	<0.0011	
beta-BHC	<0.002	<0.002	<0.002	<0.0019	
delta-BHC	<0.002	<0.002	<0.002	<0.0019	
gamma-BHC (Lindane)	<0.0016	<0.0016	<0.0016	<0.0015	
Heptachlor	<0.0012	<0.0012	<0.0012	<0.0011	
Aldrin	<0.0016	<0.0016	<0.0016	<0.0015	
Heptachlor epoxide	<0.0039	<0.0039	<0.004	<0.0038	
Endosulfan I	<0.002	<0.002	<0.002	<0.019	
Endosulfan II	<0.0016	<0.0016	<0.0016	<0.0015	
Dieldrin	<0.0008	<0.0008	<0.0008	<0.0008	
4,4'-DDE	<0.002	<0.002	<0.002	<0.0019	
Endrin	<0.002	<0.002	<0.002	<0.0019	
Endosulfan sulfate	<0.0039	<0.0039	<0.004	<0.0038	
4,4'-DDD	<0.002	<0.002	<0.002	<0.0019	
4,4'-DDT	<0.0039	<0.0039	<0.004	<0.0038	
Methoxychlor	<0.016	<0.016	<0.016	<0.015	
Endrin ketone	<0.002	<0.002	<0.002	<0.0019	
Endrin aldehyde	<0.002	<0.002	<0.002	<0.0019	
alpha-Chlordane	<0.002	<0.002	<0.002	<0.0019	
gamma-Chlordane	<0.002	<0.002	<0.002	<0.0019	
Toxaphene	<0.0098	<0.0098	<0.01	<0.0096	
Aroclor-1016	<0.02	<0.02	<0.02	<0.019	25[2]
Aroclor-1221	<0.02	<0.02	<0.02	<0.019	25[2]
Aroclor-1232	<0.02	<0.02	<0.02	<0.019	25[2]

Aroclor-1242	<0.02	<0.02	<0.02	<0.019	25[2]
Aroclor-1248	<0.02	<0.02	<0.02	<0.019	25[2]
Aroclor-1254	<0.02	<0.02	<0.02	<0.019	25[2]
Aroclor-1260	<0.02	<0 02	<0.02	<0.019	25[2]

[1]Units of all parameters are in mg/kg.
[2]The Proposed Generic Industrial Land-Use, Direct Contact Standard for Total PCB's is 25 mg/kg.

Temporary Well Points

Six temporary well points were installed at Site 5 and four temporary well points were installed at Site 7 to allow collection of ground water samples for environmental testing. The well points were constructed of PVC riser pipes with 5- to 10-foot, PVC screens. Since ground water was present in the upper soil layers, all of the well points were installed in the upper water bearing units, rather than immediately above bedrock, in accordance with the Statement of Work.

Depth to Ground Water

The depth to ground water was determined using an electronic water level meter at each temporary well point prior to ground water sample collection. Tables 20 and 21 show the depth to ground water at each well point at Sites 5 and 7, respectively. This investigation and previous unrelated investigations conducted in the vicinity of Sites 5 and 7 have revealed two zones of ground water; one zone in the upper soil layers and one zone at the bedrock/soil interface.

Table 22
Ground Water Field-Screening Results at Site 5

Date	Well Point ID	Temperature (°C)	pH	Specific Conductance (µS)
9/9/96	a	18.2	6.6	3910
9/9/96	b	20.3	6.5	1540
9/9/96	c	19.7	6.5	2220
9/9/96	d	18.8	6.5	1903
9/8/96	e	16.4	7.4	1459
9/10/96	f	13.2	7.6	2050

Table 23
Ground Water Field-Screening Results at Site 7

Date	Well Point ID	Temperature (°C)	pH	Specific Conductance (µS)
9/5/96	a	15.8	8.2	2770
9/6/96	b	15.4	7.4	973
9/5/96	c	17.7	7.5	2680
9/6/96	d	15.6	7.4	878

Ground water samples were tested in the laboratory (Laboratory Resources, Inc.) for VOC's, SVOC's, pesticides, PCB's, 23 metals, cyanide, pH, and conductivity. Ground water sample fractions to be tested for metals were field-filtered using 0.45 micron, high capacity disposable filters manufactured by "geotech". Filtration occurred prior to field-preservation. Sample fractions requiring field-preservation (i.e., VOC's, metals, and cyanide) were tested with pH paper to ensure the proper pH was achieved.

One ground water split sample was collected from Temporary Well Point a at Site 5 and one ground water split sample was collected from Temporary Well Point c at Site 7. Split samples were sent to the Missouri River/Omaha Laboratory for Quality Assurance testing. One trip blank for Site 5 and one trip blank for Site 7 were sent to Laboratory Resources, Inc. and tested for VOC's.

Site 5 Ground Water Sample Test Results

A total of six ground water samples were collected from temporary well points at Site 5 for laboratory testing. Laboratory test results of ground water samples collected from Temporary Well Points a through f are shown in Tables 24 through 28. Contaminant levels which exceed standards have been shaded. The qualifier "J" denotes an estimated result less than the quantitation limit. The qualifier "JB" denotes an estimated result less than the quantitation limit and the parameter was detected in the method blank.

Table 24
Site 5 Ground Water Sample Results
pH and Conductivity

	Well Point a	Well Point b	Well Point c	Well Point d	Well Point e	Well Point f
Sampling Date	9/9/96	9/9/96	9/9/96	9/9/96	9/8/96	9/10/96
Well Depth (ft)	15	13	15	15	15	25
pH	6.60	6.62	6.39	6.21	6.95	7.31
Conductivity (µmhos/cm)	4,500	2,000	2,600	2,300	1,600	2,500

Table 25
Site 5 Ground Water Sample Results
Inorganics

	Well Point a	Well Point b	Well Point c	Well Point d	Well Point e	Well Point f	Proposed Generic Unrestricted Potable Use Standard
Sampling Date	9/9/96	9/9/96	9/9/96	9/9/96	9/8/96	9/10/96	(mg/l)
Well Depth (ft)	15	13	15	15	15	25	
Aluminum[1]	<0.2	<0.2	<0.2	<0.2	<0.2	0.39	
Antimony	<0.01	<0.01	<0.01	<0.01	<0.01	0.013	0.006
Arsenic	0.036	0.013	0.0064	0.0098	<0.006	0.023	0.05
Barium	0.03	0.056	0.014	0.02	0.016	0.031	2
Beryllium	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	0.004
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	0.006	0.005
Calcium	470	300	350	360	200	270	
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.1
Cobalt	<0.01	<0.01	<0.01	0.012	<0.01	<0.01	
Copper	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	
Iron	3.2	<0.1	<0.1	13	<0.1	0.42	
Lead	0.0038	<0.003	<0.003	<0.003	<0.003	0.0065	
Magnesium	280	83	130	78	49	98	
Manganese	3.1	7.3	0.69	4.3	0.11	0.093	
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00073	0.002
Nickel	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.1
Potassium	28	4.2	3.5	2.6	9.3	14	
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	0.0064	0.05
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	0.017	
Sodium	87	17	26	17	32	91	
Thallium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.002
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Zinc	0.023	<0.02	<0.02	<0.02	<0.02	0.023	4.7
Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.2

[1]Units of all parameters are in mg/l.

Table 26
Site 5 Ground Water Sample Results
Volatile Organic Compounds

	Well Point a	Well Point b	Well Boring c	Well Point d	Well Point e	Well Point f	Proposed Generic UnrestrictedPotable Use Standard
Sampling Date	9/9/96	9/9/96	9/9/96	9/9/96	9/8/96	9/10/96	(mg/l)
Well Depth (ft)	15	13	15	15	15	25	
Chloromethane[1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Bromomethane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Vinyl Chloride	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.002
Chloroethane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Methylene Chloride	0.0011JB	0.0012JB	0.0013JB	0.0011JB	0.0012JB	0.0010JB	0.005
Acetone	0.01	<0.01	<0.01	<0.01	<0.01	0.0078J	
Carbon Disulfide	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,1-Dichloroethene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007
1,1-Dichloroethane	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
trans-1,2-Dichloroethene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.1
Chloroform	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,2-Dichloroethane	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
2-Butanone (MEK)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	8.6
1,1,1-Trichloroethane	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.2
Carbon Tetrachloride	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Bromodichloro-methane	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,2-Dichloropropane	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
cis-1,3-Dichloropropene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Trichloroethene (TCE)	<0.005	<0.005	<0.005	<0.005	<0.005	0.0028J	0.005
Dibromochloro-methane	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,1,2-Trichloroethane	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Benzene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005

trans-1,3-Dichloropropene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Bromoform	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
4-Methyl-2-pentanone (MIBK)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2-Hexanone	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Tetrachloroethene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Toluene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	1.0
1,1,2,2-Tetrachloroethane	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Chlorobenzene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.1
Ethyl Benzene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.7
2-Chloroethyl Vinyl Ether	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Vinyl Acetate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Styrene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.1
Xylenes (Total)	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	10

[1]Units of all parameters are in mg/l.

Table 27
Site 5 Ground Water Sample Results
Semi-Volatile Organic Compounds

	Well Point a	Well Point b	Well Point c	Well Point d	Well Point e	Well Point f	Proposed Generic Unrestricted Potable Use Standard
Sampling Date	9/9/96	9/9/96	9/9/96	9/9/96	9/8/96	9/10/96	· (mg/l)
Well Depth (ft)	15	13	15	15	15	25	
Phenol[1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.4
bis(2-Chloroethyl) ether	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2-Chlorophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.075 (p-)
2-Methylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
4-Methylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
N-Nitroso-di-n-propylamine	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Hexachloroethane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Nitrobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Isophorone	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2-Nitrophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2,4-Dimethylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
bis(2-Chloroethoxy) methane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2,4-Dichlorophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.
1,2,4-Trichloro-benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.07
Naphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.57
4-Chloroaniline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Hexachlorobutadiene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
4-Chloro-3-methylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2-Methylnaphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	

Hexachlorocyclo-pentadiene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05
2,4,6-Trichlorophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2,4,5-Trichlorophenol	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	
2-Chloronaphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2-Nitroaniline	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	
Dimethylphthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2,6-Dinitrotoluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
3-Nitroaniline	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	
Acenaphthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2,4-Dinitrophenol	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	
4-Nitrophenol	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	
Dibenzofuran	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2,4-Dinitrotoluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Diethylphthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
4-Chlorophenyl-phenyl ether	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Fluorene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
4-Nitroaniline	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	
4,6-Dinitro-2-methylphenol	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	
N-nitrosodiphenyl-amine	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
4-Bromophenyl-phenylether	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Hexachlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.001
Pentachlorophenol	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.001
Phenanthrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Carbazole	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Di-n-butylphthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	

Butylbenzylphthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
3,3'-Dichloro-benzidine	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Benzo(a)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Chrysene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
bis(2-Ethylhexyl)-phthalate	0.0043JB	0.01	0.01	0.01	0.01	0.0012JB	0.006
Di-n-octylphthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Benzo(b)-fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Benzo(k)-fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Benzo(a)pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.0002
Indeno-(1,2,3-cd)pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Dibenzo(a,h)-anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Benzo(g,h,i)-perylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Aniline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Azobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Benzidine	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	
Benzoic Acid	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Benzyl Alcohol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
bis(2-Chloroiso-propyl) ether	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
N-nitrosodimethyl-amine	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	

[1]Units of all parameters are in mg/l.

Table 28
Site 5 Ground Water Sample Results
Pesticides and PCB's

	Well Point a	Well Point b	Well Point c	Well Point d	Well Point e	Well Point f	Proposed Generic Unrestricted Potable Use Standard
Sampling Date	9/9/96	9/9/96	9/9/96	9/9/96	9/8/96	9/10/96	(mg/l)
Well Depth (ft)	15	13	15	15	15	25	
alpha-BHC[1]	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
beta-BHC	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	
delta-BHC	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
gamma-BHC (Lindane)	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	0.0002
Heptachlor	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	0.0004
Aldrin	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	
Heptachlor epoxide	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002
Endosulfan I	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
Endosulfan II	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	
Dieldrin	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	
4,4'-DDE	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
Endrin	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	0.002
Endosulfan sulfate	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
4,4'-DDD	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
4,4'-DDT	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Methoxychlor	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.04
Endrin ketone	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
Endrin aldehyde	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
alpha-Chlordane	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	0.002[2]
gamma-Chlordane	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	0.002[2]
Toxaphene	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.003
Aroclor-1016	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]
Aroclor-1221	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]

Aroclor-1232	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]
Aroclor-1242	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]
Aroclor-1248	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]
Aroclor-1254	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]
Aroclor-1260	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]

[1]Units of all parameters are in mg/l.
[2]The Generic Unrestricted Potable Use Standard for Total Chlordane is 0.002 mg/l.
[3]The Generic Unrestricted Potable Use Standard for Total PCB's is 0.0005 mg/l.

TABLE S1.20. - "WITHOUT PROJECT" CONDITION AVERAGE ANNUAL RAIL TRANSPORTATION COSTS- ADVANCE, MICHIGAN.

PROJECT YEAR	RAIL TRANSPORT COSTS	PRESENT WORTH FACTOR	50 YEAR PRESENT WORTH RAIL TRANSPORT COSTS
1	$929,796	0.92915	$863,922
2	$929,796	0.86332	$802,715
3	$929,796	0.80216	$745,844
4	$929,796	0.74533	$693,003
5	$929,796	0.69252	$643,905
6	$929,796	0.64346	$598,286
7	$929,796	0.59787	$555,899
8	$929,796	0.55551	$516,514
9	$929,796	0.51616	$479,920
10	$929,796	0.47959	$445,919
11	$929,796	0.44561	$414,327
12	$929,796	0.41404	$384,972
13	$929,796	0.38471	$357,698
14	$929,796	0.35745	$332,356
15	$929,796	0.33213	$308,809
16	$929,796	0.30860	$286,931
17	$929,796	0.28673	$266,602
18	$929,796	0.26642	$247,714
19	$929,796	0.24754	$230,164
20	$929,796	0.23000	$213,857
21	$929,796	0.21371	$198,706
22	$929,796	0.19857	$184,628
23	$929,796	0.18450	$171,548
24	$929,796	0.17143	$159,394
25	$929,796	0.15928	$148,101
26	$929,796	0.14800	$137,609
27	$961,975	0.13751	$132,284
28	$961,975	0.12777	$122,912
29	$961,975	0.11872	$114,204
30	$961,975	0.11031	$106,113
31	$961,975	0.10249	$98,595
32	$961,975	0.09523	$91,610
33	$961,975	0.08848	$85,120
34	$961,975	0.08222	$79,089
35	$961,975	0.07639	$73,486
36	$961,975	0.07098	$68,279
37	$961,975	0.06595	$63,442
38	$961,975	0.06128	$58,947
39	$961,975	0.05694	$54,771
40	$961,975	0.05290	$50,891
41	$961,975	0.04915	$47,285
42	$961,975	0.04567	$43,935
43	$961,975	0.04244	$40,822
44	$961,975	0.03943	$37,930
45	$961,975	0.03664	$35,243
46	$961,975	0.03404	$32,746
47	$961,975	0.03163	$30,426
48	$961,975	0.02939	$28,270
49	$961,975	0.02731	$26,268
50	$961,975	0.02537	$24,407

			$11,936,419
			0.07823

			$933,845

1,1,2,2-Tetrachloroethane	<0.005
Chlorobenzene	<0.005
Ethyl Benzene	<0.005
2-Chloroethyl Vinyl Ether	<0.005
Vinyl Acetate	<0.01
Styrene	<0.005
Xylenes (Total)	<0.005

[1]Units of all parameters are in mg/l.

Site 7 Ground Water Sample Test Results

A total of four ground water samples were collected from temporary well points at Site 7 for laboratory testing. Laboratory test results of ground water samples collected from Temporary Well Points a, b, c, and d are shown in Tables 30 through 34. The qualifier "J" denotes an estimated result less than the quantitation limit. The qualifier "JB" denotes an estimated result less than the quantitation limit and the parameter was detected in the method blank.

Table 30
Site 7 Ground Water Sample Results
pH and Conductivity

	Well Point a	Well Point b	Well Point c	Well Point d
Sampling Date	9/5/96	9/6/96	9/5/96	9/6/96
Well Depth (ft)	15	25	25	20
pH	7.60	7.11	7.35	7.11
Conductivity (µmhos/cm)	3,000	1,100	3,000	1,000

Table 31
Site 7 Ground Water Sample Results
Inorganics

	Well Point a	Well Point b	Well Point c	Well Point d	Proposed Generic Unrestricted Potable Use Standard (mg/l).
Sampling Date	9/5/96	9/6/96	9/5/96	9/6/96	
Well Depth (ft)	15	25	25	20	
Aluminum[1]	<0.2	<0.2	<0.2	<0.2	
Antimony	<0.01	<0.01	<0.01	<0.01	0.006
Arsenic	0.011	0.007	0.021	0.016	0.05
Barium	0.038	0.02	0.02	0.027	2.0
Beryllium	<0.005	<0.005	<0.005	<0.005	0.004
Cadmium	<0.003	<0.003	<0.003	<0.003	0.005
Calcium	350	130	300	110	
Chromium	<0.01	<0.01	<0.01	<0.01	0.1
Cobalt	<0.01	<0.01	<0.01	<0.01	
Copper	<0.025	<0.025	<0.025	<0.025	
Iron	<0.1	1.1	0.24	1.2	
Lead	<0.003	<0.003	<0.003	<0.003	
Magnesium	100	35	100	37	
Manganese	0.28	0.083	0.14	0.099	
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	0.002
Nickel	<0.02	<0.02	<0.02	<0.02	0.1
Potassium	34	2.9	12	2.7	
Selenium	<0.005	<0.005	<0.005	<0.005	0.05
Silver	<0.005	<0.005	<0.005	<0.005	
Sodium	100	22	120	24	
Thallium	<0.01	<0.01	<0.01	<0.01	0.002
Vanadium	<0.005	<0.005	<0.005	<0.005	
Zinc	<0.02	<0.02	<0.02	<0.02	4.7
Cyanide	<0.01	<0.01	<0.01	<0.01	0.2

[1]Units of all parameters are in mg/l.

Table 32
Site 7 Ground Water Sample Results
Volatile Organic Compounds

	Well Point a	Well Point b	Well Point c	Well Point d	Proposed Generic Unrestricted Potable Use Standard (mg/l)
Sampling Date	9/5/96	9/6/96	9/5/96	9/6/96	
Well Depth (ft)	15	25	25	20	
Chloromethane[1]	<0.01	<0.01	<0.01	<0.01	
Bromomethane	<0.01	<0.01	<0.01	<0.01	
Vinyl Chloride	<0.01	<0.01	<0.01	<0.01	0.002
Chloroethane	<0.01	<0.01	<0.01	<0.01	
Methylene Chloride	<0.005	<0.005	0.0011JB	0.001JB	0.005
Acetone	0.013	0.0036J	0.0074J	<0.01	
Carbon Disulfide	0.0019J	<0.005	<0.005	<0.005	
1,1-Dichloroethene	<0.005	<0.005	<0.005	<0.005	0.007
1,1-Dichloroethane	<0.005	<0.005	<0.005	<0.005	
trans-1,2-Dichloroethene	<0.005	<0.005	<0.005	<0.005	0.1
Chloroform	<0.005	<0.005	<0.005	<0.005	
1,2-Dichloroethane	<0.005	<0.005	<0.005	<0.005	0.005
2-Butanone (MEK)	<0.01	<0.01	<0.01	<0.01	8.6
1,1,1-Trichloroethane	<0.005	<0.005	<0.005	<0.005	0.2
Carbon Tetrachloride	<0.005	<0.005	<0.005	<0.005	0.005
Bromodichloro-methane	<0.005	<0.005	<0.005	<0.005	
1,2-Dichloropropane	<0.005	<0.005	<0.005	<0.005	0.005
cis-1,3-Dichloropropene	<0.005	<0.005	<0.005	<0.005	
Trichloroethene (TCE)	<0.005	<0.005	<0.005	<0.005	0.005
Dibromochloro-methane	<0.005	<0.005	<0.005	<0.005	
1,1,2-Trichloroethane	<0.005	<0.005	<0.005	<0.005	0.005
Benzene	<0.005	<0.005	<0.005	<0.005	0.005

trans-1,3-Dichloropropene	<0.005	<0.005	<0.005	<0.005	
Bromoform	<0.005	<0.005	<0.005	<0.005	
4-Methyl-2-pentanone (MIBK)	<0.01	<0.01	<0.01	<0.01	
2-Hexanone	<0.01	<0.01	<0.01	<0.01	
Tetrachloroethene	<0.005	<0.005	<0.005	<0.005	0.005
Toluene	<0.005	<0.005	<0.005	<0.005	1.0
1,1,2,2-Tetrachloroethane	<0.005	<0.005	<0.005	<0.005	
Chlorobenzene	<0.005	<0.005	<0.005	<0.005	0.1
Ethyl Benzene	<0.005	<0.005	<0.005	<0.005	0.7
2-Chloroethyl Vinyl Ether	<0.005	<0.005	<0.005	<0.005	
Vinyl Acetate	<0.01	<0 01	<0.01	<0.01	
Styrene	<0.005	<0.005	<0.005	<0.005	0.1
Xylenes (Total)	<0.01	<0.01	<0.01	<0.01	10

[1]Units of all parameters are in mg/l.

Table 33
Site 7 Ground Water Sample Results
Semi-Volatile Organic Compounds

	Well Point a	Well Point b	Well Point c	Well Point d	Proposed Generic Unrestricted Potable Use Standard
Sampling Date	9/5/96	9/6/96	9/5/96	9/6/96	(mg/l)
Well Depth (ft)	15	25	25	20	
Phenol[1]	<0.01	<0.01	<0.01	<0.01	9.4
bis(2-Chloroethyl) ether	<0.01	<0.01	<0.01	<0.01	
2-Chlorophenol	<0.01	<0.01	<0.01	<0.01	
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	0.075 (p-)
2-Methylphenol	<0.01	<0.01	<0.01	<0.01	
4-Methylphenol	<0.01	<0.01	<0.01	<0.01	
N-Nitroso-di-n-propylamine	<0.01	<0.01	<0.01	<0.01	
Hexachloroethane	<0.01	<0.01	<0.01	<0.01	
Nitrobenzene	<0.01	<0.01	<0.01	<0.01	
Isophorone	<0.01	<0.01	<0.01	<0.01	
2-Nitrophenol	<0.01	<0.01	<0.01	<0.01	
2,4-Dimethylphenol	<0.01	<0.01	<0.01	<0.01	
bis(2-Chloroethoxy) methane	<0.01	<0.01	<0.01	<0.01	
2,4-Dichlorophenol	<0.01	<0.01	<0.01	<0.01	
1,2,4-Trichloro-benzene	<0.01	<0.01	<0.01	<0.01	0.07
Naphthalene	<0.01	<0.01	<0.01	<0.01	0.57
4-Chloroaniline	<0.01	<0.01	<0.01	<0.01	
Hexachloro-butadiene	<0.01	<0.01	<0.01	<0.01	
4-Chloro-3-methylphenol	<0.01	<0.01	<0.01	<0.01	
2-Methylnaphthalene	<0.01	<0.01	<0.01	<0.01	

Hexachlorocyclo-pentadiene	<0.01	<0.01	<0.01	<0.01	0.05
2,4,6-Trichlorophenol	<0.01	<0.01	<0.01	<0.01	
2,4,5-Trichlorophenol	<0.025	<0.025	<0.025	<0.025	
2-Chloronaphthalene	<0.01	<0.01	<0.01	<0.01	
2-Nitroaniline	<0.025	<0.025	<0.025	<0.025	
Dimethylphthalate	<0.01	<0.01	<0.01	<0.01	
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	
2,6-Dinitrotoluene	<0.01	<0.01	<0.01	<0.01	
3-Nitroaniline	<0.025	<0.025	<0.025	<0.025	
Acenaphthene	<0.01	<0.01	<0.01	<0.01	
2,4-Dinitrophenol	<0.025	<0.025	<0.025	<0.025	
4-Nitrophenol	<0.025	<0.025	<0.025	<0.025	
Dibenzofuran	<0.01	<0.01	<0.01	<0.01	
2,4-Dinitrotoluene	<0.01	<0.01	<0.01	<0.01	
Diethylphthalate	<0.01	<0.01	<0.01	<0.01	
4-Chlorophenyl-phenyl ether	<0.01	<0.01	<0.01	<0.01	
Fluorene	<0.01	<0.01	<0.01	<0.01	
4-Nitroaniline	<0.025	<0.025	<0.025	<0.025	
4,6-Dinitro-2-methylphenol	<0.025	<0.025	<0.025	<0.025	
N-nitrosodiphenyl-amine	<0.01	<0 01	<0.01	<0.01	
4-Bromophenyl-phenylether	<0.01	<0.01	<0.01	<0.01	
Hexachlorobenzene	<0.01	<0.01	<0.01	<0.01	0.001
Pentachlorophenol	<0.025	<0.025	<0.025	<0.025	0.001
Phenanthrene	<0.01	<0.01	<0.01	<0.01	
Anthracene	<0.01	<0.01	<0.01	<0.01	
Carbazole	<0.01	<0.01	<0.01	<0.01	
Di-n-butylphthalate	<0.01	<0.01	<0.01	<0.01	
Fluoranthene	<0.01	<0.01	<0.01	<0.01	
Pyrene	<0.01	<0.01	<0.01	<0.01	

Butylbenzylphthalate	<0.01	<0.01	<0.01	<0.01	
3,3'-Dichloro-benzidine	<0.01	<0.01	<0.01	<0.01	
Benzo(a)anthracene	<0.01	<0.01	<0.01	<0.01	
Chrysene	<0.01	<0.01	<0.01	<0.01	
bis(2-Ethylhexyl)-phthalate	<0.01	<0.01	<0.01	<0.01	0.006
Di-n-octylphthalate	<0.01	<0.01	<0.01	<0.01	
Benzo(b)fluoranthene	<0.01	<0.01	<0.01	<0.01	
Benzo(k)fluoranthene	<0.01	<0.01	<0.01	<0.01	
Benzo(a)pyrene	<0.01	<0.01	<0.01	<0.01	0.0002
Indeno-(1,2,3-cd)pyrene	<0.01	<0.01	<0.01	<0.01	
Dibenzo(a,h)-anthracene	<0.01	<0.01	<0.01	<0.01	
Benzo(g,h,i)perylene	<0.01	<0.01	<0.01	<0.01	
Aniline	<0.01	<0.01	<0.01	<0.01	
Azobenzene	<0.01	<0.01	<0.01	<0.01	
Benzidine	<0.025	<0.025	<0.025	<0.025	
Benzoic Acid	<0.01	<0.01	<0.01	<0.01	
Benzyl Alcohol	<0.01	<0.01	<0.01	<0.01	
bis(2-Chloroiso-propyl) ether	<0.01	<0.01	<0.01	<0.01	
N-nitrosodimethyl-amine	<0.01	<0.01	<0.01	<0.01	

[1]Units of all parameters are in mg/l.

Table 34
Site 7 Ground Water Sample Results
Pesticides and PCB's

	Boring a	Boring b	Boring c	Boring d	Proposed Generic Unrestricted Potable Use Standard (mg/l)
Sampling Date	9/5/96	9/6/96	9/5/96	9/6/96	
Well Depth (ft)	15	25	25	20	
alpha-BHC[1]	<0.00003	<0.00003	<0.00003	<0.00003	
beta-BHC	<0.00005	<0.00005	<0.00005	<0.00005	
delta-BHC	<0.00005	<0.00005	<0.00005	<0.00005	
gamma-BHC (Lindane)	<0.00004	<0.00004	<0.00004	<0.00004	0.0002
Heptachlor	<0.00003	<0.00003	<0.00003	<0.00003	0.0004
Aldrin	<0.00004	<0.00004	<0.00004	<0.00004	
Heptachlor epoxide	<0.0001	<0.0001	<0.0001	<0.0001	0.0002
Endosulfan I	<0.00005	<0.00005	<0.00005	<0.00005	
Endosulfan II	<0.00004	<0.00004	<0.00004	<0.00004	
Dieldrin	<0.00002	<0.00002	<0.00002	<0.00002	
4,4'-DDE	<0.00005	<0.00005	<0.00005	<0.00005	
Endrin	<0.00005	<0.00005	<0.00005	<0.00005	0.002
Endosulfan sulfate	<0.0001	<0.0001	<0.0001	<0.0001	
4,4'-DDD	<0.00005	<0.00005	<0.00005	<0.00005	
4,4'-DDT	<0.0001	<0.0001	<0.0001	<0.0001	
Methoxychlor	<0.0004	<0.0004	<0.0004	<0.0004	0.04
Endrin ketone	<0.00005	<0.00005	<0.00005	<0.00005	
Endrin aldehyde	<0.00005	<0.00005	<0.00005	<0.00005	
alpha-Chlordane	<0.00005	<0.00005	<0.00005	<0.00005	0.002[2]
gamma-Chlordane	<0.00005	<0.00005	<0.00005	<0.00005	0.002[2]
Toxaphene	<0.0003	<0.0003	<0.0003	<0.0003	0.003
Aroclor-1016	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]
Aroclor-1221	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]
Aroclor-1232	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]

Aroclor-1242	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]
Aroclor-1248	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]
Aroclor-1254	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]
Aroclor-1260	<0.0005	<0.0005	<0.0005	<0.0005	0.0005[3]

[1]Units of all parameters are in mg/l.
[2]The Proposed Generic Unrestricted Potable Use Standard for Total Chlordane is 0.002 mg/l.
[3]The Proposed Generic Unrestricted Potable Use Standard for Total PCB's is 0.0005 mg/l.

Table 35
Site 7 Trip Blank
Volatile Organic Compounds

Shipping Date	9/6/96
Chloromethane[1]	<0.01
Bromomethane	<0.01
Vinyl Chloride	<0.01
Chloroethane	<0.01
Methylene Chloride	<0.005
Acetone	<0.01
Carbon Disulfide	<0.005
1,1-Dichloroethene	<0.005
1,1-Dichloroethane	<0.005
trans-1,2-Dichloroethene	<0.005
Chloroform	<0.005
1,2-Dichloroethane	<0.005
2-Butanone (MEK)	<0.01
1,1,1-Trichloroethane	<0.005
Carbon Tetrachloride	<0.005
Bromodichloromethane	<0.005
1,2-Dichloropropane	<0.005
cis-1,3-Dichloropropene	<0.005
Trichloroethene (TCE)	<0.005
Dibromochloromethane	<0.005
1,1,2-Trichloroethane	<0.005
Benzene	<0.005
trans-1,3-Dichloropropene	<0.005
Bromoform	<0.005
4-Methyl-2-pentanone (MIBK)	<0.01
2-Hexanone	<0.01
Tetrachloroethene	<0.005
Toluene	<0.005

1,1,2,2-Tetrachloroethane	<0.005
Chlorobenzene	<0.005
Ethyl Benzene	<0.005
2-Chloroethyl Vinyl Ether	<0.005
Vinyl Acetate	<0.01
Styrene	<0.005
Xylenes (Total)	<0.01

[1]Units of all parameters are in mg/l.

Collection of Surface Water Sample for Environmental Testing

A surface water grab sample was collected from the small pond located adjacent to the northeast corner of Site 5. The sample was collected near the southwest edge of the pond.

Site 5 Surface Water Sample Test Results

One surface water sample was collected from the small pond at Site 5 for laboratory testing. Laboratory test results of the surface water sample are shown in Tables 36 through 40. Contaminant levels which exceed standards have been shaded. The qualifier "J" denotes an estimated result less than the quantitation limit. The qualifier "JB" denotes an estimated result less than the quantitation limit and the parameter was detected in the method blank.

Table 36
Site 5 Surface Water Sample Results
pH and Conductivity

	Sample Point g	Surface Water Standard[1]
Sampling Date	9/6/96	
pH	6.60	6.5 - 9.0
Temperature (°C)	22.3	29.4 Daily Max.
Conductivity (µmhos/cm)	210	

[1]State of Ohio Water Quality Standards, Chapter 3745-1 of the Administrative Code.

Table 38
Site 5 Surface Water Sample Results
Volatile Organic Compounds

	Sample Point g	Surface Water Standard[1]
Sampling Date	9/6/96	(mg/l)
Chloromethane[2]	<0.01	
Bromomethane	<0.01	
Vinyl Chloride	<0.01	5.25
Chloroethane	<0.01	
Methylene Chloride	0.001JB	0.43
Acetone	0.005J	0.078
Carbon Disulfide	<0.005	
1,1-Dichloroethene	<0.005	
1,1-Dichloroethane	<0.005	
trans-1,2-Dichloroethene	<0.005	
Chloroform	<0.005	0.079
1,2-Dichloroethane	<0.005	
2-Butanone (MEK)	<0.01	0.0071
1,1,1-Trichloroethane	<0.005	
Carbon Tetrachloride	<0.005	0.044
Bromodichloromethane	<0.005	
1,2-Dichloropropane	<0.005	
cis-1,3-Dichloropropene	<0.005	0.31
Trichloroethene (TCE)	<0.005	
Dibromochloromethane	<0.005	
1,1,2-Trichloroethane	<0.005	0.418
Benzene	<0.005	0.56
trans-1,3-Dichloropropene	<0.005	0.31
Bromoform	<0.005	1.0
4-Methyl-2-pentanone (MIBK)	<0.01	
2-Hexanone	<0.01	

Tetrachloroethene	<0.005	
Toluene	<0.005	1.7
1,1,2,2-Tetrachloroethane	<0.005	0.107
Chlorobenzene	<0.005	0.026
Ethyl Benzene	<0.005	0.062
2-Chloroethyl Vinyl Ether	<0.005	
Vinyl Acetate	<0.01	
Styrene	<0.005	0.056
Xylenes (Total)	<0.01	

[1]State of Ohio Water Quality Standards, Chapter 3745-1 of the Administrative Code. Standards shown are "Aquatic Life Habitat, Outside Mixing Zone" criteria. For each parameter, the lower (more conservative) value of "30-day average" and "Human Health 30-day average" standard is shown.
[2]Units of all parameters are in mg/l.

Table 39
Site 5 Surface Water Sample Results
Semi-Volatile Organic Compounds

	Sample Point g	Surface Water Standard[1]
Sampling Date	9/6/96	(mg/l)
Phenol[2]	<0.01	0.37
bis(2-Chloroethyl) ether	<0.01	0.0136
2-Chlorophenol	<0.01	0.0088
1,3-Dichlorobenzene	<0.01	0.087
1,4-Dichlorobenzene	<0.01	0.043
1,2-Dichlorobenzene	<0.01	0.011
2-Methylphenol	<0.01	0.022
4-Methylphenol	<0.01	0.0062
N-Nitroso-di-n-propylamine	<0.01	0.0124
Hexachloroethane	<0.01	0.0874
Nitrobenzene	<0.01	0.74
Isophorone	<0.01	0.90
2-Nitrophenol	<0.01	
2,4-Dimethylphenol	<0.01	
bis(2-Chloroethoxy) methane	<0.01	
2,4-Dichlorophenol	<0.01	0.018
1,2,4-Trichlorobenzene	<0.01	0.077
Naphthalene	<0.01	0.044
4-Chloroaniline	<0.01	
Hexachlorobutadiene	<0.01	0.5
4-Chloro-3-methylphenol	<0.01	
2-Methylnaphthalene	<0.01	
Hexachlorocyclopentadiene	<0.01	
2,4,6-Trichlorophenol	<0.01	0.0025
2,4,5-Trichlorophenol	<0.025	
2-Chloronaphthalene	<0.01	
2-Nitroaniline	<0.025	

Dimethylphthalate	<0.01	0.073
Acenaphthylene	<0.01	
2,6-Dinitrotoluene	<0.01	0.042
3-Nitroaniline	<0.025	
Acenaphthene	<0.01	0.067
2,4-Dinitrophenol	<0.025	
4-Nitrophenol	<0.025	0.035
Dibenzofuran	<0.01	
2,4-Dinitrotoluene	<0.01	0.091
Diethylphthalate	<0.01	0.12
4-Chlorophenylphenyl ether	<0.01	
Fluorene	<0.01	
4-Nitroaniline	<0.025	
4,6-Dinitro-2-methylphenol	<0.025	0.765
N-nitrosodiphenylamine	<0.01	0.013
4-Bromophenyl-phenylether	<0.01	
Hexachlorobenzene	<0.01	0.00099
Pentachlorophenol	<0.025	3.5
Phenanthrene	<0.01	
Anthracene	<0.01	
Carbazole	<0.01	
Di-n-butylphthalate	<0.01	0.19
Fluoranthene	<0.01	0.0089
Pyrene	<0.01	
Butylbenzylphthalate	<0.01	0.049
3,3'-Dichlorobenzidine	<0.01	0.0002
Benzo(a)anthracene	<0.01	
Chrysene	<0.01	
bis(2-Ethylhexyl)phthalate	0.0046J	0.0084
Di-n-octylphthalate	<0.01	
Benzo(b)fluoranthene	<0.01	
Benzo(k)fluoranthene	<0.01	

Benzo(a)pyrene	<0.01	
Indeno(1,2,3-cd)pyrene	<0.01	
Dibenzo(a,h)anthracene	<0.01	
Benzo(g,h,i)perylene	<0.01	
Aniline	<0.01	0.00044
Azobenzene	<0.01	
Benzidine	<0.025	0.0000053
Benzoic Acid	<0.01	
Benzyl Alcohol	<0.01	
bis(2-Chloroisopropyl) ether	<0.01	4.36
N-nitrosodimethylamine	<0.01	0.16

[1]State of Ohio Water Quality Standards, Chapter 3745-1 of the Administrative Code. Standards shown are "Aquatic Life Habitat, Outside Mixing Zone" criteria. For each parameter, the lower (more conservative) value of "30-day average" and "Human Health 30-day average" standard is shown.
[2]Units of all parameters are in mg/l.

Table 40
Site 5 Surface Water Sample Results
Pesticides and PCB's

	Sample Point g	Surface Water Standard[1]
Sampling Date	9/6/96	(mg/l)
alpha-BHC[2]	<0.00003	
beta-BHC	<0.00005	
delta-BHC	<0.00005	
gamma-BHC (Lindane)	<0.00004	
Heptachlor	<0.00003	0.000001
Aldrin	<0.00004	0.00000079
Heptachlor epoxide	<0.0001	
Endosulfan I	<0.00005	0.000003
Endosulfan II	<0.00004	
Dieldrin	<0.00002	0.00000076
4,4'-DDE	<0.00005	
Endrin	<0.00005	0.000002
Endosulfan sulfate	<0.0001	
4,4'-DDD	<0.00005	
4,4'-DDT	<0.0001	0.00000024
Methoxychlor	<0.0004	0.000005
Endrin ketone	<0.00005	
Endrin aldehyde	<0.00005	
alpha-Chlordane	<0.00005	0.0000048[3]
gamma-Chlordane	<0.00005	0.0000048[3]
Toxaphene	<0.0003	0.000005
Aroclor-1016	<0.0005	0.00000079[4]
Aroclor-1221	<0.0005	0.00000079[4]
Aroclor-1232	<0.0005	0.00000079[4]
Aroclor-1242	<0.0005	0.00000079[4]
Aroclor-1248	<0.0005	0.00000079[4]

Aroclor-1254	<0.0005	0.00000079[4]
Aroclor-1260	<0.0005	0.00000079[4]

[1]State of Ohio Water Quality Standards, Chapter 3745-1 of the Administrative Code. Standards shown are "Aquatic Life Habitat, Outside Mixing Zone" criteria. For each parameter, the lower (more conservative) value of "30-day average" and "Human Health 30-day average" standard is shown.

[2]Units of all parameters are in mg/l.

[3]The Surface Water Standard for Total Chlordane is 0.0000048 mg/l.

[4]The Generic Potable Ground Water Standard for Total PCB's is 0.00000079 mg/l.

PHONE COORDINATION

U.S. Army Corps of Engineers personnel coordinated with Engineering and Environment, Inc., Parratt-Wolff, Inc., and Missouri River/Omaha Laboratory during the HTRW evaluation to ensure efficient completion of the project.

HTRW ENVIRONMENTAL EVALUATION

Site 5

Ash

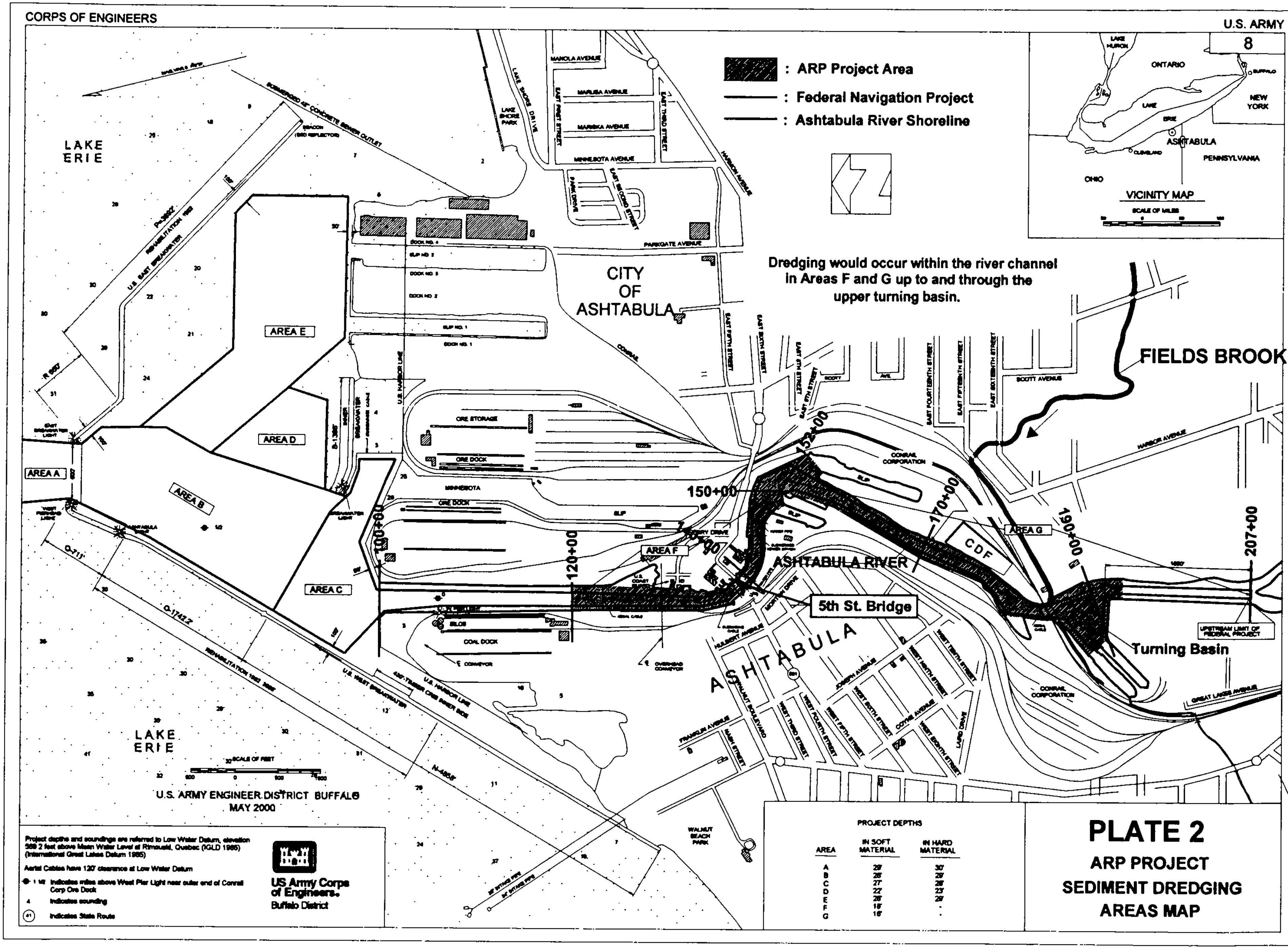
As shown in Tables 3 and 4, arsenic is present in soil/ash at levels above the Proposed Generic Industrial Direct Contact Standard of 86 mg/kg. Elevated arsenic concentrations of 100 mg/kg, 180 mg/kg, and 89 mg/kg were present in samples collected from Borings a, 1, and 4, respectively. The three samples were collected at depths ranging from 0 to 4 feet below ground level. Soil/ash samples collected from Borings 7 and 8 contained arsenic at levels of 77 mg/kg and 72 mg/kg, respectively. All other soil/ash samples collected at Site 5 contained arsenic at concentrations less than or equal to 16 mg/kg. Therefore, concentrations of arsenic exceeding the standard appear to be confined to the northern portion of Site 5 and immediately north of Site 5 where ash was previously deposited.

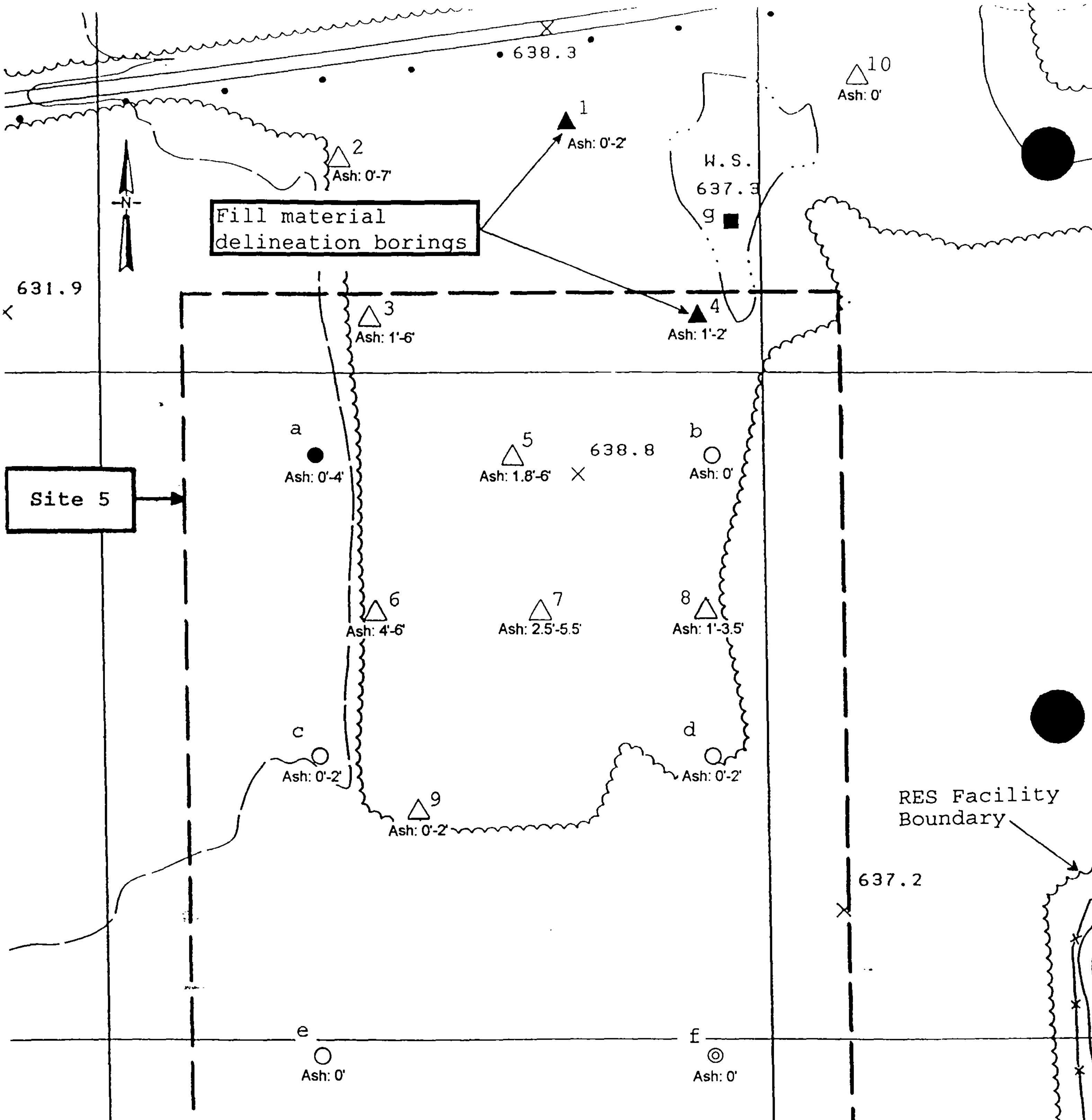
Vertical Extent of Ash

Based on observations recorded during augering, the vertical extent of ash at Borings a, 1, and 4, where arsenic standards were exceeded, is approximately 4 feet, 2 feet, and 2 feet deep, respectively. At other boring locations, where no standards were exceeded, the vertical extent of ash ranges from none at Borings b, e, f, and 10 to approximately 7 feet deep at Boring 2. The observations of vertical extent of ash recorded during augering corroborate the observations of ash recorded during the test pit excavations.

Figure 4 shows the apparent subsurface vertical interval of ash at each of the test pit excavations based on visual observations during the field work. A more detailed description of observations recorded during the test pit excavations was provided in the Test Pit Excavation section beginning on page 7 of this evaluation.

Figure 5 shows the apparent subsurface vertical interval of ash at each soil boring and each fill material delineation boring based on visual observations. A more detailed explanation of observations recorded during the soil borings and fill material delineation borings was provided in the Soil Profile Characterization Section beginning on page 10 of this evaluation.


CORPS OF ENGINEERS
U.S. ARMY
8
: ARP Project Area
: Federal Navigation Project
: Ashtabula River Shoreline
Dredging would occur within the river channel in Areas F and G up to and through the upper turning basin.
LAKE ERIE
CITY OF ASHTABULA
AREA A
AREA B
AREA C
AREA D
AREA E
AREA F
AREA G
FIELDS BROOK
ASHTABULA RIVER
5th St. Bridge
Turning Basin
CDF
100+00
120+00
150+00
152+00
170+00
190+00
207+00
ASHTABULA
VICINITY MAP
ONTARIO
NEW YORK
LAKE ERIE
ASHTABULA
PENNSYLVANIA
OHIO
U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 2000
US Army Corps of Engineers
Buffalo District
PROJECT DEPTHS
AREA | IN SOFT MATERIAL | IN HARD MATERIAL
A | 29' | 30'
B | 28' | 29'
C | 27' | 28'
D | 22' | 23'
E | 28' | 29'
F | 18' | -
G | 18' | -
PLATE 2
ARP PROJECT
SEDIMENT DREDGING
AREAS MAP



Legend

○	Soil Boring and Temporary Well Point
△	Fill Material Delineation Boring
□	Surface Water Sample
Ash: 4'-6'	Apparent Subsurface Vertical Interval of Ash
●	Arsenic Detected Exceeding Proposed Standard in Soil Boring Sample
▲	Arsenic Detected Exceeding Proposed Standard in Fill Material Delineation Sample
◎	Antimony, Beryllium, and Cadmium Detected Exceeding Proposed Standard in Ground Water
■	Iron Detected Exceeding Surface Water Standard in Surface Water Sample

Note: Sample locations are approximate.

FIGURE 5
Site 5 Sample Observations
Ashtabula, Ohio
Scale: 1" = 200"

Ash Volume Estimates

The ash at Site 5 and immediately north of Site 5 (between the site and Lake Road) occupies an area of approximately 16 acres. Based on the apparent vertical extent of ash within this area, the estimated total ash volume is approximately 107,000 cubic yards.

The volume of ash exceeding the Voluntary Action Program, Industrial Land-Use, clean-up level for arsenic is estimated at approximately 9,200 cubic yards. This estimate was calculated assuming each of the three areas where arsenic clean-up levels were exceeded are circular in shape. Generally, the radius of each circular area was assumed to equal half the distance between the contaminated sample location and the nearest sample location where arsenic clean-up criteria were not exceeded.

TCLP Results

The TCLP metals results of soil/ash samples collected from Fill Material Delineation Borings 3, 5, and 9 were well below regulatory limits. Therefore, the ash material previously deposited at Site 5 is not classified as a hazardous waste. This data is shown in Table 15.

Ground Water Contaminants

Antimony, beryllium, and cadmium were detected at concentrations slightly above the Proposed Generic Unrestricted Potable Use Standards in ground water collected from Temporary Well Point f. This data is presented in Table 25. Temporary Well Point f was located in a densely forested area on the southeast protion of Site 5. No ash was observed at this location. Antimony, beryllium, and cadmium were not detected in ground water collected from any of the other five temporary well points at the site. Therefore, the contaminants detected above criteria in ground water collected from Well Point f are probably not the result of ash disposal at Site 5.

Surface Water Contaminants

An iron concentration of 1.1 mg/l was detected in the surface water sample collected from the small pond at Site 5. This slightly exceeds the Surface Water Standard of 1.0 mg/l, as indicated in Table 37.

No other parameters exceeding relevant standards were discovered in soil/ash, ground water, or surface water at Site 5 during this investigation.

Ash Management

Sound management of the existing ash fill material at Site 5 is recommended if that site is chosen as the location for construction of a new landfill. Acceptable ash management would most likey consist of excavation and proper disposal of the soil and ash exhibiting arsenic concentrations above the proposed criteria. Therefore, the excavation work could probably be limited to the areas where arsenic concentrations exceed 86 mg/kg. The lateral extent of contamination at each area of elevated arsenic could be determined prior to or during excavation with the use of a field x-ray flourescence unit and subsequent laboratory confirmatory testing.

Site 7

No contamination above relevant standards was discovered in soil or ground water at Site 7. All parameters tested were either not detected or were well below the applicable standards. Therefore, remediation is not likely to be required if Site 7 is chosen as the location of the upland landfill.

Summary

The key results of the site investigations are briefly summarized in the table below.

Table 41
Summary of Site Investigation Contaminant Findings

Sample Media	Site 5	Site 7
Soil/Ash	Concentrations of total arsenic greater than 86 mg/kg at Borings a, 1, and 4.	No contaminants detected exceeding clean-up levels.
Ground Water	Dissolved antimony concentration greater than 0.006 mg/l at Well Point f. Dissolved beryllium concentration greater than 0.004 mg/l at Well Point f. Dissolved cadmium concentration greater than 0.005 mg/l at Well Point f.	No contaminants detected exceeding clean-up levels.
Surface Water	Dissolved iron concentration greater than 1.0 mg/l at Sample Point g.	N/A

Note: Soil/ash test results were compared to State of Ohio Voluntary Action Program, Proposed Single Chemical, Generic Industrial Direct Contact Standards. Ground water test results were compared to State of Ohio Voluntary Action Program, Proposed Generic Unrestricted Potable Use Standards. Surface water results were compared to State of Ohio Water Quality Standards, Chapter 3745-1 of the Administrative Code.

CONCLUSION

Although several parameters in soil, ground water, and surface water were detected at Site 5 at levels exceeding State of Ohio Voluntary Action Program clean-up levels or State of Ohio surface water criteria, the primary contaminant of concern is arsenic detected in soil/ash samples. The three soil/ash samples which exhibited elevated total arsenic levels were collected from the northern portion of Site 5 and immediately north of Site 5. Samples collected elsewhere at the site contained arsenic at concentrations below the proposed clean-up level.

The metal detection survey, and subsequent test pit excavations, conducted in the ash fill portion of Site 5 revealed some scrap metal. However, no buried drums or canisters were discovered.

If Site 5 is chosen as the site of an upland landfill to dispose of river sediment, ash fill material present at the site should be properly managed. No contamination was discovered at Site 7 during this investigation, so remediation is not necessary if that site is chosen for the construction of an upland landfill.

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX N

HTRW EVALUATION OF POTENTIAL LANDFILL AND TRANSFER/DEWATERING SITES

SUB-APPENDIX N-1

HTRW EVALUATION OF RMI SODIUM (STATE ROAD) LANDFILL DISPOSAL SITE

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December 2000

ASHTABULA RIVER PARTNERSHIP
SITE SELECTION FOR AN UPLAND DISPOSAL FACILITY
ASHTABULA, OHIO

SUB APPENDIX N-1
HTRW EVALUATION OF RMI SODIUM LANDFILL SITE

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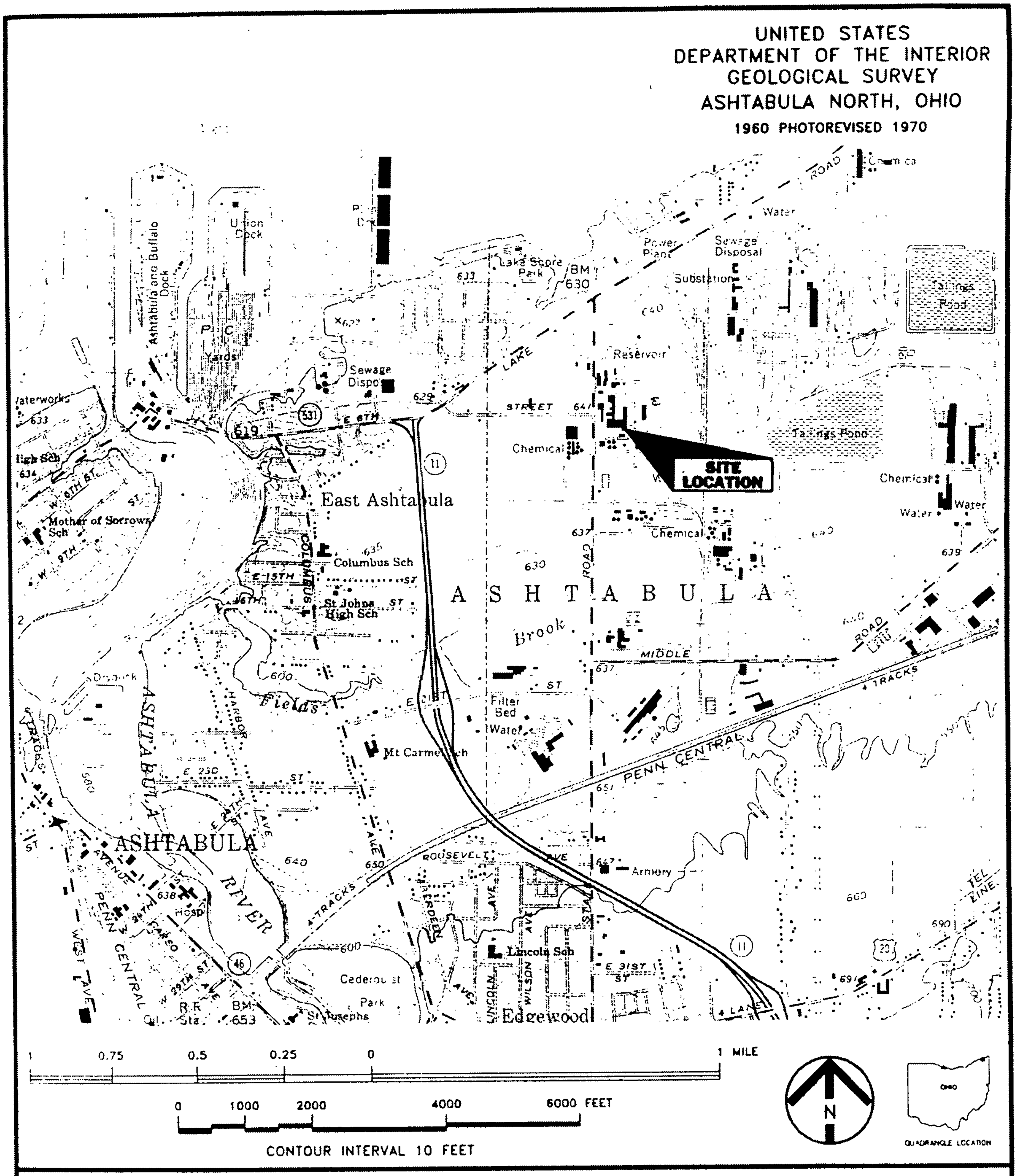
HTRW EVALUATION OF RMI SODIUM LANDFILL SITE

LOCATION OF PROPOSED LANDFILL SITE

The location of the proposed landfill is on the present RMI sodium Plant Site which is located at 600 State Road, Township of Ashtabula, Ashtabula County, Ohio (See Figure 1(N-1). The site is the center of heavy industrial activity for the Township of Ashtabula with several other industrial companies in operation bordering the RMI site. To the north is the Ash Coal Water Company; to the south is Detrex Corp.; to the east are CEI and Alchemicals; and to the west is the Occidental Chemical Company. Recently the Fields Brook Action Group has constructed a landfill on the RMI site to contain contaminated sediments excavated from the Fields Brook channel and floodplain as part of the Operable Unit remediation action. The proposed landfill containment cells (i.e. TSCA and Non-TSCA) for this project are located adjacent and east of the existing landfill (See Plate 1(N-1) for site plan).

SITE HISTORY

Prior to the initial acquisition of the land parcels in the late 1940s, it is believed that no chemical manufacturing or processing was conducted at the site. The land was purchased from the Cleveland Electric Illuminating Company and miscellaneous private landowners from 1948 to 1950. The land was used as an easement when owned by Cleveland Electric Illuminating Company and other areas owned by miscellaneous owners were idle or used for non-industrial purposes. In 1950 the National Distillers Products Corporation (NDPC) purchased the property for the purpose of chemical (sodium and chlorine) production and manufacturing. In 1964, NDPC and U.S. Steel entered into a partnership agreement for the operation of the Sodium Plant under the corporate name of Reactive Metals, Incorporated. In 1971, Reactive Metals Inc., was redesignated the RMI company. RMI has operated this facility for the manufacture of metallic sodium and chlorine while operating under both the NDPC and US Industrial Chemicals Company. In addition to sodium and chlorine, sodium peroxide was intermittently produced from 1950 to 1979. A consortium named State Road Industrial Development, LLC, purchased the property from RMI Titanium Company. At the present time the current owners of this property (State Road Industrial Development) are marketing this property for disposal sites.



GENERAL LOCATION MAP
RMI TITANIUM SODIUM FACILITY - ASHTABULA, OHIO

Figure 1 (N-1)

EPA FACILITY DATABASE INFORMATION AND PERMITS

U.S. Army Corps of Engineers personnel reviewed the USEPA's Resource Conservation and Recovery Information System (RCRIS) and the Comprehensive Environmental Response Compensation and Liability Information System (CERLIS) databases. The RCRIS database provides pertinent information on sites which generate, transport, store, treat and/or dispose of hazardous waste defined by the Resource Conservation and Recovery Act. The CERLIS database provides information on sites identified by the USEPA as abandoned, inactive, or uncontrolled hazardous waste sites, which may require cleanup.

The RMI Sodium Plant Site is listed on the RCRIS database (EPA ID: OHD000810242) for the storage and treatment of hazardous waste. In early 1987, the Sodium Plant received a final Resource Conservation and Recovery Act (RCRA) hazardous waste management-operating permit from the USEPA Region V. This permit allows RMI to continue to store and treat hazardous waste at the facility. In its RCRA permit, the RMI Company was required to conduct a RCRA Facility Investigation (RFI) at its Sodium Plant facility. Results of this investigation are discussed later in this appendix (Contaminant Levels and Comparison to Standards for Maximum Levels).

The RMI Sodium Plant is not specifically listed on the CERLIS database however; Fields Brook is listed in this database as being on the National Priority List (NPL) Superfund Cleanup Site. RMI as well as several other industries bordering the Fields Brook Watershed has been named as a potentially responsible parties (PRP) for the Fields Brook Superfund Cleanup.

SITE INVESTIGATIONS

RMI Company retained ECKENFELDER Inc. to conduct RFI (Recra Facilities Investigation) field investigations in order to comply with the EPA's requirements in issuing a permit that allowed RMI to store and treat hazardous waste. The types of field investigations performed by ECKENFELDER Inc. included: Geophysical Surveys; Surficial Soil Sampling; Soil Borings; Groundwater Monitoring Well Installation; Hydraulic Conductivity Testing; Groundwater Sampling; Wastewater Pond Sampling; and Surface Water Sampling.

The Fields Brook Action Group retained Woodward-Clyde (now URS Greiner Woodward Clyde) to conduct field site investigations to support the design for a consolidation/landfill facility located in the southern portion of the RMI Sodium Plant facility and to perform additional investigations and sampling for the SMU's (Solid Waste Management Units) at the RMI site. The types of investigations performed include: Soil Borings and Sampling; Groundwater Monitoring Well Installation; Groundwater Sampling; and Hydraulic Conductivity Testing.

The locations of the field explorations are shown on Plates 2(N-1), 2B(N-1), and 2C (N-1).

Geophysical Survey

ECKENFELDER Inc. performed a surface geophysical survey over the primary areas of known or suspected waste disposal activities at the RMI site. The survey was employed to define the areas of past waste disposal, and possibly, their effects on groundwater and soil conditions. The geophysical survey utilized both terrain conductivity and earth resistivity methods.

Surficial Soil Sampling

ECKENFINDER Inc. conducted surficial soil sampling in five areas of the RMI Sodium Plant: the fill area north of the wastewater treatment ponds (Area G), the fill area west of the wastewater treatment ponds (Area F), the fill area northeast of the closed landfill (Area B), the fill area northwest of the closed landfill (Area C), and the closed landfill (Area A). Four surficial soil samples were collected at each location: 12 background samples were also collected. The results of the surficial soil analyses were evaluated for statistical significance relative to background concentrations.

Soil Borings and Sampling

ECKENFELDR Inc. drilled 18 soil borings at locations of indicated past waste disposal, adjacent to such waste disposal areas, or in "background" areas. The borings were advanced using a rotary, hollow-stem auger stem. Samples were collected using continuous-core-drilling technique, which utilized a 5 foot long split spoon barrel. Upon completion of each 5 ft of sampling, the core barrel was opened and placed in a split PVC pipe and then logged. The sample was also analyzed with a portable Hnu photoionization meter to detect the presence of volatile organics. Only Hnu readings above background were reported on the field logs. Hnu readings were only reported on the field logs for wells 1S and 2S. All other boring samples did not have Hnu readings reported as volatile organics were not detected above background levels.

Upon completion of geologic logging, samples from the core were collected and placed into clean plastic containers for transport, on ice, to the ECKENFELDER Inc. laboratory. If Hnu readings indicated the need for organic analyses, a portion of the sample was placed in glass containers for shipment to the laboratory. In the laboratory, the samples were subjected to chemical analyses for pH; total cyanide; and the metals lead, barium, cadmium, arsenic, selenium, mercury, silver, chromium, and nickel. Three soil samples (1S at 15.1 ft, 2S at 6.0 ft, and 8S at 6.5 ft) were analyzed for volatile organic compounds, base neutral compounds, acid extractable compounds, pesticides, and PCBs. Results of the laboratory analyses are presented and summarized in the subsection entitled "Contaminant Levels and Comparison to Standards for Maximum Levels".

Woodward-Clyde drilled ten soil borings (FBAG-1 through FBAG-10) in the proposed location of the consolidation/landfill area for the Fields Brook Superfund cleanup project. Borings FBAG-1, 2, 4, 5, 7, 8, 9, and 10 were drilled with a 4.25 inch ID hollow stem auger with samples collected in a standard split spoon (1-3./8 inch ID) sampler. Borings FBAG-3 and FBAG-6 were drilled with a Diedrich D-50 ATV with automatic hammer with samples collected in split spoon sampler (Modified California, 3 inch OD). After advancing the boring through the fill material and verification of natural material, one sample was obtained for analytical testing from borings; FBAG-1, 2, 4, 5, 7, 8, 9, and 10. In exploratory borings FBAG-1, 3, 6, 8, and MW-3S selected samples were obtained for geotechnical testing. Field screening of soil samples for volatile organics utilized an Organic Vapor Analyzer (OVA). Samples collected for analytical testing were placed in coolers with ice and delivered to Quanterra Environmental Services, Inc., located in North Canton, Ohio. Analytical tests consisted of Target Compound List (TCL) for volatiles, semi-volatiles, pesticides, polychlorinated biphenyl's (PCBs), and Target Analyte List (TAL) parameters. Results of the laboratory analyses are presented and summarized in the sub-section entitled "Contaminant Levels and Comparison to Standards for Maximum Levels".

Piezometers and Monitoring Well Installation

ECKENFELDR Inc. installed twenty piezometers at key locations throughout the site to provide a definition of groundwater flow patterns. Data obtained from the piezometers were used to identify locations of soil borings and monitoring wells. Each piezometer was installed by advancing a 6-inch diameter hollow stem auger to a depth of approximately 5 feet below the water table surface (average of about 15 feet total depth at each location).

ECKENFELDR Inc. also installed ten shallow monitoring wells to provide information on the water table surface and the water quality in the glacial till water-bearing strata. Five deep monitoring wells were also installed to provide information on the piezometric surface and water quality in the bedrock water-bearing zone. Water level measurements and in-situ hydraulic conductivity tests were performed to determine the groundwater flow regimes at the site. Groundwater samples were obtained and analyzed during two episodes at each monitoring well location.

Woodward-Clyde installed six groundwater-monitoring wells (MW-1S through MW-6S) around the perimeter of the proposed consolidation/landfill area during the period of December 2 to December 5, 1997. The monitoring wells had the slotted PVC pipe set at depths of sixteen to twenty feet below the ground surface and extending up with a solid PVC riser pipe to two feet above ground surface. From each monitoring well groundwater level measurements were performed and groundwater samples were obtained for laboratory analytical tests.

Hydraulic Conductivity Testing

ECKENFELDER Inc. performed hydraulic conductivity tests at deep wells; 4D, 5D, 9D, and 11D and shallow wells; 4S, 5S, 7S, 8S, 9S, and 10S. Variable head recovery tests were performed to determine the hydraulic conductivity of the saturated materials. The field tests involved rapidly lowering the water level in the well and measuring the change in head with respect to time as the well recovered to static equilibrium. Results of the hydraulic conductivity tests are discussed in the sub section entitled "Hydraulic Conductivity".

Woodward-Clyde performed hydraulic conductivity tests at selected groundwater monitoring wells MW-1S, 3S, 4S, and 6S located in the proposed Fields Brook consolidation/landfill area. Monitoring well MW-2S was not tested because of low water volume. A slug test was performed to determine the hydraulic conductivity using a Hermit 1000C data logger and a 10-psi pressure transducer. The instantaneous change in water level was completed by removing water with a clean, 1.5-inch diameter polyethylene bailer. Results of the hydraulic conductivity tests are discussed in the sub section entitled "Hydraulic Conductivity".

Groundwater Sampling

ECKENFELDER Inc. obtained groundwater samples during the periods of November 16 through 18, 1988 and, January 11 through 13, 1989. The monitoring wells that the samples were obtained from were purged by bailing prior to sampling to insure representative samples. Upon collection of each sample the pH, specific conductance, and temperature were determined. Groundwater samples collected for metal analyses were field-purchased through a 0.45 micron membrane filter prior to preservation with nitric acid. Samples were preserved in accordance with USEPA protocol and shipped on ice to the ECKENFELDER inc. laboratory in Nashville, Tennessee. All monitoring wells, with the exception of wells 1S, 2S, and 7D were analyzed for the following parameters: major ions (calcium, magnesium, sodium, potassium, bicarbonate, sulfate, and chloride); dissolved metals (arsenic, barium, cadmium, lead, mercury, selenium, silver, and chromium); conductivity; TDS; pH; and TOC. Monitoring wells 1S and 2S were not analyzed for the above parameters due to the extremely high concentrations of volatile organic compounds, which could contaminate the laboratory and cause a flammability hazard. Monitoring well 7D was analyzed for metals and major cations only, because of insufficient sample due to low water levels in the well. In addition, monitoring wells 1S, 2S, 4S, and 4D (November 1988 sampling event) and wells 3S, 4S, and 4D (January 1989 sampling event) were subjected to an organic priority pollutant scan which included the following parameters: cyanide, volatile organic compounds, base neutral compounds, acid extractable compounds, pesticides, PCBs. Results of the analytical tests are discussed in the sub section entitled "Groundwater Contaminants".

Woodward-Clyde obtained groundwater samples on December 12, 1997 from the groundwater monitoring wells located in the area of the proposed Fields Brook consolidation/landfill and from existing and additional wells located in the southern portion of the property. Prior to sampling, three volumes of water were purged from each well. Sampling commenced when the monitoring wells returned to near static conditions. The groundwater samples were analyzed for TCL and TAL parameters, calcium, sodium, potassium, magnesium, chloride, sulfate, nitrate, and alkalinity. Quality Assurance/Quality Control (QA/QC) samples were also submitted to the laboratory and consisted of 1 rinsate and 1 duplicate samples. Samples were placed on ice in coolers and transported to the Solon, Ohio office for pick-up by the analytical laboratory. All analytical data was reviewed for holding times, surrogate recoveries, MS/MD recoveries, field duplicates, trip blanks, method blanks, laboratory control samples and sample preservation methodology. Results of the analytical tests are discussed in the sub section entitled "Groundwater Contaminants".

Wastewater Treatment Pond Sampling

ECKENFELDER Inc. performed sampling of the wastewater treatment pond system into three separate sub tasks. The subtasks included sampling of the pond supernatant, sediment, and the collection manholes for the french drain system. This sampling effort was performed during the periods of January 31, 1989 through February 2, 1989.

Surface water from each of the five wastewater treatment ponds was collected from two separate locations . Discrete samples (A and B) were collected from the banks of the ponds. A Kemmerer sampling device was used to obtain a representative water sample from each location. These two discrete samples were the composited into the appropriate sample containers in the field. Compositing was performed on a equal volume basis.

Sediment from each of the wastewater treatment ponds was also collected from two discrete locations. These locations coincided with the discrete water samples. Sediment samples was also collected from the bank of the ponds. A scoop consisting of a glass jar connected to a PVC pole was used to collect the samples. Each sediment sample was collected in a large glass jar and allowed to settle. The clear water portion was then decanted, the remaining sediment sample was thoroughly mixed, and a representative sample was taken and placed into a sample container.

Water in the four concrete collection manholes for the french drain system surrounding the wastewater treatment ponds were also sampled. Water in three of the four french drain manholes were sampled utilizing a small electric centrifugal pump and placed into sample containers. The water level in the manhole near pond 5 was too low to use a centrifugal pump and was instead collected from the discharge pipe to the permanent pump for the manhole.

Prior to and during the above sampling subtasks, air monitoring utilizing a HNU photoionizing probe and Draeger tubes were conducted. Results of monitoring using the HNU probe indicated no quantitative organic concentrations above background. The Draeger Tubes indicated the presence of chlorine in unquantifiable amounts.

Surface Water Sampling

ECKENFELDER Inc. sampled the surface water in the drainage ditch system on the southern portion of the RMI property at seven locations. The drainage ditch sampled is located in the vicinity of the closed landfill on the southeast portion of the RMI property. Three samples (E, F, G) were collected in the downstream tributary. The other four samples (A, B, C, D) were collected from a feeder to the DS tributary. The tributary ditch is used to convey stormwater runoff from the RMI property. It also receives run runoff from other adjacent property. In addition, the ditch system is believed to be a discharge point for portions of the shallow groundwater beneath the property.

HTRW ENVIRONMENTAL EVALUATION

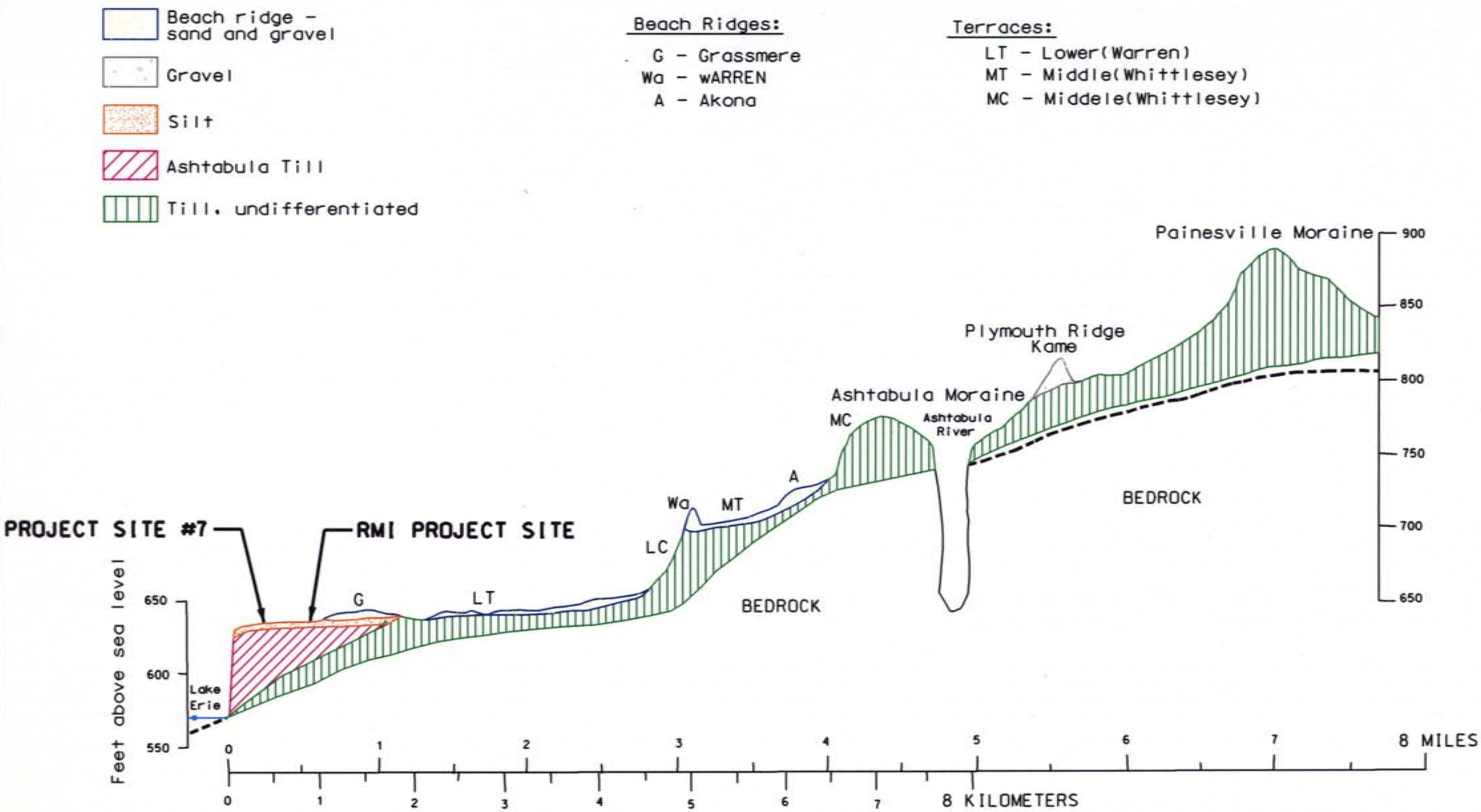
Site Geology and Hydrogeology

Site Stratigraphy

Ashtabula County is covered by Pleistocene glacial deposits of at least seven continental ice sheets. The RMI site is underlain by Wisconsin Stage till deposits, which are the most recent deposits of glacial history. The tills generally overlie the bedrock, sometimes separated by the presence of a weathered bedrock surface, and in turn are occasionally overlain by localized deposits of silt derived from wave washing and reworking of the till (White and Totten, 1979).

Shown in Figure 2(N-1) is a generalized soil profile for Ashtabula County. This figure shows that the RMI site is underlain by Ashtabula Till deposits, the youngest of the Wisconsin stage till deposits. The Ashtabula Till in the Lake Plain has been more or less wave washed, so that the uppermost part of the till has been eroded and in places completely removed. The overlying silt has been at least partly derived from reworking of till. The Ashtabula Till is a calcareous silty clay till, sparingly to moderately pebbly. Unaltered Ashtabula Till is gray while altered and oxidized till is brown. The lower part of the till contains layers or pods of silt and clay and pieces of "smeared" shale in the matrix of the till. The Ashtabula Till overlies older, undifferentiated tills overlying the bedrock.

Profile A-A' shown on Figure 3(N-1) and Profile B-B' shown on Figure 4(N-1) are general geologic profiles running North to South across the RMI site in the area of the



REF: White, G.W., Totten, S.M., "Galcial Geologiy of Ashtabula County, Ohio, ODNR Report No.112, 1979. Section F-F'.

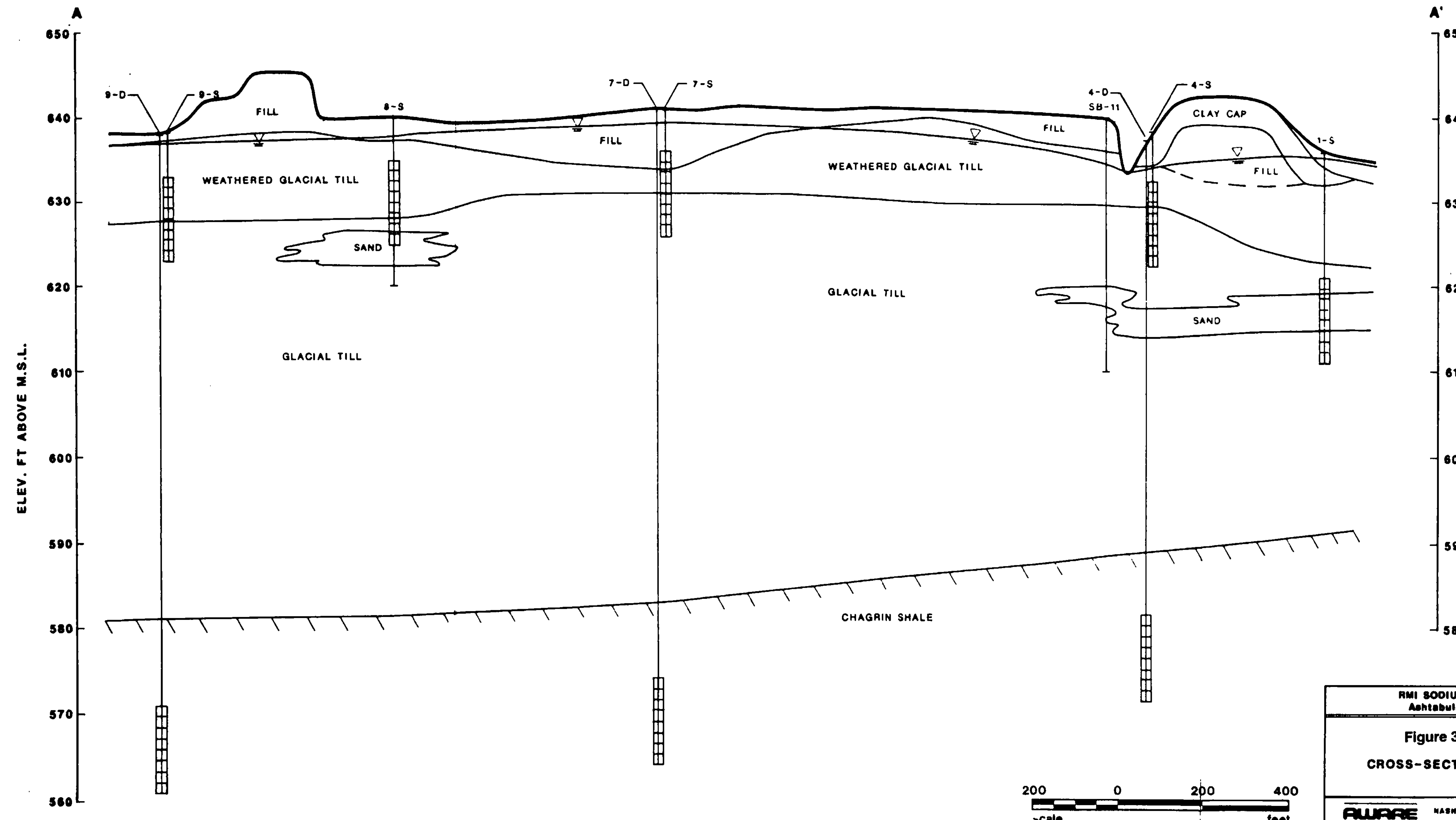
ASHGLAC.DGN

ASHTABULA RIVER DREDGING
LANDFILL DESIGN

GLACIAL GEOLOGY CROSS SECTION
NORTHERN ASHTABULA COUNTY
SITE #7 AND RMI SITE

US ARMY ENGINEER DISTRICT BUFFALO

FIGURE 2 (N-1)



RMI SODIUM PLANT
Ashtabula, Ohio

Figure 3 (N-1)

CROSS-SECTION A-A'

AWARE INCORPORATED
NASHVILLE, TENNESSEE
MAHWAH, NEW JERSEY

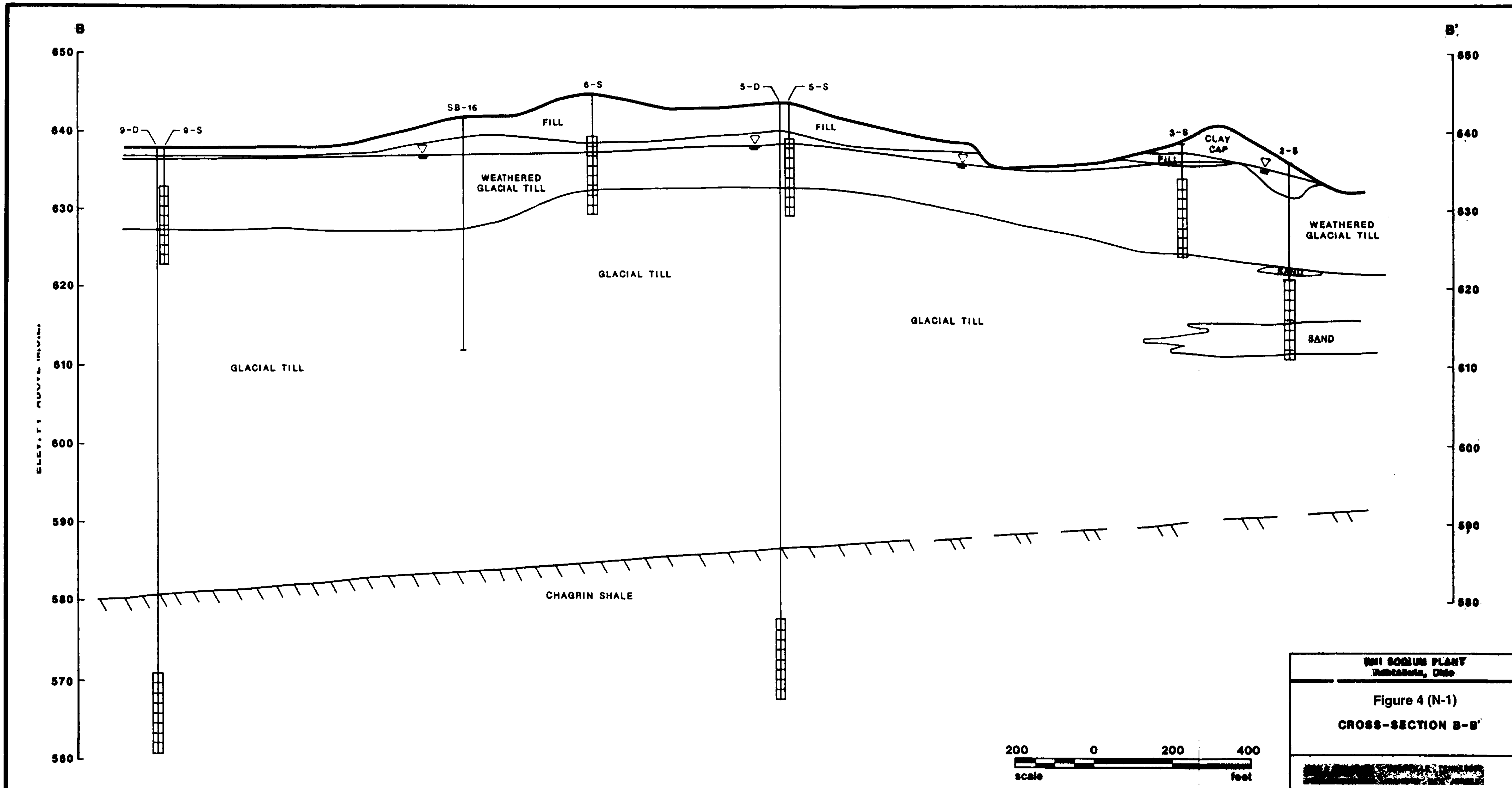
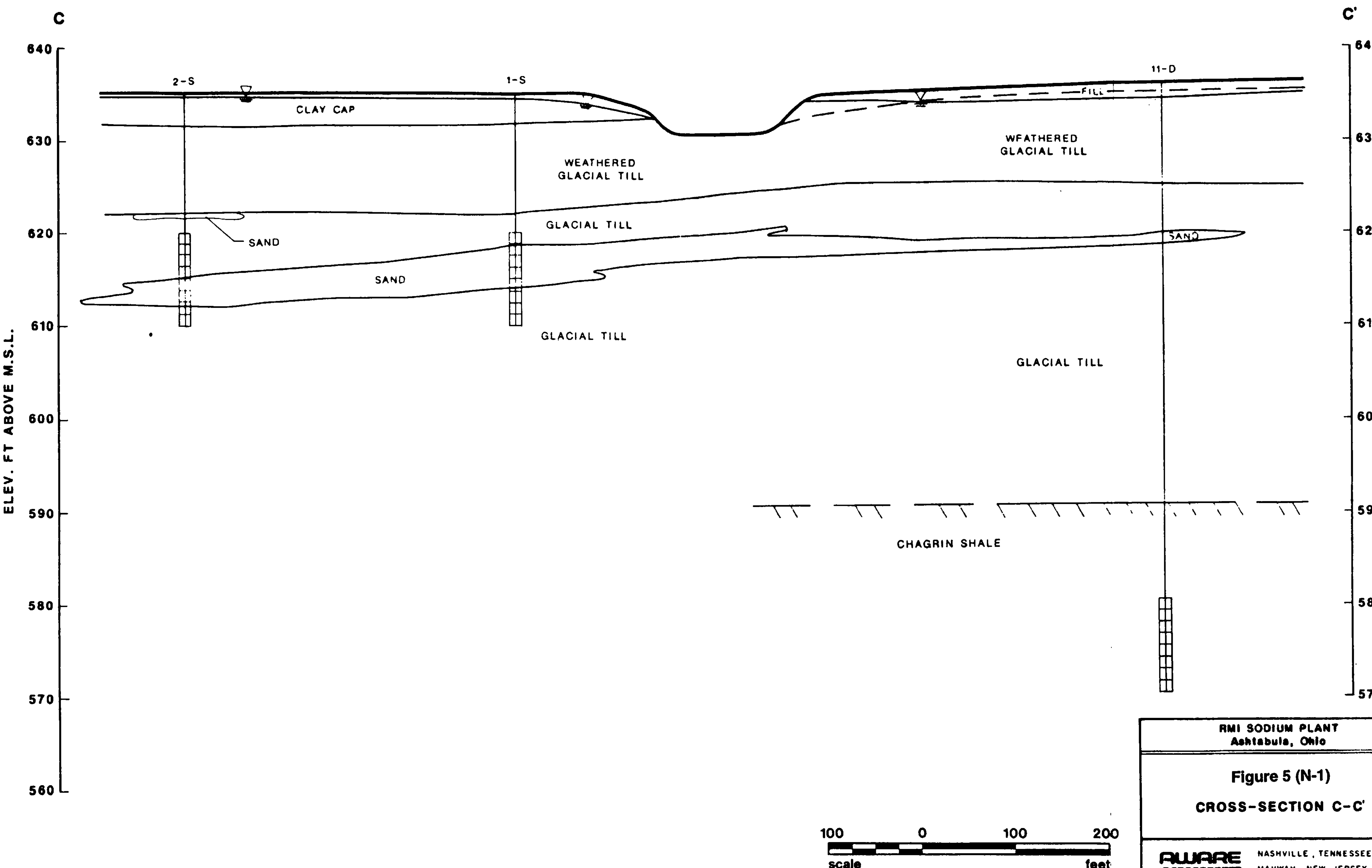


Figure 4 (N-1)

CROSS-SECTION B-B'



RMI SODIUM PLANT
Ashtabula, Ohio

Figure 5 (N-1)

CROSS-SECTION C-C'

AWARE INCORPORATED
NASHVILLE, TENNESSEE
MAHWAH, NEW JERSEY

proposed landfill. Profile C-C' Shown on Figure 5(N-1) is a general geologic profile running east to west across the southern end of the RMI site. These profiles show that approximately 44 to 59 feet of unconsolidated deposits (Ashtabula Till, fill) overlie the shale bedrock at the RMI site.

The upper 6 to 13 feet consist have weathered till and fill. These deposits were found to be composed of a mottled orange-brown-gray silty clay containing traces of fractured or broken shale fragments, thin silt and fine sand layers, and large oxidized fractures. The oxidized fractures appear to be large vertical and minor horizontal fractures resulting from desiccation cracks formed by the shrinkage of clay in the course of drying and are typically lined with fine sand. It seems clear that these fractures serve as the primary pathways for the movement of water in the upper weathered zone of the till.

The unweathered till deposits range from approximately 31 to 48 feet in thickness. The unweathered till consists of gray silty clay containing lenses of sand and fractured or broken shale fragments. The unweathered till does not contain any fractures or other results of weathering, and therefore, has a very low permeability.

The bedrock consists of the Chagrin Shale formation, which is a gray, platy shale, encountered at elevations 581.4 to 591.5 MSL. The geologic profiles show that bedrock surface slopes slightly to the north, toward the Lake Erie basin.

Groundwater Conditions

Groundwater has been observed to occur within two zones beneath the RMI site:

- An unconfined water table zone within the fill and upper weathered glacial till with moderate hydraulic conductivity and within the deeper unweathered till with presumed lower hydraulic conductivity.

- A confined water-bearing zone within the low hydraulic conductivity shale.

The unconfined water table in the upper fill and glacial till receives recharge predominantly through direct infiltration of precipitation. Therefore, its water table surface is likely to be more sensitive to seasonable variations than the deeper shale zone.

The direction of groundwater flow direction within the upper fill and glacial till are variable due to the recharge effects to the water table by the seven clay lined ponds in the north, east, and southeast areas of the site. The two brine ponds in the southwest corner of the site are synthetically lined and, therefore, have minimal impact on groundwater. In general, the groundwater is mounded around the clay lined ponds and the overall groundwater flow directions radiate outward from the site. At least a portion of the groundwater appears to discharge to the DS tributary of Fields Brook and the drainage ditch to the east of the ponds (See Plate 3(N-1)).

Groundwater occurs under generally confined conditions in the deeper shale bedrock water-bearing zone. Plate 4(N-1) shows Piezometric surface contours obtained from the deep monitoring wells. In general, the data shows that the overall groundwater flow is towards the north. However, there appears to be a mounding of the piezometric surface near the eastern property boundary. The source of this mounding is most likely the off-site coal piles located north east of the RMI property. These coal piles most likely raise the groundwater elevation to a height within the coal pile. The elevated water table in the coal piles can then be reflected by mounding of the piezometric surface of deeper semi-confined aquifers.

Hydraulic Conductivity

Hydraulic conductivity tests were performed by ECKENFELDER Inc. in 1989 and by Woodward-Clyde in 1997. In the upper fill/weathered till water bearing zone the hydraulic conductivity's varied from 1.38×10^{-6} cm/sec to 6.8×10^{-5} cm/sec. Hydraulic conductivity tests were not conducted in wells screened totally within the unweathered till zone. However, ECKENFELDER Inc. performed conducted hydraulic conductivity tests on wells screened entirely within the unweathered till at the RMI Extrusion Plant which is located approximately ½ mile from the RMI Sodium Plant. Hydraulic conductivities at the Extrusion Plant varied from 5.1×10^{-8} cm/sec to 2.4×10^{-7} cm/sec. ECKENFELDER Inc. estimated the hydraulic conductivity's in the bedrock to be 5.6×10^{-8} cm/sec to 1.2×10^{-6} cm/sec.

Groundwater Classification

The USEPA issued a groundwater classification system in December, 1986. The purpose of this classification system is to develop a protection policy that recognizes that different groundwater's require different levels of protection. A three-tiered classification system was established as the vehicle to implement this strategy:

- Class I: Special groundwater (irreplaceable sources of drinking water and/or ecologically vital).
- Class II: Groundwater currently a source of drinking water (subclass IIA) or potentially a source of drinking water (Subclass IIB).
- Class III: Groundwater not a source of drinking water due to insufficient yield, high salinity, or contamination that cannot be reasonably treated. Subclass IIIA groundwater's exhibit an intermediate to high degree of interconnection to adjacent groundwater units or surface waters or have insufficient yield. Subclass IIIB groundwater's exhibit a low degree of interconnection to adjacent groundwater units or surface waters.

Using the above USEPA groundwater classification guidelines it was determined that The RMI Sodium Plant site be classified as a Class IIIA groundwater based primarily on insufficient yield. Using the mean hydraulic conductivity's, ECKENFELDER Inc. estimated the total yield of the till formation to be 117 gpd (75 gpd weathered upper till + 42 gpd unweathered till). The USEPA guidance for Class IIIA groundwater is that the aquifer yield must be less than 150 gpd.

Contaminant Levels and Comparison to Standards

Groundwater Contaminants (Inorganics)

In the closed landfill at the southern end of the RMI site and former fill areas, barium, cadmium, and lead were suspected hazardous constituents. In addition, previous samples from the wastewater treatment ponds have contained trace amounts of chromium, lead, selenium, and silver. Therefore, ECKENFELDER Inc. obtained groundwater samples in the shallow fill/glacial till water-bearing zone and tested them for the following constituents: arsenic, barium, cadmium, lead, chromium, lead, mercury, selenium, and silver. These metals could not be effectively analyzed in the groundwater samples from wells 1S and 2S due to the high concentrations and very complex nature of the organics in the groundwater at these locations. The results the metals test data are summarized on Table 1(N-1). Barium and cadmium were the only metals consistently detected above background values. Elevated concentrations Ba and Cd were detected in the areas north (Area G) and east of the groundwater treatment ponds (Area D). The highest concentration of barium detected in groundwater was 1900 ppb (1.9 mg/l), in well 8S near pond G; the highest concentration of Cd was 25.7 ppb (.026 mg/l), near Area D. The presence of these constituents in groundwater is believed to be due, in part, to recharge of the groundwater from the wastewater treatment ponds, and most likely not from the leaching of subsurface soils or buried wastes.

The direction of contaminant (barium and cadmium) migration in groundwater appears to radiate outward from the mounded groundwater in the vicinity of the five ponds near the eastern end of the property. The direction of contaminant migration in the vicinity of the closed landfill is assumed to be flow outward towards the DS tributary of Fields Brook. The rate of barium and cadmium migration in the groundwater is controlled by the speciation and sorption of the barium and cadmium ions.

ECKENFELDER Inc. obtained groundwater samples from five deep monitoring wells (4D, 5D, 7D, 9D, 11D) which have been screened within the shale. These samples were tested it for the eight metals discussed above. The metals data are summarized in Table 1(N-1). The concentration of metals measured in the shale groundwater zone were at background levels. Barium was the only metal consistently detected in the bedrock groundwater wells and it occurred at concentrations greater than the shallow groundwater background values. The maximum concentration of barium was 18,000 ppb (18 mg/l)

Table 1 (N-1)
Dissolved Metals In Groundwater

Well Number	Sample Date	pH	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
		Concentration (ppb)								
3S	11/18/88	6.39	BMDL[a]	910	4.0	9.8	BMDL	BMDL	BMDL	BMDL
	1/11/89	7.08	BMDL	1200	1.4	9.7	BMDL	BMDL	1.1	BMDL
4S	11/17/88	-----	BMDL	BMDL	11.8	14.5	BMDL	0.6	1.5	BMDL
	1/11/89	7.12	BMDL	830	14.3	8.0	BMDL	BMDL	BMDL	BMDL
4D	11/17/88	-----	BMDL	6200	2.6	8.2	BMDL	0.6	BMDL	BMDL
	1/11/89	6.94	BMDL	6800	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL
5S	11/18/88	6.42	BMDL	530	6.5	9.8	BMDL	BMDL	BMDL	BMDL
	1/11/89	7.10	BMDL	610	9.7	6.9	BMDL	BMDL	BMDL	BMDL
5D	11/18/88	7.08	BMDL	6210	2.0	5.8	BMDL	BMDL	BMDL	BMDL
	1/11/89	7.00	BMDL	5600	2.8	8.3	BMDL	BMDL	BMDL	BMDL
6S	11/18/88	6.34	BMDL	1500	18.3	BMDL	BMDL	BMDL	3.7	BMDL
	1/12/89	7.04	BMDL	1100	25.7	BMDL	BMDL	0.4	2.4	BMDL
7S	11/17/88	7.15	BMDL[b]	BMDL	8.3	5.9	BMDL	BMDL	BMDL	BMDL
	1/12/89	6.98	BMDL/BMDL	BMDL/BMDL	3.0/4.0	BMDL/BMDL	BMDL/BMDL	BMDL/BMDL	BMDL/BMDL	BMDL/BMDL
7D	NA[c]	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1/13/89	-----	9.0	BMDL	BMDL	8.1	BMDL	BMDL	BMDL	BMDL
8S	11/18/88	6.29	BMDL	1900	11.7	BMDL	BMDL	BMDL	BMDL	BMDL
	1/12/89	7.02	BMDL	830	6.9	13.0	BMDL	BMDL	BMDL	BMDL
9S	11/16/88	7.35	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL
	1/12/89	6.98	BMDL/BMDL	BMDL/BMDL	BMDL/1.3	13.6/BMDL	BMDL/BMDL	BMDL/BMDL	BMDL/BMDL	BMDL/BMDL
9D	11/16/88	7.83	BMDL	1100	2.7	6.1	BMDL	BMDL	BMDL	BMDL
	1/12/89	6.99	BMDL	1400	6.3	13.5	BMDL	BMDL	BMDL	BMDL
10S	11/16/88	6.94	BMDL/BMDL	BMDL/BMDL	BMDL/BMDL	BMDL/6.1	BMDL/BMDL	BMDL/BMDL	BMDL/BMDL	BMDL/BMDL
	1/13/89	7.08	BMDL	BMDL	BMDL	8.4	BMDL	BMDL	BMDL	BMDL
11D	11/17/88	7.67	BMDL/BMDL	3400/5800	7.9/BMDL	7.1/6.7	BMDL/BMDL	BMDL/BMDL	BMDL/BMDL	BMDL/BMDL
	1/12/89	7.12	BMDL	18000	7.2	11.6	BMDL	BMDL	BMDL	BMDL
Field Blank	11/17/88	7.05	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL
	1/12/89	7.05	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL
Detection Limits		-----	5.0	500.0	1.0	5.0	10.0	0.4	1.0	30.0

[a]BMDL = Below Method Detection Limit

[b]Field Duplicate

[c]NA = Not Analyzed - Dry Well

Ref: RCRA Facility Investigation Report, RMI Sodium Plant Echenfelder Inc, June 1980

which was at well 11D (south west corner of the RMI property). The presence of barium in the deep bedrock groundwater does not necessarily indicate a connection with the SMUs on site. Based upon the low permeability and considerable thickness of the unweathered glacial till, and the relatively small hydraulic gradient between the bedrock and shallow aquifer, it is apparent that only a minimal downward component of flow exists between the two water bearing zones. In addition, major ion data demonstrate that the bedrock groundwater has a distinctively different chemistry than the shallow groundwater. Barium in the deep groundwater occurs at higher concentrations than shallow groundwater, while chloride concentrations in the deep groundwater are much lower than in shallow groundwater. These inverted ratios indicate that the barium in the deep groundwater is naturally occurring. Therefore, water quality in the bedrock groundwater is not affected by the SMUs on site.

Additional groundwater samples collected by Woodward-Clyde in 1992 and 1993 in the southern portion of the site contained the following inorganic analytes contained in samples collected in RM1S7 and RM1S1: arsenic, antimony, beryllium, cadmium, chromium, copper, lead, nickel, and zinc. Most inorganics were detected at concentrations of less than 100 µg/l, nickel was detected at a concentration of 700 µg/l at RMSMW05S.

Groundwater Quality Standards (Inorganics)

Test results were compared to the State of Ohio Code (Chapter 3746) for Generic Unrestricted Potable Use Standards for Groundwater. This standard was compared to groundwater test results performed by ECKENFELDER Inc. to determine if any of the contaminant levels exceed the cleanup standards. The Standards for the metals tested are summarized in Table 2(N-1) below:

Table 2(N-1)

Metal Tested	Potable Water Use Standards (mg/l)
Arsenic	0.05
Barium	2.0
Cadmium	0.005
Chromium	0.1
Lead	-
Mercury	0.002
Selenium	0.05
Zinc	4.7

Comparison of the test results to the above standards reveal that the maximum concentration of barium (1.9 mg/l) is below the standard (2.0 mg/l) and the concentration of cadmium (0.026 mg/l) is above the standard (0.005 mg/l). All other metals tested were below the detection limit or had insignificant levels.

Groundwater Contaminants (Volatile Organics)

A dense non-aqueous phase liquid (DNAPL) comprised of chlorinated solvents and associated dissolved constituents were found on the southern border of the RMI site is believed to be the result of an off site source located to the south. This conclusion is based on the fact that RMI has never used chlorinated solvents at the Sodium Plant. Site investigations have shown that the DNAPL only occurs at the southern boundary of the RMI site. A chemical manufacturing facility, located to the southern border of the RMI site, has historically discharged chlorinated solvents to Fields Brook and unlined settling lagoons on their property. Therefore, sufficient evidence has been collected to conclude that the DNAPL source is off site to the south of the RMI property.

ECKENFELDER Inc. obtained groundwater samples from wells 1S, 2S, 4S, and 4D (sampled November 21, 1988) and wells 3S, 4S, and 4D (sampled January 16, 1989) which were subjected to a GC/MS organic priority pollutant scan. A summary of the test results are presented on Table 3(N-1).

The test results reveal that the highest levels of organic compounds occurs in well 2S located at the southern border of the RMI site. The only other groundwater samples with detectable organic compounds was from well 1S (Southern border of RMI Site). The DNAPL in well 2S appears to be confined to the sandy till zone from 16 to 21.5 feet below the ground surface. The clay till above and below the sandy till zone would serve to confine the DNAPL within the sandy till zone due to its relatively low hydraulic conductivity.

There are two possible scenarios for the source of DNAPL. One very likely source is the unlined lagoons that could have discharged chlorinated solvents into the sandy layer through infiltration and seepage. The other potential source is the tributary to Fields Brook that could have received outfall discharges and lagoon runoff from the manufacturing facility located on the southern border of the RMI Sodium Plant. This would result in the saturation of the sandy till by the DNAPL through time. The DNAPL movement is controlled by the geometry of the sandy till zone and, therefore could migrate north under the RMI site.

Additional groundwater samples collected by Woodward-Clyde in 1992 and 1993 in the southern portion of the site contained elevated levels of organic compounds . Shallow groundwater analytical tests performed on a sample from well DETMW20S had concentrations for Tetracholoroethene and trichloroethene greater than the EPA cleanup goal of 10,000 μg/l (13,000 and 130,000 μg/l). Samples collected at the source areas RM1S7 and RM1S1 contained two organic compounds: methylene chloride and bis(2-ethylhexyl)phythalene with concentrations less than 3 μg/l. Methylene chloride (3 μg/l), acetone (2 μg/l), and bis(2-ethylhexyl)phythalene (1 μg/l) were detected in deep groundwater well RMSMW05D.

Table 3 (N-1)
Soil and Groundwater Data for Suspected Area of DNAPL[a]

Parameter[b] (ppm or mg/kg)	Sample Number								
	Soil 1S (15.1 ft)	Groundwater 1S	Soil 2S (6 ft)	Groundwater 2S (DNAPL)	Groundwater 3S	Groundwater 4S	Groundwater 4D	Surface Water DW-E	Surface Water Dw-G
1,1,2,2-Tetrachloroethane	11.5	37.700	114	33100	ND[c]	ND	ND	ND	BMDL
Tetrachloroethylene	6.2	46.300	13	16400	ND	ND	ND	ND	ND
Trichloroethylene	3.2	63.100	42	23000	ND	ND	ND	ND	0.0026
1,3-Dichlorobenzene	15.4	ND	21	BMDL/ND[d]	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	2100/437[d]	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	0.083	3	3200	ND	ND	ND	ND	ND
Hexachloroethane	ND	0.156	4	18000	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	2	1900	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	761	ND	ND	ND	ND	ND
1,2-trans-Dichloroethylene	ND	ND	ND	ND	ND	ND	ND	0.0379	0.0100
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	0.0026
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	0.0027	0.0127
beta-BHC	ND	ND	ND	808	ND	ND	ND	ND	ND
gamma-BHC	BMDL	BMDL	ND	633	ND	ND	ND	ND	ND

[a]Groundwater sample dates: 1S, 2S on 11/21/88; 3S, 4S, and 4D on 1/16/89; Wells 4S and 4D were also on 11/21/88 but no organic compounds were detected. Soil samples were collected on 10/27/88 (1S) and on 10/24/88 (2S).

[b]Results are listed only for the organic compounds that were detected.

[c]ND = Not detected.

[d]Volatile organic scan result/base neutral scan result.

Ref: RCRA Facility Investigation Report, RMI Sodium Plant Echenfelder Inc, June 1980

Groundwater Quality Standards (Organics)

The State of Ohio Unrestricted Potable Use Standards for the volatile organic compounds for the compounds tested are summarized in Table 4(N-1) below:

Table 4(N-1)

Organic Compound Tested	Potable Water Use Standards (mg/l)
1,1,2,2-Tetrachloroethane	-
Tetrachloroethylene	0.005
Trichloroethylene	0.005
1,3-Dichlorobenzene	-
1,2-Dichlorobenzene	0.075(p-)
Hexachlorobutadiene	-
Hexachloroethane	-
Hexachlorobenzene	0.001
Hexachlorocyclopentadiene	-
1,2-trans-Dichloroethylene	0.1
1,1,2-Trichloroethane	0.005
Trichlorofluoromethane	-
Beta-BHC	-
Gamma-BHC	-

Comparison of the test results to the above standards reveal that the test results especially for the first three constituents listed in Table 4 above far exceed the standards for groundwater wells 1S and 2S.

Surface Water Contaminants

Wastewater Treatment Ponds Surface Water and Sediments

At the present time the five waste water treatment ponds are dry. Thus, the chemical analysis performed by ECKENFELDER Inc. on samples obtained from the surface water in the ponds are no longer relevant. However, the analytical data obtained on the sediment samples still have some bearing on this present evaluation as these materials have not been excavated or removed from these ponds. The sediment analytical test data is summarized in Table 5(N-1).

The test data indicate that metals were the main parameters of concern in this media. This is collaborated by the low percentage of volatile organics detected in the samples, which ranged form 1.8 to 3.4 percent. Arsenic, mercury, and selenium were not found in any of the sediment samples. Lead and silver was detected in all sediment samples but in relatively low concentrations (2.9 mg/kg to 9.2 mg/kg and BMDL to 0.23 mg/kg respectively). Only barium and chromium were detected in appreciable

Table 5 (N-1)
Analytical Results for Watewater Treatment Pond Sediments[a]

Parameter	Sample Number						
	Detection Limit	PS 1	PS 2	PS 3	PS 4	PS 5	PS 6[c]
Arsenic	5.0	BMDL[b]	BMDL	BMDL	BMDL	BMDL	BMDL
Barium	20.0	1280.0	31.5	1420.0	3020.0	2500.0	5.1
Cadmium	1.0	BMDL	BMDL	BMDL	BMDL	BMDL	2.1
Chromium	2.5	17.5	6.1	7.6	5.5	4.2	10.0
Lead	1.0	9.2	2.9	6.7	2.9	3.8	9.0
Mercury	0.2	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL
Selenium	0.5	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL
Silver	0.05	0.22	BMDL	0.18	0.23	0.14	0.21
pH (units	-----	10.8	11.4	10.7	10.9	10.8	9.79
% Solids	-----	49.5	46.6	35.3	45.1	58.2	37.4
% Volatile Solids	-----	3.0	3.4	1.8	2.5	2.3	1.9

[a]All results expressed in mg/kg (ppm), wet weight.
[b]BMDL = Below method detection limit
[c]Blind duplicate of PS-3.

Ref: RCRA Facility Investigation Report, RMI Sodium Plant Echenfelder Inc, June 1980

concentrations. Barium concentration varied from 31.5 mg/kg to 3,020 mg/kg while chromium concentrations ranged less than an order of magnitude, from 4.2 mg/kg to 17.5 mg/kg. Because chromium concentrations measured were low, chromium does not appear to be at levels of concern.

The french drain for the wastewater ponds not only collects water from the treatment ponds but also from the shallow groundwater zone. Thus, the previous analytical data obtained by ECKENFELDER Inc. for collection manholes water is relevant to this evaluation. Test data indicated that Cadmium was the only constituent detected in appreciable concentrations (BMDL to 26.8 ppb or .0027 mg/l).

Drainage Ditch Surface Water and Sediments

ECKENFELDER Inc. collected water samples from seven on-site locations (samples DW-A through DW-G) in the drainage system on the southern portion of the RMI site. Analytical test results for these samples are presented on Table 6(N-1). The analytical data shows very low concentrations for most constituents; the highest levels detected were: zinc(Zn) at 359 ppb (.359 mg/l) at location DW-E, cadmium (Cd) at 37.9 ppb (.038 ppb) at location DW-B. Because of the location of DW-E (the southeast corner of the property, where the ditch originates offsite), it is believed that the Zn could be attributed to an offsite source to the east. The concentration of cadmium (Cd) at location DW-B is believed to be the result of the presence of suspended sediment in the water sample which likely originated from the erosion of surficial soils from area B. Although the presence of organics was indicated from the results of priority pollutant scans (conducted on samples DW-E and DW-G), the presence of organics is believed to be due to sources originating off site.

ECKENFELDER Inc. also collected two collected two off site surface water samples (SW-3 and SW-4) from the drainage ditch located along the eastern boundary of the site. The off site ditch water samples were analyzed for arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), lead (Pb), nickel (Ni), selenium (Se), silver (Ag), zinc (Zn), and cyanide. Results of the analytical test data show detectable concentrations at relatively low levels. Cyanide, Se, and Ag were not detected in either of the samples. As, Ba, Cu, and Zn were detected only in sample SW-3, at relatively low concentrations ranging from 5.1 ppb (.00051 mg/l) to 510 ppb (.51 mg/l). Low levels of Cd, Cr, Pb, and Ni were detected in both samples and were detected in the field blank at similar levels, with the exception of Ni in SW-3 (38.2 ppb, .0382 mg/l), which was elevated with respect to the field blank value (2.3 ppb).

Four sediment samples were also collected from the drainage ditches: two (samples SD-1 and SD-2) in the vicinity of on-site ditch water sample DW-B, and two off site (samples SD-3 and SD-4) located in the eastern drainage ditch. Analytical inorganic test data showed that the on-site ditch samples had similar concentration as the off site

Table 6 (N-1)
Summary of Inorganic Analytic Results From RMI On-Site Drainage Ditch Surface Water Samples[a]
February 1989

Constituent	Total Concentration (ppb)								
	Detection Limit	DW A	DW B	DW C	DW D	DW E	DW F	DW G	DW H
Arsenic (As)	1.0	NA[b]	NA	NA	NA	BMDL[c]	NA	1.8	NA
Barium (Ba)	500.0	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL
Cadmium (Ca)	1.0	1.9	37.9	BMDL	BMDL	BMDL	3.1	2.1	BMDL
Chromium (Cr)	5.0	NA	NA	NA	NA	BMDL	NA	BMDL	NA
Lead (Pb)	2.0	3.7	BMDL	BMDL	3.6	4.9	3.8	3.6	BMDL
Nickel (Ni)	0.4	NA	NA	NA	NA	BMDL	NA	BMDL	NA
Mercury (Hg)	100.0	NA	NA	NA	NA	BMDL	NA	BMDL	NA
Selenium (Se)	1.00	NA	NA	NA	NA	BMDL	NA	BMDL	NA
Silver (Ag)	1.0	NA	NA	NA	NA	BMDL	NA	BMDL	NA
Zinc (ZN)	10.0	NA	NA	NA	NA	359.00	NA	77.0	NA
pH (units	-----	6.56	7.16	7.50	7.35	6.27	6.97	6.51	7.93
Hardness (mg/L as $CaCO_3$)[d]	-----	283.00	1144.00	153.00	135.00	1030.00	1456.00	317.00	BMDL

[a]See Table 6-9 of the Revised RFI report.
[b]NA = Not analyzed.
[c]BMDL = Below method detection limit.
[d]Hardness calculated from Ca and Mg concentration (see Appendix 9 of the Revised RFI report) from *Standard Methods*, No. 314A (AWWA, 1985).
[e]Field blank.

Ref: RCRA Facility Investigation Report, RMI Sodium Plant Echenfelder Inc, June 1980

samples with the exception of barium. Barium for on site samples SD-1 and SD-2 had concentrations of 3,590 ppm and 3,220 ppm, respectively; barium concentrations in the off site sample locations (SD-3 and SD-4) were significantly less at 121 ppm and 846 ppm respectively. Cd concentrations in the on site sediment were also slightly elevated with respect to the off site sediment samples (51.8 ppm and 35.7 ppm, compared to BMDL and 32.5 ppm, respectively). The highest erosion losses for Ba and Cd was predicted for Area B, which is located adjacent to on site sampling locations SD-1 and SD-2. Therefore, it is likely that the concentrations of Ba and Cd measured in these samples are due to erosion of surficial samples from Area B.

Sediment Cleanup Standards (Inorganic Metals)

The waste water treatment pond sediment analytical data was compared to the Ohio EPA Generic Direct Contact soil cleanup standards for Residential, Commercial, and Industrial Land-Use Categories. These standards for the constituents tested are summarized in Table 7(N-1) below:

Table 7(N-1)

Metal Tested	Generic Industrial Direct Contact Standard (mg/kg)
Arsenic	86
Barium	140,000
Cadmium	300
Chromium	2800
Lead	2800
Mercury	230
Selenium	-
Silver	-

Comparison of the sediment test results to the above standards show that the concentrations of constituents tested are all below the cleanup standard.

Surficial and Deep Soil Contaminants (Inorganic Metals)

ECKENFELDER Inc. obtained split spoon samples from borings and wells located in areas A, B, C, D, F, and G which were analyzed at a wide range in depths for the following constituents: total cyanide, lead, cadmium, nickel, arsenic, selenium, mercury, silver, and chromium. Table 8(N-1) summarizes the test results. Anomalous high metal concentrations, compared to background values (wells 9S/9D, 10S, and 11D), were observed in soils from borings SB-16 and SB-17 and well 8S (Area G). These soils exhibited high values for lead, barium, cadmium, and nickel at depths from 0.5 to 3.3 feet below ground surface but not deeper than 6.5 feet. In addition, deep soils from Area D

Table 8 (N-1)
Deep Soil Data Averaged By Depth[a]

Area	Depth Range (ft)	Metals (mg/kg)									
		Pb	Ba	Cd	Ni	As	Se	Hg	Ag	Cr	Total Cyanide
Background	1.0 - 5.0	29.9	67.2	BMDL[b]	14.5	22.8	0.66	BMDL	BMDL	15.9	0.10
(Wells 9S/9D, 10S, 11D)	9.7 - 10.0	BMDL	98.8	BMDL	22.1	16.5	BMDL	BMDL	BMDL	19.0	BMDL
	14.4 - 19.5	BMDL	73.2	BMDL	21.0	18.7	BMDL	BMDL	BMDL	18.2	BMDL
	56.5 - 57	BMDL	BMDL	BMDL	29.3	16.4	BMDL	BMDL	BMDL	20.6	BMDL
A:											
Closed Landfill	3.5 - 6.0	16.0	67.5	BMDL	14.9	14.5	BMDL	BMDL	BMDL	14.6	BMDL
(Wells 1S, 2S, 3S, 4D)	9.5 - 17.0	15.5	60.5	3.95	17.1	14.9	BMDL	0.24	BMDL	15.8	BMDL
	21.0 - 24.5	15.6	52.1	BMDL	19.8	13.7	BMDL	BMDL	BMDL	15.1	BMDL
	46.2 - 46.7	BMDL	54.0	BMDL	25.9	19.1	BMDL	BMDL	BMDL	19.7	BMDL
B, C:											
Fill Areas North	0.8 - 3.0	15.6	92.5	BMDL	7.5	20.8	0.75	BMDL	BMDL	9.6	0.12
Closed Landfill	7.5 - 11.5	15.6	47.9	BMDL	14.2	19.4	BMDL	BMDL	BMDL	14.3	0.11
(Borings SB11, SB12, SB13)	28.0 - 29.5	15.6	39.2	BMDL	14.2	15.6	BMDL	BMDL	BMDL	13.5	0.14
D:											
Former Fill Areas In	3.0 - 6.5	37.4	524.8	BMDL	87.2	20.8	BMDL	BMDL	BMDL	18.7	BMDL
Vicinity of Waste Water											
Treatment ponds	13.3	BMDL	72.1	BMDL	19.3	20.4	BMDL	BMDL	BMDL	17.6	BMDL
(Wells 5D, 6S)	56.5 - 57.0	BMDL	36.0	BMDL	25.9	20.8	BMDL	BMDL	BMDL	19.7	BMDL
F:											
Fill Areas West of	0.5 - 1.7	BMDL	40.5	1.1	11.3	17.7	0.86	BMDL	BMDL	10.1	BMDL
Wastewater Treatment Ponds	8.5 - 14.5	15.4	48.9	BMDL	19.2	15.5	BMDL	BMDL	BMDL	15.7	BMDL
(Well 7D, Borings SB14, SB15)	29.5 - 30.0	BMDL	26.0	BMDL	18.5	20.0	BMDL	0.25	BMDL	15.0	BMDL
	57.6 - 58.1	BMDL	BMDL	BMDL	27.6	22.7	BMDL	BMDL	BMDL	20.6	BMDL
G:											
Fill Areas North of	0.5 - 3.3	189.9	1396.0	85.2	156.6	17.2	BMDL	0.51	3.40	35.2	BMDL
Wastewater Treatment Ponds	6.5	BMDL	72.1	BMDL	22.6	18.9	BMDL	BMDL	BMDL	16.7	BMDL
(Well 8S, Borings SB16, SB17)	17.3 - 18.0	21.1	162.0	3.1	11.3	20.1	BMDL	BMDL	BMDL	11.9	BMDL
	29.5 - 30.0	BMDL	63.1	BMDL	20.9	16.3	BMDL	BMDL	BMDL	16.3	BMDL
Detection Limits		15.00	25.00	1.00	5.00	1.00	0.50	0.20	1.50	2.50	0.10

[a]If an analytical result was below the method detection limit (BMDL) the value of the detection limit was used in averaging.
[b]BMDL = below method detection limit.

Ref: RCRA Facility Investigation Report, RMI Sodium Plant Echenfelder Inc, June 1980

(wells 5D and 6S) exhibited high values for lead, barium, and nickel at depths from 3.0 to 6.5 feet below ground surface.

Surficial soil samples were also collected from the five areas on the plant site (Areas A, B, C, F, and G) and analyzed them for the nine metal parameters. The analytical results are summarized in Table 9(N-1). A statistical test was applied to the surficial soil data to assess the significance of the differences in means found between samples from background and test areas. Compared to background concentrations, barium, cadmium, lead, nickel, and arsenic in Area B; barium, arsenic, lead, and selenium in Area C; barium, cadmium, lead, nickel, and arsenic in Area F; and barium, cadmium, chromium, nickel, and arsenic in Area G were determined to be present in surficial soils at elevated concentrations. In addition to analysis of the eight metals, a priority pollutant scan was conducted on a sample collected from Area G. There were no detectable amounts of volatile organic compounds, acid extractable compounds, base neutral compounds, pesticides, PCBs, phenols, or cyanide. Other metals were detected, including zinc (123 ppm), beryllium (1.5 ppm) and copper (30.3 ppm).

The subsurface soils generally have higher concentrations of these consituents than the surficial soils in the vicinity of the five active ponds and adjacent fill areas (Areas D, F, and G). In the fill areas northeast and northwest of the landfill (Areas B and C), the opposite is true. The surficial soils exhibit much higher concentrations of these metals than the subsurface soils. Therefore, it is apparent that the SWMUs (Solid Waste Management Unit) in the vicinity of the ponds (Areas D, F, and G) were used as fill areas and have since been graded over with non-fill materials; and the SWMUs in the vicinity of the closed landfill (Areas B and C) were used as temporary surficial storage zones for material that was later placed in the landfill. In addition to the analysis of the eight metals, priority pollutant scan was conducted on samples 8S (6.5 ft), 1S (15.1 ft), and 2S (6.0 ft). Volatile organic, base neutral, and acid extractable compounds were only detected in samples obtained from wells 1S and 2S (Southern property border in DNAPL area discussed previously). Copper and zinc were the only additional metals detected in soil samples from 8S (24.5 and 70.0 ppm respectively), 1S (20.5 and 59.9 ppm respectively), and 2S (22.2 and 60.5 ppm respectively).

Surface soil samples collected by Woodward-Clyde in source areas RMIS10, RMIS6, RMIS5, RMIS3, and RMIS9 (See Plate 2C(N-1)) contained arsenic, beryllium, cadmium, copper, lead, mercury, nickel, and zinc. Most analytes were detected at concentrations of less than 50 mg/kg, except for lead (230 mg/kg), nickel (244 mg/kg), and zinc (498 mg/kg) at RMSSS10.

Subsurface soils collected by Woodward-Clyde in source area RMIS7 (south west corner of property) detected arsenic, chromium, beryllium, copper, lead, nickel, and zinc. Most analytes were at concentrations of less than 50 mg/kg, except for zinc (97.2 and 62.9 mg/kg) at depths of 7.0 and 18.0 feet below ground surface.

Table 9 (N-1)
Surficial Soils Metals Data[a]

Surficial Soil Sample	Ba	Cd	Pb	Cr	Ni	Ag	Hg	As	Se
Landfill Cap (Area A)									
SS1-1	53.7	BMDL[b]	BMDL	13.5	28.3	BMDL	BMDL	16.4	BMDL
SS1-2	78.5	BMDL	BMDL	15.2	23.0	BMDL	BMDL	15.2	BMDL
SS1-3	90.9	BMDL	15.3	15.2	21.2	BMDL	BMDL	12.6	BMDL
SS1-4	78.5	BMDL	BMDL	15.2	17.7	BMDL	BMDL	14.1	BMDL
Average[c]	75.4	BMDL	15.1	14.8	22.6	BMDL	BMDL	14.6	BMDL
North of Landfill (Area C)									
SS2-1	1240	26.4	83.4	22.9	255	BMDL	BMDL	23.4	0.69
SS2-2	382	2.59	15.3	12.7	24.8	BMDL	BMDL	21.6	0.54
SS2-3	155	1.24	209	34.7	743	BMDL	0.72	18.9	0.75
SS2-4	603	BMDL	BMDL	9.3	17.7	BMDL	BMDL	23.0	0.75
Average[c]	595	7.81	80.7	19.9	260	BMDL	0.33	21.7	0.68
Northeast of Landfill (Area B)									
SS3-1	1230	46.5	141	18.6	177	BMDL	BMDL	13.6	BMDL
SS3-2	2590	18.2	99.2	27.1	442	BMDL	1.29	23.6	0.72
SS3-3	1880	731	1140	25.4	558	BMDL	BMDL	12.8	BMDL
SS3-4	593	1.35	41.5	12.7	28.3	BMDL	BMDL	23.5	0.70
Average[c]	1573	199	355	21.0	301	BMDL	0.47	18.4	0.60
West of Ponds (Area F)									
SS4-1	474	3.41	62.5	13.5	40.7	BMDL	0.27	13.1	BMDL
SS4-2	353	3.82	93.9	16.9	47.8	BMDL	0.33	23.0	BMDL
SS4-3	211	2.59	152	33.0	117	BMDL	BMDL	18.0	BMDL
SS4-4	233	2.59	41.5	18.6	37.2	BMDL	BMDL	16.4	BMDL
Average[c]	317.8	3.10	87.5	20.5	60.7	BMDL	0.25	17.6	BMDL
North of Ponds (Area G)									
SS5-1	132	15.9	33.7	18.6	32.8	BMDL	BMDL	22.4	0.94
SS5-2	101	8.33	31.1	19.5	28.3	BMDL	BMDL	10.0	0.64
SS5-3	105	5.05	25.8	16.9	33.6	BMDL	BMDL	18.3	BMDL
SS5-4	140	3.00	25.8	19.5	24.8	BMDL	0.51	23.5	0.84
Average[c]	119.5	8.07	29.1	18.6	29.9	BMDL	0.28	18.5	0.73
Background									
SSB-1	124	BMDL	20.6	16.9	26.5	BMDL	BMDL	16.1	BMDL
SSB-2	86.8	BMDL	20.6	15.2	23.0	BMDL	BMDL	14.7	BMDL
SSB-3	120	5.46	31.1	17.8	31.8	BMDL	BMDL	17.0	0.51
SSB-4	178	BMDL	25.8	16.9	53.1	BMDL	0.23	11.5	0.62
SSB-5	60.1	BMDL	60.5	14.6	11.5	BMDL	BMDL	15.9	BMDL
SSB-6	127	41.6	16.6	14.6	63.0	BMDL	BMDL	10.8	BMDL
SSB-7	51.1	BMDL	BMDL	11.1	7.0	BMDL	BMDL	8.3	BMDL
SSB-8	42.2	BMDL	BMDL	11.1	11.5	BMDL	BMDL	13.1	BMDL
SSB-9	42.2	BMDL	16.6	9.0	BMDL	BMDL	BMDL	10.9	BMDL
SSB-10	37.7	BMDL	36.1	9.7	BMDL	BMDL	BMDL	BMDL	BMDL
SSB-11	195	BMDL	BMDL	12.5	12.5	BMDL	BMDL	8.8	BMDL
SSB-12	105	BMDL	26.4	18.1	63.0	BMDL	BMDL	12.0	BMDL
Average[c]	97.4	4.75	24.9	14.0	26.1	BMDL	0.20	12.0	0.51
Detection Limit	25.0	1.0	15.0	2.5	5.0	1.5	0.2	5.0	0.5

[a]Concentrations expressed in ppm.
[b]BMDL = below method detection limit.
[c]If an analytical result was below the method of detection limit (BMDL), the value of the detection limit was used in averaging.

Ref: RCRA Facility Investigation Report, RMI Sodium Plant Echenfelder Inc, June 1980

Deep Soil and Surficial Sediment Cleanup Standards (Inorganic Metals)

The same cleanup standard (Ohio EPA Generic Direct Contact soil cleanup standards for Residential, Commercial, and Industrial Land-Use Categories) was used to compare the analytical test data (Tables 8 and 9) to the standards (Table 7) for the eight metals tested. Results of this comparison for the deep soil sediments show that even in the area where anomalous high concentrations occur (Area G), the highest concentrations for barium (1,396 mg/kg) lead (189.9 mg/kg), and cadmium (85.2 mg/kg) were well below the cleanup standard of 140,000 mg/kg, 2,800 mg/kg, and 300 mg/kg respectively. Comparison of the analytical results for the surficial soils to the cleanup standards show that all of the concentrations for the eight metals for all areas are well below the cleanup standards.

Surficial and Deep Soil Contaminants (Organic Compounds)

Woodward-Clyde collected two surface soil samples in source areas RMIS7 and RMIS4 (See plate 2C(N-1)). Both samples contained benzene, acenaphtene, napthalene, benzo(a)antracene, benzo(a)pyrene, chrysene, fluranthene, and pyrene. All compounds were detected at concentrations less than 300 µg/l except benzo(b)fluoranthene (640 µg/l) and PCB's at 56 µg/l.

Subsurface soil samples collected by Woodward-Clyde in the southwestern portion of the property contained organic compounds. Most of the compounds were detected at concentrations less than 200 µg/kg, with the exception of tricloroethene and bis(2-ethylhexyl)phthalate. At sample location RMSSB05, tricholoroethene was detected at 100 µg/kg in the shallow sample and at 1,200 µg/kg in the deep sample. Subsurface samples were also collected at locations DETSB19 and DETSB20 in the southern portion of the property were several compounds were detected at concentrations greater than 10,000 µg/kg.

Potential for Contaminant Migration and Exposure

Groundwater

Site investigations indicate that there are two water bearing zones at the RMI Site: (1.) A shallow water bearing zone that exists in the fill and weathered glacial till and, (2.) a deep water bearing zone that exists within the shale bedrock. ECKENFELDER Inc. found that these water bearing zones are characterized by low groundwater yields (estimated to be approximately .08 gpm in the shallow water bearing zone). Because of the low ground water yields and abundant surface water supplies, there are few domestic wells and no municipal wells in the area. For the estimated groundwater yield at the RMI site, the groundwater at the RMI site is classified to be an EPA Type III, which is defined as not a source of drinking water due to insufficient yield. The two major contaminants detected in above background concentrations in the shallow groundwater at the RMI site are barium and cadmium. However, analytical data shows that the maximum concentrations of barium falls below and the maximum concentration of cadmium was slightly above the Ohio EPA potable water the standard. Although there is the potential for the shallow groundwater to migrate off the site, this migration is believed to limited north and possibly south of the site and is expected to move slowly due to the low permeability of the glacial till. Thus, it is concluded that the shallow groundwater at the RMI site is not a potential human receptor.

In the deep groundwater barium was the only inorganic constituent consistently detected above background and occurred in concentrations significantly higher than the shallow groundwater concentrations. However, these concentrations are to be naturally occurring or from an off-site source.

The only area of concern is at the southern end of the RMI site where DNAPL was detected in the shallow groundwater. It is believed that the source of this DNAPL is from an off site manufacturing facility to the south of the RMI site. Analytical test data conducted on shallow groundwater samples collected at the southern border of the RMI site (ECKENFELDER Inc.,1989) showed concentrations of volatile organics well above the Ohio EPA potable drinking water standards. Since this DNAPL is confined in a sandy till zone which may extend into the RMI site, it is possible that with time this DNAPL may migrate north into the RMI site.

Surface and Subsurface Soils

The only potential migration pathways of site constituents in soils to other media include: leaching to shallow groundwater or site drainage ditches; erosion of soils to air/and or site drainage ditches. Leaching of soils to on site drainage ditches or groundwater was not expected to occur, based on evidence of attenuation of site constituents with depth (ECKENFELDER Inc.,1994). This was substantiated by the actual leaching tests (EP Toxicity) being performed on borings with the highest concentrations of berium (Ba), cadmium (Cd) and lead (Pb) which showed that these constituents were not leached. Because leaching of subsurface soils to shallow groundwater was shown to be not likely to occur, it is assumed that the elevated levels of barium and cadmium in the groundwater may be due to leakage from wastewater treatment ponds in Areas D and G. Erosion of surficial soils and possible migration offsite through surface water was considered to a potential pathway of concern. On a per area basis, Area B was shown to be present the greatest potential concern for erosion losses. However, in comparing the estimated erosion losses to the Agency generated criteria, which were established to be protective of human health, none of the losses present a potential concern. As discussed in the previous section it was concluded that groundwater at the RMI site was not a human receptor. Therefore it can also be concluded that the leaching of constituents to the subsurface soils can also be considered not to be a receptor to humans and the off site environment.

Erosion of surficial soils into the air was not considered to be a significant release pathway as these effects would be localized. Erosion of surficial soils to through surface water ditches, however is considered a potential pathway of concern. However, ECKENFELDER Inc.(1994) compared the highest estimated erosion losses of the eight metals of concern to the USEPA criteria which are established to be protective of human health. This comparison showed that none of the estimated erosion losses exceeds the EPA criteria and thus does not present any concerns.

Comparison of analytical data for eight metal constituents tested for the subsurface soils to the Ohio EPA Generic Direct Cleanup Standards showed that even in the areas of the highest concentrations (Area G), the elements with the highest concentrations (barium, lead, and cadmium) do not exceed the cleanup standards. Comparison of the analytical results for the surficial soils to the cleanup standards also show concentrations for the eight metals tested to be below the cleanup standards.

In the Woodward-Clyde Phase I Source Control Report (Ref No.5), the only areas were inorganic concentrations exceed the EPA Cleanup Goal (CUG) was in the East and West Brine Ponds located in the south western portion of the property and in a drainage area located in the central portion of the facility (See Fig. 6(N-1)). In both areas arsenic was found to exceed the CUG. Volatile organic compounds and arsenic were found to exceed the CUG in the southern portion of the property.

Surface Water

Although there are several on site release mechanisms which may explain the presence of constituents in the site surface water, there is only one potentially significant source of release of constituents from the surface water: the migration of constituents in water via the DS tributary from the southwest corner of the RMI property (near DW-G). Potential receptors of the site constituents from the migration pathway were determined to be limited populations of extremely tolerant aquatic plant and animal species present downstream in Fields Brook. No human receptors were identified.

In comparing the concentrations of constituents thought to be representative offsite (concentrations at DW-G), it was shown that none of the water concentrations measured in DW-G exceeds the State of Ohio Potable Water Standard (See Tables 6(N-1) and Table 2(N-1)).

CONCLUSIONS

A HTRW site evaluation was made for the proposed TSCA (Toxic Substances Control Act) and non-TSCA landfill based upon review of existing site investigation and analytical chemical data performed (metals, volatile organic compounds) expected to be found at the proposed site. Based upon this review is concluded that there are no significant environmental HTRW concerns at this site with the exception of at the south end of the RMI property where DNAPL was found in the shallow groundwater. Analytical tests show concentrations of volatile organic compounds found in the DNAPL for exceed the State of Ohio Potable Water Standards and the Generic Cleanup Goals. Since the DNAPL is confined in a till sand layer which may extend into the RMI site, it is expected that with time this DNAPL may move north into the RMI site. To further define the extent of this DNAPL plume it is recommended that additional wells and testing be performed near the southern end of the RMI property.

Contaminants found in elevated concentrations in the shallow groundwater on the RMI site include barium and cadmium which are located in areas north and east of the treatment ponds (Area D and Area G). However, analytical test data showed that the concentrations of these constituents are below or slightly above the State of Ohio Potable Water Standards and thus do not pose a significant environmental concern.

Elevated concentrations in the subsurface and surface soils (lead, barium, and cadmium) were also below the Ohio Generic Cleanup Goals and also do not pose a significant environmental concern. The USEPA established cleanup action levels for constituents of concern based upon human health risks and exposure. Action levels for cadmium (Cd), lead (Pb) and arsenic (As) were established for areas B, C, D, and G and are summarized in Table 10(N-1). The Final Corrective Measures Study by Brown and Caldwell (Formerly Eckenfelder, Inc.), recommended that Alternative No.4F as the most technical feasible, environmentally acceptable, minimize human exposure, and cost effective alternative to remediate the RMI site. This alternative consists of excavation of areas B, C, and G; and placement of the excavated material into a engineered landfill on site. The removal of contaminated soils from areas B, C, and G will decrease constituent concentrations in the shallow groundwater, thereby reducing the potential for future exposure to groundwater contamination by on site or off site receptors. At the present time the engineered landfill has been constructed and site remediation has been started.

Although none of the remaining on site constituents are in levels to pose a significant environmental and health concern, appropriate handling and personal protective clothing should be worn by personnel involved in construction activities for the landfill. Also construction activities should be performed to minimize the spread of contamination through the air and into the surface water ditches (i.e. silt fences).

Table 10 (N-1)
Site Area Dimensional and Constituent Data
RMI Sodium Facility -- Ashtabula, Ohio

Area Designation	Medium	Constituent(s) of Interest	Measured Level[a]	USEPA Action Level[a]	Area (sq ft)	Area (Ac)	Approximate Vertical Extent of Constituent Presence (ft)	Depth of Excavation/ Treatment (ft)	Estimated Volume (CF)	Estimated Volume (CY)
B&C	Area B Surficial Soils	Cd	199	40	73300	1.68	0 - 0.33	0.5	36650	1357[b]
		Pb	355	29.9						
		As	18.4	12						
	Area B Drainage Ditch Surface Water	Cd	37.9 ppb (DW-B)	9.5 ppb						
	Area C Surficial Soils	Pb	80.7	24.9						
		As	21.7	12						
D	Shallow Soils	Pb	37.4	29.9	8130	0.19	3 - 6.5	6.5	52845	1957
F_1					5730	0.13	0 - 0.5	0.5	2865	106
F_2					2100	0.05	0 - 0.5	0.5	1050	39
F_3					14170	0.33	0 - 0.5	0.5	7085	262
F_4					17000	0.39	0 - 0.5	0.5	8500	315
F_5					1130	0.03	0 - 0.5	0.5	565	21
F_{total}(1-5)	Surficial Soils	Pb	87.5	25.9	40130	0.93	0 - 0.5	0.5	20065	743
		As	17.6	12						
G	Surficial Soils	As	18.5	12	50000	1.15	0 - 0.5			
		Pb	29.1	24.9						
	Shallow Soils	Cd	85.2	40	50000	1.15	0.5 - 3.3			
		Pb	189.9	29.9						
G_{total}	Shallow Soils				50000	1.15		3.5	175000	6482
Project Totals	(B + C + D + F + G)				171560	3.94			284560	10539
	(B + C + F + G)				163430	3.75			231715	8582
	(B + C + F)				113430	2.60			56715	2100
	(B + C + G)				123300	2.83			211650	7839

[a]Concentrations in ppm unless utherwise noted.
[b]Includes approximately 100 cu yd of sediment from ditch immediately east of area B.

Ref: Final Corrective Measures Study, RMI Sodium Plant, Ashtabula Ohio, Prepared by Eckenfelder Inc., May 1995

REFERENCES

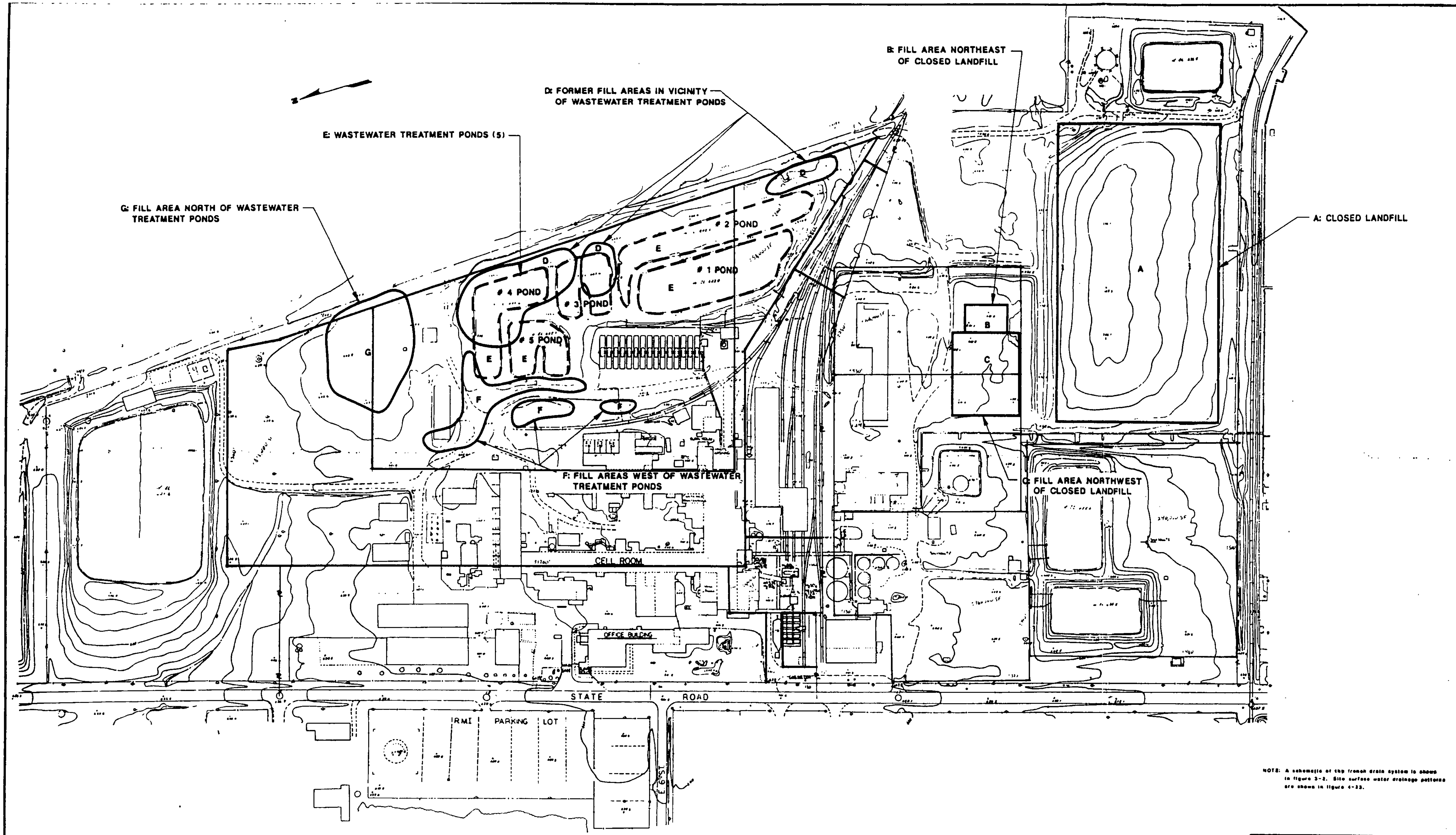
1. Eckenfelder, Inc., "RCRA Facility Investigation Report, RMI Sodium Plant", June 1980.

2. Eckenfelder, Inc., "Supplemental Investigation Report for The RCRA Facility Investigation RMI Sodium Plant Ashtabula, Ohio", April 1991.

3. Eckenfelder, Inc., "Final Corrective Measures Study RMI Sodium Plant Ashtabula, Ohio", Vol. 1 and Vol. 2, September, 1994.

4. Woodward-Clyde, "Consolidation/Landfill Area Siting Report, Fields Brook Superfund Site Ashtabula, Ohio", May 21, 1998.

5. Woodward-Clyde, "Final SCRI Report, Phase I, Rev 3, Source Control Operable Unit, Fields Brook Site, Ashtabula, Ohio", May 30, 1997.



NOTE: A schematic of the trench drain system is shown in figure 3-2. Site surface water drainage patterns are shown in figure 4-33.

NO.	REVISIONS	REV'D BY	DATE	APPR'D BY

AWARE INCORPORATED
NASHVILLE, TENNESSEE
MAHWAH, NEW JERSEY

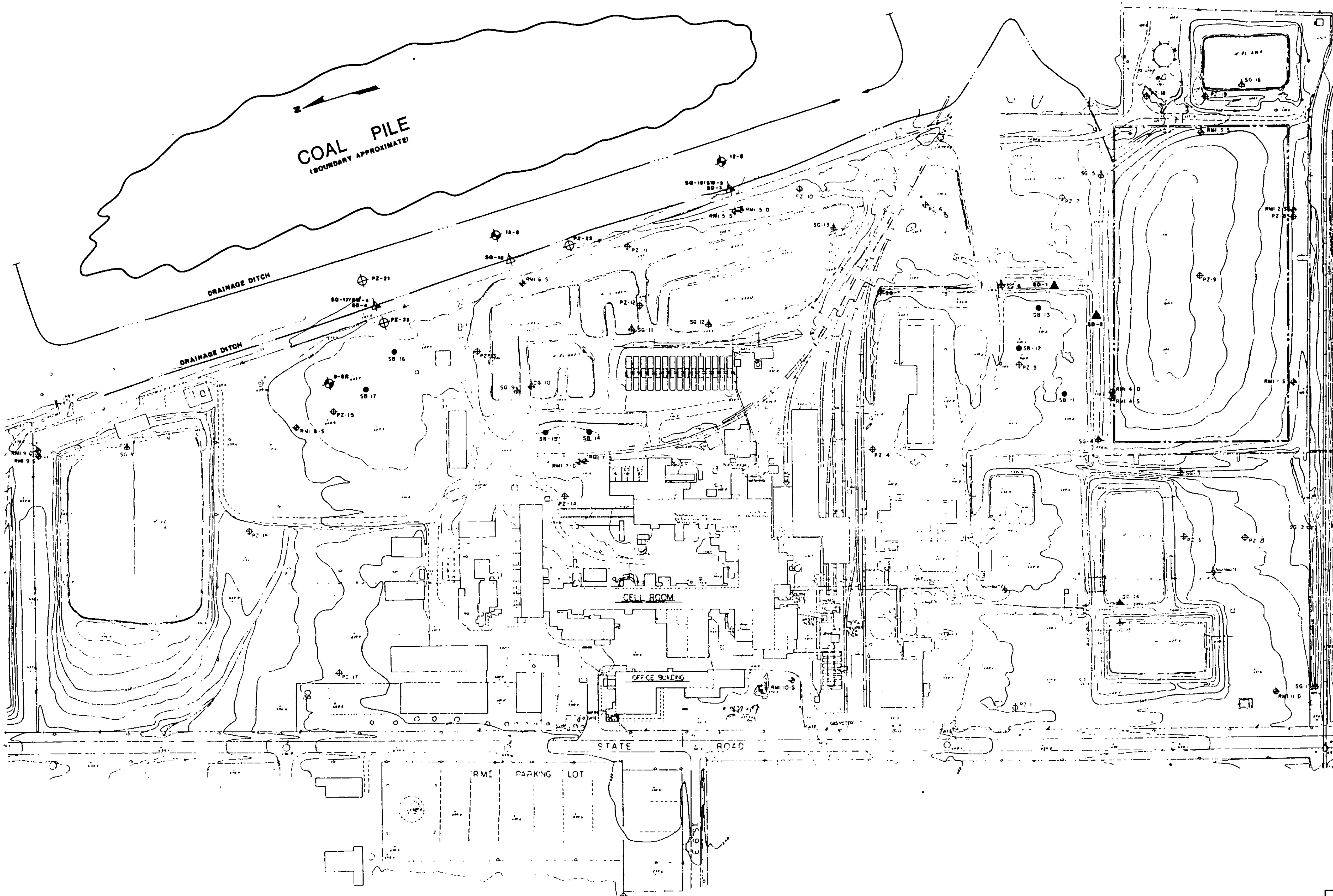
SCALE: 1" = 100'

DRAWN BY | DATE | CHECKED BY | APPROVED BY

RMI SODIUM PLANT
Ashtabula, Ohio

PLATE 1 (N-1)
TOPOGRAPHIC MAP AND LOCATIONS OF SWMU'S INCLUDED IN THE RCRA FACILITY INVESTIGATION

DRAWING NUMBER



LEGEND:

- PIEZOMETER
- STREAM GAUGE
- MONITORING WELL
- SOIL BORING
- SUPPLEMENTAL PIEZOMETER
- SUPPLEMENTAL STREAM GAUGE
- SUPPLEMENTAL MONITORING WELL
- SUPPLEMENTAL STREAM GAUGE, SURFACE WATER AND SEDIMENT SAMPLE LOCATION
- SUPPLEMENTAL SEDIMENT SAMPLE LOCATION

100 0 100 200
scale feet

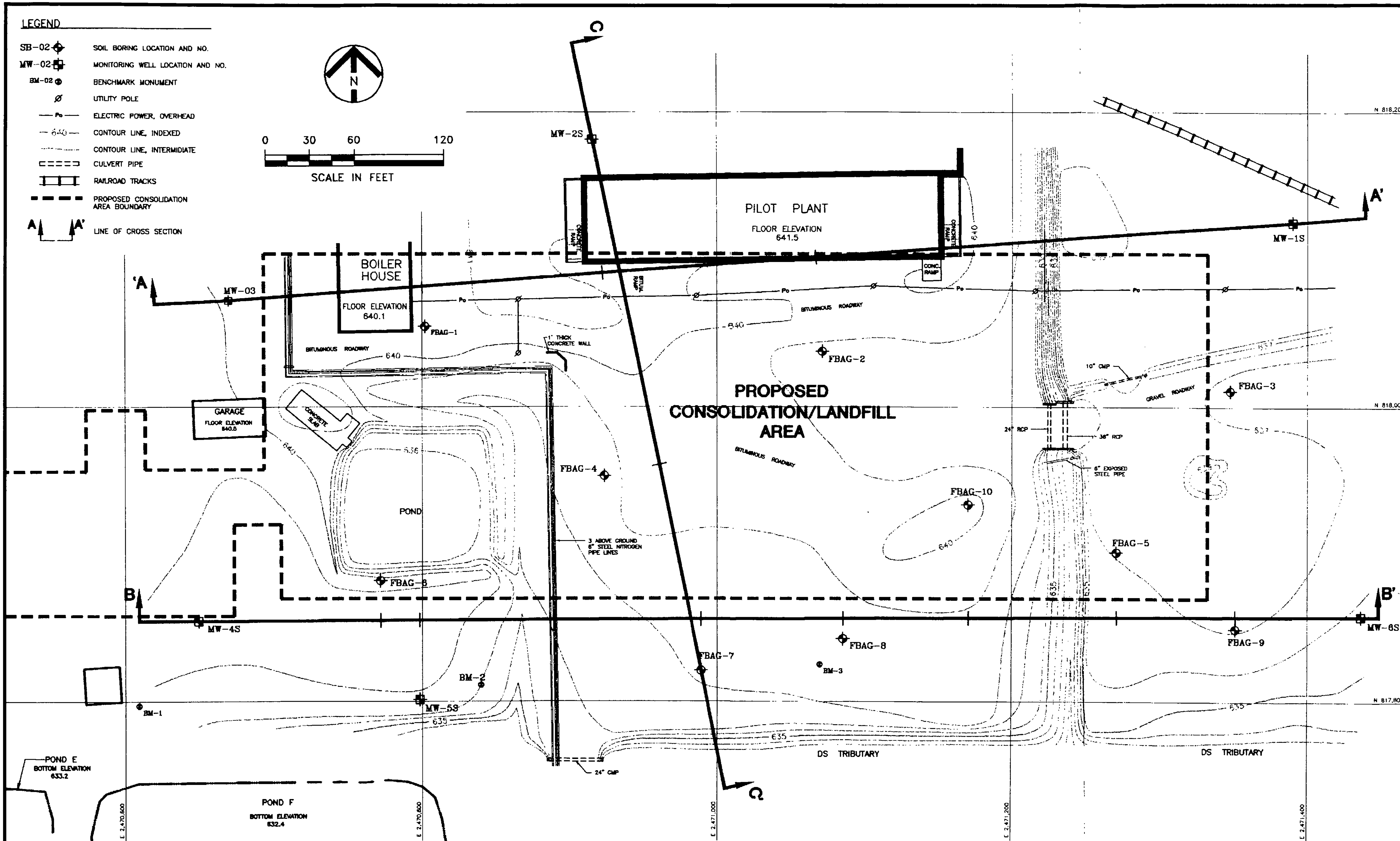
NO.	REVISIONS	REV'D BY	DATE	APPRO'D BY

ECKENFELDER INC.
Nashville, Tennessee
Mahwah, New Jersey

RMI SODIUM PLANT
Ashtabula, Ohio

PLATE 2 (N-1)
SAMPLING LOCATIONS

SCALE: 1" = 100'				
DRAWN BY	DATE 4/85	CHECKED BY	APPROVED BY	DRAWING NUMBER 6128



Source: Woodward-Clyde Consolidation/Landfill Area Siting Report (Draft) May 21,1998

Woodward-Clyde International-Americas
Engineering & sciences applied to the earth & its environment
30775 Bainbridge Road, Suite 200
Solon, Ohio 44139

DESIGNED	
DRAWN	MMS
CHECKED	WEC
PEER REVIEWED	
PROJECT MANAGER	MLS
DATE	05-10-98

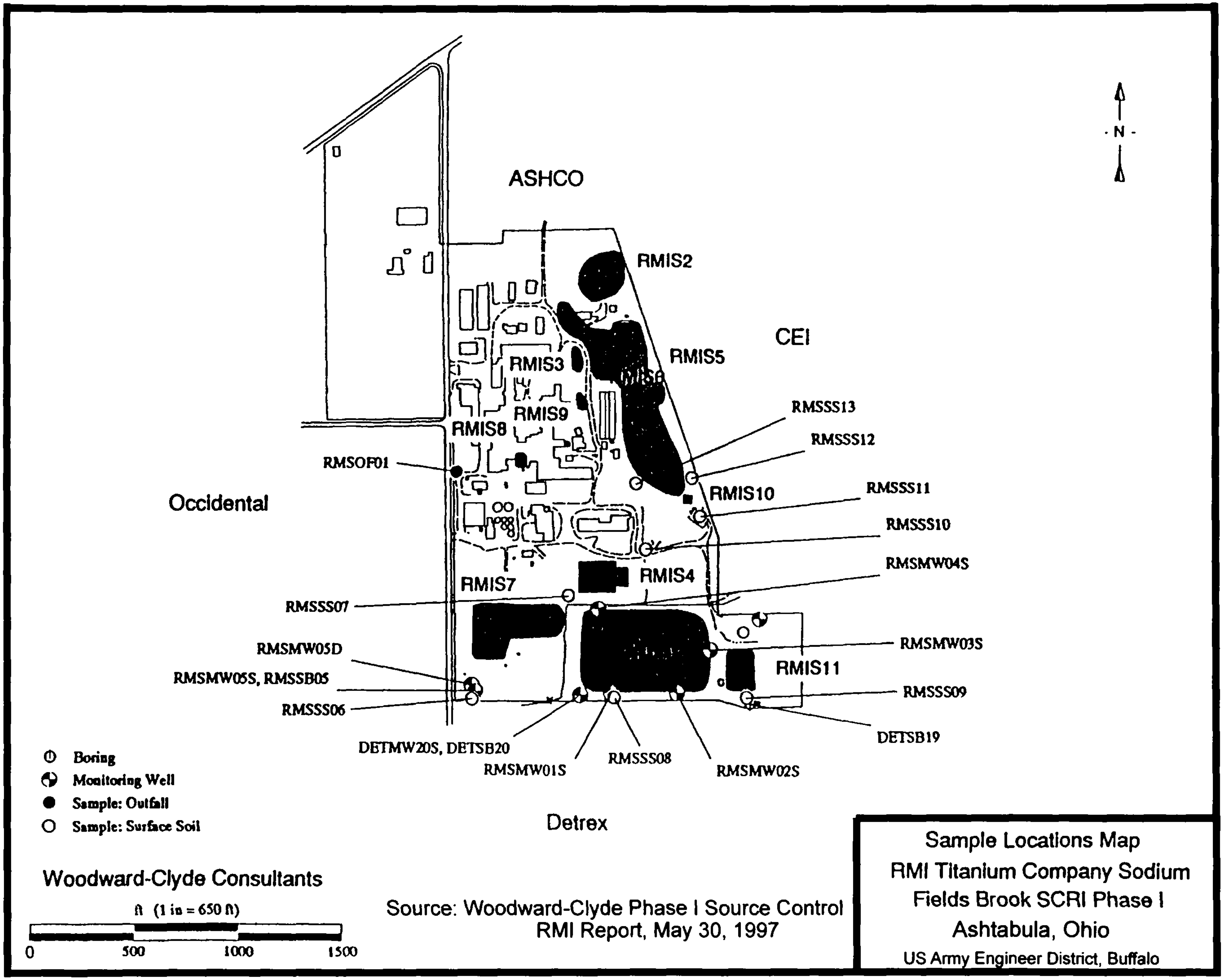
CROSS SECTION LOCATION MAP

FIELDS BROOK ACTION GROUP
RMI SODIUM SITE
ASHTABULA, OHIO

REVISION

PROJECT 86C3609S

Plate 2B (N-1)


ASHCO
RMIS2
CEI
RMIS5
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RMIS8
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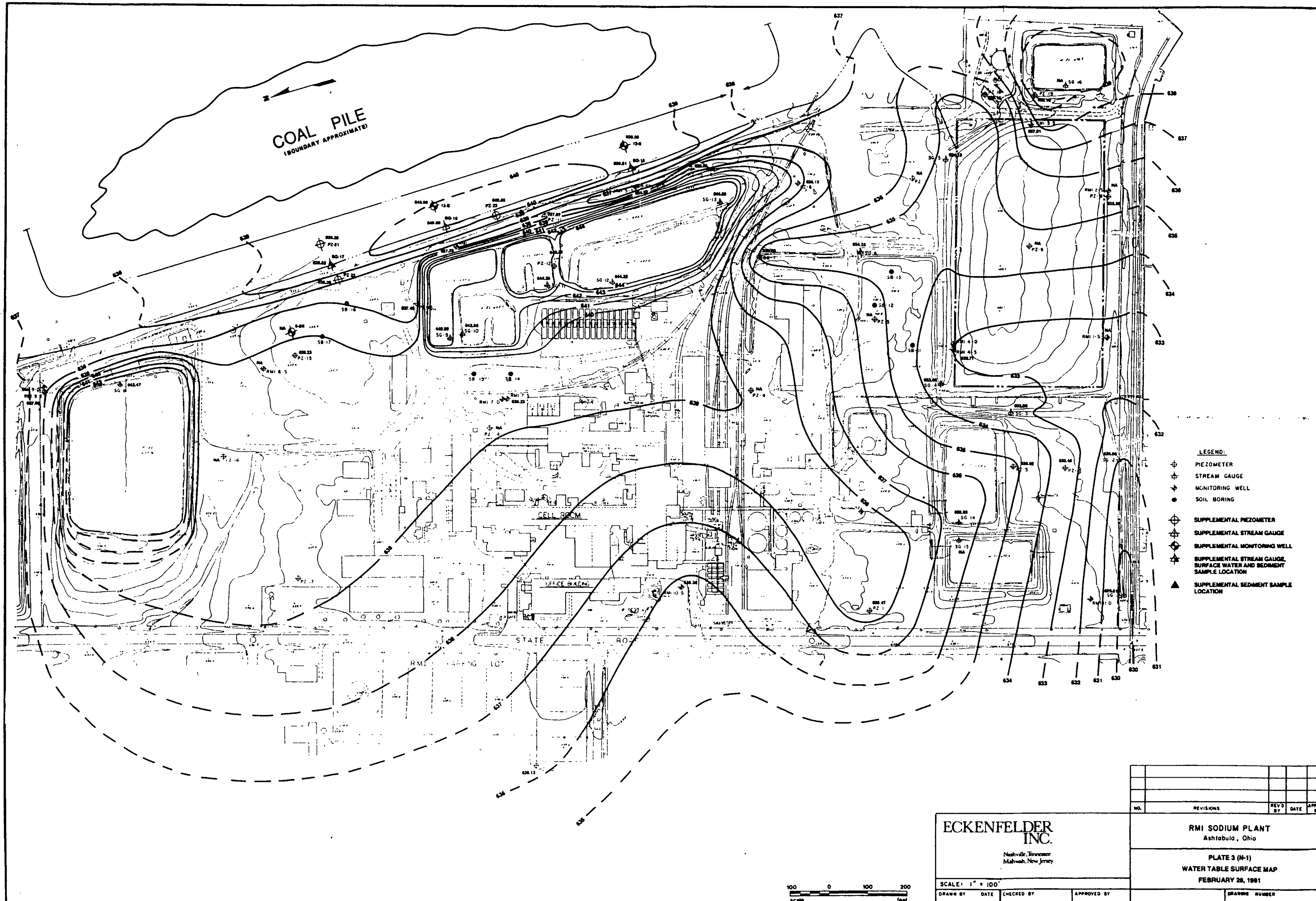
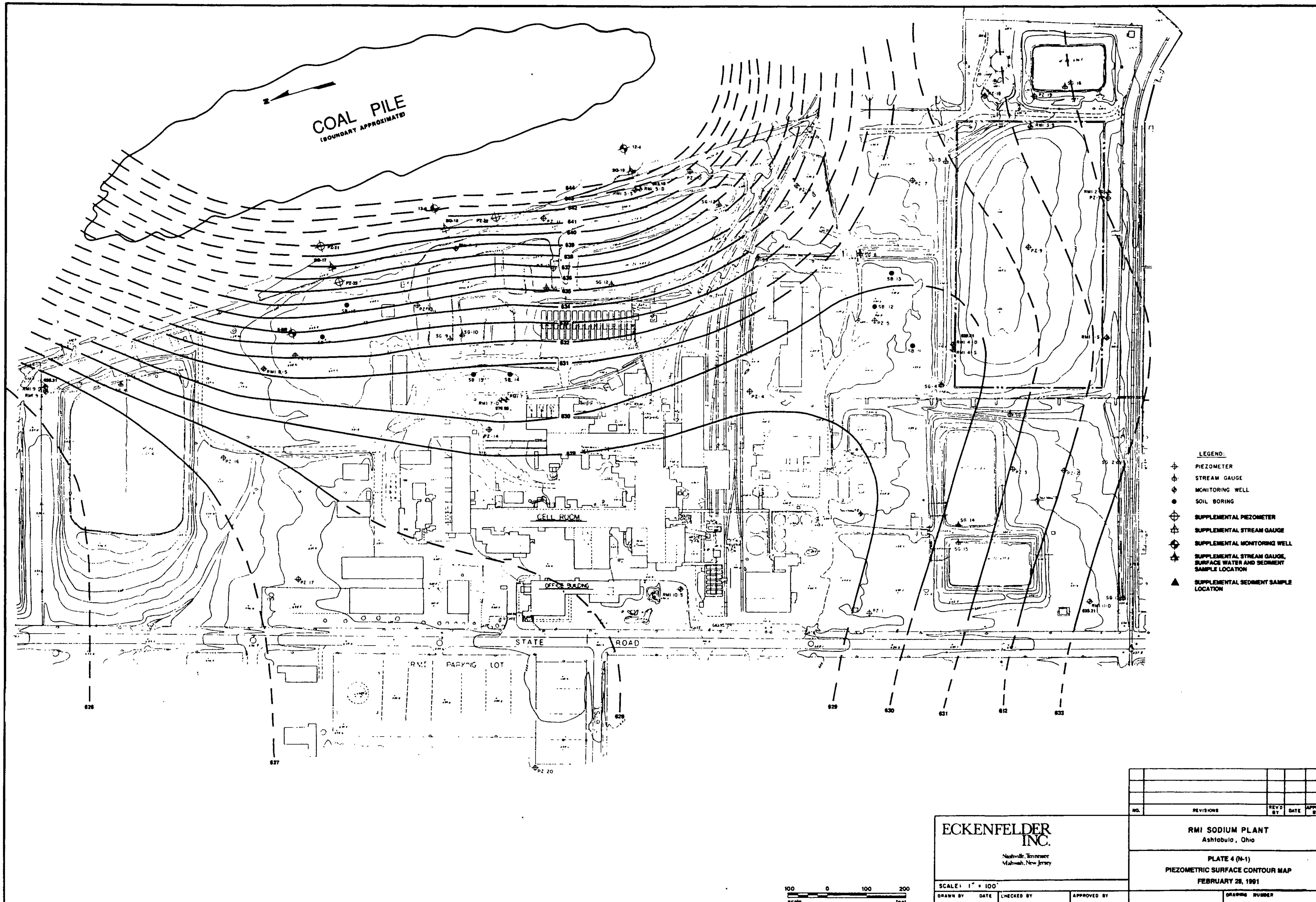
Occidental
RMSSS10
RMSMW04S
RMIS4
RMIS7
RMSSS07
RMSMW05D
RMSMW03S
RMIS11
RMSMW05S, RMSSB05
RMSSS09
RMSSS06
DETSB19
DETMW20S, DETSB20
RMSMW01S
RMSSS08
RMSMW02S
N
Boring
Monitoring Well
Sample: Outfall
Sample: Surface Soil
Detrex
Woodward-Clyde Consultants
ft (1 in = 650 ft)
0
500
1000
1500
Source: Woodward-Clyde Phase I Source Control
RMI Report, May 30, 1997
Sample Locations Map
RMI Titanium Company Sodium
Fields Brook SCRI Phase I
Ashtabula, Ohio
US Army Engineer District, Buffalo

Plate 2C (N-1)



COAL PILE
(BOUNDARY APPROXIMATE)
CELL ROOM
STATE ROAD
RMI PARKING LOT
LEGEND:
PIEZOMETER
STREAM GAUGE
MONITORING WELL
SOIL BORING
SUPPLEMENTAL PIEZOMETER
SUPPLEMENTAL STREAM GAUGE
SUPPLEMENTAL MONITORING WELL
SUPPLEMENTAL STREAM GAUGE, SURFACE WATER AND SEDIMENT SAMPLE LOCATION
SUPPLEMENTAL SEDIMENT SAMPLE LOCATION
100 0 100 200
scale feet
ECKENFELDER INC.
Nashville, Tennessee
Mahwah, New Jersey
SCALE: 1" = 100'
DRAWN BY
DATE 4/91
CHECKED BY
APPROVED BY
NO.
REVISIONS
REV'D BY
DATE
APPROV'D BY
RMI SODIUM PLANT
Ashtabula, Ohio
PLATE 3 (N-1)
WATER TABLE SURFACE MAP
FEBRUARY 25, 1991
DRAWING NUMBER
6120


COAL PILE
(BOUNDARY APPROXIMATED)
CELL ROOM
OFFICE BUILDING
STATE ROAD
RMI PARKING LOT
LEGEND:
PIEZOMETER
STREAM GAUGE
MONITORING WELL
SOIL BORING
SUPPLEMENTAL PIEZOMETER
SUPPLEMENTAL STREAM GAUGE
SUPPLEMENTAL MONITORING WELL
SUPPLEMENTAL STREAM GAUGE, SURFACE WATER AND SEDIMENT SAMPLE LOCATION
SUPPLEMENTAL SEDIMENT SAMPLE LOCATION
100 0 100 200
scale feet
ECKENFELDER INC.
Nashville, Tennessee
Mahwah, New Jersey
SCALE: 1" = 100'
DRAWN BY
DATE 4/91
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APPROVED BY
NO.
REVISIONS
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DATE
APPR'D BY
RMI SODIUM PLANT
Ashtabula, Ohio
PLATE 4 (N-1)
PIEZOMETRIC SURFACE CONTOUR MAP
FEBRUARY 28, 1991
DRAWING NUMBER
6120

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX N

HTRW EVALUATION OF POTENTIAL LANDFILL AND TRANSFER/DEWATERING SITES

SUB-APPENDIX N-2

HTRW EVALUATION OF TRANSFER/DEWATERING FACILITY SITE

PREPARED BY:

Environmental Analysis Section,
Coastal/Geotechnical Section
U.S. Army Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, New York 14207
December 2000

ASHTABULA RIVER PARTNERSHIP
SITE SELECTION FOR AN UPLAND DISPOSAL FACILITY
ASHTABULA, OHIO

SUB APPENDIX N-2
HTRW EVALUATION OF TRANSFER/DEWATERING FACILITY

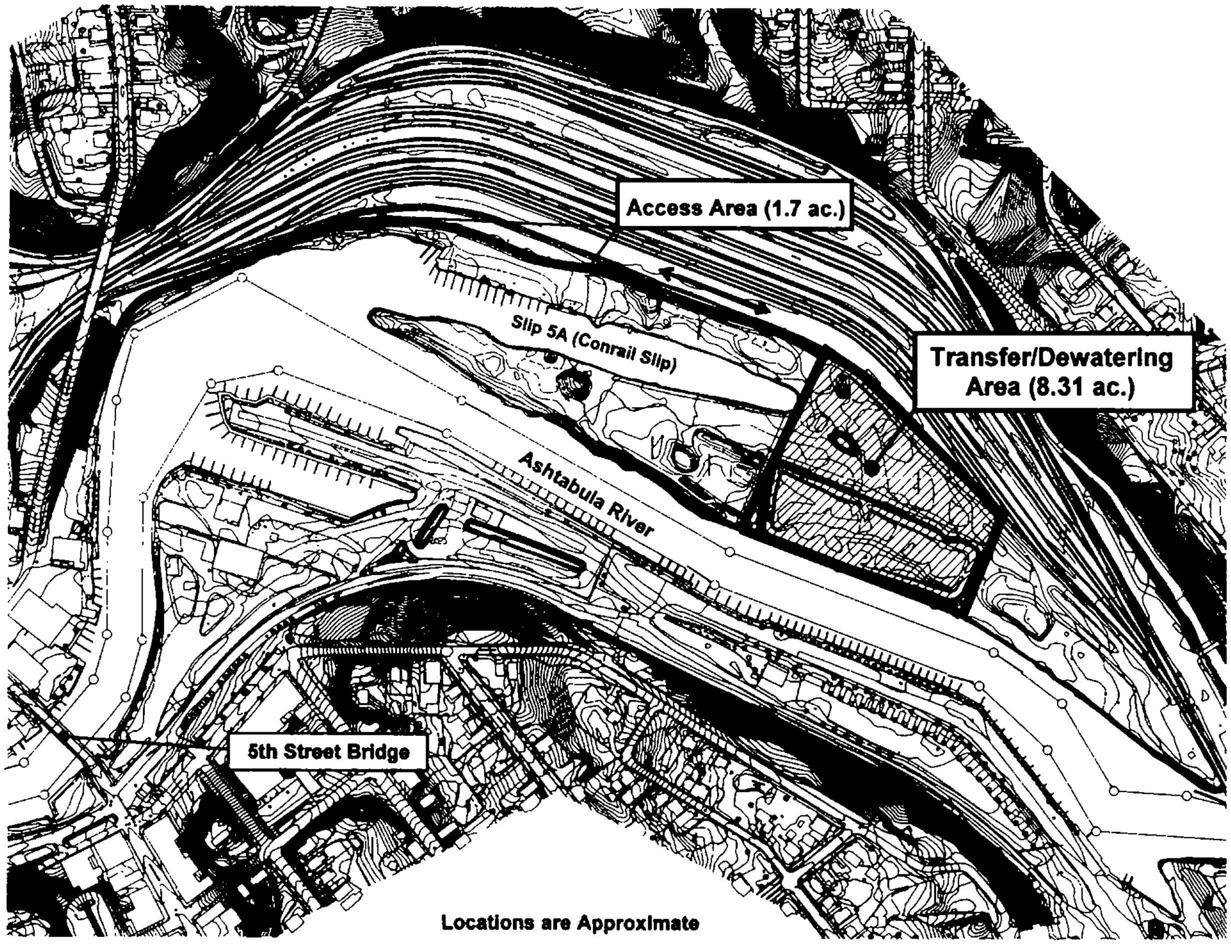
LOCATION OF PROPOSED TRANSFER/DEWATERING FACILITY SITE

The location of the proposed transfer/dewatering facility is on the banks of the Ashtabula River on Conrail Corporation property, 1.25 miles upstream of the mouth of the river, south of the 5th street bridge, City of Ashtabula, Ashtabula County, Ohio (Seee Figures 1(N-2) and 2(N-2)). In the past the site was used for material handling and storage. Dredged material from operation and maintenance dredging of the Harbor in 1993 was deposited at the site. Railroad tracks exists immediately to the east of the site.

SITE HISTORY AND EXISTING SITE INVESTIGATIONS

In the past the site was used for material handling and storage. In 1993 the City of Ashtabula was issued a permit by the U.S. Army Corps of Engineers to construct a temporary dike disposal facility to dewater dredgings from the upper Ashtabula River containing PCB's which will be subsequently transported to an upland disposal facility for final disposal. The surface area of the facility, as defined by the inside toes of the containment dikes, was 2.75 acres. The containment dikes had the following dimensions: height of approximately 10 feet, crest width of 4 feet, side slopes of 1V on 2H. The dikes were constructed of compacted fill having a maximum permeability of 1×10^{-7} cm/sec. The interior of the disposal facility had a 1 ft thick low permeability clay liner which had a maximum permeability of 1×10^{-7} cm/sec. The permit required that the toe of the containment dikes were to be maintained at a distance of 15 feet landward of the River bank . However, a site visit by Army Corps personnel revealed that the toe of the dikes were contructed at the river bank in violation of the permit.

In July 1993 prior to construction of the diked dredge disposal facility four drive sample borings were drilled by the Marine Dredging Contractor in the interior of the disposal facility. The purpose of the explorations were to determine if a clay liner was needed on the interior floor of the facility. The borings were drilled to depths of 2 to 3 feet below the ground surface. Boring logs (Copies included in Attachment No.1(N-2)) show that the surficial material (upper 1 to 3 feet) is described as fill consisting of clayey silt, with sand, gravel, shale, slag, cinders, iron ore pellets, organics, and brick. In two borings pervious material consisting of cinders, slag, or sand underlay the the thin surficial material. Based upon the composition of disposal area floor, the Marine Contractor was required to place a low permeability clay liner.



Map Not To Scale

: Transfer/Dewatering Area
: Access Area
: Federal Authorized Channel

EXHIBIT A

SITE ONE

Transfer/Dewatering

Figure 2 (N-2)

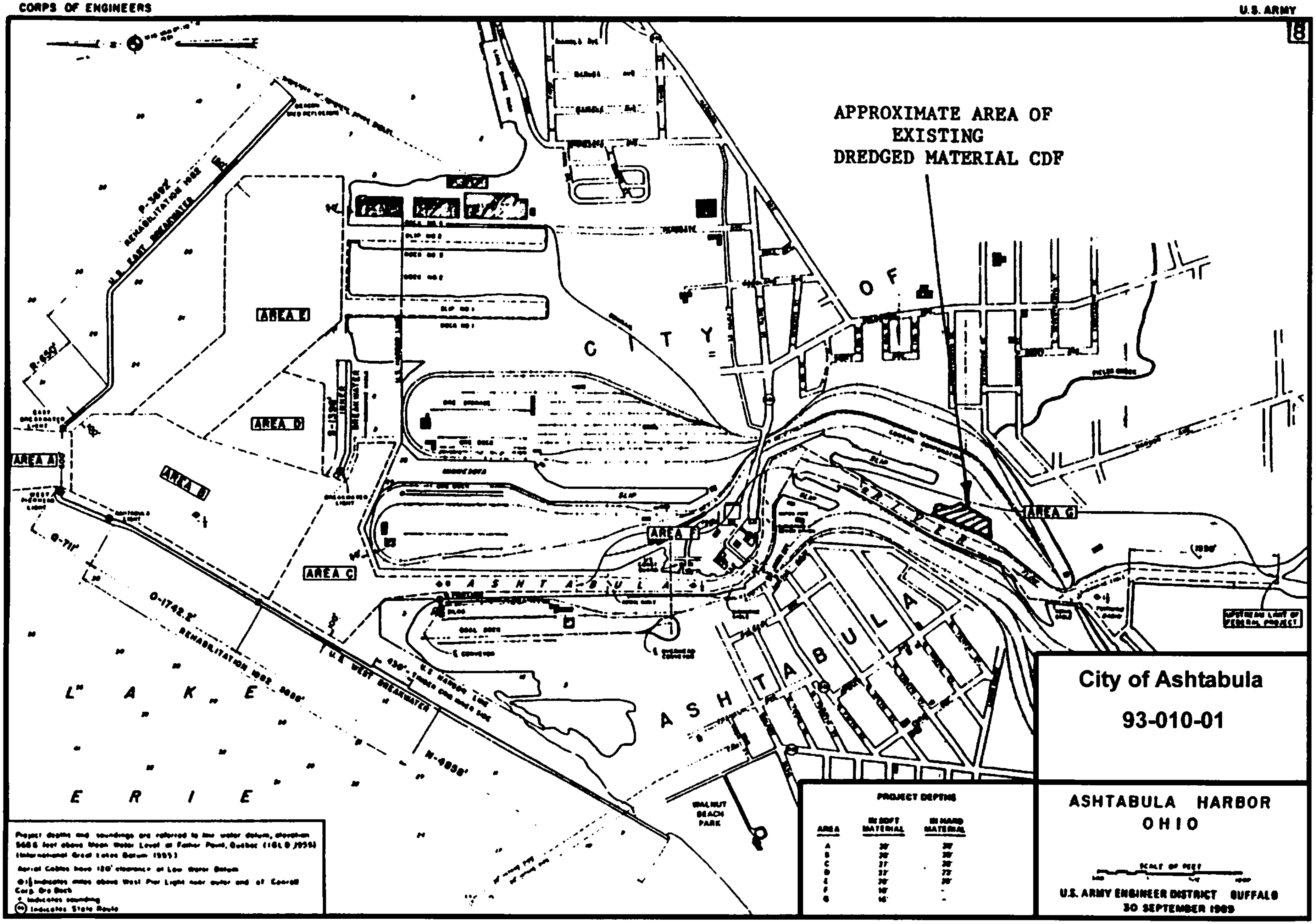

CORPS OF ENGINEERS
U.S. ARMY
APPROXIMATE AREA OF
EXISTING
DREDGED MATERIAL CDF
AREA A
AREA B
AREA C
AREA D
AREA E
AREA F
AREA G
CITY OF
ASHTABULA
LAKE ERIE
City of Ashtabula
93-010-01
ASHTABULA HARBOR
OHIO
PROJECT DEPTHS
U.S. ARMY ENGINEER DISTRICT BUFFALO

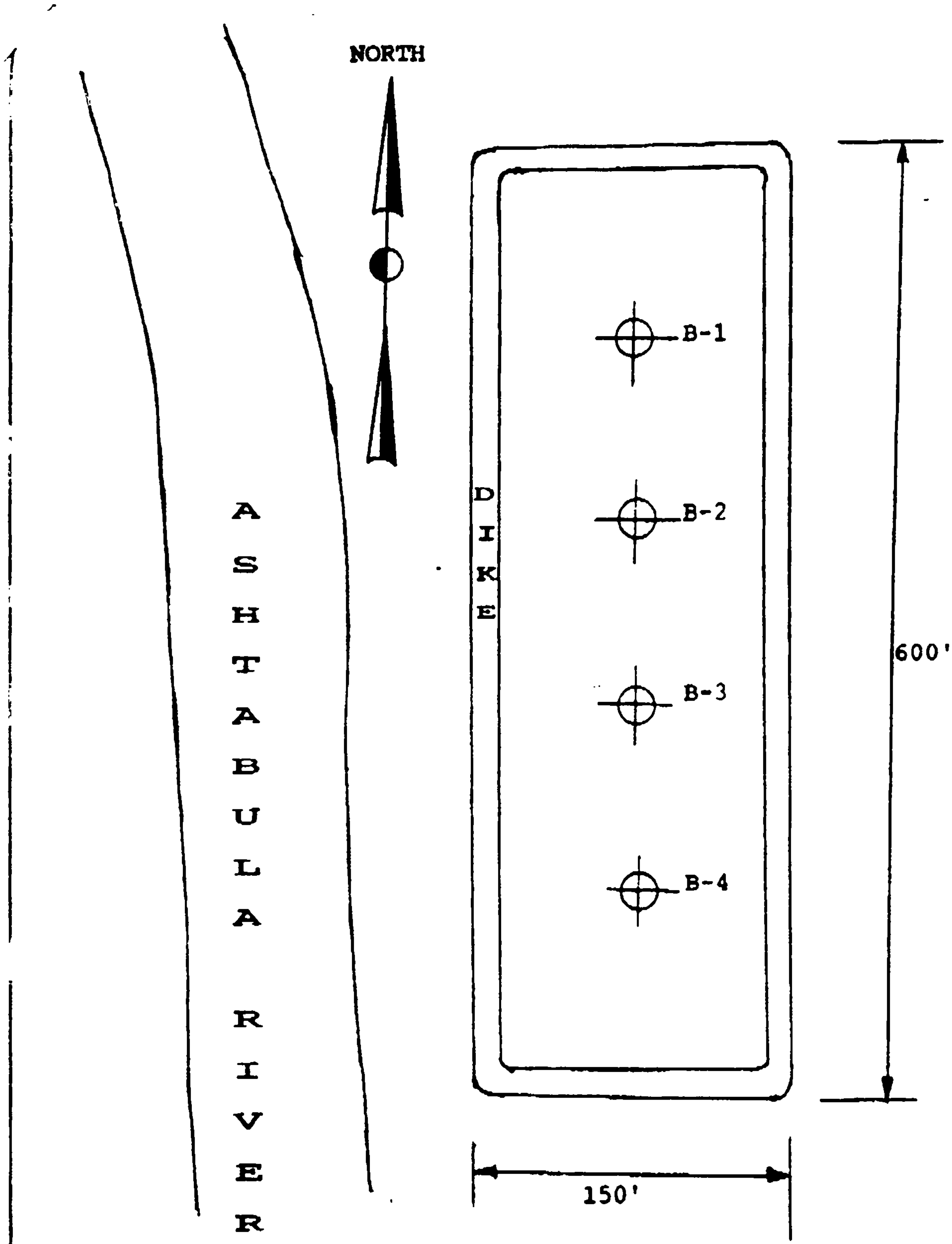
Figure 1 (N-2)

HTRW EVALUATION OF SITE

There are no known HTRW site investigations performed at this site other than the previously mentioned subsurface exploration program performed in 1993 for the design of the temporary dredge disposal facility. Prior to detailed design of the dewatering facility a HTRW and subsurface exploration program should be performed in order to determine the baseline HTRW site conditions.

ASHTABULA RIVER PARTNERSHIP
SITE SELECTION FOR AN UPLAND DISPOSAL FACILITY
ASHTABULA, OHIO
SUB APPENDIX N-2

ATTACHMENT No.1
SUBSURFACE EXPLORATION PLAN AND FIELD LOGS
DIKE DISPOSAL FACILITY (MARINE CONTRACTING CORP)



NOTE. NOT TO SCALE

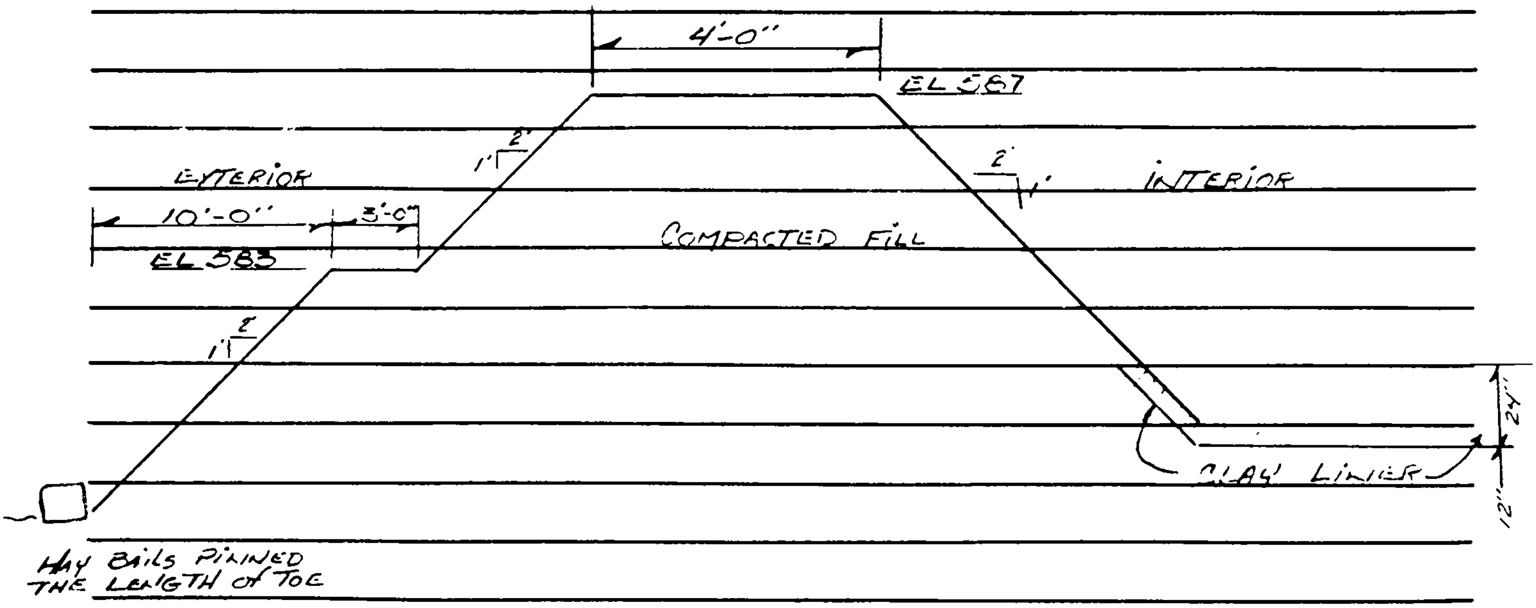
BORING LOCATION PLAN
Maintenance Building
at Ashtabula River
Ashtabula, Ohio
STL Project #A93520x10
July 13, 1993

M.C.C.

MARINE CONTRACTING CORPORATION
P.O. BOX 389, LORAIN, OH 44052 (216) 246-3903

DAILY QUALITY CONTROL REPORT

ASHTABULA CONFINEMENT DIKE 22 JUNE 93



SIGNATURE

PROJECT: Maintenance Dredging	BORING NO: B-1	DATE: 07-01-1993
LOCATION: At Ashtabula River, Ashtabula, Ohio.	SUR. ELEV:	DEPTH: 2 ft.
CLIENT: Marine Contracting Corporation	DRILLING METHOD: REMARK: Continuous Sampling	

SAMPLE TYPE & DEPTH (ft)	WATER ON ENCOUNTER : WATER ON COMPLETION: 1.5 ft. WATER AFTER HRS: SOIL DESCRIPTION	STANDARD PEN. (blows/6")	WC (%)	Qu (tsf)	DRY DENS. (pcf)	PERMEABILITY (cm/sec)
SS 0–1	Gray-brown CLAYEY SILT, little sand, trace gravel, organics, shale fragments, slag, cinder (Fill)					
SS 1	Black CINDER. (Fill)	3- 7-13-13	28.3			
SS	Red and gray SLAG, trace organics. (Fill)					
2	End of test hole at 2 ft.					

E NO: A93520X10
LER: Joe Poucher

SOLAR TESTING LABORATORIES, INC.

PROJECT: Maintenance Dredging	BORING NO: B-2	DATE: 07-01-1993
LOCATION: At Ashtabula River, Ashtabula, Ohio.	SUR. ELEV:	DEPTH: 2 ft.
CLIENT: Marine Contracting Corporation	DRILLING METHOD: REMARK: Continuous Sampling	

SAMPLE TYPE & DEPTH (ft)	WATER ON ENCOUNTER : WATER ON COMPLETION: 1.5 ft. WATER AFTER HRS: SOIL DESCRIPTION	STANDARD PEN. (blows/6")	WC (%)	Qu (tsf)	DRY DENS. (pcf)	PERMEA-BILITY (cm/sec)
SS ST* 1	Brown and gray SILT and CLAY, some iron ore pellets, little sand, trace gravel, organics. (Fill)	SHELBY TUBE 2- 1- 3- 5	16.0 19.5 23.4		124.0	$9.86X10^{-7}$
2	End of test hole at 2 ft. * Shelby Tube sample was taken in an adjacent borehole.					
7 8 9						

Jon,

Chuck Gilberts
Office
- 2:00pm

Steve G.

Shawn

.E NO: A93520X10

[illegible]

SOLAR TESTING LABORATORIES, INC.

PROJECT: Maintenance Dredging	BORING NO: B-3	DATE: 07-01-1993
LOCATION: At Ashtabula River, Ashtabula, Ohio.	SUR. ELEV:	DEPTH: 3 ft.
CLIENT: Marine Contracting Corporation	DRILLING METHOD: REMARK: Continuous Sampling	

SAMPLE TYPE & DEPTH (ft)	WATER ON ENCOUNTER : WATER ON COMPLETION: None WATER AFTER HRS: SOIL DESCRIPTION	STANDARD PEN. (blows/6")	WC (%)	Qu (tsf)	DRY DENS. (pcf)	PERMEA-BILITY (cm/sec)
SS 1	Brownish-gray **CLAYEY SILT**, little sand, trace shale fragments, iron ore pellets, little brown oxide stain. (Fill)	4- 3- 5	29.2			
	Brown **SILTY SAND**. (Fill)					
SS 2	Gray **SILT** and **CLAY**, little sand, trace iron ore pellets, coal. (Fill)	4- 5- 8	20.9			
3	End of test hole at 3 ft.					

Depth scale (ft): 1, 2, 3, 4, 5, 6, 7, 8, 9

NO: A93520X10
ER: Joe Poucher

SOLAR TESTING LABORATORIES, INC.

PROJECT: Maintenance Dredging	**BORING NO:** B-4	**DATE:** 07-01-1993
LOCATION: At Ashtabula River, Ashtabula, Ohio.	**SUR. ELEV:**	**DEPTH:** 3 ft.
CLIENT: Marine Contracting Corporation	**DRILLING METHOD:** **REMARK:** Continuous Sampling	

SAMPLE TYPE & DEPTH (ft)	**WATER ON ENCOUNTER :** **WATER ON COMPLETION:** None **WATER AFTER HRS:** **SOIL DESCRIPTION**	**STANDARD PEN.** (blows/6")	**WC** (%)	**Qu** (tsf)	**DRY DENS.** (pcf)	**PERMEA-BILITY** (cm/sec)
SS		2- 3- 7	21.6			
	Brown **CLAYEY SILT**, little sand, few shale fragments, trace iron ore pellets, organics, brick. (Fill)					
SS		4- 7- 9	17.2			
3	End od test hole at 3 ft.					

Depth scale (ft): 1, 2, 3, 4, 5, 6, 7, 8, 9

JOB NO: A93520X10
DRILLER: Joe Poucher

SOLAR TESTING LABORATORIES, INC.

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX O

CONCEPTUAL
DEWATERING FACILITY DESIGN

NOTE: FOR purposes of this feasibility study, the Ashtabula River Partnership (ARP) decided to use the dewatering and upland transport design presented in the U.S. Army Corps of Engineers, Buffalo District, Ashtabula, Ohio Harbor, Design Analysis – An Environmental Solution Report dated November 1984.

This Appendix presents only those portions of the overall design pertinent to this Feasibility Study. The attached appendix does not include the November 1984 design Sub-Appendices A: "Geotechnical Design" and B: "General Design Calculations and Information" and Plates 5, 6 and 7. It should be notes that the "Pertinent Project Specific Data" presented in the November 1984 specific to the design as prepared at that time is not included. This includes the cost and benefit information. Current cost and benefit information for the ARP Project can be referenced in Appendices R and S.

C. COMMERCIAL NAVIGATION BENEFIT RE-EVALUATION

1. Re-evaluation Introduction Table S1.24 provides a summary of average annual commercial navigation transportation benefits, by origin/destination pair. These average annual benefits reflect a 7.625 percent annual interest rate, a 50 year project life and May 1996 price levels.

Given the length of time that has elapsed since the evaluation had been performed, a re-evaluation of the benefits was completed. The current report reflects October 2000 prices and the current Federal Discount Rate is 6.375%. Consequently, the re-evaluation would need to reflect the new price level and interest rate.

The analysis was based on origin/destination patterns and tonnages that took place in Calendar Year 1994. The first step in the re-evaluation would be to determine if these tonnages were still representative of the 50 year project evaluation period. If these tonnages were found to be representative, the origin/destination patterns of 1994, as well as the vessel sizes used in these movements, would also still be representative of traffic patterns that would take place over the 50 year evaluation period.

2. Determination Of Representative Tonnages And Traffic Patterns. An analysis of historical tonnages through 1998 was performed. These tonnages were then compared to the 1994 levels to see how the 1994 season compared to the last five to ten years of commodity movements through Ashtabula. The analysis is provided below in Table S1.25. Based upon Table S1.25, it was determined that the 1994 season would be representative of tonnages moving through Ashtabula Harbor over the last five to ten years. Consequently, the 1994 tonnages and origin/destination routes, and vessels used to carry these tonnages would be representative of the tonnages, routes and vessels that would be used during the 50 year project evaluation period.

Table S1.25 Historical Ashtabula Tonnages, By Commodity- 1985 to 1998

Year	Iron Ore	Coal	Limestone	Subtotal	Total Harbor Tonnage	Big 3 As % Of Total Tonnage
1985	1,876,000	4,449,000	447,900	6,772,900	7,039,000	96.22%
1986	2,775,000	3,685,000	346,000	6,806,000	7,164,000	95.00%
1987	2,084,000	6,077,000	266,700	8,427,700	8,888,000	94.82%
1988	3,070,000	5,991,000	550,600	9,611,600	10,335,000	93.00%
1989	4,670,000	4,763,000	438,500	9,871,500	10,387,700	95.03%
1990	5,589,000	5,328,000	480,000	11,397,000	11,852,000	96.16%
1991	5,008,000	4,784,000	476,000	10,268,000	10,638,000	96.52%
1992	4,326,000	5,340,000	516,000	10,182,000	10,572,000	96.31%
1993	4,685,000	3,445,000	409,000	8,539,000	8,979,000	95.10%
1994	4,369,600	4,823,500	667,300	9,860,400	10,368,500	95.10%
1995	3,865,000	5,152,000	617,000	9,634,000	10,010,000	96.24%
1996	3,299,000	5,231,000	641,000	9,171,000	9,523,000	96.30%
1997	3,187,000	7,682,000	724,000	11,593,000	11,929,000	97.18%
1998	6,052,000	8,320,000	676,000	15,048,000	15,602,000	96.45%
10 Yr Avg 89-98	4,505,060	5,486,850	564,480	10,556,390	10,986,120	96.09%
5 Yr Avg 94-98	4,154,520	6,241,700	665,060	11,061,280	11,486,500	96.30%

3. Re-evaluation Update Process. The re-evaluation could now concentrate on updating the 1994 evaluation with respect to price levels and interest rates. The 1994 evaluation compiled Without Project and With Project condition transportation costs by origin/destination pair based on various tonnages being moved by specific vessel classes.

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA Conc Floor Finishes, Stl Trowel				0.02	0.54	0.02	0.00	0.00	0.56
	400.00	SF	ACMAC	6	215	9	0	0	224
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	100.00	LF	ACARJ	10	334	6	65	0	405
MIL AA Pour Slab on Gr,>= 6", Dir Chute				0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	18.00	CY	ALABE	5	136	5	972	0	1,113
MIL AA Concrete Floor Finishes, Screed				0.01	0.37	0.00	0.00	0.00	0.37
	440.00	SF	ACMAA	5	164	1	0	0	165
MIL AA Conc Floor Finishes, Stl Trowel				0.02	0.54	0.02	0.00	0.00	0.56
	440.00	SF	ACMAC	7	236	10	0	0	247
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	90.00	LF	ACARJ	9	301	6	58	0	365
MIL PL 2" (50mm) A53 Pipe, T&C Sch 40				0.31	11.27	0.13	2.13	0.00	13.53
Incl Hanger & 125# CI Fitting	240.00	LF	MPLUE	75	3,279	38	620	0	3,937
AF AA Pump C.I. Close Coupling 3 HP				0.00	0.00	0.00	1097.00	0.00	1097.00
90 GPM	2.00	EA	N/A	0	0	0	2,194	0	2,194
B MIL PL 5000Gal Stl Stor Tk,w/3/16"Shell				50.47	1884.48	146.80	3775.80	0.00	5807.08
Abv Gnd w/Supp,Coating&Fittings	2.00	EA	MSPFP	101	4,570	356	9,157	0	14,084
B MIL PL 5000Gal Stl Stor Tk,w/3/16"Shell				50.47	1884.48	146.80	3775.80	0.00	5807.08
Abv Gnd w/Supp,Coating&Fittings	1.00	EA	MSPFP	50	2,285	178	4,579	0	7,042
MIL PL 2" (50mm) A53 Pipe, T&C Sch 40				0.31	11.27	0.13	2.13	0.00	13.53
Incl Hanger & 125# CI Fitting	80.00	LF	MPLUE	25	1,093	13	207	0	1,312
MIL AA Pour Slab on Gr,>= 6", Dir Chute				0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	12.00	CY	ALABE	3	91	3	648	0	742
MIL AA Concrete Floor Finishes, Screed				0.01	0.37	0.00	0.00	0.00	0.37
	300.00	SF	ACMAA	3	112	1	0	0	112
MIL AA Conc Floor Finishes, Stl Trowel				0.02	0.54	0.02	0.00	0.00	0.56
	300.00	SF	ACMAC	5	161	7	0	0	168
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	70.00	LF	ACARJ	7	234	4	45	0	284
USR AA solid contact clarifier				363.04	14368.10	3038.79	15000.00	0.00	32406.89
PURCHASE AND INSTALL ONLY	1.00	EA	SIWSO	363	14,368	3,039	15,000	0	32,407
MIL PL 2" (50mm) A53 Pipe, T&C Sch 40				0.31	11.27	0.13	2.13	0.00	13.53
Incl Hanger & 125# CI Fitting	220.00	LF	MPLUE	69	3,005	35	568	0	3,609

1. GENERAL

a. Background.

(1) USEPA has designated the Ashtabula River sediments as heavily polluted and toxic. As a result of this designation, all of the sediments dredged from the Ashtabula River (see ARP Project Sediment Dredging Areas Map on preceding page) require disposal in a confined disposal facility.

(2) The major source of pollution to the Ashtabula River sediments has been identified as Fields Brook, a tributary of the Ashtabula River. In a joint agreement between USEPA and the Corps, USEPA has agreed to prevent (to the extent required) Fields Brook contaminated sediment from entering the Ashtabula River. Fields Brook is presently (2000) being remediated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

(3) The restriction on the dredged material disposal has prevented the District from maintaining adequate river navigation depths and, more significantly, is anticipated to restrict the commercial operations in the lower river, and possibly, the Outer Harbor, as the polluted sediments continue moving downstream.

(4) The approved plan for dredging, transporting, and disposing of the polluted Ashtabula River sediments entails the following components:

(a) Dredging - The dredging will be performed with a modified clam shell dredge which has a "watertight" bucket to minimize the release of contaminants at the dredging site.

(b) Transfer/Dewatering and Transport - The transfer/dewatering and transport operation will be performed using barges/scows and watertight haul trucks. A transfer/dewatering facility will be constructed for dredged material transfer, dewatering, and if necessary, for temporary dredged material storage operations.

(c) Disposal - All the dredged material will be disposed of in a privately owned disposal facility, such as the State Road facility. The approved plan is strongly supported by all the appropriate Federal, State, and local agencies, in addition to the local citizens. Their support has been conveyed to the Buffalo District as feedback during our coordination effort and based on the comments received concerning the Draft Environmental Impact Statement (DEIS).

(5) The DEIS addressed the entire approved plan with detail assessment provided on both the Dredging and Transport Plan. The private contractor will be responsible for obtaining environmental clearance for the facility and will do so through the permit process. At this stage, no project terminating environmental restrictions are anticipated.

b. Purpose of Report.

The purpose of this Design Analysis Report is to present detailed information on the approved Ashtabula River Dredging and Disposal plan, outlined in the Letter Report. The information will be used to update project cost and provide the basis for plans and specifications. As a result of this report, the economical efficiency and environmental acceptability of the approved plan has been verified.

c. Scope of Report.

(1) This report presents detail information on the dredging operation and transfer/dewatering facility portion of the approved plan presented in the December 1983 Ashtabula Harbor Letter Report. The design of the truck hauling operation and the final disposal facility, as stated in the Letter Report, is the responsibility of the private contractor performing the work.

(2) The majority of this report contains detail design information on the various transfer/dewatering components such as: access roads, decontamination facility, settling basins, filter cells, drainage system, and a temporary dredged material storage facility (see Plates 3 and 4). Each component's purpose, design considerations, and design criteria are presented. The resulting design is described in detail with additional information and calculations contained in the appendices.

(3) After the design information, the construction schedule, real estate requirements, project benefits, project costs, and recommendations are presented. The project authority and the navigation project description will not be addressed because both were adequately addressed in the approved December 1983 Letter Report.

2. STAGING AREA OVERVIEW

a. Location

(1) Ashtabula Harbor, shown in Plate1, is on the south shore of Lake Erie, at the mouth of the Ashtabula River. The harbor is 59 miles northeast of Cleveland, OH, and about 37 miles southwest of Erie, PA, as shown on Plate 1.

(2) The staging area, shown on Plates 2, is located south of the end of Slip 5a along the Ashtabula River. The site covers an area between 5 and 10 acres on land owned by Norfolk Southern.

b. Staging Area Layout.

(1) The staging area is divided into two zones. Zone 1, temp storage, has two alternative layouts and Zone 2 has one layout, as shown on Plates 3 and 4. These alternatives provide a contractor with the flexibility to perform the main function of the staging area, as discussed below, in such a manner to best fit the company's equipment and management capabilities. The staging area was designed to process approximately 4,000 cubic yards of dredge material per day. Current plans now call for processing approximately 1,600 cubic yards per day.

(2) The main function of the staging area is the transfer of dredged material from scows to haul trucks. Alternative 1 provides for temporary storage area should the Contractors dredging exceed the availability of haul trucks while Alternative 2 only incorporates the ability to directly transfer dredged material into haul trucks. Another direct transfer (loading/unloading) area is provided in Zone 2 of the staging area.

(3) There exist four important support facilities contained within the chain linked fenced staging area. They are the drainage system, decontamination facility, settling basins, and filter cells. These facilities are all contained in Zone 2 with the drainage system extending into Zone 1 (see Plates 3 and 4). The purpose of these facilities is to prevent the release of contaminants to the environment to the extent that is economically feasible and environmentally acceptable.

(4) The site layout design has the following advantages:

(a) provides for direct transfer of dredged material from scows to either haul trucks or a temporary storage and dewatering facility;

(b) the decontamination pad is close to the unloading/loading operation, centrally located and provides a single control point for all vehicles leaving the site;

(c) the drainage system drains all potentially contaminated areas (see Plates 3 and 4). Underdrainage must be provided at the temporary storage facility to effect maximum dewatering;

(d) the settling basins are centrally located between the contaminated water collection points such as from the scows (supernatant), from the decontamination pad (washwater), and from the drainage collection area (runoff); and

(e) the filter cells receives influent from the settling basins and discharges effluent to the Ashtabula River, therefore, the cells are close to both.

c. Operations

(1) The objective of the staging area operation is fourfold. First, to remove from the scows excess water, which is introduced during the dredging operation, secondly, to achieve, enhanced dewatering, thirdly, to transfer the dredged material from the scows to watertight haul trucks. The fourth objective is to prevent, to the extent possible, the release of contaminants to the environment, which may result when performing the first three operations.

(2) The excess water or supernatant is pumped to the settling basin once the primary settling process in the scow or temporary stage area has effectively stopped. The remaining solids or dredged material is either placed in a temporary storage facility and eventually loaded on haul trucks (Alternative 1) or placed directly on haul trucks (Alternative 2). Equipment exiting the staging area must be washed (decontaminated) and the wash water processed through the settling basin.

(3) A drainage system lined with two impermeable (defined for this short-term project as having a permeability of 1×10^{-6} cm/sec or less) liners, will be required in the areas which could potentially become contaminated. Runoff from these areas will be collected in open drainage channels and pumped to the settling basins for settling and further treatment as may be required. The purpose of the settling basins is to produce a final effluent with a PCB concentration of less than 1 ug/L. It is expected that additional treatment after settling will be required to achieve this. This may include the addition of flocculent polymers, multi-media filtration and activated carbon polishing.

(4) Bench scale tests will be conducted to obtain design parameters for the water treatment system. The treated effluent will be released at the Conrail Slip. Final discharge will be monitored to determine of it meets Ohio EPA discharge standards for PCB's and possibly other parameters such as ammonia, solvents, selected metals, and radionuclides.

3. STAGING AREA ACCESS ROADS

a. Purpose.

The purpose of the roads is to provide the haul trucks an environmentally acceptable and functional access to the polluted dredged material contained within the scows, the temporary storage facility, settling basins, and the filter cells, as shown on Plates 3 and 4.

b. Design Considerations and Criteria.

(1) The major concerns when laying out the staging area access roads involved maintaining an adequate traffic flow and obtaining access to all the required areas (areas or facilities containing dredging material) such to promote an efficient operation and to accomplish the work in the required time period. While fulfilling the previous requirements, to the extent possible, other factors such as minimizing the access road length (provide direct access) and using existing site roads can be advantageous.

(2) The access roads must be capable of withstanding for 6 months between 200 and 300 vehicles per day, most of which are haul trucks if 4,000 yds/day are processed. This would be reduced to approximately 75 to 150 trucks if 1,600 yds/day are processed.

(3) A major factor, which affects the design of the staging area access roads, is whether or not the staging area operation could potentially contaminate the access roads. Access roads (defined as any road on the Conrail property used by the Corps Contractor to perform work outlined by the subject project) outside the chain link fence enclosed staging area and a section within the staging area immediately east of the decontamination pad will not be exposed to contaminants. Road surfaces not expected to become contaminated will have the following surface characteristics; smooth, inhibits dust, and drains readily. However, the majority of the access roads within the staging area have the potential of becoming contaminated. This potential exists from the point of loading the haul trucks to the point of decontamination. The loading operation will be the major source of contaminants to the access roads and the truck traffic will spread the contaminants on the access roads until the trucks are washed on the decontamination pad. These access roads within the staging area have been designed to provide surface drainage and to effectively eliminate infiltration of contaminants into the existing soil and groundwater. Curbs and a sloped surface will facilitate surface drainage, where as a double impermeable liner system will be used to meet the no infiltration objective. Maintaining the integrity of this system is a critical design objective.

c. Access Road Design.

(1) In order to minimize contaminant infiltration and maintain a functional road surface, an asphalt surface is planned. The design requires a 3-1/2 inch asphalt base and a 1-1/2 inch asphalt top. This is based on a 20 ton haul truck making over 200 passes per day for a 6-month period. The detail calculations are contained in Appendix B. To maintain uniformity, all the potentially contaminated roads will have the same asphalt thickness which is based on the worst case condition, as shown on Plates 10 and 11.

(2) The non-contaminated access roads must meet the requirements listed in Section B of this chapter. Six inches of crush stone will most likely satisfy the requirements.

(3) The potentially contaminated access roads, as stated in paragraphs 2 above, will have a 5-inch asphalt surface, with a ½-inch per foot transverse slope aided by a 4-inch curb to control surface drainage. A synthetic membrane liner serves as a backup to the asphalt surface in preventing the infiltration of contaminants. This liner also has a ½-inch per foot transverse slope. The layer between the membrane liner and the asphalt is

continually drained, through either 2-inch diameter, 3 feet long perforated ("weep") pipe placed at 5 feet on center or by one continuous 6-inch diameter perforated pipe (depending on location). The pipe discharge must be at least 6 inches above the average site elevation to prevent the layer between the liners from becoming saturated. To assure that the integrity of the synthetic membrane liner is maintained, 6 inches of sand is placed above and below the liner, as shown on Plates 10 and 11.

(4) The minimum width and elevation dimensions of the access road vary because of usage rate and drainage, respectively. In high use areas the access roads will be 30 feet wide and in low use areas the access roads will be 15 feet wide. A 30-foot wide two lane road enables a truck to bypass other trucks and loading equipment, such that the slowest loading operation is not governing. The road elevation will provide both surface and subsurface drainage. It varies between 18 inches and 33 inches above the average site elevation.

4. STAGING AREA DECONTAMINATION FACILITY

a. Purpose.

The purpose of the decontamination pad is to provide an impermeable area where dredged material and associated contaminants can be washed off equipment. This operation will assist in preventing the release of contaminants to the environment from project operations.

b. Design Considerations and Criteria.

(1) The decontamination facility shall be designed to prevent the release of contaminants to the unprotected surface area near the pad, to the subsurface, and to roads on which the vehicles will travel when leaving the facility. This prevention shall be performed in a timely manner to prevent traffic flow problems.

(2) Incorporated in the design will be wash areas, sufficient in size and number, a durable and impermeable surface, and an adequate collection system for both washed material and water. Specific criteria which influenced the design includes, the existing well drained sub-grade, a flow rate of one vehicle every 5 to 7 minutes, and a maximum repeat load of 18,000 pounds per axle.

c. Decontamination Facility Design.

(1) As shown on the decontamination pad plan view Plate 12, the pad is 50 feet by 50 feet. This provides adequate room for parallel wash areas and depending on type of equipment used (truck size), two vehicles could be washed simultaneously in each wash area. However, based on calculations, only two vehicles (one in each of the wash areas) need to be washed simultaneously in order to maintain a steady flow of vehicles needed to truck 4,000 cubic yards of dredged material per day. This equates to one vehicle leaving the staging area every 5 to 7 minutes or 10 minutes to wash a truck. Therefore, the decontamination pad size is adequate to accommodate various size equipment and permit flexible transfer rates.

(2) As shown on Plate 13, the pad consists of 6 inches of concrete rein forced with welded wire fabric. Dowels 15 inches long ¾-inch in diameter and 11 inches on center will be placed along the construction joints to transfer the load from one section to another. (Detail calculations used to determine the pad design are contained in Appendix B). All joints are sealed to prevent infiltration. A 4-inch high curb and a concrete surface sloped on the average of ½-inch per foot facilitates washed material and water collection in two centrally located troughs. A 4-inch PVC pipe drains the top 8 inches of the 1-foot trough into the adjacent drainage collection area.

(3) Even though the existing ground will serve as an adequate foundation, it will not prevent infiltration of contaminants, if wash water accidentally seeps through the concrete pad. To prevent infiltration of contaminants, an impermeable synthetic membrane liner coupled with good drainage above the liner (to prevent head build-up) will compose part of the pad's sub-base. The sub drain must discharge at least 6 inches above the average site elevation to prevent back-flow due to storm runoff. In addition, a minimum of 6 inches of sand is required above and below the liner for pro-tection against puncturing. Based on these subsurface drainage requirements and the sloped pad surface, the pad will be 43 inches above the average site elevation at each corner, which does not include the 4-inch high curb.

(4) There will be three portable washing systems required at the wash pad. Each one is capable of producing over 500 pounds per square inch of pressure with a maximum flow of 5 gallons per minute.

5. STAGING AREA TEMPORARY DREDGED MATERIAL STORAGE FACILITY

a. Purpose.

A temporary dredged material storage facility provides flexibility, to account for any temporary differences between dredging and trucking rates. For example, the dredging operation can proceed at a constant rate even if trucking is reduced during certain hours (i.e., night) or trucking can be continuous even when the dredging operation has temporarily shut down for repairs.

b. Design Considerations and Criteria.

(1) Once again, as is the case for all facilities exposed to contaminated dredged material, containment of the contaminants is essential. Containment is critical not only within the storage facility, but also when unloading the scows and loading the haul trucks.

(2) Maintaining a functional area within the storage facility in which equipment can be used to distribute and load the dredged material.

(3) The storage facility was sized to contain all the dredged material from a typical 1-day dredging operation. This volume is approximately 1,600 cubic yards.

c. Storage Facility Design.

A scow unloading area, a storage area and a haul truck loading area composes the temporary dredged material storage facility.

(1) The scow unloading area consists of a splashguard, contamination control basin (see Plate 9) and the outer slope of the storage area dike. Dredged material spilled on the splashguard will flow either into the scow or the control basin, which collects spillage from the remainder of the bucket's flight to the storage facility. A control basin 50 feet wide with dikes 1-foot above the average site elevation will contain the drippings from two clamshells.

(a) Dredging Plan - The dredging will be performed with a modified clam shell dredge which has a "watertight" bucket to minimize the release of contaminants at the dredging site.

(b) Transport Plan - The transport operation will be performed using scows and watertight haul trucks. A staging area will be constructed for dredged material transfer, water treatment, and if necessary, for temporary dredged material storage operations.

(c) Disposal Plan - All the dredged material will be disposed of in a privately-owned disposal facility, such as the State Road facility. The approved plan is strongly supported by all the appropriate Federal, State buckets unloading a scow simultaneously. To inhibit infiltra-tion a 1.5-foot thick layer of compacted clay (permeability 1 X 1O-6 centimeter per second or less) lines the control basin and the outer storage area dike. Above the clay, in the control basin is a synthetic membrane liner sand-wiched between two 6-inch layers of sand and sloped to provide drainage. A perforated drainage pipe conveys the water to a sump upon which the water is pumped into the storage facility (for more drainage, see Chapter 6).

(2) The storage facility is sized to contain approximately 4,000 cubic yards of dredged material, which corresponds to a 24-hour dredging operation. Such a facility occupies a 245 feet by 140 feet area. The containment dikes have a 5-foot crest width, side slopes of 2 on 1 and an elevation which varies from 10 feet adjacent to the slip to 4 feet furthest from the slip as shown on Plate 8. Elevation differences reflect the anticipated slope of the dredged material after being clammed into the facility.

(3) The outer dike section is protected against erosion by establishing vegetation on 4 inches of topsoil; however, in heavily traveled areas (haul truck loading areas) crushed stones will be used (see Plate 8). Beneath the erosion protection, in the loading and unloading areas, there will be a 1.5-foot compacted clay barrier (permeability less than 1 X 10-6 cm/sec.

(4) The inner dike section and the base of the storage area have approximately the same composition. 1.5-foot compacted clay barrier is continuous over the entire facility. Above the clay is a synthetic membrane liner sandwiched between two 6-inch layers of sand. At the toe of the slope, cold mix asphalt is used to provide a cut off such that water flowing along the liner is diverted to a drainage pipe for collection. A 5-inch thick asphalt layer consisting of a 3-1/2-inch asphalt binder on 1-1/2-inch asphalt top is placed on top of the sand layer to form the storage area pad. A pad is required to support front-end loaders, which must access the facility in order to distribute and load the dredged material.

(5) In order to collect excess water attributed to the dredging operation or to precipitation, a 6-inch perforated pipe is placed at the dike toe. This pipe is covered with 1.5 feet of crush stone, which enables equipment to pass over it. The stone thickness decreases to 4 inches at the top of the dike and meets the asphalt at a 5 on 1 slope. The drainage pipe flow is split and has a slope of 0.6 percent. The asphalt pad is sloped at ¼-inch per foot toward the 4-foot dike to assist in water collection. A sump located at the toe of the 4-foot dike collects water from each pipe drainage paths and pumps it across the access road into open drainage channel (see Chapter 6 for more drainage details).

(6) Underdrainage may be provided to enhance dewatering from the storage facility. Decant water and underdrain water will be sent to the settling basins.

6. STAGING AREA DRAINAGE SYSTEM

a. Purpose of Drainage System.

The purpose of the drainage system is to collect and contain water from potentially contaminated areas and convey this water to the treatment facilities (see Plates 3 and 4).

b. Design Considerations and Criteria.

(1) Potentially contaminated areas shall be designed to enhance immediate and direct water flow into open channels without causing erosion. Preventing localized ponding will reduce infiltration of contaminants while minimizing erosion will reduce the quantity of solids requiring removal during the treatment process.

(2) Containment of contaminated water within the open channel is essential. Therefore, overflow and seepage into non-contaminated areas must be prevented. Because seepage is not readily detected, assurances must be built into the design. In addition, drainage from non-contaminated areas shall remain separate from the potentially contaminated runoff.

(3) The drainage system shall be capable of conveying the peak flow (assuming 100 percent runoff) from a 100-year frequency storm. Drainage channel depth below average site elevation is limited based on a minus 4-foot water table elevation at the site. This restriction will limit both the channel slope and length. Providing a single collection area will simplify the pumping operation which is required to process the contaminated water through the treatment facilities.

c. Drainage System Design.

(1) The potentially contaminated areas (i.e., access roads and dikes) either require no slope or a steep slope (2-foot horizontal : 1-foot vertical). Special features are incorporated into the design to enhance contaminated water collection. Flat surfaces (i.e., access roads) are sloped perpendicular to the longitudinal axis (flow of traffic) at 1/2 inch per foot. Steep dike slopes exhibit immediate and direct drainage. Erosion is inhibited on most of the slopes by establishing vegetation on a 4-inch topsoil base. However, where there is repeat traffic, (i.e., storage facility truck loading area) crush stones are used. Where there is water level fluctuation and a potential for high velocities (i.e., settling basin and drainage channel), a synthetic membrane liner is used.

(2) Containment of surface water (runoff) from potentially contaminated area is critical. The open channel is designed with a 1 foot (above average site elevation) freeboard to assure runoff from the potentially contaminated and non-contaminated areas do not mix. Peak flow from potentially contaminated areas does not raise the water elevation in the channel above the average site elevation. In addition, little surface runoff is anticipated from the non-contaminated area because of the permeable nature of the in-situ material. Release of contaminated water by seepage is inhibited by a double liner system except for the infrequently contaminant exposed steep dike slopes which has a single liner. Each liner exhibits a permeability of 1 X 10-6 centimeter per second or less. Six inches of concrete, 5 inches of asphalt, synthetic membrane and a 1- to 2-foot compacted clay layer all serve as liners. Preventing head (water) buildup by maintaining drainage above the liner, as discussed in Chapter 3 and 4, further inhibits seepage. Areas where there are no subsurface drainage (storage area and settling basin), extra liner protection is provided. Dredging will be conducted over a 3-year period with a 6-month active dredging period each year. A 10-foot head of water will only produce 6 inches of seepage; therefore a 1 .5-foot to 2-foot clay layer is sufficient to prevent the release of contaminants without drainage.

(3) The open channel and culverts are designed based on a peak flow from a 30-minute (which is the time of concentration for the staging area), 100-year frequency design storm. Peak flow into the drainage collection area is 6 cubic feet per second while the maximum peak flow through any one of the three drainage paths leading to the collection area varies from 1 to 2.5 cubic feet per second. A triangular designed open channel cross section with 2 on 1 side slopes, a 0.4 percent slope and a depth that varies between 1 and4 feet will convey the peak flow while maintaining an average freeboard of 1 foot as shown on Plates 10 and 11. Two culverts are required to convey water under the access roads. An 18-inch diameter, 75-foot long culvert is required to convey a peak flow of 2.5 cubic feet per second under the access road near the decontamination pad. A 12-inch diameter, 30-foot long culvert is required at the northwest corner of the settling basin, to convey a peak flow of 1 cubic foot per second. In addition, a 12-inch in diameter, 275-foot long culvert is required between the settling basin and the slip to convey a peak flow of 1 cubic foot per second. The positions of those culverts are shown on Plates 3 and 4. This third culvert is necessary instead of a continuous open channel in order to maintain an adequate access road width. Precautions must be taken to assure that the 275-foot culvert remains watertight, because no liner is beneath it.

(4) Pumps are required to transfer water from the control basin to the storage area, from the storage area to the drainage channel, from the drainage collection area to the settling basin, from the scows to the settling basin and from the settling basin to the filter cells. Four-inch pumps (Empo-Cornel Pump Company Model No. 461110) are sufficient to move water through 4-inch diameter flexible hoses and 6-inch diameter plastic pipes to and from the settling basin. The design pump will move 460 gallons per minute against a total head of 33 feet and can pass a 3-inch diameter solid. Four pumps are required to handle the drainage flow from a 100-year frequency, 30-minute design storm. One pump is required for the floating weir in each settling basin and one is needed to pump supernatant out of the scows. A total of seven 4-inch pumps are needed, however, because these pumps are interchangeable, five pumps could be sufficient depending on whether normal staging area dredged material transfer operations will be con-tinuous during major storm events. If the transfer operation is discontinued during storm events, the 4-inch pumps are easily repositioned. Other pumps required consist of a household sump-pump (submersible type) with a 1-1/4 inch diameter discharge pipe for the control basin and a Peabody Barnes Model SSB41 for the storage area. (These pumps are only needed if Alternative 1, Zone 1 is chosen.) The Model SSB41 can pump 3,600 gallons per hour against a total head of 10 feet. This model has sufficient capacity to handle a 100-year frequency, 24-hour intensity design storm.

(5) Two sump wells are required in the drainage collection area. Each well is a prefabricated manhole well with the following dimensions: 4-foot inner diameter, 4-foot deep, 4-inch thick concrete walls, and a 13-inch thick, 5-foot 8-inch diameter concrete base. Two pumps are contained in each well as shown on Plate 15. The sump wells in both the control basin and storage area have a 2-foot inner diameter and are 2 feet deep. Since these are not below the groundwater table, buoyancy is of no concern.

7. STAGING AREA SETTLING BASINS

a. Purpose of Settling Basins.

The purpose of the settling basins is to remove solids by gravity settling. As shown by lab test performed by Aqua Tech and referenced many times in the literature, the majority of contaminants are associated with the solid sediment particles. As a result, contaminants are removed when the solids settle out.

b. Design Considerations and Criteria.

(1) The size and number of settling basins are determined based on the quantity of fluid, degree of treatment (settling) and flexibility required. To enhance settling, the basins shall have a 3 to 1 length to width ratio and an operating depth between 7 and 10 feet, including a 1-foot freeboard.

(2) The type of material used to construct the basins depends on the operation of the facility and once again, inhibiting infiltration, preventing leakage and eliminating the introduction of solids from the basin structure.

c. Settling Basin Design.

(1) Water requiring treatment comes from two sources. A continuous dredging source and a non-continuous precipitation runoff source. As shown in Appendix B, 25,500 cubic feet per day of supernatant is produced for each 4,000 cubic yards of sediment dredged. Maximum runoff volume expected from 100-year frequency, 24-hour intensity storm varies from 26,500 to 30,000 cubic feet depending on the staging area plan.

(2) In order to be accepted in a landfill, dewatered sediments must pass a paint filter test. Bench scale tests have been conducted to determine the settling time required to pass the filter test (i.e. no free drainage through filter). Solids content at optimum settling time was determined. It was found that after 48 hours of settling time paint filter tests were passes at solids contents of 60 to 63 percent.

(3) In order to provide flexibility to handle basin clean out activities and peak inflows from precipitation runoff, the required treatment volume is divided into two basins. Each basin is designed to contain 25,650 cubic feet of water at a constant depth of 10.5 feet (includes 1 foot freeboard). A 90-foot by 30-foot area will contain this volume. However, 2 on 1 dike slopes, as shown on Plate 14, will produce an additional volume approximately equal to the first. This side slope storage volume provides an added safety factor.

(4) The settling basin operation entails adjusting the inflow, the outflow and removing accumulated solids when they affect the solids settling operation. The inflow will occur at four equally spaced point discharges at the basin's eastern end. Outflow will be collected at the basin's western end using a floating raft weir with a 12.5-foot weir length. Discharge will occur from the top 3- to 6-inch water layer. A floating boom will encircle the raft and minimize the release of floatables.

(5) Accumulated solids will be removed from the basins using a (clamshell bucket) crane positioned on the 12-foot high, 15-foot wide dike crest. Solids will be clamed from the settling basin, after the water level is lowered, and placed in haul trucks positioned adjacent to and outside the settling basin. The basin's bottom has a stone layer to prevent the clam bucket from accidentally penetrating the synthetic membrane and clay liners which are continuous, see Plate 14, under the entire settling basin to inhibit infiltration, prevent leakage and eliminate erosion. As shown on other sections, the synthetic liner is sandwiched between layers of sand for protection. A 0.5-foot thick sand layer is used between the membrane liner and the stone protective layer. The compacted clay liner is 2 feet thick beneath the fluid and 1.5 foot thick in the outside dike slopes exposed to contaminants during the cleaning operation.

8. STAGING AREA MULTI-MEDIA FILTER CELLS AND CARBON TREATMENT

a. Purpose of Filter Cells.

The purpose of the filter cells is to attain solids removal from settling basin decant. Bench scale tests with the addition of polymers will be conducted to obtain design parameters. Plate 16 shows a typical representation of a water treatment train process taken from the Fields Brook Superfund site project. This diagram is included to illustrate the general concepts for the water treatment process, which will be designed for the ARP Project after the bench scale testing.

b. Design Considerations and Criteria.

(1) Considerations used when determining surface area, depth, and media size of the filter are the surface loading rates, effluent suspended solids concentration and the depth in which the media will remove the solids from the water.

(2) A filter cell or tank used to contain the filter media shall be of standard size which meet or exceeds the minimum depth and cross sectional area requirements. The cell shall exhibit sufficient strength to contain saturated media under the required head.

(3) The filter cell area shall be designed such that media replacement can occur. Since the media replacement operation may contaminate the area surrounding the cells, runoff from this area must be contained.

c. Filter Cell Design.

(1) A dual media filter using 3.25 feet of anthracite and 3.25 feet of sand will produce an effluent with a suspended solids concentration less than 50 milligrams per liter based on a 150 milligrams per liter influent con-centration. The effective grain size is 1.5 -and 1.0 millimeters for anthra-cite and sand, respectively. A uniformity coefficient (D60/D10) shall be in the range of 1.5 to 3. This dual media filter will remove solids over its entire design depth. The design surface area per filter is 146 square feet, which is less than the 177 square feet provided by a standard tank size. A total of 11,200 cubic feet of sand and anthracite is required to filter all the anticipated dredging associated supernatant.

(2) The filter cell must have the following minimum specifications: 15-foot depth, 13.5-foot diameter and 18 gage steel walls. The chosen standard tank exceeds all the minimum requirements with the following dimensions; 16-foot depth, 15-foot diameter and 9 gage steel walls. The depth is composed of a 1.5-foot gravel underdrain with a 6-inch diameter pipe, 3.25 feet of sand, 3.25 feet of anthracite, 7 feet of maximum head and 1 foot freeboard. No special foundation is required for the filter cell. It can be placed directly over sand.

(3) Three filter cells are required, one for each settling basin with one reserve. A filter cell area is designed to accommodate all three 16-foot diameter filter cells with sufficient room for media replacement operations. Media replacement will be performed using crane and haul trucks positioned on the access road adjacent to the settling basin. Drippings from the clam shell bucket will fall on the area protected by a synthetic membrane and a 1-foot compacted clay liners, as shown on Plate 9. The membrane liner slopes at 1/4 inch per foot and drains into the open channel through weep holes spaced 5-foot apart. The membrane liner is protected by a 6-inch sand layer beneath it and a sand layer on top, which varies from 6 inches beneath the southern tank edge to 1 foot at the open channel. This top layer of sand also provides a flat foundation for the filter cells. A 3.5-foot high dike surrounds the filter cells on three sides to direct the flow of water to the open drainage channel should a leak develop in the filter cell membrane.

f. Carbon Treatment

The purpose of carbon column treatment is to effect further removal of PCB and possibly other contaminants, if necessary, to meet discharge standards for the Ashtabula River. Carbon treatment is usually done after multi-media filtration. Carbon filter bench scale testing will be conducted to obtain design parameters and determine achievable and acceptable PCB discharge concentrations. Removal to less than 1 ug/L PCB is expected to be achievable.

9. DREDGING OPERATION

a. Purpose.

The purpose of the dredging operation is to remove all the sediments within authorized project depths and limits in an environmental acceptable and economically efficient manner.

b. Dredge Equipment.

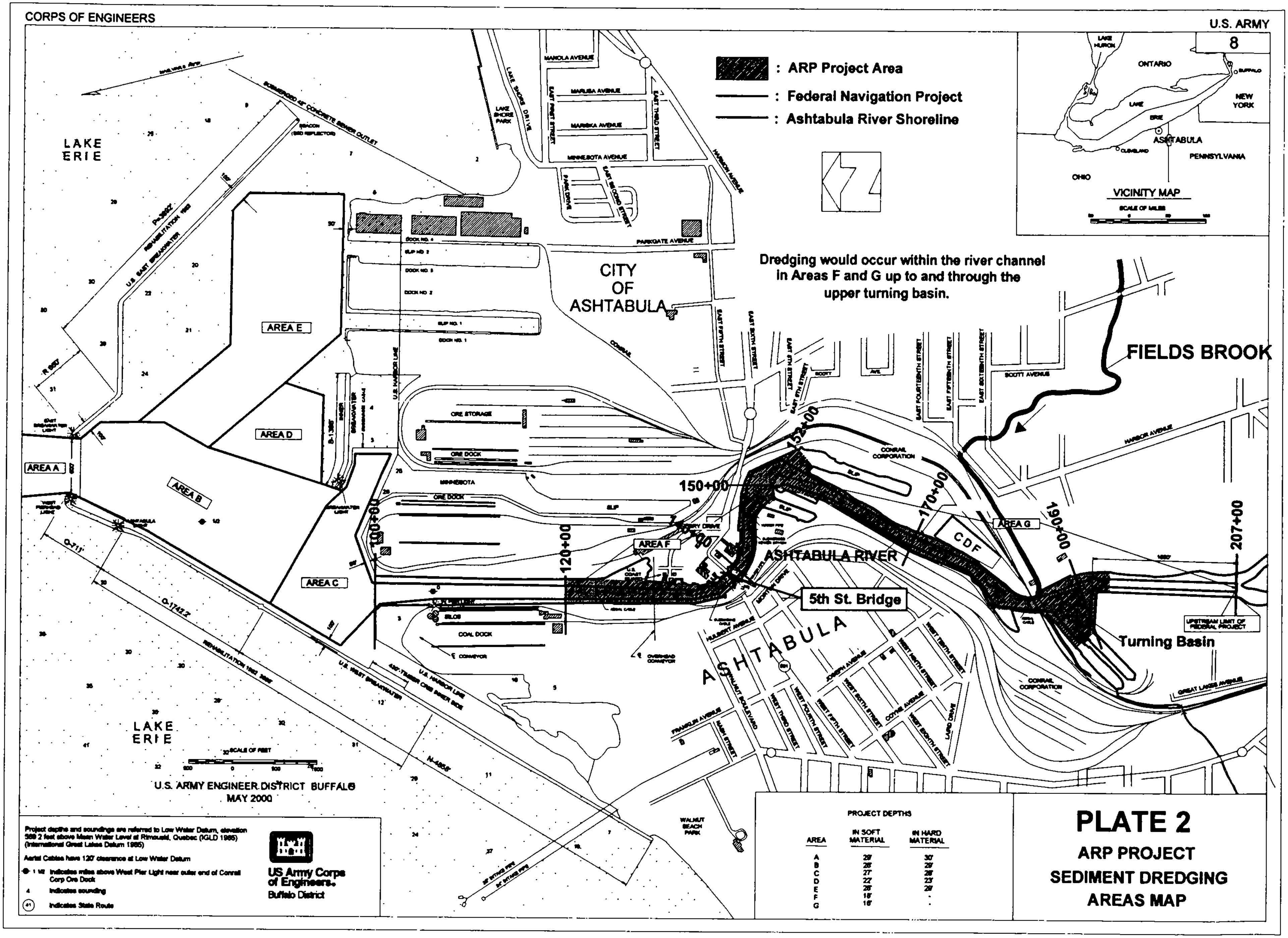
A clam shell bucket dredge will be required due to its maneuverability and availability and capability to acceptably dredge and dispose of the polluted sediments. The loss of material from the bucket as it is pulled through the water, spillage of turbid water from the top and through the jaws of the bucket, will be reduced significantly by modifying the bucket. The modification consists of welding side and top plates onto the standard clamshell bucket with interlocking tongue-and-groove edge. A rectangular opening is left in the top of the box for the pulley and to allow air to escape during submersion. These modifications, based on past studies, have increased the clamshell's capacity. Importantly, the enclosed bucket or so called "watertight" 'bucket will reduce, by greater than 50 percent, sediment resuspension in the upper water column. Sediments resuspended in the upper water column are par-ticularly serious since a greater potential for both suspended sediment disposal and contaminant release exists in the upper water column. The dredged material (what ever is contained in the bucket as it ascents through the water column) is placed into scows which are transported to the staging area by tug. Material will not be permitted to overflow the scow and reenter the river.

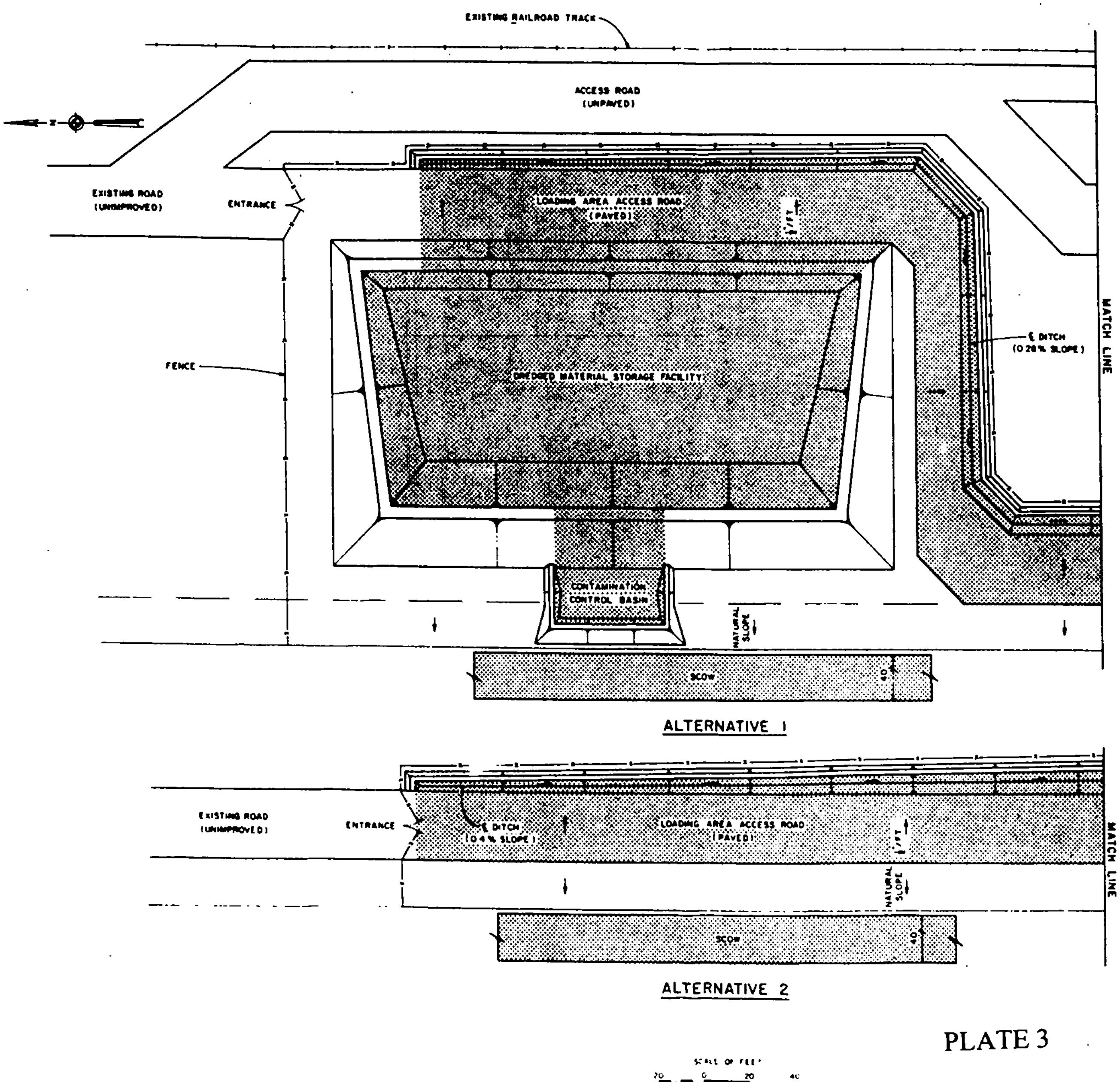
c. Dredging Procedure.

The dredging operation will start after the disposal facility and staging area are completed and ready for operation. Ideally, the dredging operation should start at the upstream limit of the Federal channel and proceed continuously downstream, however, the shallow water depth may prevent dredge equipment access. Therefore, dredging will begin as far upstream as not to cause significant resuspension of sediment due to tug traffic and proceed to the upstream limit of the Federal channel, prior to dredging the downstream portion of the channel. The turning basin, see Plate 2, will not be dredged until USEPA Superfund work is completed in the Fields Brook watershed. Both Areas F and G (see Plate 2) will be dredged down to project depths with allowance for 1 foot over depth due to equipment in accuracy. All the sediments dredged from Area F and G will be processed through the staging area. The dredge will probably operate 6 days per week, 10 hours per day for six months per year for a three year period processing approximately 1,600 cubic yards/day. Areas A through E (see Plate 2) will be dredged upon completion of the river dredging (Areas F and G) and disposed in the open lake.

10. REAL ESTATE REQUIREMENTS

The Real Estate Plan for the Norfolk and Southern locations calls for a five year Temporary Work Area Easement for 10.01-acre area for the dewatering/transfer facility. Of the 10.01 acres, 8.3 acres will be used primarily for the dewatering/transfer facility the area is vacant and the remaining 1.7-acre area is used for access by the Fish City Marina to their docks and Norfolk and Southern to the back of their property. The use of the area does not involve crossing tracks. In addition, usage of the Slip 5A will be secured.


CORPS OF ENGINEERS
U.S. ARMY
8
: ARP Project Area
: Federal Navigation Project
: Ashtabula River Shoreline
LAKE ERIE
AREA A
AREA B
AREA C
AREA D
AREA E
AREA F
AREA G
CITY OF ASHTABULA
Dredging would occur within the river channel in Areas F and G up to and through the upper turning basin.
FIELDS BROOK
VICINITY MAP
ONTARIO
NEW YORK
ASHTABULA
PENNSYLVANIA
OHIO
100+00
120+00
150+00
152+00
170+00
190+00
207+00
ASHTABULA RIVER
5th St. Bridge
CDF
Turning Basin
ASHTABULA
U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 2000
US Army Corps of Engineers
Buffalo District
PROJECT DEPTHS
AREA
IN SOFT MATERIAL
IN HARD MATERIAL
PLATE 2
ARP PROJECT
SEDIMENT DREDGING
AREAS MAP



NOTES

1. SPLASH GUARDS ARE PLACED BETWEEN BOTH THE EFFECTED LOADING AREA AND CONTROL BASIN DURING SCOW UNLOADING OPERATION
2. ONLY ONE WAY TRAFFIC ALLOWED THROUGHOUT THE STAGING AREA
3. VEHICLES ARE ONLY PERMITTED TO EXIT THE STAGING AREA NEAR THE DECONTAMINATION PAD.
4. SEE DECONTAMINATION PAD PLAN FOR DRAINAGE DETAILS

LEGEND

SLOPE

FLOW

(POTENTIAL) CONTAMINATED AREAS

PLATE 3

ASHTABULA HARBOR, OHIO
DREDGE AND CONFINE - DISPOSAL PROJEC

CONTAMINATED AREAS
STAGING AREA ZONE I
ALTERNATIVES 1 AND 2

U S ARMY ENGINEER DISTRICT BUFF
NOVEMBER 1984

PLA

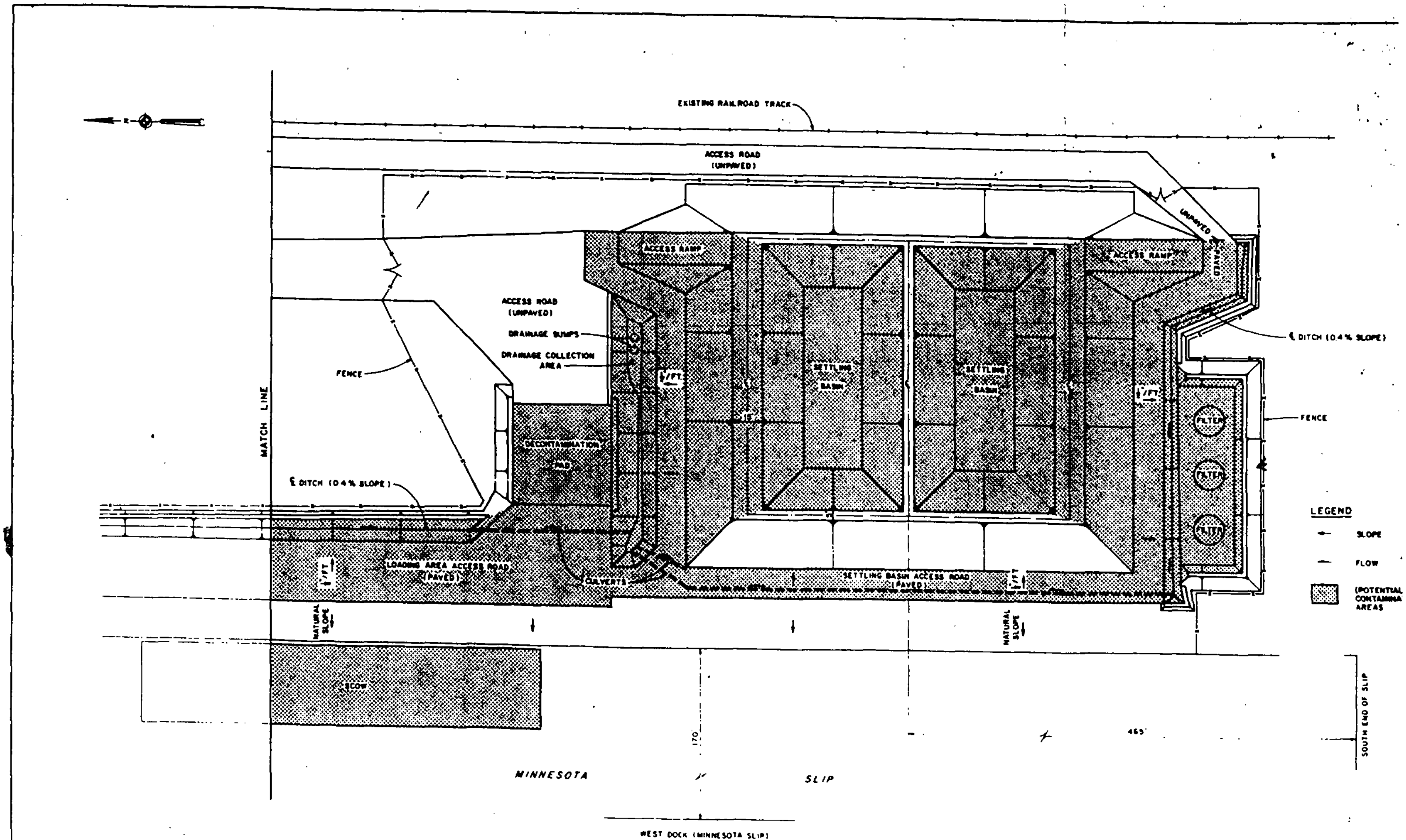


PLATE 4

ASHTABULA HARBOR, OHIO
DREDGE AND CONFINE - DISPOSAL PROJECT

CONTAMINATED AREAS
STAGING AREA ZONE 2

U.S. ARMY ENGINEER DISTRICT BUFFAL
NOVEMBER 1984

PLATE

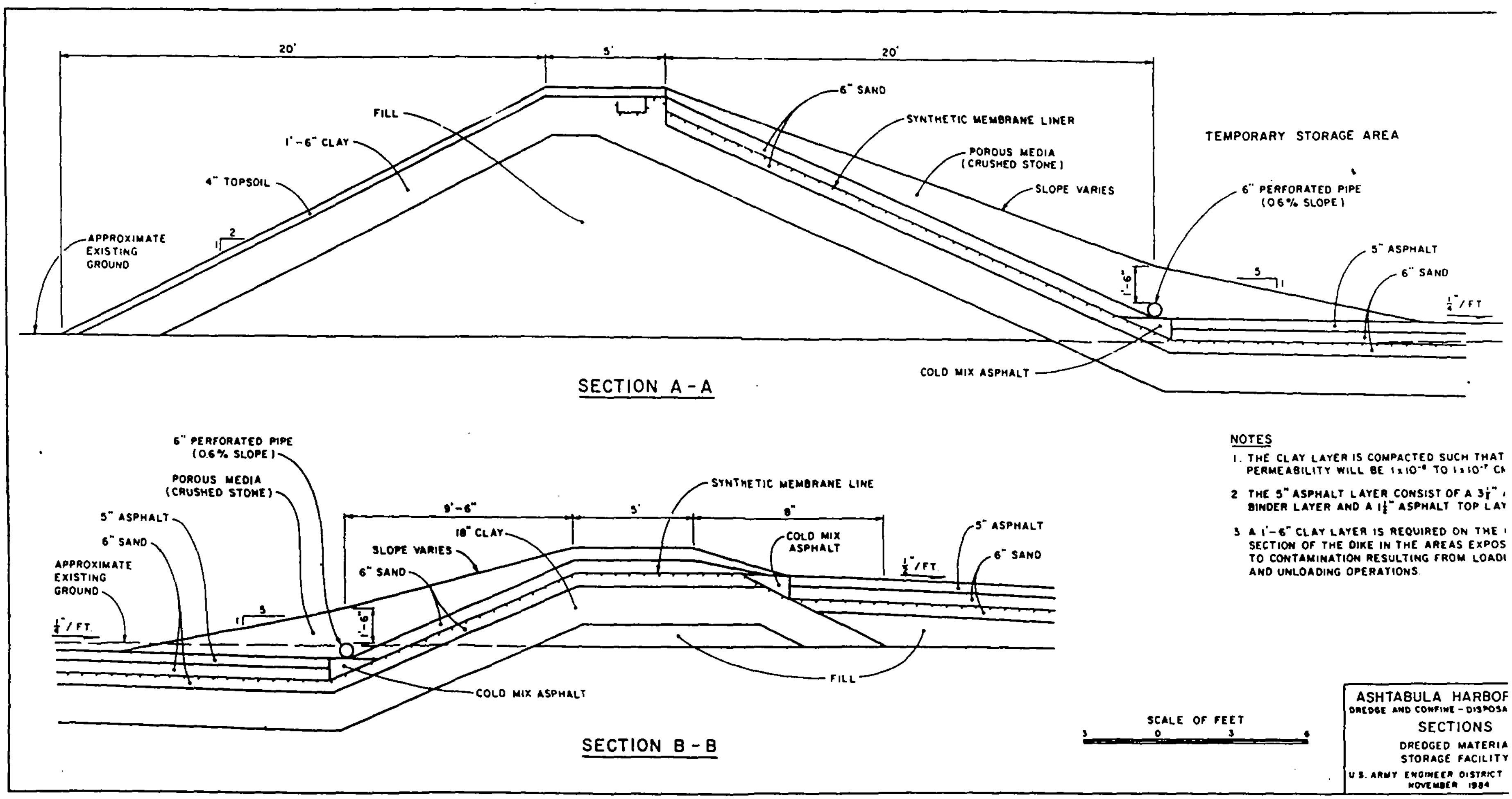

20'
5'
20'
6" SAND
SYNTHETIC MEMBRANE LINER
FILL
TEMPORARY STORAGE AREA
1'-6" CLAY
POROUS MEDIA (CRUSHED STONE)
4" TOPSOIL
SLOPE VARIES
6" PERFORATED PIPE (0.6% SLOPE)
APPROXIMATE EXISTING GROUND
5" ASPHALT
6" SAND
1'-6"
1/4"/FT
COLD MIX ASPHALT
SECTION A-A
6" PERFORATED PIPE (0.6% SLOPE)
POROUS MEDIA (CRUSHED STONE)
SYNTHETIC MEMBRANE LINE
5" ASPHALT
9'-6"
5'
8'
6" SAND
18" CLAY
COLD MIX ASPHALT
5" ASPHALT
APPROXIMATE EXISTING GROUND
SLOPE VARIES
1/4"/FT.
6" SAND
6" SAND
1/4"/FT.
FILL
COLD MIX ASPHALT
SECTION B-B
NOTES
1. THE CLAY LAYER IS COMPACTED SUCH THAT PERMEABILITY WILL BE 1x10⁻⁶ TO 1x10⁻⁷ CM
2. THE 5" ASPHALT LAYER CONSIST OF A 3½" BINDER LAYER AND A 1½" ASPHALT TOP LAY
3. A 1'-6" CLAY LAYER IS REQUIRED ON THE SECTION OF THE DIKE IN THE AREAS EXPOS TO CONTAMINATION RESULTING FROM LOADI AND UNLOADING OPERATIONS.
SCALE OF FEET
3 0 3 6
ASHTABULA HARBOR
DREDGE AND CONFINE - DISPOSA
SECTIONS
DREDGED MATERIA STORAGE FACILITY
U.S. ARMY ENGINEER DISTRICT
NOVEMBER 1984

PLATE 8

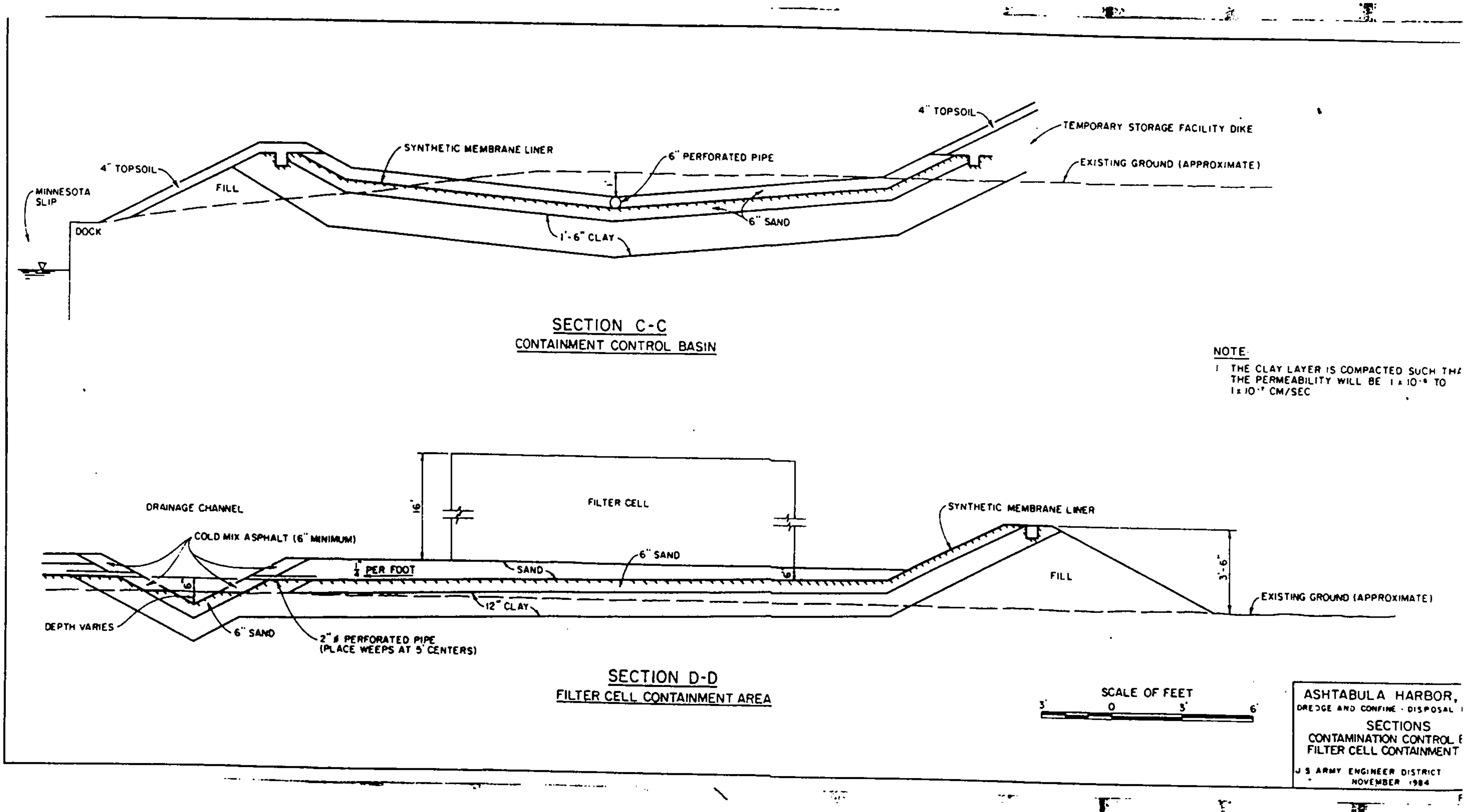

4" TOPSOIL
TEMPORARY STORAGE FACILITY DIKE
SYNTHETIC MEMBRANE LINER
6" PERFORATED PIPE
EXISTING GROUND (APPROXIMATE)
4" TOPSOIL
MINNESOTA SLIP
FILL
DOCK
6" SAND
1'-6" CLAY
SECTION C-C
CONTAINMENT CONTROL BASIN
NOTE
1 THE CLAY LAYER IS COMPACTED SUCH THA
THE PERMEABILITY WILL BE 1 x 10⁻⁶ TO
1 x 10⁻⁷ CM/SEC
16'
FILTER CELL
DRAINAGE CHANNEL
SYNTHETIC MEMBRANE LINER
COLD MIX ASPHALT (6" MINIMUM)
6" SAND
1/4 PER FOOT
SAND
FILL
3'-6"
12" CLAY
EXISTING GROUND (APPROXIMATE)
DEPTH VARIES
6" SAND
2" ⌀ PERFORATED PIPE
(PLACE WEEPS AT 5' CENTERS)
SECTION D-D
FILTER CELL CONTAINMENT AREA
SCALE OF FEET
3' 0 3' 6'
ASHTABULA HARBOR,
DREDGE AND CONFINE · DISPOSAL
SECTIONS
CONTAMINATION CONTROL
FILTER CELL CONTAINMENT
U.S. ARMY ENGINEER DISTRICT
NOVEMBER 1984

PLATE 9

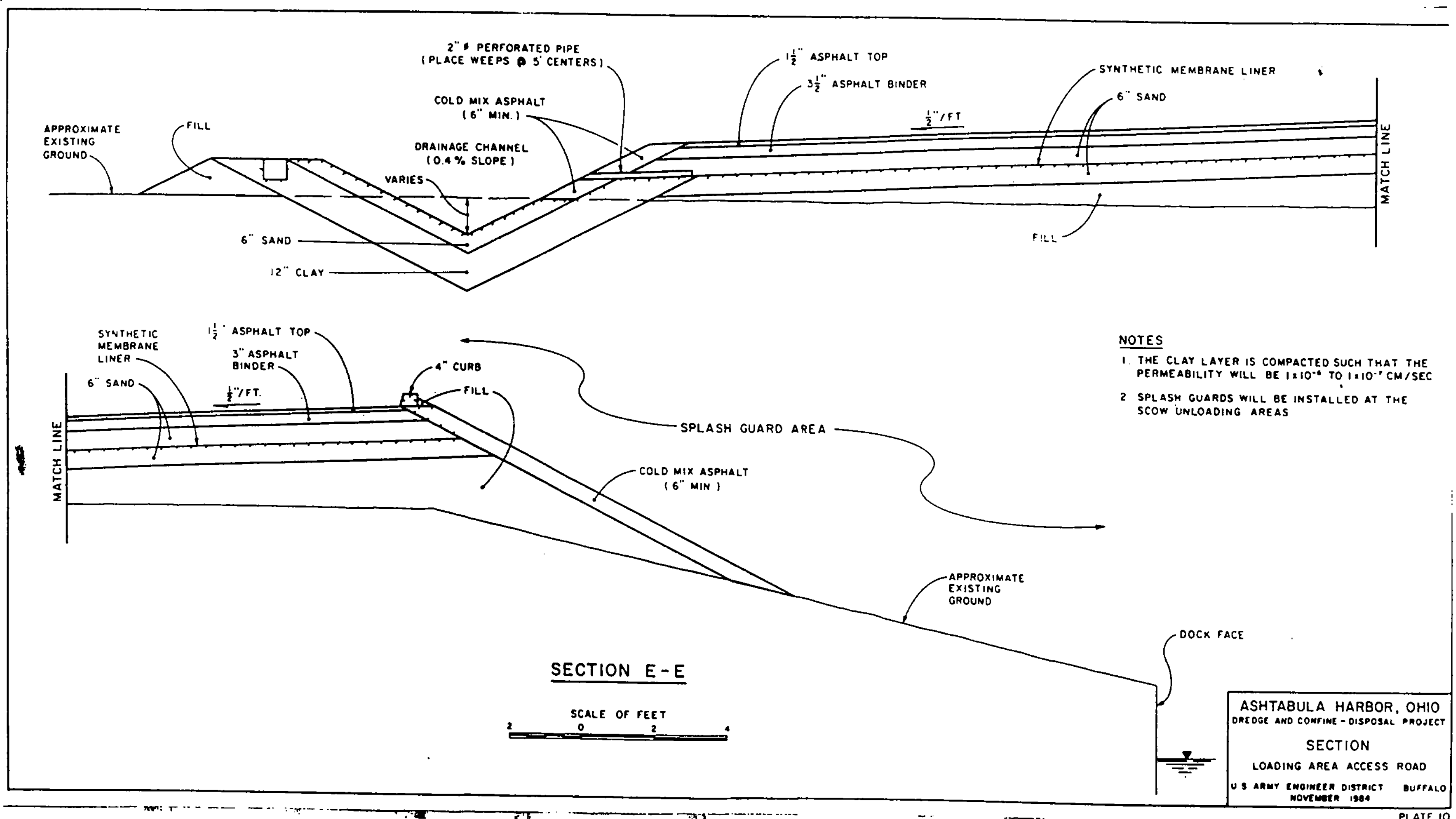
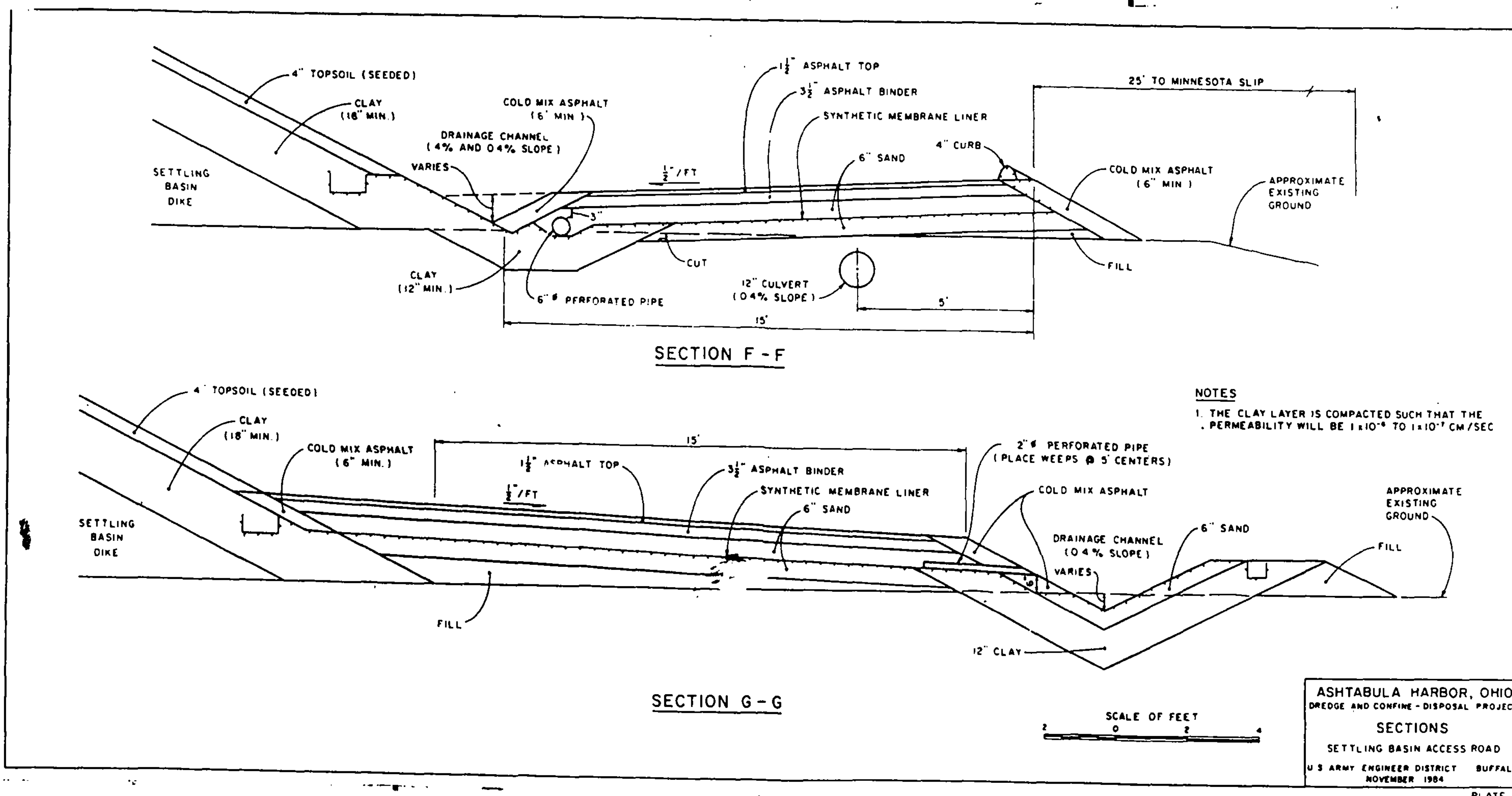
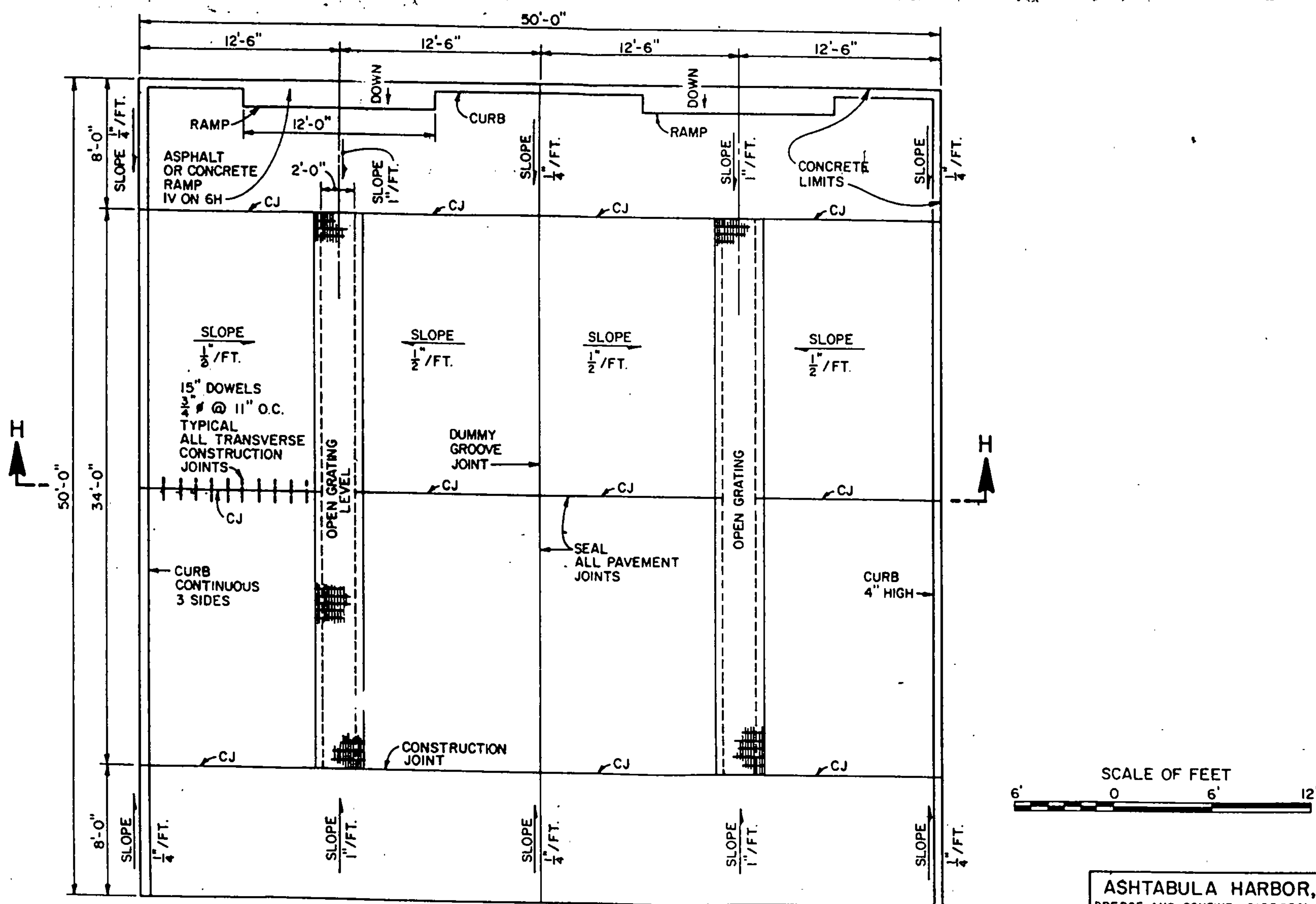

2" ø PERFORATED PIPE
(PLACE WEEPS @ 5' CENTERS)
1½" ASPHALT TOP
3½" ASPHALT BINDER
SYNTHETIC MEMBRANE LINER
6" SAND
½"/FT
COLD MIX ASPHALT
(6" MIN.)
APPROXIMATE EXISTING GROUND
FILL
DRAINAGE CHANNEL
(0.4% SLOPE)
VARIES
MATCH LINE
6" SAND
12" CLAY
FILL
SYNTHETIC MEMBRANE LINER
1½" ASPHALT TOP
3" ASPHALT BINDER
4" CURB
6" SAND
½"/FT.
FILL
NOTES
1. THE CLAY LAYER IS COMPACTED SUCH THAT THE PERMEABILITY WILL BE 1x10⁻⁶ TO 1x10⁻⁷ CM/SEC
2. SPLASH GUARDS WILL BE INSTALLED AT THE SCOW UNLOADING AREAS
SPLASH GUARD AREA
MATCH LINE
COLD MIX ASPHALT
(6" MIN)
APPROXIMATE EXISTING GROUND
DOCK FACE
SECTION E-E
SCALE OF FEET
2 0 2 4
ASHTABULA HARBOR, OHIO
DREDGE AND CONFINE-DISPOSAL PROJECT
SECTION
LOADING AREA ACCESS ROAD
U S ARMY ENGINEER DISTRICT BUFFALO
NOVEMBER 1984
PLATE 10

PLATE 10


4" TOPSOIL (SEEDED)
CLAY (18" MIN.)
COLD MIX ASPHALT (6" MIN)
DRAINAGE CHANNEL (4% AND 0.4% SLOPE)
VARIES
SETTLING BASIN DIKE
1/2"/FT
1 1/2" ASPHALT TOP
3 1/2" ASPHALT BINDER
SYNTHETIC MEMBRANE LINER
6" SAND
4" CURB
25' TO MINNESOTA SLIP
COLD MIX ASPHALT (6" MIN)
APPROXIMATE EXISTING GROUND
3"
CUT
FILL
CLAY (12" MIN.)
6" Φ PERFORATED PIPE
12" CULVERT (0.4% SLOPE)
5'
15'
SECTION F-F
4" TOPSOIL (SEEDED)
CLAY (18" MIN.)
COLD MIX ASPHALT (6" MIN.)
15'
1 1/2" ASPHALT TOP
1/2"/FT
3 1/2" ASPHALT BINDER
SYNTHETIC MEMBRANE LINER
6" SAND
SETTLING BASIN DIKE
FILL
2" Φ PERFORATED PIPE (PLACE WEEPS @ 5' CENTERS)
COLD MIX ASPHALT
DRAINAGE CHANNEL (0.4% SLOPE)
VARIES
6" SAND
APPROXIMATE EXISTING GROUND
FILL
12" CLAY
SECTION G-G
NOTES
1. THE CLAY LAYER IS COMPACTED SUCH THAT THE PERMEABILITY WILL BE 1x10⁻⁶ TO 1x10⁻⁷ CM/SEC
SCALE OF FEET
2 0 2 4
ASHTABULA HARBOR, OHIO
DREDGE AND CONFINE - DISPOSAL PROJECT
SECTIONS
SETTLING BASIN ACCESS ROAD
U S ARMY ENGINEER DISTRICT BUFFALO
NOVEMBER 1984
PLATE 11



PLAN

DECONTAMINATION PAD

PLATE 12

ASHTABULA HARBOR, O

DREDGE AND CONFINE - DISPOSAL PR

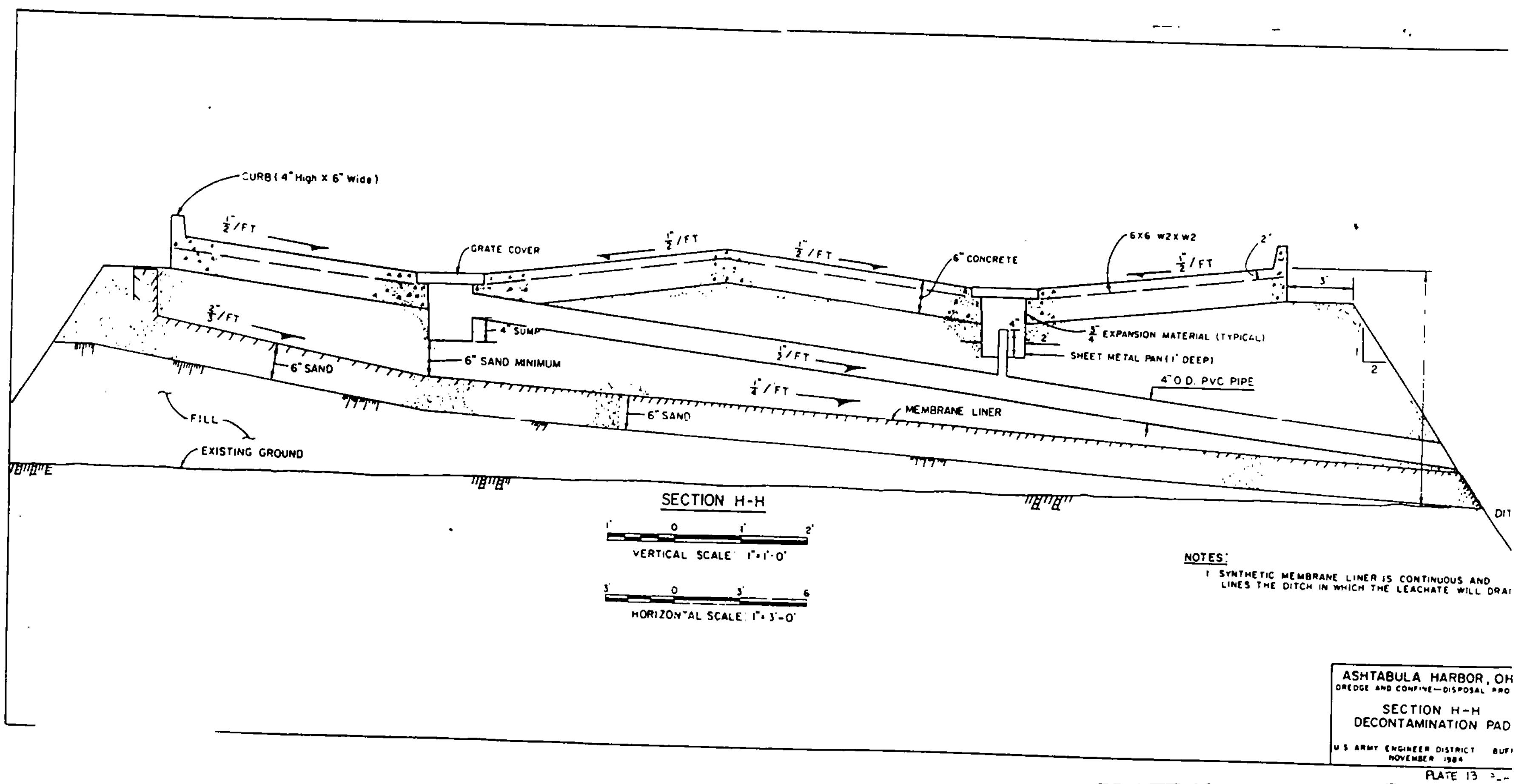
PLAN

DECONTAMINATION PA

U.S. ARMY ENGINEER DISTRICT BU

NOVEMBER 1984

PL



CURB (4" High X 6" Wide)
GRATE COVER
6" CONCRETE
6X6 W2XW2
EXPANSION MATERIAL (TYPICAL)
SHEET METAL PAN (1' DEEP)
4" O.D. PVC PIPE
4" SUMP
6" SAND MINIMUM
6" SAND
FILL
EXISTING GROUND
MEMBRANE LINER
SECTION H-H
VERTICAL SCALE: 1" = 1'-0"
HORIZONTAL SCALE: 1" = 3'-0"
NOTES:
1 SYNTHETIC MEMBRANE LINER IS CONTINUOUS AND LINES THE DITCH IN WHICH THE LEACHATE WILL DRAI
ASHTABULA HARBOR, OH
SECTION H-H
DECONTAMINATION PAD
NOVEMBER 1984
PLATE 13

PLATE 13

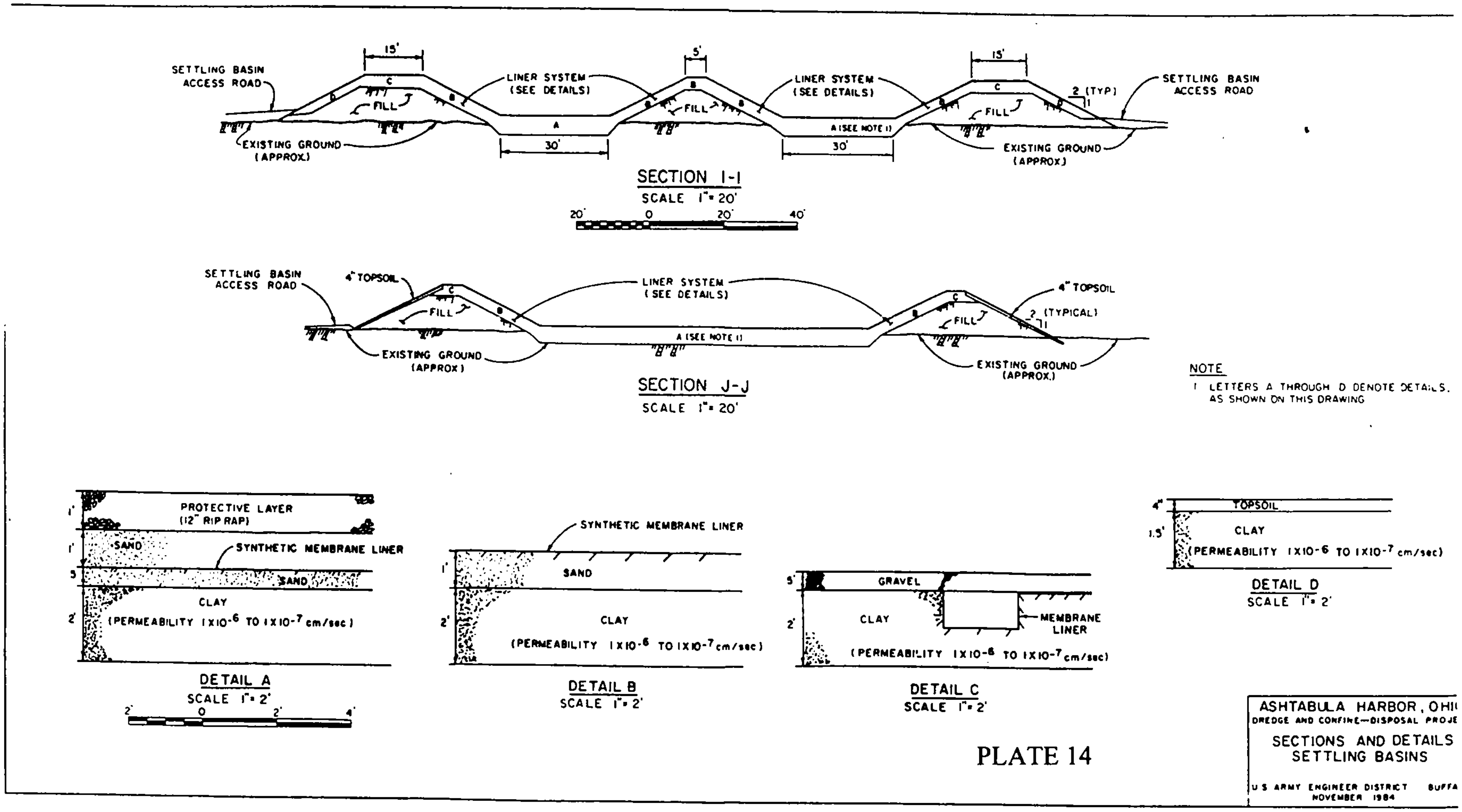
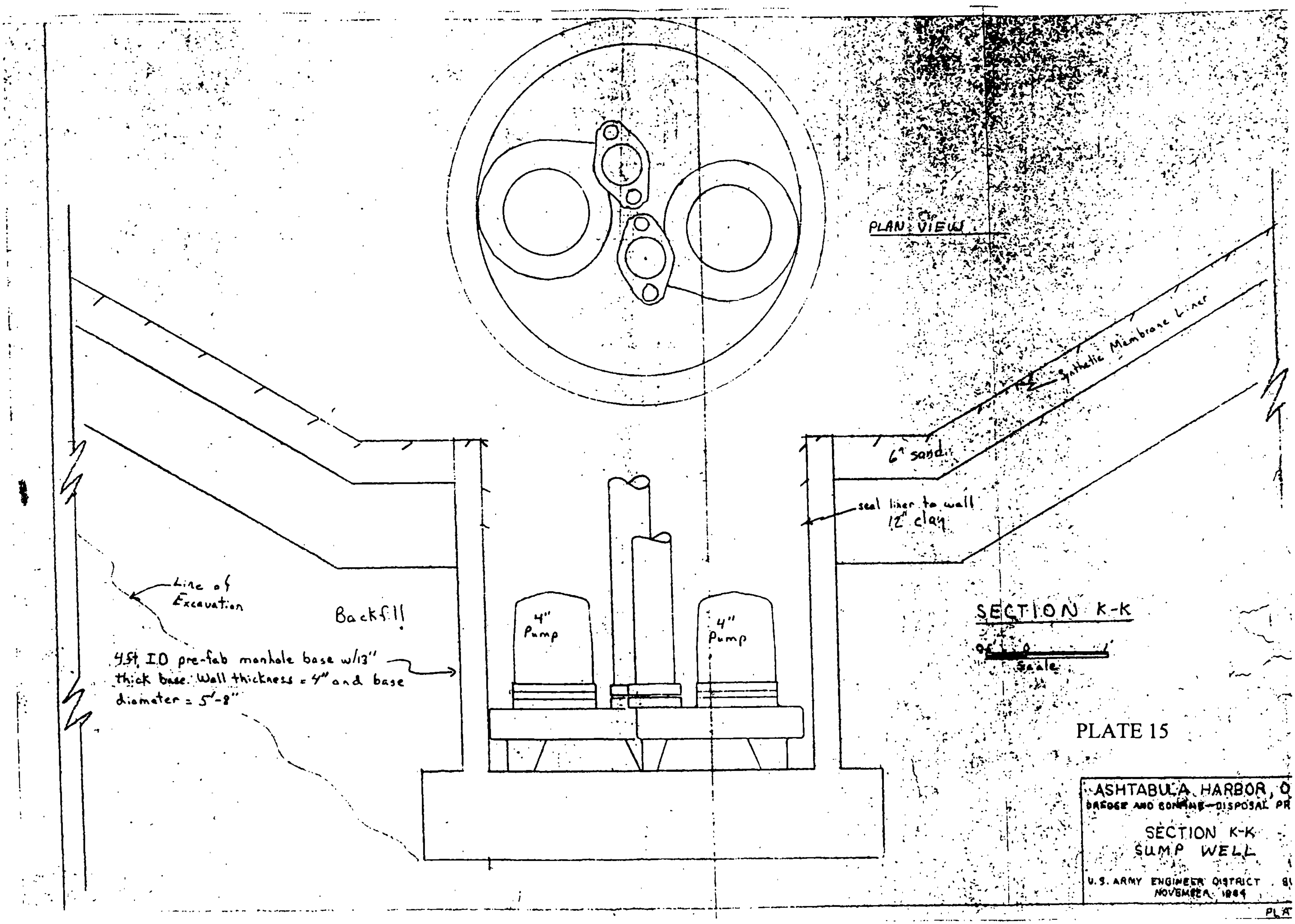
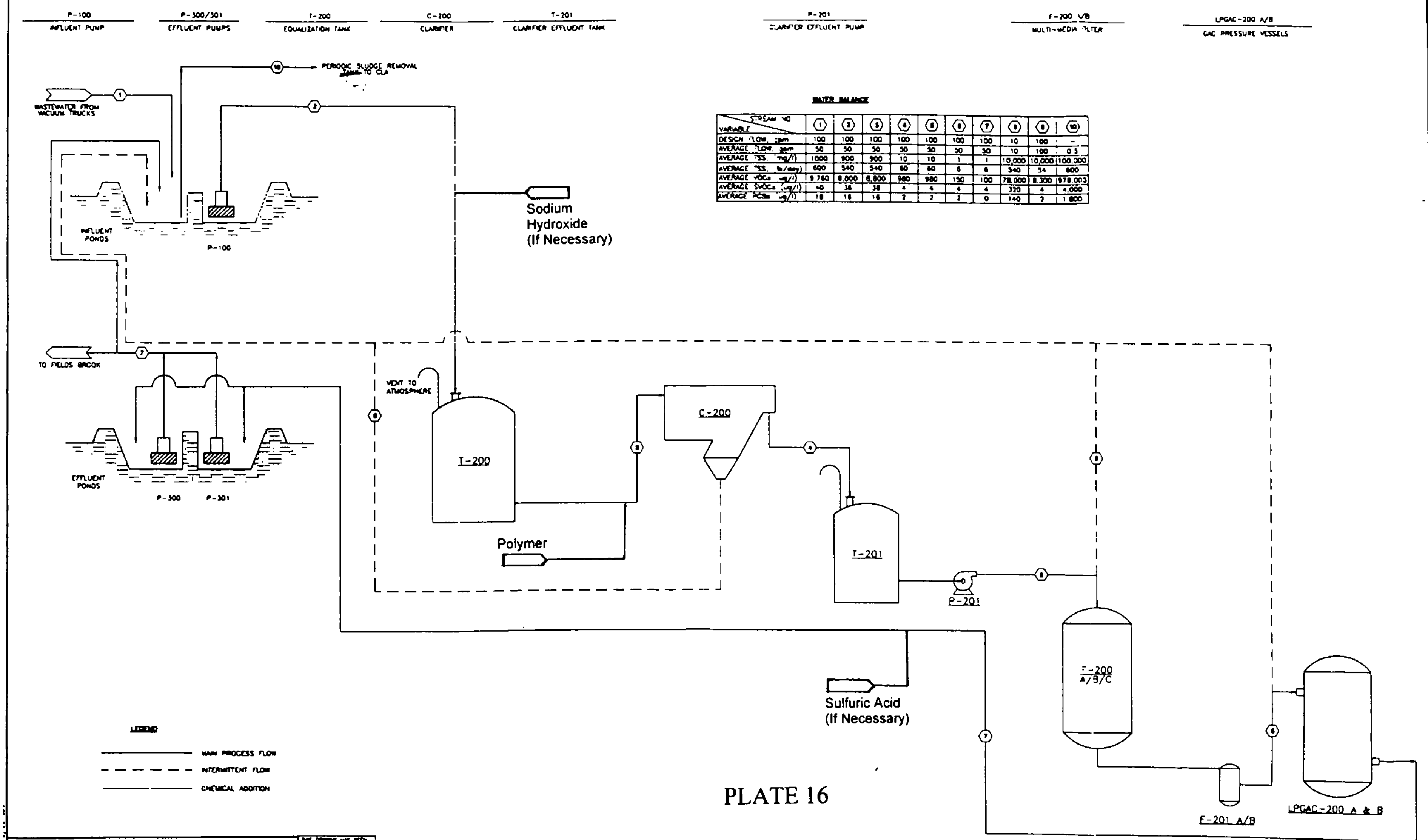

SETTLING BASIN ACCESS ROAD
15'
5'
LINER SYSTEM (SEE DETAILS)
FILL
EXISTING GROUND (APPROX)
30'
A (SEE NOTE 1)
2 (TYP)
SECTION I-I
SCALE 1" = 20'
20' 0 20' 40'
4" TOPSOIL
2 (TYPICAL)
SECTION J-J
SCALE 1" = 20'
NOTE
1 LETTERS A THROUGH D DENOTE DETAILS, AS SHOWN ON THIS DRAWING
PROTECTIVE LAYER (12" RIP RAP)
SAND
SYNTHETIC MEMBRANE LINER
CLAY
(PERMEABILITY 1X10-6 TO 1X10-7 cm/sec)
DETAIL A
SCALE 1" = 2'
2' 0 2' 4'
DETAIL B
SCALE 1" = 2'
GRAVEL
MEMBRANE LINER
DETAIL C
SCALE 1" = 2'
TOPSOIL
DETAIL D
SCALE 1" = 2'
ASHTABULA HARBOR, OHI
DREDGE AND CONFINE—DISPOSAL PROJE
SECTIONS AND DETAILS SETTLING BASINS
U S ARMY ENGINEER DISTRICT BUFFA
NOVEMBER 1984

PLATE 14



PLAN VIEW
Synthetic Membrane Liner
6" sand
seal liner to wall
12" clay
Line of Excavation
Backfill
4" Pump
4" Pump
4.5ft I.D pre-fab manhole base w/13" thick base. Wall thickness = 4" and base diameter = 5'-8"
SECTION K-K
Scale
ASHTABULA HARBOR, O
DREDGE AND CONFINE—DISPOSAL PR
SECTION K-K
SUMP WELL
U.S. ARMY ENGINEER DISTRICT
NOVEMBER 1984

PLATE 15



WATER BALANCE

STREAM NO / VARIABLE	1	2	3	4	5	6	7	8	9	10
DESIGN FLOW, gpm	100	100	100	100	100	100	100	10	100	-
AVERAGE FLOW, gpm	50	50	50	50	50	50	50	10	100	0.5
AVERAGE TSS, (mg/l)	1000	900	900	10	10	1	1	10,000	10,000	100,000
AVERAGE TSS, (lb/day)	600	540	540	60	60	6	6	540	54	600
AVERAGE VOCs (ug/l)	9,760	8,800	8,800	980	980	150	100	78,000	8,300	978,003
AVERAGE SVOCs (ug/l)	40	36	38	4	4	4	4	320	4	4,000
AVERAGE PCBs (ug/l)	18	18	16	2	2	2	0	140	2	1,800

PLATE 16

THIS DRAWING HAS BEEN REDUCED APPROXIMATELY HALF SCALE FROM IT'S ORIGINAL SIZE OF 22x34

NO	DATE	REVISIONS	BY	CHK
1		WASTEWATER TREATMENT PLAN		

DRAWN: JAZ | PROJECT NO: 48484,44.02
ENGINEER: KSC | SCALE: NTS
CHECKED: | APPROVED:
DATE: | DATE:

Harding Lawson Associates
Engineering and Environmental Services
707 Seventeenth Street
Suite 2400
Denver, Colorado 80202
(303) 292-5365

FIELDS BROOK SUPERFUND SITE

ASHTABULA, OHIO

PROCESS

PROCESS FLOW DIAGRAM

DRAWING NO P-4

Appendix P

Landfill Design

Prepared by:
Environmental Engineering Section
U.S. Army Corps of Engineers Buffalo District
August 1997
Revised December 2000, March 2001

1.0 PURPOSE

The purpose of this appendix is to investigate and summarize design requirements for the construction, maintenance and closure of a landfill used to dispose of sediments dredged from the Ashtabula River. This is a feasibility level design which will be used to form the basis for a cost estimate to determine if landfill construction is an appropriate and cost effective alternative for the disposal of Ashtabula River Sediments. A more detailed design will be completed if it is determined that landfilling the sediments is a viable option. The State Road site is currently the prime candidate site for the landfill. More detail on the potential disposal site is included in Appendix N to this report.

2.0 ASSUMPTIONS

The following assumptions were made in the preparation of this appendix.

1. The Ashtabula River Partnership goal is to dredge the river using the "deep dredging scenario" discussed in Appendix E. The volume of sediments removed in this scenario is calculated at approximately 696,000 cubic yards. This number includes 21,000 cubic yards of extra dredging in areas that may require specialty dredging due to high PCB concentration.

2. Approximately 150,000 cubic yards of dredged sediment will be disposed in a Toxic Substances Control Act (TSCA) regulated landfill. This estimate is based on preliminary calculations made by Buffalo District using the Groundwater Modeling System (GMS) software. Both the USEPA and the OEPA have concurred with the results of the volume estimates done by WES which show that there is approximately 28,000 cubic yards of sediment in the river with PCB concentrations greater than 50 mg/kg and 53,000 cubic yards greater than 40 mg/kg. Both agencies have also concurred that it would be appropriate, given the uncertainties in the modeling approach, to use 40 mg/kg as a cut-off for sediments to be disposed as TSCA waste. The total of 150,000 cubic yards of sediment is based on the actual volume of sediment that would have to be removed, given the location of the contamination and the limitations of dredging equipment, to remove the sediment greater than 40 mg/kg.

3. Additional dredging and/or disposal of non-TSCA sediments may be necessary and will be planned as shown below:

Source of Sediments	Volume
Interim Dredging and Levee Disposal	70,000 cy

4. Available area for the site is limited to about 33 acres.

5. The sediments will be delivered to the site at a solids concentration of at least 70%, which will allow the sediment to past the paint filter test. The unconfined compressive strength of the sediment will be at least 10 psi which will be

sufficient to ensure the stability of the landfill and allow moving the sediment within the landfill using standard equipment. Details on the dewatering operation are included in Appendix O.

6. Calculations done to show the amount of settling in the landfill determined that to contain the 696,000 cubic yards of sediment dredged (150,000 cy TSCA and 546,000 cy non-TSCA) a non-TSCA landfill with a capacity of 400,000 cy and a TSCA landfill with a capacity of 100,000 cy would be required. These landfill capacities account for bulking, dewatering, and settling, along with disposal of 70,000 cy from the interim disposal facility. Details of the settling analysis are included in Appendix M.

3.0 REGULATORY CONSIDERATIONS

The sediments from the Ashtabula River have been extensively sampled for both PCBs and compounds regulated under the Resource Conservation and Recovery Act (RCRA). The RCRA sampling was conducted using the Toxicity Characteristic Leaching Procedure as detailed in 40 CFR Part 261. None of the samples taken from the river contained leachable levels of regulated compounds in excess of RCRA levels. Consequently, the USEPA and the OEPA have agreed that sediments dredged from the river will not be considered hazardous waste under RCRA. It has also been agreed that separate disposal cells will be constructed to isolate the TSCA sediments from the non-TSCA sediments.

3.1 TSCA Regulated Sediments

The Toxic Substances Control Act of 1976 (TSCA), 15 U.S.C. 2601-2671, is a federal law enacted to protect human health and the environment by requiring testing and necessary use restrictions on certain chemical substances, such as PCBs. In general, the chemicals subject to TSCA, such as PCBs, are those not regulated by other laws such as RCRA. The regulations developed by the U.S. Environmental Protection Agency (USEPA) to regulate PCBs under TSCA are found at Title 40 CFR Part 761.

The USEPA is the sole authority for enforcement of the Toxic Substances Control Act, although the Act specifically provides that the states are not prohibited from enacting their own legislation to regulate chemicals. Consequently, while the state of Ohio has a TSCA office, the final decision on TSCA issues rests with the Federal Government at Region 5 USEPA.

The portion of the PCB regulations applicable to the design and operation of a landfill is 40 CFR § 761.75. Subpart D of 40 CFR Part 761 governs the storage and disposal of PCBs. This subpart requires dredged materials with PCB concentrations greater than or equal to 50 mg/kg to be disposed in one of three ways:

1. In an incinerator which complies with paragraph 761.70;

2. In a chemical waste landfill which complies with paragraph 761.75; or

3. Using an alternative treatment or disposal method approved by the Regional Administrator [40 CFR 761.60 (a) (5)]. The application must contain information that, based on technical, environmental, and economic consideration, disposal in an incinerator or chemical waste landfill is not reasonable and appropriate, and that the alternate disposal method will provide adequate protection to health and the environment.

Appendix L of this report discusses the feasibility and costs of disposal in a commercial facility, incineration and other potential sediment treatment technologies. Consequently, the only option that will be discussed in the appendix is the design and construction of a landfill.

3.2 Non-TSCA Regulated Sediments

Sediments with PCB concentrations less than 50 mg/kg are not regulated under TSCA if the spill occurred before February 17, 1978 (before TSCA was implemented). Based on earlier review of this appendix, the USEPA has concurred that the sediments in the Ashtabula River fall in this "historic" category since the contamination pre-dates TSCA. These sediments, while not considered a solid waste by the Corps of Engineers, will require disposal in a manner acceptable to the State of Ohio. The State of Ohio has requested that Ohio Solid Waste Regulations be used as a guide for this conceptual design, to ensure protection of the environment.

The State of Ohio is a RCRA authorized state which has its own regulations for solid waste landfills. Since these regulations are at least as strict and in some cases stricter than the Federal Regulations, State Regulations and Guidance will be used to conceptually design the non-TSCA portion of the Landfill. Regulations covering the design and operation of solid waste landfills in Ohio are discussed in Ohio Administrative Code (OAC) Chapter 3745-27.

4.0 LANDFILL SITING AND DESIGN REQUIREMENTS

The objectives in siting and designing a landfill are to provide long-term environmental protection, ensure regulatory compliance, and achieve cost-effective utilization of resources, manpower, equipment, and space. This section will discuss in detail some of the siting and design requirements of TSCA and the Ohio Solid Waste Regulations. Table 1 shows a summary of the requirements of TSCA and the Ohio Solid Waste Regulations for various aspects of the design. A more detailed discussion follows the table and additional information can be found in the governing regulations.

Table 1. Summary of TSCA and Ohio Solid Waste Landfill Requirements

Issue	TSCA Reference	TSCA Requirement	State Solid Waste Reference	State Solid Waste Requirement
Soil	40 CFR761.75 (b) (1)	>30% clay and silt content soil 4 feet thick in-place soil, or 3 feet thick compacted soil, permeability <10^{-7} cm/sec, liquid limit >30, plasticity index >15	OAC Chapter 3745-27-08 (C) (1)	Constructed in eight lifts with permeability of <10^{-7} cm/sec. Soil particles less than two inches. <10%by weight greater than 0.75 inches. >50 % of soil particles passing through a 200 mesh sieve. >25% of particles with dimension greater than 0.002 mm. >95% compaction using ASTM D-698. Consider slope stability. Must be able to bear weight of waste without failure. Five feet thick or three feet thick with geosynthetic clay liner. Must be modeled by test pads.
Hydrologic Conditions	40 CFR 761.75 (b) (3)	Bottom of liner must be at least 50 feet from historical high water table. Avoid floodplains, shorelands, groundwater recharge areas. No hydraulic connection between site and surface waters.	OAC Chapter 3745-27-08 (C) (6) OAC Chapter 3745-27-07 (H) (2)(e) OAC Chapter 3745-29-07 (H) (2)(e) OAC Chapter 3745-30-06 (B) (15)	Designed to accommodate 25 year - 24 hour storm event. Bottom must be at least 15 feet above aquifer. Surface water treatment, such as settling ponds, required during construction and operation, but not required after closure.
Topography	40 CFR 761.75	Low to moderate relief to minimize erosion and prevent landslides and slumping.	OAC Chapter 3745-27-20	Prohibitions: Unstable Areas and Seismic Impact Zones.
Synthetic Membrane Liner	40 CFR 761.75 (b) (2)	Use when hydrogeology requires permeability equivalent to 10^{-7} cm/sec. 30 mils minimum thickness.	OAC Chapter 3745-27-08 (C) (2)	60 mil minimum thickness. 40 mils allowed with waiver.
Leachate Collection System	40 CFR 761.75 (b) (7)	Install above landfill bottom. System design (simple or compound leachate collection or suction lysimeter) depends on geologic setting.	OAC Chapter 3745-27-08 (C) (4)	Designed to prevent clogging and crushing. Drainage layer 1 foot thick with a permeability >10^{-3} cm/sec. Pipes slope at least 0.5 percent. Clean-out capabilities and sealed joints.
Explosive Gas Control and Monitoring			OAC Chapter 3745-27-08 (C) (10 and 11)	Explosive gas control structures shall be designed to prevent accumulation or lateral travel of explosive gas. Discussions with OEPA indicate that a waiver from this requirement may be appropriate. Further investigation is required.
Supporting Facilities	40 CFR 761.75 (b) (9)	6 foot woven mesh fence, wall or other device to prevent entry of people or animals. Adequate roads to support operation.	OAC Chapter 3745-27-08 (C) (8)	Grades of access roads not to exceed 12 %. Survey in facility using three permanent third order bench marks. Restrict public access.
Waste Placement	40 CFR 761.75 (b) (8) (i)	Segregate TSCA and non-TSCA wastes. Don't store with incompatible wastes such as organic solvents.	OAC Chapter 3745-27-19 (L)	PCB waste regulated under TSCA and hazardous waste prohibited. Variance would require separation of TSCA and non-TSCA waste.
Pre-Operation	40 CFR 761.75 (b) (6) (i)	Sample prior to commencing operation.	OAC Chapter 3745-27-10	Initial four replicate samples for full Appendix I parameters.

Table 1. Summary of TSCA and Ohio Solid Waste Landfill Requirements

Issue	TSCA Reference	TSCA Requirement	State Solid Waste Reference	State Solid Waste Requirement
Ground and Surface Water Sampling	A			Also require establishment of background wells. May be able to reduce the number of parameters sampled based on knowledge of waste.
Surface Water Sampling During Operation	40 CFR 761.75 (b) (6) (i) (B)	Sample any surface water course designated by USEPA.	OAC Chapter 3745-27-19 (J) OAC Chapter 3745-27-08 (C) (6)	Surface water discharges regulated under NPDES Industrial Discharge Permit. ORC Chapter 6111 monitoring may be required under OAC 3745-27-10.
Post-Closure Surface Water Sampling	40 CFR 761.75 (b) (i) (C)	Sample any surface water course designated by the USEPA. Sample at least every six months after final closure for a time period specified by the USEPA.	OAC Chapter 3745-27-19 (J) OAC Chapter 3745-27-08 (C) (6)	Surface water discharges regulated under NPDES Industrial Discharge Permit. ORC Chapter 6111 monitoring may be required under OAC Chapter 3745-27-10.
Leachate Collection System Monitoring	40 CFR 761.75 (b) (6) (iii) and 40 CFR 761.75 (b) (6) (ii) (A)	Monitor monthly for quantity and physicochemical parameters (PCBs, pH, specific conductance and chlorinated organics). Drainage layer with permeability $>10^{-2}$cm/sec	OAC Chapter 3745-27-10 OAC Chapter 3745-27-19 (M)	Yearly grab samples for Appendix I parameters and/or other contaminants of concern as agreed to by OEPA. May be able to reduce the number of parameters sampled based on knowledge of waste.
Groundwater Monitoring Well Requirements	40 CFR 761.75 (b) (6) (ii) (B)	At least three wells are required that are equally spaced along a line through the center of the disposal area from highest to lowest water table elevation.	OAC Chapter 3745-27-10	Analyze for contaminants of concern at least semi-annually during construction and after closure around perimeter of landfill, as close to the limits of waste as possible. Establish and monitor background wells.
Groundwater Monitoring Well Design Requirements	40 CFR 761.75 (b) (7)	Must be cased, have a removable cap, have annular space between the monitor zone and the surface backfilled with Portland cement or equivalent. Sample as specified in permit	OAC Chapter 3745-27-10	Must be cased in a manner that maintains integrity of borehole. Annular space must be sealed. Casing shall be properly screened.
Initial Report	40 CFR 761.75 (c) (1)	Location and detailed description. General site plan and site drawing. Engineering report describing compliance requirements. Available facilities and sampling and monitoring requirements. PCB waste volume. Local, State and federal permits or approvals.	OAC Chapter 3745-27-06	Permit-to-Install application, detailed description, site plans, engineering information and zoning designation.

Operations Plan	40 CFR 761.75 (b) (8) (ii) and 40 CFR 761.75 (c) (1) (vii)	Explanation of Recordkeeping. Surface water handling, excavation and backfilling procedures. Waste segregation burial coordinates. Vehicle and Equipment Movement. Roadway use. Leachate collection systems. Sampling and monitoring procedures. Emergency contingency plans. Vandalism and unauthorized waste security measures.	OAC Chapter 3745-27-09 OAC Chapter 3745-27-06 OAC Chapter 3745-27-19	Operating plans, known as the operating record, must include plan drawings of the facility, leachate collection system and surface water control. Must include cost estimates and financial assurance mechanisms. Explosive gas monitoring plan, as well as closure and post closure plans are required. Annual Operating report must be submitted to OEPA.
Landfill Cap Design			OAC Chapter 3745-27-08 (C) (15)	Must consist of 18" recompacted soil barrier, and 12" granular material drainage layer. Frost protection is also necessary in Ashtabula County which brings the required total thickness to 36".

4.1 Soil Base

The purpose of the soil base is to support the weight of the landfill and provide a barrier to prevent or limit the amount of leachate escaping the landfill. The requirements of the Ohio Solid Waste Regulations are generally more restrictive than TSCA and require that the soil base meet the following requirements.

1. Be constructed using loose lifts eight inches thick or less to achieve uniform compaction. Each lift shall have a maximum permeability of 1×10^{-7} cm/sec.

2. Be constructed of a soil with a maximum clod size of three inches or half the lift thickness, whichever is less.

3. Be constructed of a soil:

    - With one hundred percent of the particles having a maximum dimension not greater than two inches.

    - With not more than ten percent of the particles, by weight, having a dimension greater than 0.75 inches.

    - With not less than fifty percent of the particles, by weight, passing through the 200-mesh sieve.

    - With not less than twenty-five percent of the particles, by weight, having a maximum dimension not greater than 0.002 millimeters.

4. Be compacted to at least ninety-five percent of the maximum "Standard Proctor Density" using ASTM D-698 or at least ninety percent of the maximum "Modified Proctor Density" using ASTM D-1557.

5. Be compacted at a moisture content at or wet of optimum.

6. Not be comprised of solid waste.

7. Be constructed using the number of passes and lift thickness, and the same or similar type and weight of compaction equipment established by required testing.

8. Be placed on the bottom and exterior excavated sides of the landfill and have a minimum bottom slope of two percent and a maximum slope based on:

    - Compaction equipment limitations.

    - Maximum friction angle between any soil-geosynthetic interface and between any geosynthetic-geosynthetic interface.

- Resistance of geosynthetic and geosynthetic seams to tensile forces.

9. Be constructed on a prepared surface that shall:

    - Be free of debris, foreign material, and deleterious material.
    - Be able to bear the weight of the landfill and its construction and operations without causing or allowing a failure of the liner to occur through settling.
    - Not have any abrupt changes in grade that may result in damage to geosynthetics.

10. Be at least:

    - Five feet thick, unless the director approves an alternate thickness, to be no less than three feet, based on the result of the engineering calculations.
    - Three feet thick with a geosynthetic clay liner unless the director approves an alternate thickness for the recompacted soil liner, to be no less than one and one-half feet thick if the director approves the alternate thickness based on the results of engineering calculations.
    - Based on a design acceptable to the director that is no less protective of human health and the environment than the two options listed above.

11. Have a factor of safety for hydrostatic uplift not less than 1.4. This issue is discussed in more detail in Appendix M.

12. Be adequately protected from damage due to desiccation, freeze/thaw cycles, wet/dry cycles, and the intrusion of objects during construction and operation.

13. The recompacted soil liner and the recompacted soil barrier layer in the cap system shall be modeled by the construction of test pads. Test pads shall:

    - Be designed such that the proposed tests are appropriate and their results are valid.
    - Be constructed to establish the construction details, or verify or amend the construction details proposed in the approved permit, which are necessary to obtain sufficient compaction to satisfy the permeability requirement. The construction details include such items as the lift thickness, the water content necessary to achieve

the desired compaction, and the type, weight, and number of passes of construction equipment.

- Be constructed prior to the construction of the sanitary landfill component which the test pad will model.

- Be constructed whenever there is a significant change in soil material properties or equipment used in construction.

- Have a minimum width three times the width of compaction equipment, and a minimum length two times the length of compaction equipment, including power equipment and any attachments.

- Be comprised of at least four lifts.

- Be tested for field permeability, following the completion of test pad construction, using methods acceptable to the director. For each lift, a minimum of three tests for moisture content and density shall be performed.

- Be reconstructed as many times as necessary to meet the permeability requirement. Any amended construction details shall be noted for future soil liner or soil barrier layer in alterations section of the construction certification report prepared in accordance with OAC Chapter 3745-27-08 (H).

- An alternative to test pads may be used if it is demonstrated to the satisfaction of the director or his authorized representative that the alternative meets the requirements of OAC Chapter 3745-27-08(H).

14. Construction details will be modified as necessary to incorporate changes necessitated by the results of the test pad.

15. Moisture content and density testing of the recompacted soil liner and recompacted soil barrier in the cap system shall be performed at a frequency of no less than five tests per acre per lift. Any penetrations shall be repaired using methods acceptable to the director.

16. Additionally, TSCA requires that the soil used in the liner have a liquid limit greater than 30 and a plasticity index greater than 15.

4.2 Hydrologic Conditions

The requirements of TSCA are generally more restrictive than the Ohio Solid Waste Regulations. TSCA requires that the bottom of the landfill be at least 50 feet above the historical high groundwater table. Since there is no location near Ashtabula that can meet this requirement, representatives from the TSCA section of Region 5 USEPA have indicated that they may require a double liner and double leachate collection to mitigate this deficiency.

OEPA requires the bottom of the landfill to be isolated at least 15 feet from the uppermost aquifer system. This requirement cannot be waived and is discussed in detail in OAC Chapter 3745-27 and 3745-30. Appendix N provides additional information on the hydrogeology of the potential landfill site.

OEPA and TSCA also require that floodplains, shorelands, and groundwater recharge areas shall be avoided and that there is no hydraulic connection between the site and standing or flowing surface water. Both TSCA and the Ohio Solid Waste Regulations have requirements for wells to conduct groundwater monitoring.

4.3 Flood Protection

Both TSCA and the Ohio Solid Waste Regulations include a requirement for flood protection. The general requirements are the same under both regulations, but the Ohio Solid Waste Regulations provide more detail and thus is described below. Since the site being considered for the disposal area is above the 100 year flood plain, requirements for disposal facilities built within the 100 year floodplain will not be discussed. The requirements for facilities built above the 100 year floodplain include:

1. Any permanent or temporary surface water control structures, excluding sedimentation ponds shall at a minimum, be designed to accommodate, by non-mechanical means, the peak flow from the twenty-five year/twenty-four hour storm event and to minimize silting and scouring.

2. Any temporary surface water control structures shall be designed to accommodate the peak flow from the twenty-five-year/twenty-four-hour storm event.

3. Surface water control structures shall be designed to minimize silting and scouring.

Discussions with the OEPA indicate that control of surface water with impoundments will likely be required during the construction of the landfill to prevent scouring and large sediment loads from reaching waterways. Surface impoundments may also be used to store water pumped from the landfill that has ponded due to rainfall or separation from the moist sediments. Since a cap will cover the completed landfill, no surface water impoundment or treatment will be required after the landfill is covered and closed.

4.4 Synthetic Membrane Liner

The requirements of the Ohio Solid Waste Regulations are more restrictive than TSCA. The Ohio Solid Waste Regulations require:

A flexible membrane layer, placed on the recompacted soil liner or recompacted soil barrier layer, shall be sixty-mil high density polyethylene (HDPE). Other materials or thicknesses may be used if, at a minimum, the flexible membrane liner (FML) meets all of the following:

- Be negligibly permeable to fluid migration.
- Be physically and chemically resistant to chemical attack by the solid waste, leachate, or other materials which may come in contact with the flexible membrane liner.
- Be seamed to allow no more than negligible amounts of leakage; the seaming material shall be physically and chemically resistant to chemical attack by the solid waste, leachate, or other materials which may come in contact with the seams.
- Have properties for its installation and use which are acceptable to the director.
- Be protected from the drainage layer by a cushion layer as required by the director.
- Have a minimum thickness of forty mils and be tested in accordance with State of Ohio Regulations.

4.5 Leachate Collection

Both TSCA and the Ohio Solid Waste Regulations include requirements for leachate collection, but the latter is more specific and restrictive. The Ohio Solid Waste Regulations require that:

1. The leachate collection system shall be constructed and designed to prevent clogging and crushing of the system and to maintain less than a one foot depth of leachate over the composite liner.
2. The leachate collection system shall include the following components:
    - A drainage layer placed on top of the flexible membrane liner that is able to rapidly collect leachate for removal from the system.
    - The drainage layer may consist of either a granular material with a minimum thickness of twelve inches and a minimum permeability

of 1 x 10^{-3} cm/sec, or a drainage net constructed of high density polyethylene (HDPE) or an equivalent physically and chemically resistant material. TSCA generally requires a permeability of 10^{-2} cm/sec. OEPA forbids the use of carbonate materials in the drainage layer.

- A filter layer on top of the drainage layer to prevent clogging of the drainage layer.

- A protective layer to protect the composite liner and leachate collection system from intrusion of objects during construction and operation.

3. Lift stations are to be protected from adverse effects from leachate and differential settling. If manholes are used as lift stations, they shall be equipped with automatic high level alarms located no greater than six feet above the invert of the leachate inlet pipe. Lift station pumps shall be of adequate capacity and shall automatically commence pumping before the leachate elevation activates the high level alarm.

4. Any leachate conveyance structures outside the limits of solid waste placement shall be no less protective of the environment than the residual waste landfill.

4.6 Supporting Facilities and Other Requirements

Both TSCA and the Ohio Solid Waste Regulations have requirements for the design and construction of support facilities at landfills and other requirements. These requirements are discussed separately below.

1. TSCA

   - A six foot woven mesh fence, wall or similar device shall be placed around the site to prevent unauthorized persons and animal from entering. Roads shall be maintained to and within the site, which are adequate to support the operation and maintenance of the site without causing safety or nuisance problems or hazardous conditions.

   - The site shall be operated and maintained in a manner to prevent safety problems or hazardous conditions from spilled liquids and windblown materials.

2. Ohio Solid Waste Regulation

A natural or man-made barrier (fence) is required around the perimeter of the facility. At least three permanent third order benchmarks on separate sides of the sanitary landfill facility shall be within easy access to the limits of solid waste placement in accordance with the following:

- Survey marks shall be referenced horizontally to the 1927 North American Datum, 1983 North American Datum, or State Plane Coordinate System and vertically to the 1929 or 1988 North American Vertical Sea Level Datum as identified on the 7.5 minute series quadrangle sheets published by the United States Geological Survey.

- Survey marks shall be at least as stable as a poured concrete monument ten inches in diameter installed to a depth of forty-two inches below the ground surface. Each constructed survey mark shall include a corrosion resistant metallic disk which indicates horizontal and vertical coordinates of the survey mark and shall contain a magnet or ferromagnetic rod to allow identification through magnetic detection methods.

- Grades of access roads shall not exceed twelve percent. All access roads shall be designed to allow passage of loaded vehicles during all weather conditions with minimum erosion and dust generation and with adequate drainage.

- Ohio EPA has indicated that they will likely require an air permit for fugitive dust emissions during the construction and filling process.

4.7 Waste Placement Incompatibility

TSCA includes a requirement that wastes that are incompatible with PCBs, such as organic solvents, not be disposed with PCBs. This will not be an issue, since this landfill will only be used for the disposal of dredged material and not organic solvents. The concentration of solvents in the dredged material is very low, significantly less than 1 mg/kg on average, and should not have a detrimental effect on the leachability of the PCBs. Both Federal and State regulations prevent disposal of liquid wastes in the type of landfills under consideration in Ashtabula.

4.8 Explosive Gas Removal and Monitoring

The Ohio Solid Waste Regulations generally require explosive gas removal and monitoring at Solid Waste landfills. However, it is anticipated that there will not be significant amounts of methane produced by the degradation of dredged material. Additional investigation will be required to confirm this before OEPA will grant a waiver from the explosive gas removal and monitoring requirements.

4.9 Landfill Cover

TSCA has no specific requirements for the cover on a completed landfill. The Ohio Solid Waste Regulations require a composite cap system in all areas of solid waste placement which shall minimize infiltration and shall, at a minimum, consist of the following components:

1. A barrier layer that is either,

   - 24 inches of recompacted clay with a conductivity of 10^{-7} cm/sec or less. With this option a flexible membrane liner as described below is not required.

   - 18 inches of recompacted clay with a conductivity of $1x10^{-6}$ cm/sec or less.

   - A geosynthetic clay liner of equal or less permeability as the recompacted soil barrier layer with an engineered subgrade.

2. A flexible membrane liner on top of the soil barrier layer or geosynthetic clay liner.

3. A drainage layer, that is either a minimum of twelve inches of granular material, or a drainage net that has equivalent performance capabilities as the granular material.

4. A frost protection layer placed on top of the drainage layer. The frost protection layer shall be a minimum of thirty-six inches thick in the northern tier of counties in Ohio, including Ashtabula County. If a drainage layer is constructed using a granular material, then the drainage layer may be used as part of the frost protection layer.

5. A vegetative layer, consisting of soil and vegetation, placed on top of the frost protection layer. The soil shall be of sufficient thickness and fertility to support its vegetation and to protect the recompacted soil barrier layer and flexible membrane liner from damage due to root penetration. Soil from the frost protection layer may be used as a part of the vegetative layer. Healthy grasses or other vegetation shall form a complete and dense vegetative cover.

6. The cap system shall have a maximum projected erosion rate of five tons per acre per year and shall have a slope between five and twenty five percent, or some greater slope based on stability analyses.

7. Any penetrations into the cap system shall be sealed so that the integrity of the recompacted soil barrier layer is maintained.

8. Comparable materials and/or thicknesses for the soil barrier layer, the granular drainage layer, and the soil vegetative layer may be used if approved by the director.

9. Ohio Solids Waste Regulations require post-closure care for a minimum of 30 years, while TSCA requires care in perpetuity.

5.0 LEACHATE COLLECTION AND TREATMENT

This section discusses the treatment of leachate generated from the landfill. In general, there are three types of mechanisms that can be used to treat leachates. These include physical, chemical and biological treatment, as discussed below.

5.1 Physical Treatment

Physical treatment involves separating chemicals from the leachate, allowing the leachate to be discharged through a permitted outfall, or possibly to a Publicly Owned Treatment Works (POTW), such as the Ashtabula POTW. Typical processes associated with physical treatment include carbon adsorption, air and steam stripping, ion exchange, filtration, flocculation/sedimentation, and reverse osmosis.

5.2 Chemical Treatment

Chemical treatment involves modifying contaminants through chemical reactions so that they are less hazardous or non-hazardous. It may also be used to make contaminants more treatable by subsequent processes. Chemical treatment processes include ultraviolet oxidation, precipitation, neutralization and reduction.

5.3 Biological Treatment

Biological treatment involves using biological activity for the removal of contaminants. Biological treatment is used primarily to remove the biodegradable organic substances (colloidal or dissolved) in wastewaters. Some examples of biological treatment include rotating biological contractors, trickling filters and activated sludge. Biological treatment processes can be aerobic or anaerobic.

5.4 Treatment Criteria

Selection of an appropriate treatment train to treat the leachate requires definition of input concentrations and required effluent concentrations or contaminant removal efficiencies. For a detailed design, bench scale tests will have to be run to determine the composition of Ashtabula River sediment leachate. Contaminant concentrations and volume of leachate have not been estimated to date, but information is available for potential treatment criteria. The volume of leachate produced will be estimated using the Corps of Engineers Waterways Experiment Station's Hydrologic Evaluation of Landfill Performance (HELP) Model. Table 2 shows some potentially applicable standards for the Ashtabula Publicly Owned Treatment Works (POTW) and the State of Ohio Water Quality Standards.

Table 2. Wastewater Feed Concentration and Required Treatment Level

Contaminant	Required Treatment Concentration
PCB	<.001 ug/l[1]
Hexachlorobenzene	<1 ug/l[1]
Hexachlorobutadiene	<500 ug/l[1]
Mercury	<2 ug/l[2]
Lead	<400 ug/l[2]
Arsenic	<50 ug/l[2]
Total Solids	<400 ug/l[2]

[1] Treatment Level required by State of Ohio Water Quality Standards
[2] Treatment Level required by Ashtabula POTW

5.5 Proposed Contaminant Treatment Train

The treatment train that was selected for this conceptual design includes a granular media filter to remove suspended material, followed by a carbon adsorption system to remove dissolved contaminants. This is a standard treatment system and is similar to the leachate treatment system selected for the Indiana Harbor and Canal Dredged Material Disposal Project and at other landfill sites.

The other primary treatment process considered was UV/Ozone Oxidation. However, the capital costs for this process are almost 100 times higher than those for carbon adsorption with similar flow rates (USEPA, 1994). The unit processes of the proposed treatment train are discussed below.

5.6 Granular Media Filter

The purpose of the Granular Media Filter is to remove suspended material within the leachate. The removal of suspended material is generally the most important process in water treatment because most of the contaminants, especially hydrophobic compounds such as PCBs, are associated with the suspended sediment particles. The top half of the filter typically contains sand, while the bottom half contains anthracite coal. The wastewater leaving this stage will have a solid concentration below the required treatment level of 400 mg/l, but may still contain dissolved organics and possibly low levels of dissolved metals. The granular media filter was placed first in the treatment train because it removes suspended material, which can have a negative impact on removal efficiencies of the Carbon Adsorption System.

5.7 Carbon Adsorption System

Carbon adsorption is a technology that has been used widely in the drinking water treatment industry, and that is being used with increasing frequency in the wastewater and hazardous waste industry (Corbitt, 1990). The process takes advantage of the highly sorptive capacity of activated carbon to remove organic compounds, including PCBs and other chlorinated organic compounds from water. In a Carbon Adsorption System, water is passed through a column or columns containing granular activated carbon. Over time, the activated carbon will become spent and must be replaced in order to ensure proper contaminant removal (USEPA, 1994). The carbon system should remove organics below the treatment criteria outlined in Table 2.

5.8 Leachate Monitoring

The requirements of TSCA are more restrictive in this area. TSCA requires monthly sampling of the leachate for contaminants of concern. For this landfill, the contaminants of concern would likely be PCBs, chlorinated organics and heavy metals. TSCA also discusses sampling for other aspects of groundwater quality, such as pH and specific conductance. The OEPA requires yearly grab samples of parameters listed in Appendix I of OAC Chapter 3745-27-10.

5.9 Leachate Discharge

There are three primary options for handling the leachate from the landfill. The first option would be to discharge the treated effluent directly to Lake Erie or one of the small tributaries in the area. This option would require meeting requirements of the Clean Water Act, Ohio Water Quality Regulations and would also require a National Pollution Discharge Elimination System (NPDES) permit prior to discharge.

A second option would be to discharge the treated leachate to the Ashtabula POTW. The treated leachate could either be pumped into the sewer at an approved location or stored in on-site holding tanks pending periodic collection with a tanker truck.

The OEPA requires that plans for landfills include a general site layout for a leachate pre-treatment facility, even if one is not anticipated for use. This is to ensure that space is available if, at a later date, a pre-treatment facility is required prior to discharging to a POTW.

A final option would be to transport the untreated leachate to a facility that is permitted for treating and discharging a similar waste stream. A leachate treatment facility is located at the Reserve Environmental Services Facility near the proposed landfill State Road site. Details on the leachate treatment system will be determined after bench scale testing of the sediments and calculation of leachate production using the HELP Model.

It is anticipated that the leachate, after treatment will contain PCBs at less than 1 ppm and as such the leachate would not be regulated under TSCA which only regulates the disposal of PCB leachate at greater than 50 ppm. However, if leachate measuring 1 ppm to 50 ppm PCBs is disposed, the volume and final destination of disposal must be reported annually to Region 5.

Dilution of leachate to achieve PCB discharge limits is prohibited by both the USEPA and the OEPA. Sampling for discharge to the proposed treatment system must be conducted so that the sample represents a specific batch of leachate. Consequently, leachate from the TSCA cell cannot be mixed with leachate from the non-TSCA cell unless the concentration of the leachate from the TSCA cell is less than 1 ppm before it enters the treatment system.

6.0 LANDFILL DESIGN SUMMARY

The previous section outlined the various requirements of the Ohio Solid Waste Regulations and the Toxic Substances Control Act. In many instances, options for the design were available, even within the same governing regulation. The purpose, therefore, of this section is to identify and summarize conceptual landfill design criteria from the various possibilities.

The selection of the most appropriate design criteria was made based on discussions with Federal and State Regulators and on the specific conditions likely to be found at the potential landfill site. Design information provided by Reserve Environmental Services, Ashtabula, Ohio for its state-of-the-art industrial waste landfill built in Ashtabula County was also used, along with information from the USEPA on the design of TSCA landfills in Michigan. Appendix M includes a summary of the geotechnical information available for the potential disposal site along with a geotechnical analysis of the conceptual design.

The primary difference between the TSCA cell and the non-TSCA cell is in the construction of the bottom liner and leachate collection system. The TSCA cell includes a double liner with double leachate collection and leak detection monitoring. Although this level of protection is not specifically mandated by TSCA regulation, Region 5 TSCA regulators have indicated that this level of construction will likely be required because groundwater is not deeper than 50 feet from the bottom of the landfill.

Table 3 shows the components of the bottom liner and leachate collection system for the TSCA and non-TSCA cells, going from top to bottom in the landfill. Table 4 shows the parameters that are common to both disposal cells. Figure 2 shows a cross-section of the proposed non-TSCA facility and Figure 3 shows the proposed TSCA facility. Both of these figures represent the deep dredging alternative.

Table 3. Landfill Base and Leachate Collection Components for TSCA and non-TSCA Cells

TSCA Cell	Non-TSCA Cell
Primary Drainage Layer 12" pea gravel with PVC piping Geonet on side slopes Filter fabric 60 mil HDPE FML Secondary Drainage Layer 12" pea gravel with PVC piping Geonet on side slopes Filter fabric 60 mil HDPE FML 48" in-situ or 36" recompacted clay liner	Drainage Layer 12" pea gravel with PVC piping Geonet on side slopes Filter fabric 60 mil HDPE FML 48" in-situ or 36" recompacted clay liner

Table 4. Conceptual Landfill Design Parameters Common to Both Disposal Cells

Landfill Parameter	Proposed Design Requirement
Soil Base	material with $k \leq 10^{-7}$ cm/sec
Soil Base Slope	2%
Soil Side Slope	1 vertical to 3 horizontal in interior 1 vertical to 2.5 horizontal on exterior
Synthetic Membrane Liner	60 mil high density polyethylene textured to increase friction coefficients
Drainage Layer Above Liner	material with $k \geq 10^{-2}$ cm/sec
Site Survey	three third order benchmarks
Explosive Gas Monitoring	May be required dependent on OEPA evaluation of additional information on disposed material
Cap System	36 inches vegetation geonet drainage layer geosynthetic clay liner 60 mil HDPE liner
Leachate Collection	6" perforated PVC pipes spaced about 100 foot feeding main 12" PVC pipe.
Leachate Treatment	granular media filter followed by carbon adsorption.
Leachate Discharge	through outfall, Ashtabula POTW, or other permitted process.
Post Closure	quarterly groundwater sampling and site maintenance
Site Fence	6 foot high woven mesh fence around entire facility

7.0 ISSUES TO RESOLVE DURING DETAILED DESIGN

One option that could decrease cost, while still protecting the environment, is to dispose of the non-TSCA sediment in a residual waste landfill. A residual waste landfill is a sanitary landfill which exclusively disposes of one or any combination of nontoxic residual wastes, such as flyash, bottom ash and foundry sand.

While dredged material is not specifically mentioned in the Ohio Administrative Code as being a residual waste, it would seem to generally fit in with the other types of wastes categorized as such and meet the intent of the regulation.

Residual waste landfills include four classifications: Class I, Class II, Class III and Class IV. Class I is the most protective landfill and has requirements substantially equivalent to the construction of a solid waste sanitary landfill. The design and construction requirements become less strict as the class number of the landfill increases, with a Class IV landfill being used for the least contaminated wastes.

The determination of which class of residual waste landfill is appropriate for a given residual waste is made by comparing Toxicity Characteristic Leaching Procedure (TCLP) analysis of the waste against standards outlined in Appendix I of OAC Chapter 3745-30-04.

TCLP testing of the Ashtabula River sediments was conducted during the 1995 sampling of the Ashtabula River. The OEPA and USEPA approved sampling regime included taking samples from the areas of the river with the highest potential for failing the TCLP test based on earlier studies. The analysis showed that none of the samples taken from the river would be regulated under RCRA. Since the samples were taken from the most contaminated areas of the river and were below RCRA levels, the USEPA and OEPA agreed that none of the dredged material would be considered a RCRA hazardous waste.

Table 5 and Figure 4 show a comparison of the 1995 TCLP sampling results versus the residual waste landfill classification requirements. The samples where standards were exceeded are shown in bold in the table below. As can be seen, only one sample from the river exceeds the Class III standard (Arsenic at 186-B) and only two samples exceed the Class IV standards (Arsenic at 186-B and Cadmium at 189-D). It is important to note that sediments in the area where samples exceed the Class III and IV standards are also contaminated with PCBs at levels exceeding TSCA. Consequently these sediments will be disposed of in a TSCA landfill which will exceed the requirements of a Class I or sanitary landfill.

Table 5. TCLP Results From Ashtabula River Sediments Compared to Residual Waste Landfill Standards

Sample Station	Contaminant	Measured TCLP Value (mg/l)	Class II Standards (mg/l)	Class III Standards (mg/l)	Class IV Standards (mg/l)
186-B	Arsenic	**2.9**	3.0	**1.5**	**0.25**
149-C	Barium	1.7	60	30	5
168-C	Barium	4.3	60	30	5
181-E	Barium	2.7	60	30	5
188-A	Barium	3.3	60	30	5
189-D	Barium	4	60	30	5
190-C	Barium	1.5	60	30	5
189-D	Cadmium	**0.12**	0.6	0.3	**0.05**
181-E	Chromium	0.21	3	1.5	0.25
189-D	Chromium	0.24	3	1.5	0.25
188-A	1,4 - Dichlorobenzene	0.04	4.50	2.25	0.38
189-D	Chlorobenzene	0.006	60	30	5

Disposal of the non-TSCA sediments in a Class III or Class IV residual waste landfill would reduce requirements and costs for the cap and bottom liner system, along with monitoring and post closure care requirements. Additionally, the required isolation distance between the bottom of the landfill and an aquifer is reduced to 10 feet for a Class II residual waste landfill and to 5 feet for a Class III residual waste landfill (OAC Chapter 3745-30-06 (15)).

The State of Ohio has indicated that ongoing policy discussions and investigations could result in approval to dispose of non-TSCA sediment in a residual waste landfill (probably Class III). This could be done by approving and permitting the landfill under the residual waste landfill statutes. It is also possible that the landfill could be permitted and approved under Ohio Revised Code 6111.45. This authority allows the OEPA to grant approval for disposal of "industrial wastes" in a manner acceptable to the OEPA Director. While there are no specific construction standards associated with landfills permitted under this authority, discussions with the OEPA have indicated that requirements would be substantially the same as for a Class III residual waste landfill. This is one of several issues expected to be explored during the detailed design phase of this project.

The purpose of this appendix was to develop preliminary design requirements for the construction, maintenance and closure of a landfill used to dispose of sediments dredged from the Ashtabula River. The general design requirements were established to form the basis for a cost estimate to determine if landfill construction is an appropriate and cost effective alternative for the disposal of Ashtabula River Sediments. As previously noted, this preliminary conceptual design is subject to change based on additional design analysis and discussions with regulatory agencies. Additionally, the final landfill design will need to include a contingency to account for dredging quantity differences.

References

1. Corbitt, R.A. 1990. Standard Handbook of Environmental Engineering, McGraw-Hill, New York, NY.

2. U.S. Environmental Protection Agency. 1994. "ARCS Remediation Guidance Document." USEPA 905-B94-003. Great Lakes National Program Office, Chicago, IL.

3. U.S. Environmental Protection Agency. 1990. How to Meet Requirements for Hazardous Waste Landfill, Design, Construction, and Closure. Noyes Data Corporation, Park Ridge, NJ.

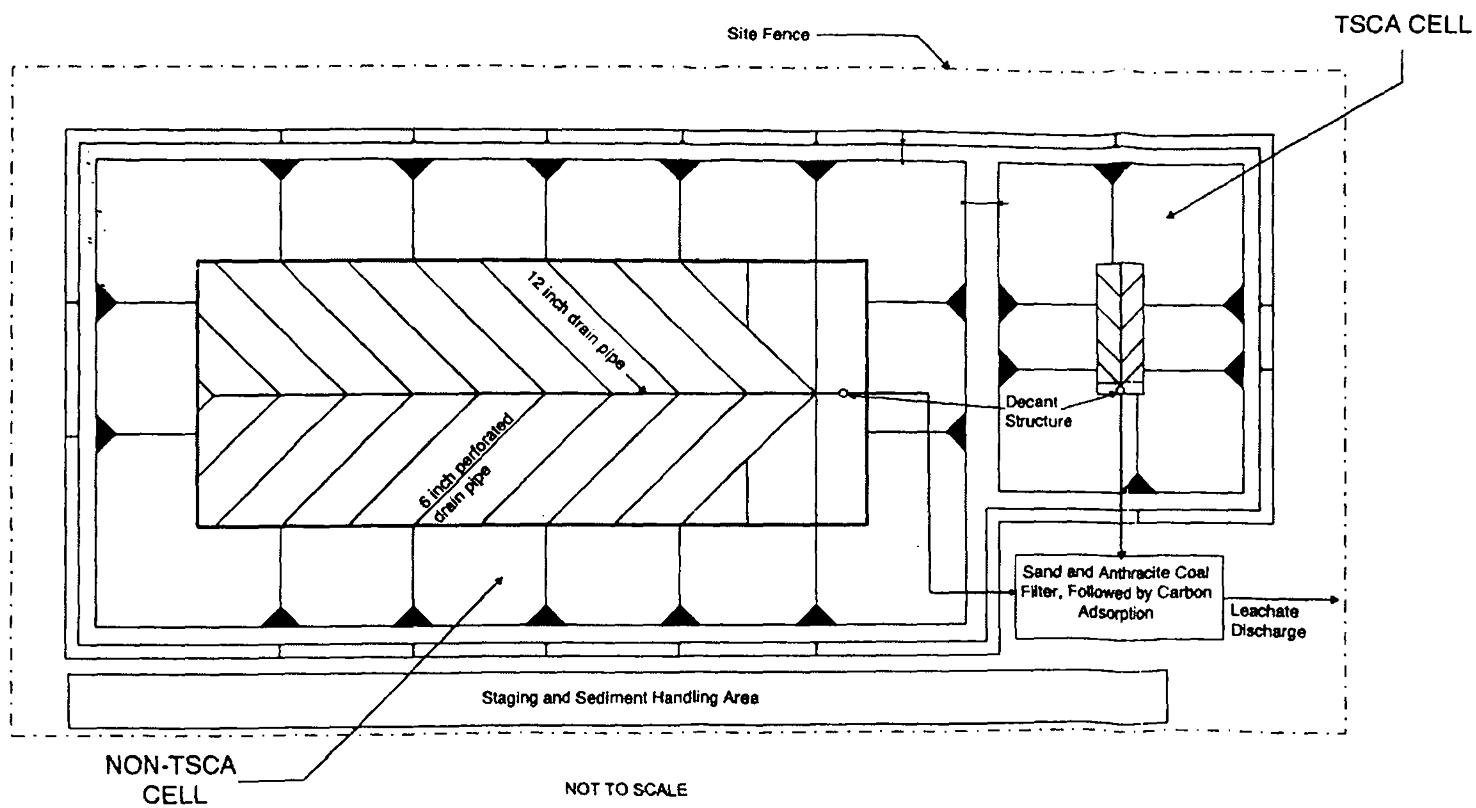


Figure 1. Conceptual Layout of Disposal Facility for Ashtabula River Sediments

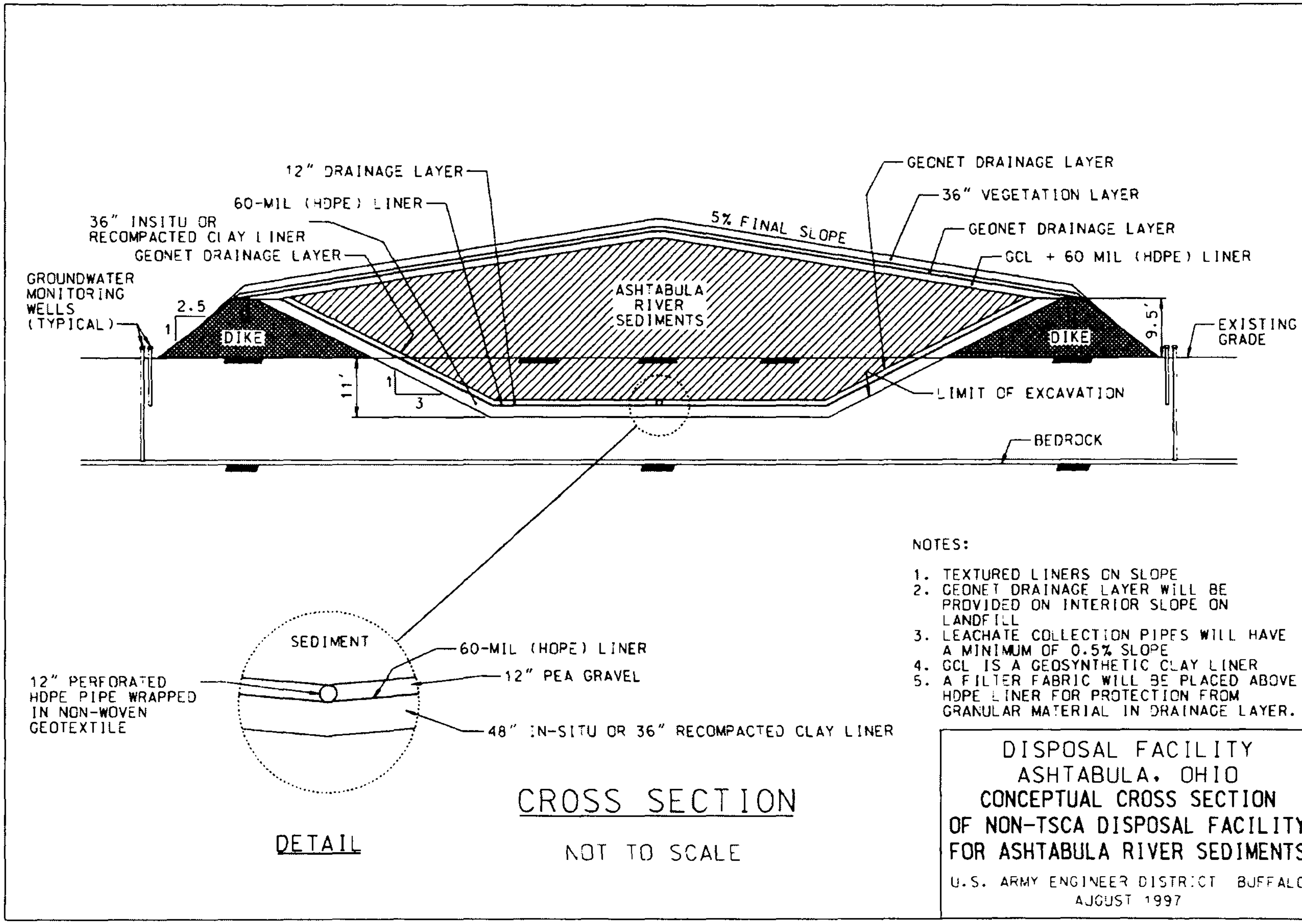
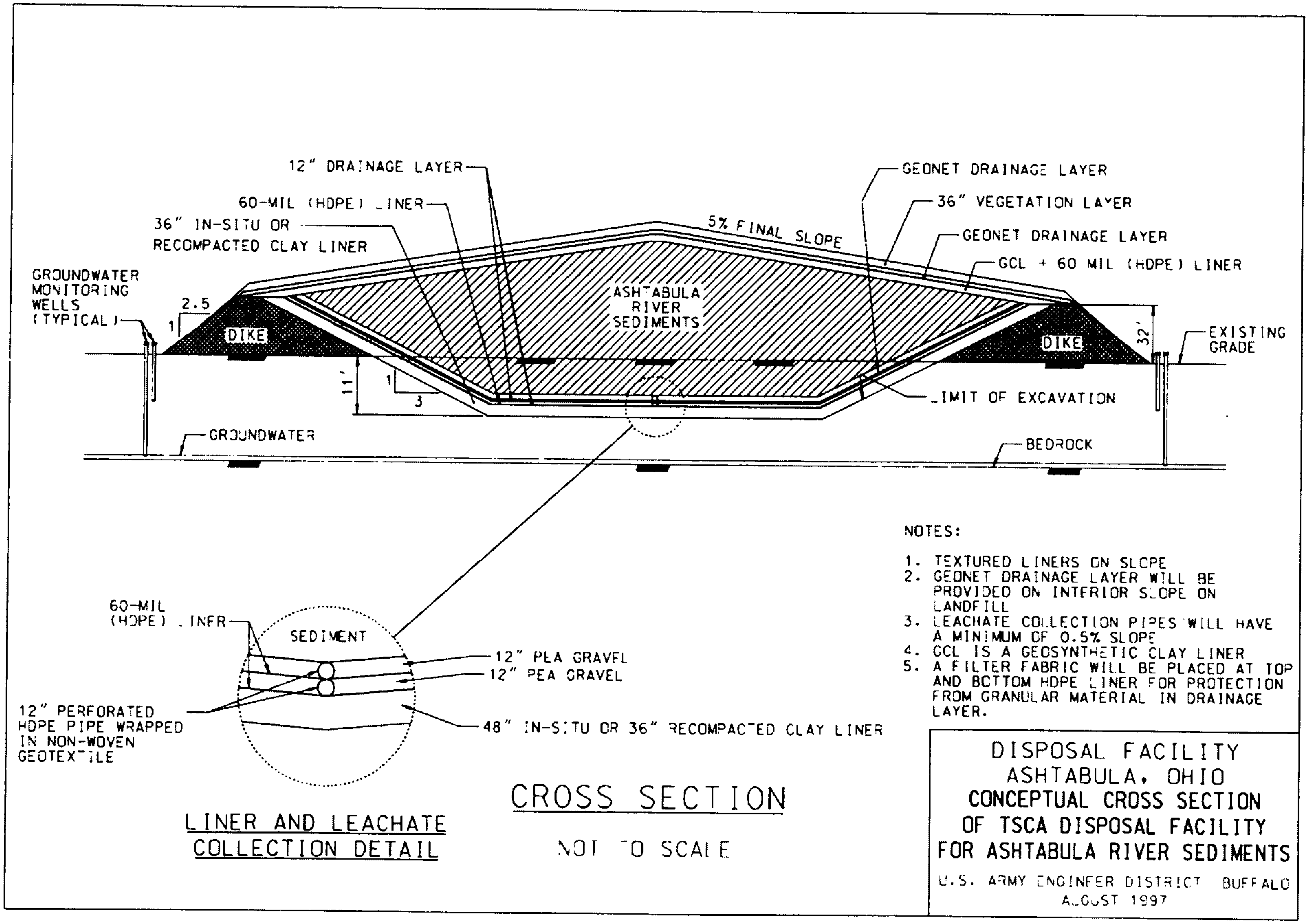

12" DRAINAGE LAYER
60-MIL (HDPE) LINER
36" INSITU OR RECOMPACTED CLAY LINER
GEONET DRAINAGE LAYER
GROUNDWATER MONITORING WELLS (TYPICAL)
2.5
1
DIKE
11'
1
3
ASHTABULA RIVER SEDIMENTS
5% FINAL SLOPE
GEONET DRAINAGE LAYER
36" VEGETATION LAYER
GEONET DRAINAGE LAYER
GCL + 60 MIL (HDPE) LINER
9.5'
EXISTING GRADE
DIKE
LIMIT OF EXCAVATION
BEDROCK
NOTES:
1. TEXTURED LINERS ON SLOPE
2. GEONET DRAINAGE LAYER WILL BE PROVIDED ON INTERIOR SLOPE ON LANDFILL
3. LEACHATE COLLECTION PIPES WILL HAVE A MINIMUM OF 0.5% SLOPE
4. GCL IS A GEOSYNTHETIC CLAY LINER
5. A FILTER FABRIC WILL BE PLACED ABOVE HDPE LINER FOR PROTECTION FROM GRANULAR MATERIAL IN DRAINAGE LAYER.
SEDIMENT
60-MIL (HDPE) LINER
12" PEA GRAVEL
12" PERFORATED HDPE PIPE WRAPPED IN NON-WOVEN GEOTEXTILE
48" IN-SITU OR 36" RECOMPACTED CLAY LINER
DETAIL
CROSS SECTION
NOT TO SCALE
DISPOSAL FACILITY
ASHTABULA, OHIO
CONCEPTUAL CROSS SECTION
OF NON-TSCA DISPOSAL FACILITY
FOR ASHTABULA RIVER SEDIMENTS
U.S. ARMY ENGINEER DISTRICT BUFFALO
AUGUST 1997

FIGURE 2


12" DRAINAGE LAYER
60-MIL (HDPE) LINER
36" IN-SITU OR RECOMPACTED CLAY LINER
GROUNDWATER MONITORING WELLS (TYPICAL)
2.5
1
DIKE
11'
1
3
GROUNDWATER
ASHTABULA RIVER SEDIMENTS
5% FINAL SLOPE
GEONET DRAINAGE LAYER
36" VEGETATION LAYER
GEONET DRAINAGE LAYER
GCL + 60 MIL (HDPE) LINER
32'
EXISTING GRADE
LIMIT OF EXCAVATION
BEDROCK
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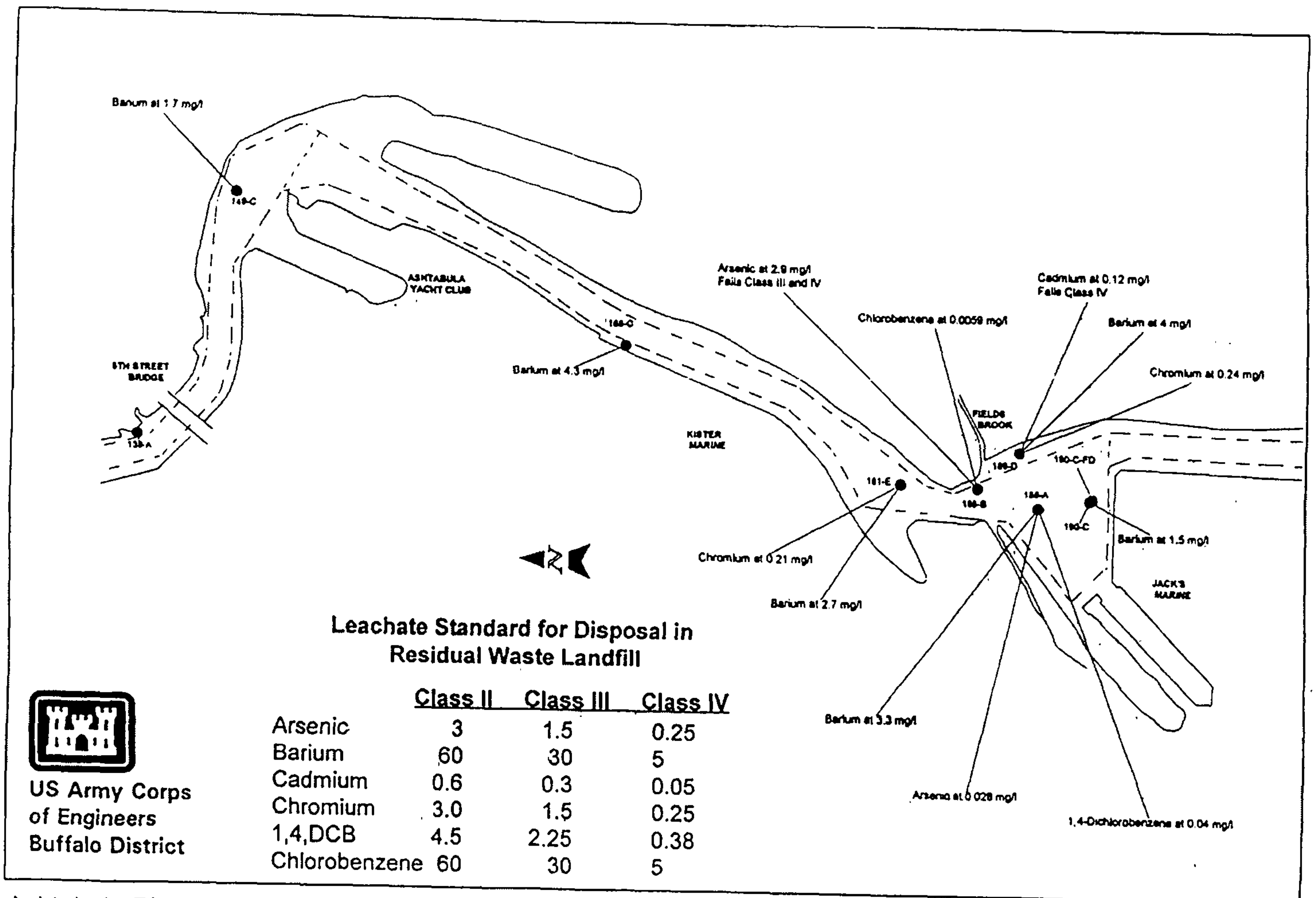
LINER AND LEACHATE COLLECTION DETAIL
CROSS SECTION
NOT TO SCALE
DISPOSAL FACILITY
ASHTABULA, OHIO
CONCEPTUAL CROSS SECTION OF TSCA DISPOSAL FACILITY FOR ASHTABULA RIVER SEDIMENTS
U.S. ARMY ENGINEER DISTRICT BUFFALO
AUGUST 1997

FIGURE 3



Leachate Standard for Disposal in Residual Waste Landfill

	Class II	Class III	Class IV
Arsenic	3	1.5	0.25
Barium	60	30	5
Cadmium	0.6	0.3	0.05
Chromium	3.0	1.5	0.25
1,4,DCB	4.5	2.25	0.38
Chlorobenzene	60	30	5

Ashtabula River Sediment TCLP Concentrations Compared to Regulatory Levels for Residual Waste Landfills

FIGURE 4

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX Q

COASTAL ENGINEERING DESIGN

PREPARED BY:

U.S. Army Corps of Engineers, Buffalo District

ASHTABULA RIVER PARTNERSHIP

COASTAL ENGINEERING DESIGN

FIGURES

TABLES

ASHTABULA RIVER PARTNERSHIP
APPENDIX O
COASTAL ENGINEERING DESIGN

Q1. INTRODUCTION

This appendix presents the preliminary coastal design for an offshore wave attenuation structure to provide shelter for scows, tugs, barges and pumpout facilities during unloading operations. A rubblemound breakwater was designed to be placed parallel to shore, east of Ashtabula Harbor and offshore from the proposed upland disposal site at SR531 and La Bounty Road, Ashtabula, OH. It is estimated that 700,000-1,000,000 cubic yards of material will be dredged over a three year period that will require confined disposal.

As an alternative, the use of a single point mooring system was discussed. This would be feasible if dredging could be accomplished with a larger hopper dredge rather than a clamshell operation. This would not be a suitable option at this time due to the shallow areas to be dredged.

It is estimated that a clamshell/barge dredging operation would be able to discharge dredge material under open lake wave conditions of 1-2 feet or less. Using WIS Report 22, Hindcast Wave Information for the Great Lakes: Lake Erie, October 1991, Percent Occurrence Tables it was determined that waves would exceed this criteria approximately 80% of the time. Therefore, it would be necessary to provide shelter for clamshell/barge operations under open lake conditions at this site.

Q2. DESIGN CONSIDERATIONS

The size of equipment used for dredging in this area was used to determine the location and length of structure required for safe unloading under open lake conditions. According to field personnel the following equipment is used in the Ashtabula area:

Equipment	Size	Vessel Draft
Pumpout Station	76'x26'x5'	5'
Crane Barge	125'x44'x8'	3'
Dump Scow	177'x43'x16'	15'
Dump Scow	224'x43'x15'	15'
Deck Barge	131'x34'x9'	3'
Tug	70' long	10'

A 15-foot draft is required for the dump scows. Therefore, the breakwater will be placed to allow a minimum of 15 feet of water depth under low water conditions behind the breakwater. Lake Erie water levels average approximately 2.5 feet above low water datum allowing adequate water depth for a 15-foot draft vessel at the -15' LWD contour.

The breakwater's length was sized to protect two scows and a tug. A plan view is shown on Figure O1.

Q3. STRUCTURAL DESIGN

a. Design Lake Level

The design water levels used for this analysis were obtained from "Design Water Level Determination on the Great Lakes", prepared by the Detroit District in 1993. The annual design water level with 10-year and 20-year return periods are currently used in design of shore protection. This reference provides water levels for Fairport, Ohio and Erie, Pennsylvania. Therefore, the water levels at Ashtabula Harbor were interpolated between these two frequency curves. Figure O2 shows the Annual Design Water Levels (DWL) for Lake Erie Central. The 10-year DWL is 574.7 feet (+6.1 feet) and the 20-year DWL is 574.9 feet (+6.3 feet) for Ashtabula, Ohio.

b. Deepwater Wave Heights and Wave Periods

The deepwater wave heights which can be expected at Ashtabula, Ohio were estimated using WIS Report 22, "Hindcast Wave Information for the Great Lakes - Lake Erie" dated October 1991. The corresponding wave periods were taken from Technical Report H-76-1 "Design Wave Information for the Great Lakes Report 1 - Lake Erie", January 1976. Table O1 presents the deepwater wave heights and periods used for this design.

Table Q1: Deepwater Wave Heights and Wave Periods
Station 15 (42.02N, 80.03W)

Return Period (year)	Angle Class					
	1		2		3	
	Wave Height (ft)	Period (sec)	Wave Height (ft)	Period (sec)	Wave Height (ft)	Period (sec)
10	13.8	8.5	10.8	7.1	15.1	10.1
20	14.1	8.6	11.1	7.2	15.4	10.3

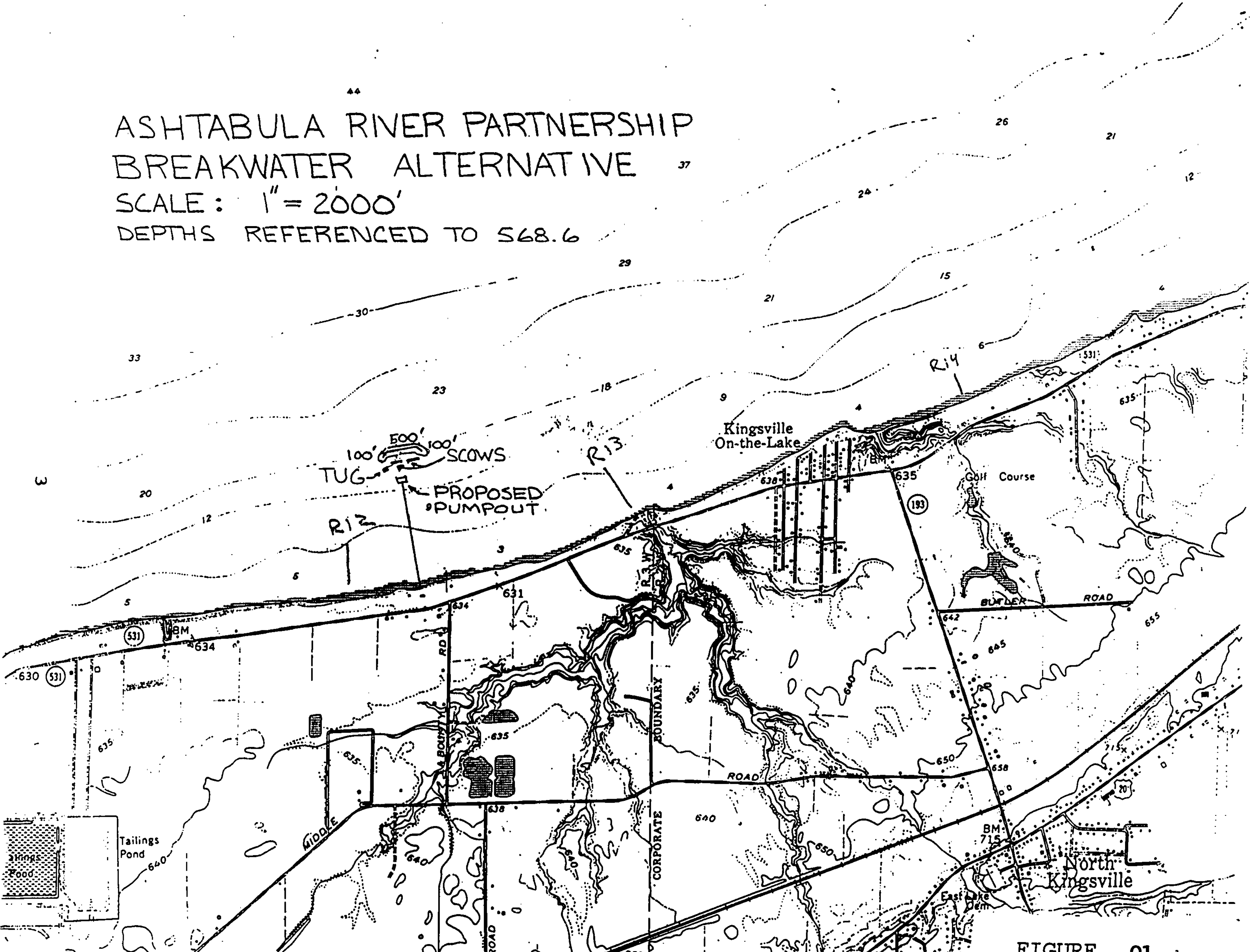
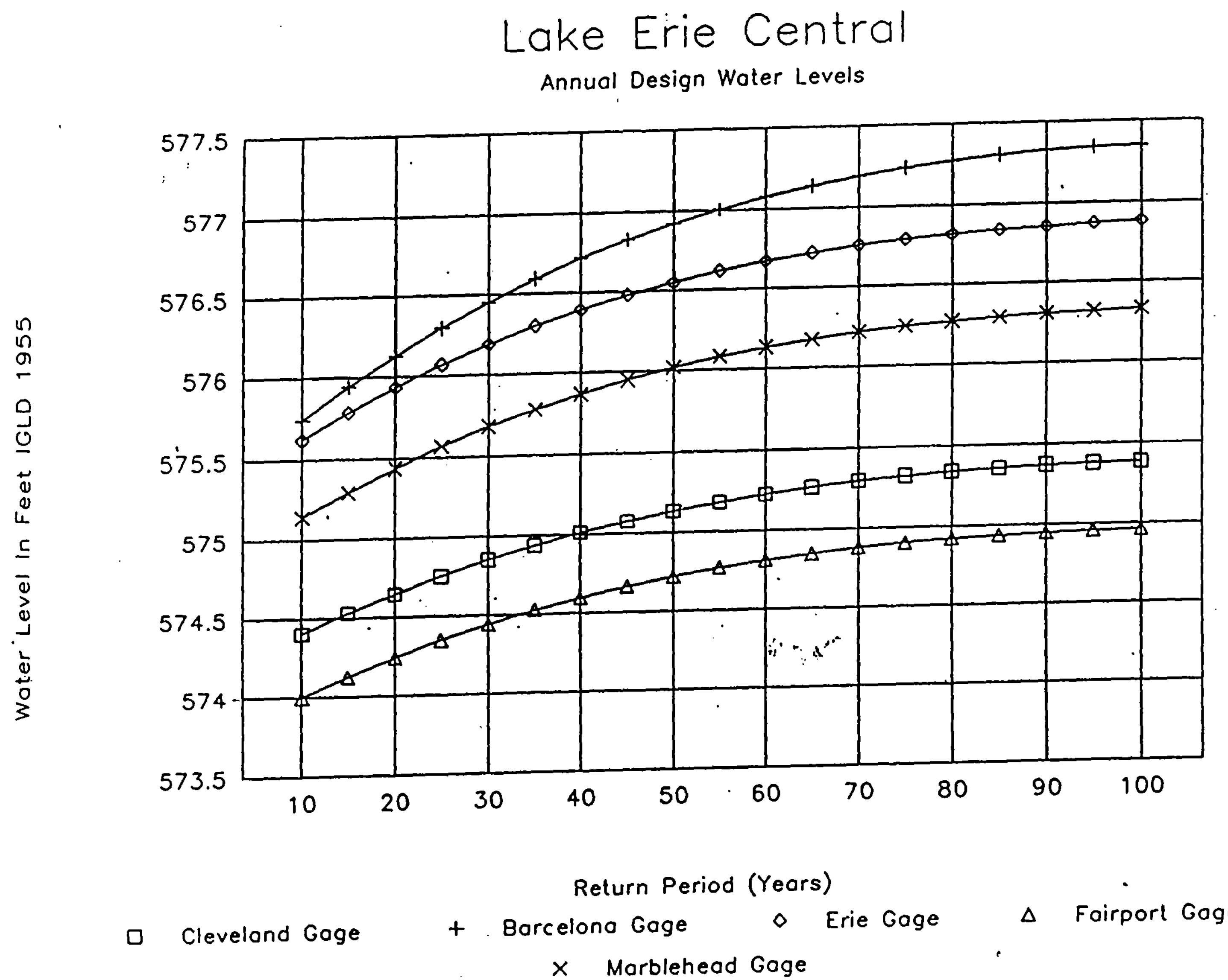

ASHTABULA RIVER PARTNERSHIP
BREAKWATER ALTERNATIVE
SCALE: 1" = 2000'
DEPTHS REFERENCED TO 568.6
500'
100'
100'
SCOWS
TUG
PROPOSED PUMPOUT
R12
R13
R14
Kingsville On-the-Lake
Golf Course
BUTLER ROAD
ROAD
CORPORATE
BOUNDARY
MIDDLE
Tailings Pond
North Kingsville

FIGURE Q1



Lake Erie Central
Annual Design Water Levels
Water Level In Feet IGLD 1955
577.5
577
576.5
576
575.5
575
574.5
574
573.5
10
20
30
40
50
60
70
80
90
100
Return Period (Years)
Cleveland Gage
Barcelona Gage
Erie Gage
Fairport Gage
Marblehead Gage

4

FIGURE Q2

c. Design Water Depth

The design water depth is defined as the difference between the elevation of structure toe and design lake level. For this preliminary design it is assumed that the lakeward structure toe will be placed along the -18 foot LWD contour. The design water depths are as follows:

10-year design depth = +6.1′ + -18′ = 24.1 feet

20-year design depth = +6.3 + -18′ = 24.3 feet

d. Design Incident Waves

The design incident waves were computed using TP80-3, "Estimating Nearshore Conditions for Irregular Waves" by William N. Seelig and John P. Ahrens, June 1980. Table O2 shows the results of the analysis, and the determination of the design significant wave heights for each angle class. The largest significant wave height at this location will be used to compute the stone sizes required for the structure. The breakwater will be designed for an incident significant wave height of 13.1 feet.

e. Breaking Wave Conditions

Since it is not known whether the design waves calculated are breaking or nonbreaking waves, an analysis was performed to determine the wave type. Using figures 7-2 and 7-3 of the Shore Protection Manual, Table O2 was developed to determine the maximum and minimum breaking depths. If the design depths fall within or less than this range, the wave would be considered a breaking wave. Table O3 shows that the design wave is a nonbreaking wave.

f. Stone Size Computations

The structure is designed as a rubblemound structure with a 1V:2H sideslope. The procedures outlined in Chapter 7 of the Shore Protection Manual (SPM) were used to determine the cross section. The design is based on the use of stone having a density of 165 lb/ft^3.

Stone sizes were calculated by application of Hudson's Formula, equation 7-116 of the Shore Protection Manual:

$$W = \frac{w_r H^3_{sig}}{K_d (S_r - 1)^3 \cot\theta}$$

Where: W = weight of armor unit in primary cover layer (pounds)
w_r= unit weight of armor unit (lb/ft^3)
H_{sig} = design wave height at structure location (feet)
K_D=stability coefficient of the armor unit
S_r=specific gravity of armor stone
cot θ = structure sideslope

Table Q2 : Determination of Significant Wave Heights at proposed Ashtabula Breakwater

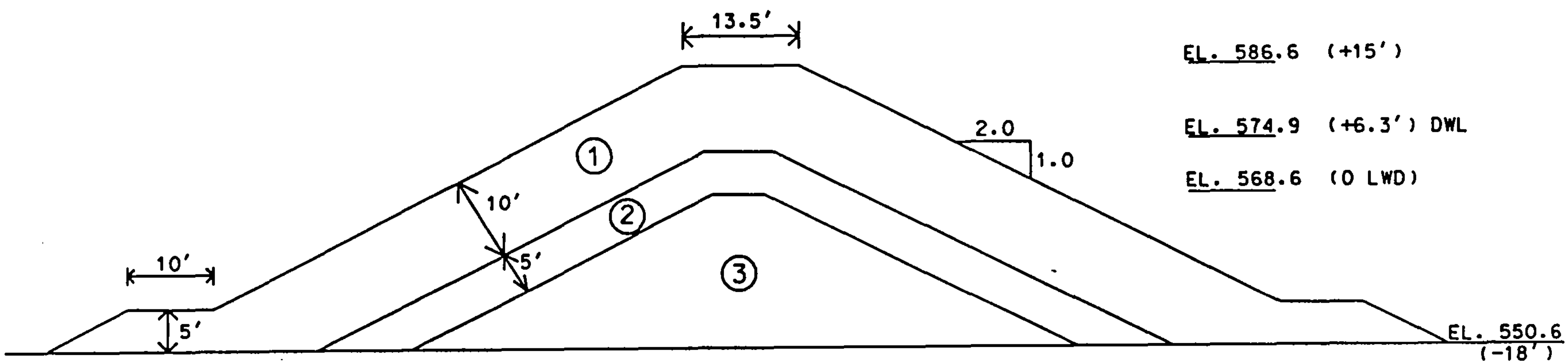
Angle Class	H_o (ft)		K_r	H_o' (ft)	Lake Level (1955 IGLD)		d_s (ft)	T (sec)	S	$\frac{H_o'}{L_o}$	$\frac{d}{H_o'}$	$\frac{H_{sig}}{H_o'}$	H_{sig} (ft)
	10-yr	20-yr			10-yr (ft)	20-yr (ft)							
1	13.8		.88	12.1		574.4	24.3	8.5	.01	.033	2.00	1.00	12.1
1		14.1	.88	12.4	574.1		24.1	8.6	.01	.033	1.94	0.97	12.0
2	10.8		.93	10.0		574.4	24.3	7.1	.01	.039	2.43	0.95	9.5
2		11.1	.93	10.3	574.1		24.1	7.2	.01	.039	2.33	0.95	9.8
3	15.1		.87	13.1		574.4	24.3	10.1	.01	.025	1.85	1.00	13.1
3		15.4	.87	13.4	574.1		24.1	10.3	.01	.025	1.80	0.95	12.7

Table 03 : Breaking Wave Conditions for proposed Ashtabula Breakwater

H_o' (ft)	T (sec)	$\frac{H_o'}{gT^2}$	S	$\frac{H_b}{H_o'}$ 1	H_b (ft)	$\frac{H_b}{gT^2}$	$\frac{d_b}{H_b}$ 2 min	$\frac{d_b}{H_b}$ 2 max	d_b (ft) min	d_b (ft) max	d_s (ft)
13.1	10.1	.004	0.01	1.1	14.4	.0044	1.2	1.52	17.3	21.9	24.3

1 From SPM Figure 7-3
2 From SPM Figure 7-2

ASHTABULA RIVER PARTNERSHIP
BREAKWATER PLAN - TYPICAL CROSS SECTION



Scale: 1" = 20'

Stone Sizes

(1) Armor Stone: 7 to 15 Ton

(2) Underlayer: 0.5 to 1.5 Ton

(3) Bedding Stone: 5 to 150 LB.

FIGURE Q3

A range of 0.9W to 2.0W was used to define the maximum and minimum limits for armor stone size. This range is adequate in size to insure that suppliers can produce the stones economically. Also, 0.9W is close enough to insure that at least 75 percent of the individual armor units, as required by the SPM, will have a weight greater than W without any further gradation restrictions. The underlayer stone was sized using a gradation of 0.06W to 0.2W. The bedding stone forms the breakwater core and is sized to prevent migration through the adjacent stone layers. The bedding stone will range in size from 0.01W to 0.00015W. The design stone sizes are listed in Table O4.

Table Q4: Design Stone Sizes

Layer	Stone Size	Layer Thickness
Armor Layer	7 to 15 ton	10 feet
Underlayer	0.5 to 1.5 ton	5 feet
Bedding Stone	5 to 150 pounds	varies

Crest Width

The breakwater is designed for a three stone crest width which results in a crest width of 13.5 feet.

Crest Height

Initially, the breakwater was designed for no overtopping using CETA 80-7, "Estimation of Wave Transmission Coefficient for Overtopping of Impermeable Breakwaters" by William M. Seelig. This yielded a crest height of +17 ft. LWD. Since a 1 to 2 foot transmitted wave will be acceptable, an additional analysis was performed which incrementally decreased the crest height to determine the optimum elevation. The computer program MADSEN as described in CETA 79-6, "Estimation of Wave Transmission Coefficients for Permeable Breakwaters" by William N. Seelig was used to determine the transmitted waves for varying crest heights. The results are shown below:

Crest Height	Transmitted Wave Height
+15'	1.69'
+14'	2.23'
+13'	2.75'

The selected crest height is +15' above LWD. A typical cross section of the breakwater is shown on Figure O3.

FUTURE CONSIDERATIONS

The following items should be considered in the next phase of study:

a. Obtain hydrographic surveys of the proposed site.

b. Further evaluation of the wave conditions implementing the hydrographic survey information and performing detailed wave refraction and diffraction analyses.

c. A detailed investigation of navigation depths required for dredging equipment at the pumpout site.

d. Investigate moving the breakwater closer to shore and dredging a channel to accommodate the vessels' drafts.

e. Use of a smaller hopper dredge with the capability to discharge over the bow could be investigated further. This would be dependent on the acceptability of using a hopper dredge for removal of contaminated material.

CENCB-PE-TC March 25, 1997

MEMORANDUM TO: Steve Golyski, Project Manager

THRU: Tom Bender, Chief, Coastal/Geotechnical Section

SUBJECT: Ashtabula River Partnership

1. Attached is the Coastal Engineering Design for the Ashtabula River Partnership Study. This covers the preliminary design of an offshore wave attenuation structure to provide shelter for scows, tugs, barges and pumpout facilities during dredge disposal unloading operations.

2. In addition to this structural option, use of alternative pumping operations was investigated. A conversation with Stan Ekren, Sr. Vice President of B + B Dredging Company yielded the following information:

a. A single point offshore mooring system may be feasible if the dredging could be accomplished using a larger hopper dredge rather than a clamshell operation. This may not be a suitable option due to the shallow areas to be dredged.

b. Use of a smaller dredge with the capability to discharge over the bow could be investigated further. The dredge would be able to withstand waves up to 7 feet whereas a barge operation is limited to 1-2 foot wave conditions.

These options would be dependent on the acceptability of using a hopper dredge for removal of contaminated material.

3. If you have any questions regarding this matter, please contact the undersigned at extension 4116.

Darlene D. Rowen
Civil Engineer
Coastal/Geotechnical Section

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX R

PROJECT COST ESTIMATES

NOTE: This Appendix was originally designated as "Appendix P" in the Draft CMP Technical Appendices. The Final CMP Technical Appendices refers to this Appendix as "Appendix R." Included in the Final Appendix R is Sub-Appendix R-2, which is the Project Cost Estimate for the Recommended Environmental Dredging Plan completed in December 2000 to update the cost estimate to October 2000 p.l.

The Sub-Appendices in Appendix R are as follows:

SUB-APPENDIX R-1 - DETAILED COST ESTIMATES FOR DREDGING ALTERNATIVES.

- DEEP DREDGE OPTION
- BANK-TO-BANK/BEDROCK OPTION
- SHALLOW DREDGE OPTION

SUB-APPENDIX R-2 – PROJECT COST ESTIMATE (DECEMBER 2000)

SUB-APPENDIX R-3 – DETAILED PROJECT COST ESTIMATE (RECOMMENDED ENV. DREDGING PLAN) (DECEMBER 2000)

PREPARED BY:

U.S. Army Corps of Engineers, Buffalo District
December 1996
Updated December 2000

COST ESTIMATES
ASHTABULA RIVER PARTNERSHIP
SEDIMENT DREDGING/DEWATERING/TRANSPORT/DISPOSAL COSTS

1. Introduction

To develop costs for the assessment and evaluation of disposal sites, various combinations of methods were considered for moving the material from the Ashtabula River to the disposal facility. These material handling costs comprise a portion of the dredging and disposal facility construction costs to determine the direction the project should take.

The following paragraphs provide the basic assumptions and information on what is behind the cost estimates. The costs presented are based on feasibility level concepts; future detailed design will affect the project costs, possibly increasing costs for various components above that which the applied contingency attempts to cover. Regulatory requirements labor, equipment, and material costs, and the construction schedule may also influence on the costs as time passes.

This appendix presents the preliminary estimates developed by the Partnership and the subsequent revisions to those cost estimates reflecting modifications to overall contingencies, reanalysis of requirements and costs associated with various project features such as mitigation and real estate acquisition costs.

2. Basis of Estimates

This project was broken into several components to allow the Partnership the greatest flexibility in selecting the most attractive means of accomplishing the project objective, removing contaminated sediments from the Ashtabula River. The main components are; dredging, transfer of sediments from the river to the disposal facility, and construction and operation of the disposal facility. The estimates were developed to include costs of the features described below.

3. Dredging

Dredging costs are based on the use of a marine operation utilizing a derrick boat which would excavate the sediments with an environmental or closed clamshell bucket. The sediments would be loaded into dredge scows and transported to a transfer site. The use of this special clamshell bucket will lead to lower daily production as silt curtains would be placed around the excavation as well. The need to place, maintain, maneuver, and avoid the curtain while dredging are the leading causes of the high unit cost over conventional dredging operations.

4. Transfer Facility

The handling of the sediments after dredging involved examination of several alternatives. Each alternative included a facility for unloading the sediments from the scow. Generally, the alternatives were: (1) dewater sediments at an off-shore plant and unload the scows at a commercial dock; (2) unload and dewater sediments at a specially constructed facility near the river; and three, pump the sediments to the disposal facility from an off-shore pumpout platform. The method selected for handling the dredged sediments is Alternative 2, the specially constructed facility near the river.

4.1 Riverside Dewatering/Transfer Facility

Costs for this alternative are based on the construction of a facility adjacent to the river at the interim CDF on Conrail property. Much of the cost was derived from earlier study efforts and updated to current costs. The facility would include diked areas for storing the decanted, untreated water, water treatment equipment, and a diked area for storing sediments during times when carrier transport is slow and the barge is being unloaded, and decon pads for trucks and facility equipment. Operation includes the unloading, water treatment, and transfer of sediments to on land carriers. The estimated construction cost for this facility amounted to $2,180,000, while operation costs totaled $2.55/cy.

4.2 Transporting Sediments to the Disposal Facility

Prior to selection of Site 7 as the recommended upland disposal site, three sites were under consideration. To transport the sediments to the disposal facility, several methods were evaluated. These methods were; trucking on local roads, transport by railroad, and pumping slurry through pipeline.

Costs were determined for infrastructure construction (as necessary) and operation. Travel routes to each potential upland facility under consideration were determined for each transfer method examined. From this estimate, it was determined that hauling over local roads by carrier would be the least costly regardless of where along the river or harbor the transfer facility was located.

The pipeline alternative was eliminated because of the cost and time to construct a lengthy line through an urban area to the disposal facility. The shortest pipeline route between the interim CDF and site 7 was estimated to be 3.9 miles, which would cost approximately $2,200,000. A comparable cost for installing gas pipelines was solicited to compare against in-house estimates. Their figure of $100 per foot resulted in construction costs which reached those for trucking. Adding operation costs to the construction costs removed this alternative from further consideration. Furthermore, the uncertainty of requirements that environmental regulatory agencies may place on the pipeline along with the need to overcome public concerns also served as the basis for elimination.

Use of existing rail lines was also eliminated due to costs. For each transfer facility and upland disposal facility location considered, substantial lengths of track and siding would need to be constructed. At the proposed interim CDF transfer facility site, 1,000 LF of siding was planned. To reach site 7, additional track extending nearly 1.75 miles would be needed, plus a parallel track of 2,000 feet for storing and/or maneuvering rail cars. This cost added up to nearly 75% of the trucking cost alone. Further complicating this option would be the need to construct the lines through existing wetlands and wooded areas and the need to mitigate these crossings. Finally, the economics of transport by rail are not realized unless the distance is 250 miles or greater. For this project, the use of local track networks requiring continual switching activities, plus the mitigation and construction costs removed this option from consideration. However, if sediments are transported to a commercial facility that exceeds 250 miles, then rail transport should be re-examined.

5. Sediment Disposal

Costs for disposing of the dredged sediments were developed for three alternatives, with the final cost being one of the three, or a combination of the three. Disposal options included commercial disposal, construction of an upland disposal facility for TSCA and Non-TSCA sediments, and off-shore CDF. The upland CDF was selected as the preferred disposal method.

Costs for an upland disposal facility that would store both TSCA and non-TSCA sediments were based on a conceptual design developed by Buffalo District's Environmental Engineering Section. The estimate for construction was prepared using cost estimating software and adjusting database material prices as necessary. Recent bid prices for various materials was referenced where appropriate.

6. Project Cost Estimates for the Dredging Alternatives

Cost estimates were developed for the three cleanup scenarios - Deep Dredging, Bank-Bank-Bedrock Dredging, and Shallow Dredging. The costs for each dredging scenario are summarized in Tables No. 1, 2, and 3, respectively.

Each cleanup scenario evaluated multiple components for handling, transfer, disposal, and containment of the TSCA and Non-TSCA sediments. These components of the project are discussed in the following paragraphs.

6.1 Dewatering and Sediment Transfer

After dredging, a filled scow will be transported to a transfer facility where the sediments will be dewatered to acceptable levels, and then transferred to a carrier for shipping to the disposal facility. One alternative is a facility constructed on Conrail property along the Ashtabula River (the site of a Corps constructed interim CDF for sediment confinement) that allows mooring of scows, unloading of scows, and dewatering of the sediments. A storage cell will contain the sediments until they are acceptable for disposal. At the conclusion of dredging and dewatering, this property will be restored to its original condition, and the interim CDF contained sediments and CDF construction materials will be disposed of as required.

6.2 Sediment Disposal

Final disposal of the dredged and dewatered sediments also examined multiple alternatives. Generally, these included constructing the upland CDF, constructing an in-lake CDF, commercial disposal, or a combination of these. Commercial disposal facilities that accepted TSCA and non-TSCA sediments were located both locally and out-of-state. The in-lake CDF would be typical of Corps constructed CDFs for dredged material unacceptable for offshore disposal, and would be located adjacent to the lake near the upland CDF. A detailed estimate for each of the landfill costs associated with the 3 dredging scenarios is presented in Appendix P1.

7. Other Costs

The various alternatives for the three scenarios also include sampling and analysis, wetlands mitigation, and liability costs where applicable. The total of all project construction costs includes a 25%(±) contingency. Study, design, construction administration, and real estate costs have also been presented in these tables.

8. Revisions to Project First and Post Construction Cost Estimates

The Ashtabula Partnership conducted an independent cost evaluation of the initial project cost estimate, as prepared by USACE, Buffalo, for the Recommended Plan/Deep Dredging Alternative in order to identify/determine areas of potential cost savings and/or increases. The Partnership determined that overall contingencies appeared to be generally over-stated even though the contingency amounts used are traditionally required for feasibility-level studies and that a reanalysis of requirements was necessary for real estate, wetland mitigation, project liability and post construction costs.

Contingencies represent allowances to cover unknowns, uncertainties, and/or unanticipated conditions that are not possible to adequately evaluate from the data on hand at the time the cost estimate is prepared but must be represented by a sufficient cost to cover the identified risk. Contingencies are necessary to assure that unforeseen items of work or level of detail found later to be needed will not jeopardize the project recommended in the feasibility level as one worthy of progressing to the detailed design stage. The level of design effort and field investigations performed warranted the reduction of the initially estimated contingencies.

Revisions to the Real Estate costs were revised in accordance with the reanalysis of requirements as presented in the Real Estate Plan (Appendix R). Subsequent revisions to the Wetland Mitigation feature, partially based on the costs presented in the Real Estate Plan, had costs for associated lands deleted (from this line item) whereby the cost estimate line item reflects associated construction costs for the restoration and enhancement/restoration aspects of the mitigation plan.

The preliminary costs estimates for the Comprehensive Management Plan (CMP) called for providing liability funding for the project based on constructing a slurry wall around the entire perimeter of the disposal facility. This was based on a worst-case scenario involving failure of the confinement dike, leachate collection system, facility liner, and or/and facility capping systems. Based on more recent information it has been determined that this liability contingency is no longer required for the project.

Discussions with regulatory authorities and engineers involved with the project, review of applicable law and regulation, review of design and construction requirements, and historical performance of like facilities, suggest that any failure that would necessitate the construction of a slurry wall cannot, within reason, be ever expected to occur. The design of the facility has been performed using conservative factors of safety that provide more than a reasonable level of comfort that the facility will perform as designed. Additionally, conservative estimates of the post-closure maintenance costs have been developed that will provide an adequate level of funding for any expected failure that typically occurs in similar facilities. Given this determination, the liability funding has been deleted from the CMP cost estimates for the Recommended Plan.

In addition, as determined by the Partnership's Landfill Subcommittee, the post construction maintenance costs were revised based on a reanalysis of requirements which are presented in Table 4.

In general, the costs for dredging required a contingency line item, landfill contingency costs required revision and the costs for the dewatering/transfer facility required additional review. It was determined that the contingency factor for landfill will be 35 percent of construction costs, the contingency factor for dredging will remain at 25 percent and the additional review of costs associated with the dewatering/transfer facility indicated that there were excessive costs added for real estate acquisition which were deleted and the contingency factor would be 25 percent of construction costs.

Therefore, based upon the review of the cost estimate for project implementation by the Partnership it has been determined that an overall reduction in total contingencies is warranted and reallocation of project features is necessary. In addition, costs need to be broken out so as to determine what are the first costs of construction and what is required for post-construction/operations and maintenance activities.

The following items are considered first cost of construction which shall be identified in the project cost agreement (PCA) as such:

- Cost of construction:
  - Dredging
  - Transport of sediments
  - Dewatering of dredged sediments
  - Landfill construction
  - Capping & closure
- Costs for Planning, Engineering and Design
  - Engineering during construction
- Supervision and Administration
  - Supervision and Inspection
- Mitigation
- LERRDs

The following items are considered post-construction/operations & maintenance costs which shall be presented on an annualized basis:

- Post-construction/Operations & Maintenance
  - Annual inspections/post construction monitoring period
  - Security/infrastructure maintenance (ie. grass mowing)
  - Leachate/stormwater treatment

Based on inspection of existing USACE policies, regulations and manuals, it has been determined that overall costs need to be broken down as above in order to process the PCA.

9. Recommended Plan Description

Based upon the evaluation of costs associated with the three cleanup scenarios the Recommended Plan is the Deep Dredging Scenario-Dewatering Facility At Interim CDF-Option 3.

The Recommended Plan calls for disposal of approximately 696,000 cubic yards (CY) of sediments. Approximately 150,000 CY of sediment proposed for removal is classified as TSCA which is significantly PCB contaminated. These TSCA classified sediments would be handled and disposed of in accordance with Toxic Substance Control Act (TSCA) regulations. The remaining 546,000 CY of sediment is non TSCA.

The recommended plan would have the following components: dredging of the contaminated bottom sediments, movement of the sediments to a staging area, developing and utilizing a land based transfer/dewatering/transfer facility located along the river portion of the harbor area, dewatering of the sediments at the transfer/dewatering/transfer facility, trucking of the dewatered dredged material from the staging area to a final disposal site, disposing of the material as appropriate and post construction monitoring of the disposal site (for purposes for the economic analyses/life of this project, the report utilizes a 50 year post construction period for monitoring and maintenance).

The staging area would be located somewhere along the river. The final disposal site would be in a newly developed site (Site 7). A portion of the disposal facility would be built to TSCA disposal standards to receive the 150,000 cubic yards of TSCA material. The remainder of the disposal facility would be used to store the non TSCA material. The facilities would also address leachate collection, treatment and monitoring procedures, and closure and post closure monitoring measures. Design environmental protection measures have been incorporated into the project design, construction, operation , and maintenance. The recommended plan also included construction costs associated with the staging area as well as the final disposal site.

Dredging would start at the upper turning basin and proceed down stream to just past the U.S. Coast Guard Station. TSCA material is located primarily in the reach from the upper turning basin to just past Kister Marine. Construction of project features for sediment transfer/dewatering and disposal would take about one year. Sediment dredging, transfer/dewatering/transfer, and disposal would take about 3 years. Construction would begin in 2002 and the project would be completed in 2005.

Dredging, transfer/dewatering/transfer, and disposal of TSCA material would take place the first year. Dredging would likely occur from upstream to downstream, in order to try to recapture any re-suspended sediments and associated contaminants.

10. Recommended Plan Costs

All preliminary cost estimates associated with the Recommended Plan were reevaluated by the Partnership and a new cost estimate was developed. This cost reevaluation concentrated on contingencies and concluded that contingencies, in general, appeared to be overstated in the preliminary Deep Dredge scenario cost estimate. The new cost estimate placed total First Costs for the Recommended Plan at $42,380,000.

A construction cost estimate for this Recommended Plan is provided in Table 5. Average annual costs were computed for the Recommended Plan. Table 5 provides a summary of First Costs, Investment Costs and Average Annual Costs associated with the Recommended Plan. First Costs are basically Construction Costs, Habitat Restoration Costs, Study Costs, Engineering and Design Costs, Construction Management Costs and Real Estate Costs associated with building the Recommended Plan. All costs reflect September 1996 price levels.

Construction Costs associated with polluted sediment remediation came to $34,875,000. This $34,875,000 included: dredging costs ($11,716,000), construction of a dewatering facility and operation thereof ($2,912,400), TSCA related landfill construction costs ($3,091,700), non TSCA related landfill construction costs ($8,514,800), sampling and analysis costs for the construction period ($321,600), sampling and analysis at the disposal facility after construction ($437,000), wetlands mitigation costs ($167,000) and contingencies ($7,714,500).

Habitat restoration costs came to $860,000. These costs included construction costs ($662,000), contingencies on the habitat restoration construction costs ($103,000) and Engineering And Design and Supervision and Administration costs associated with habitat restoration ($95,000).

Study Costs were $3,800,000. Engineering And Design costs during construction were $530,000. Construction Management costs were $1,765,000. Real estate costs were $550,000: $370,000 associated with Section 312 and O&M and $180,000 for Section 206. Total First Costs came to $42,380,000.

Interest During Construction assumed a 4 year construction period, starting in May of 2002 and ending in September 2005. It was assumed no construction took place in January February or March. Construction cost time streams were developed for 20 cost categories on a monthly expenditure basis. Interest During Construction was computed using a 7.625 % annual interest rate and monthly compounding. Interest During Construction came to $6,410,900.

Interest During Construction ($6,410,900) was added to Project First Costs ($42,380,000) to arrive at project Investment costs. Project Investment costs came to $48,790,900.

There were a number of expenditures that would be made after the project was constructed. There were three general categories of post construction expenditures: Disposal Site expenditures, Wetland Mitigation area expenditures and Section 206 related expenditures.

Disposal Site expenditures included post construction monitoring (sampling and laboratory analysis) of the completed disposal facility and operations and maintenance expenditures associated with the TSCA and non-TSCA portion of the CDF. Each of these costs would be incurred every year over a 50 year period. Since these costs would be incurred every year, these are average annual costs. These average annual costs reflect a 7.625 percent annual interest rate and a 50 year evaluation period. These yearly expenditures will now be discussed

After the project is completed, post construction monitoring will take place at the disposal facility on a yearly basis. Test wells at the final disposal site would be inspected and monitored annually for the next 50 years. Annual Post Construction Monitoring Costs were placed at $57,100. Post Construction monitoring includes groundwater sampling, groundwater laboratory analysis, groundwater statistical analysis and reporting, NPDES sampling, NPDES monthly analysis, NPDES semi-annual analysis, NPDES annual organic analysis, NPDES reporting and miscellaneous monitoring.

Another annual cost at the disposal site was associated with annual maintenance of the CDF after construction. After the project is completed, the final disposal site would incur some annual maintenance costs for the next 50 years. Annual Maintenance Costs were placed at $44,900. These annual costs included such items as: repair of the capping system, revegetation, sedimentation basin cleanout, mowing, fence repair, monitoring well repairs, quarterly inspections and reports, implementation of a leachate management system, leachate transportation and disposal from the TSCA and Non-TSCA cells of the disposal site, maintenance of facility roads, and other miscellaneous items.

Wetland mitigation area post construction expenditures included post construction inspections of the mitigation area and operations and maintenance expenditures associated with maintaining the mitigation areas over the 50 year project life. Post construction wetland mitigation inspections would take place yearly and would cost $2,000 annually. Once every five years, the wetlands would need some maintenance performed on them to insure their continued viability. This would continue over the 50 years of the project life, resulting in 10 cycles. The maintenance cost per event is $10,400. This time stream of costs was converted to a present worth value and then an average annual cost using a 7.625 percent annual interest rate and a 50 year project life. Average annual wetland mitigation area operation and maintenance costs came to $1,800.

Section 206 post construction expenditures included post construction inspections of the Section 206 area and operations and maintenance expenditures associated with maintaining the Section 206 habitat areas over the 50 year project life. Post construction Section 206 habitat inspections would take place yearly and would cost $2,000 annually. Once every five years, the habitat areas created by Section 206 would need some maintenance performed on them to insure their continued viability. This would continue over the 50 years of the project life, resulting in 10 cycles. The maintenance cost per event is $38,300. This time stream of costs was converted to a present worth value and then an avenge annual cost using a 7.625 percent annual interest rate and a 50 year project life. Average annual wetland mitigation area operation and maintenance costs came to $6,600.

Total average annual project costs for the Recommended Plan came to $3,931,500. These average annual costs had four component average annual costs associated with sediment remediation and habitat restoration, annual post construction Disposal Site Costs, annual post construction Wetland Mitigation costs and annual post construction Section 206 costs.

The conversion of sediment remediation and habitat restoration Sated project costs, post construction Disposal Site costs, post construction Wetland Mitigation costs and post construction 206 costs to avenge annual costs, used a 7.625% annual interest rate and a 50 year project evaluation period. All costs reflect September 1996 price levels.

The explanation of the revisions to the overall cost estimate from the preliminary project cost estimate of $56,500,000 to the re-evaluated project cost estimate of $42,380,000 is addressed in Table 6.

Cost-sharing (Table 7) is dependent on guidance received from the USACE, Director of Civil Works, in the form of Policy Guidance Letter No.49 dated 28 January 1998, based upon the Water Resources Development Act of 1996. Cost-sharing may be impacted by the classification and volume of sediments regulated by the Toxic Substances Control Act (TSCA)-- volumes associated with Environmental Dredging (contaminated sediments outside of the Federal channel) and volumes of sediments associated with commercial navigation. An assessment and breakdown of sediment volumes versus pro-rata share of project costs based on sediment classification is presented in Table P2-2.

Cost-sharing is based on quantities associated with the different authorities represented in the recommended plan. O&M lower river dredging costs 100 percent Federal $2,015,000. Disposal costs are 80 percent Federal $1,263,000 and 20 percent non-Federal (with credit for Lands, Easements, Rights-of Way, Relocations and Dike Disposal Areas (LERRDs)) $316,000. Dredging outside of and adjacent to the channel Section 312(a) costs 100 percent Federal $1,710,000. Disposal costs 100 percent non-Federal $1,340,000. Environmental dredging upstream of the 5th Street Bridge (Segment H) cost-shared 50 percent Federal $9,413,000 and 50 percent non-Federal $9,413,000. Aquatic Fishery Shelves (Section 312(b) Habitat) Restoration project features are cost-shared $676,000 Federal and $364,000 non-Federal in accordance with the sediment remediation portion of the project LERRDs related costs are cost shared $23,000 Federal (for Administrative Costs only) and $347,000 for total non-Federal costs (includes Administrative and Acquisition Costs). The total cost-sharing for the comprehensive project is estimated $15,100,000 Federal (35.6%) and $27,280,000 non-Federal *(64.4%).*

DEEP DREDGING PLAN

	WORK ITEM	Qty	UOM	UNIT COST	ESTIMATED COST
1	MOB/DEMOB (Dredging Only)		LS		$580,000
2	CLAMSHELL DREDGING	696,000	CY	$16.00	$11,136,000
3	MARINE DEWATERING STATION				
	- Mob. Equipment & Assemble Plant		LS		
	- Operation	696,000	CY	$2.60	
4	TRANSFER FACILITY				
	A. Dewatering/Transfer (Interim CDF)				
	- Construction		LS		$2,180,000
	- Operation	696,000	CY	$2.55	$1,774,800
	B. Transfer Only (Sidley Dock)				
	- Operation	696,000	CY	$2.30	
	C. Off-Shore Pumpout/CDF Dewatering Facility				
	- Construction				
	a. Off-Shore Brkwtr/Pumpout Sta.		LS		
	b. Dewatering Station @ CDF		LS		
	- Operation (Pumpout & Dewater)	696,000	CY	$6.30	
5	SEDIMENT DISPOSAL OPTIONS - TSCA LEVELS (Based on 100,000 CY Dewatered Sedime				
	A. Commercial Options				
	- Model City, NY (Common Carrier)	150,000	TON	$150.00	
	- ECDC Landfill (Utah) by Rail	150,000	TON	$115.00	
	B. Upland CDF (Site 7)				
	- Construction		LS		$3,600,000
	- Transport Sediments to CDF	100,000	CY	$2.65	$265,000
	- CDF Operation	100,000	CY	$1.60	$160,000
6	SEDIMENT DISPOSAL OPTIONS - Non TSCA LEVELS (Based on 400,000 CY @ 1.5 Tn/CY)				
	A. Upland CDF (Site 7)				
	- Construction		LS		$9,200,000
	- Transport Sediments to CDF	400,000	CY	$2.65	$1,060,000
	- CDF Operation	400,000	CY	$1.60	$640,000
	B. Lakefront CDF				
	- Construction		LS		
	- Transport Sediments to CDF	400,000	CY	$1.25	
	- CDF Operation	400,000	CY	$2.00	
	C. Commercial - BFI Landfill	600,000	TON	$30.00	
7	SAMPLING & ANALYSIS				
	A. Dredging		LS		$271,000
	B. Transfer Facility		LS		$131,000
	C. Disposal Facility (CDFs)		LS		$2,276,500
8	WETLANDS MITIGATION				
	A. Transfer Site		LS		$50,000
	B. Upland TSCA Only Landfill		LS		
	C. Upland TSCA & Non-TSCA Landfill		LS		$400,000
9	LIABILITY / O & M				
	A. Non-TSCA Landfill		LS		$2,700,000
	B. TSCA Only Landfill		LS		$3,500,000
	Construction Cost ------				$39,924,300
	25% Contingency ------				$9,975,700
	Project Construction Cost Subtotal ------				$49,900,000
10	CMP STUDY COSTS				
	A. CMP/EIS		LS		$1,800,000
	B. Detailed Design		LS		$1,000,000
	C. Plans & Specificiations		LS		$1,000,000
	Subtotal				$3,800,000
11	ENG. & DESIGN DURING CONSTRUCTION (1.5% Construction Cost)		LS		$600,000
12	SUPR. & ADMIN. DURING CONSTRUCTION (5% of Construction Cost)		LS		$1,979,000
13	REAL ESTATE				
	A. Landfill Area				$65,000
	B. Transfer Site/Dewatering Facility				$156,000
	Subtotal				$221,000
	Total Project Cost -------				$56,500,000

TABLE 1

22-Oct-97

	WORK ITEM	Qty	UOM	UNIT COST	ESTIMATED COST
1	MOB/DEMOB (Dredging Only)		LS		$580.000
2	CLAMSHELL DREDGING	1,140,000	CY	$16.00	$18,240,000
3	MARINE DEWATERING STATION				
	- Mob. Equipment & Assemble Plant		LS		
	- Operation	1,140,000	CY	$2.60	
4	TRANSFER FACILITY				
	A. Dewatering/Transfer (Interim CDF)				
	- Construction		LS		$2,180,000
	- Operation	1,140,000	CY	$2.55	$2,907,000
	B. Transfer Only (Sidley Dock)				
	- Operation	1,140,000	CY	$2.30	
	C. Off-Shore Pumpout/CDF Dewatering Facility				
	- Construction				
	a. Off-Shore Brkwtr/Pumpout Sta.		LS		
	b. Dewatering Station @ CDF		LS		
	- Operation (Pumpout & Dewater)	1,140,000	CY	$6.30	
5	SEDIMENT DISPOSAL OPTIONS - TSCA LEVELS (Based on 100,000 CY Dewatered Sedime				
	A. Commercial Options				
	- Model City, NY (Common Carrier)	150,000	TON	$150.00	
	- ECDC Landfill (Utah) by Rail	150,000	TON	$115.00	
	B. Upland CDF (Site 7)				
	- Construction		LS		$4,900,000
	- Transport Sediments to CDF	100,000	CY	$2.65	$265,000
	- CDF Operation	100,000	CY	$1.60	$160,000
6	SEDIMENT DISPOSAL OPTIONS - Non TSCA LEVELS (Based on 700,000 CY @ 1.5 Tn/CY)				
	A. Upland CDF (Site 7)				
	- Construction		LS		$10,900,000
	- Transport Sediments to CDF	700,000	CY	$2.65	$1,855,000
	- CDF Operation	700,000	CY	$1.60	$1,120,000
	B. Lakefront CDF				
	- Construction		LS		
	- Transport Sediments to CDF	700,000	CY	$1.25	
	- CDF Operation	700,000	CY	$2.00	
	C. Commercial - BFI Landfill	1,050,000	TON	$30.00	
7	SAMPLING & ANALYSIS				
	A. Dredging		LS		$271,000
	B. Transfer Facility		LS		$131,000
	C. Disposal Facility (CDFs)		LS		$2,276,500
8	WETLANDS MITIGATION				
	A. Transfer Site		LS		$50,000
	B. Upland TSCA Only Landfill		LS		
	C. Upland TSCA & Non-TSCA Landfill		LS		$400,000
9	LIABILITY / O & M				
	A. Non-TSCA Landfill		LS		$2,700,000
	B. TSCA Only Landfill		LS		$3,500,000
	Construction Cost ——				$52,435,500
	25% Contingency ——				$13,064,500
	Project Construction Cost Subtotal ------				$65,500,000
10	CMP STUDY COSTS				
	A. CMP/EIS		LS		$1,800,000
	B. Detailed Design		LS		$1,000,000
	C. Plans & Specificiations		LS		$1,000,000
	Subtotal				$3,800,000
11	ENG. & DESIGN DURING CONSTRUCTION (1.5% Construction Cost)		LS		$800,000
12	SUPR. & ADMIN. DURING CONSTRUCTION (5% of Construction Cost)		LS		$2,579,000
13	REAL ESTATE				
	A. Landfill Area				$65,000
	B. Transfer Site/Dewatering Facility				$156,000
	Subtotal				$221,000
	Total Project Cost -------				$72,900,000

TABLE 2

22-Oct-97

SHALLOW DREDGING PLAN

	WORK ITEM	Qty	UOM	UNIT COST	ESTIMATED COST
1	**MOB/DEMOB (Dredging Only)**		LS		$580,000
2	**CLAMSHELL DREDGING**	592,000	CY	$16.00	$9,472,000
3	**MARINE DEWATERING STATION**				
	- Mob. Equipment & Assemble Plant		LS		
	- Operation	592,000	CY	$2.60	
4	**TRANSFER FACILITY**				
	A. Dewatering/Transfer (Interim CDF)				
	- Construction		LS		$2,180,000
	- Operation	592,000	CY	$2.55	$1,509,600
	B. Transfer Only (Sidley Dock)				
	- Operation	592,000	CY	$2.30	
	C. Off-Shore Pumpout/CDF Dewatering Facility				
	- Construction				
	a. Off-Shore Brkwtr/Pumpout Sta.		LS		
	b. Dewatering Station @ CDF		LS		
	- Operation (Pumpout & Dewater)	592,000	CY	$6.30	
5	**SEDIMENT DISPOSAL OPTIONS - TSCA LEVELS (Based on 100,000 CY Dewatered Sediments**				
	A. Commercial Options				
	- Model City, NY (Common Carrier)	150,000	TON	$150.00	
	- ECDC Landfill (Utah) by Rail	150,000	TON	$115.00	
	B. Upland CDF -S ite 7 (Quantity shown is dewatered volume)				
	- Construction		LS		$3,300,000
	- Transport Sediments to CDF	100,000	CY	$2.65	$265,000
	- CDF Operation	100,000	CY	$1.60	$160,000
6	**SEDIMENT DISPOSAL OPTIONS - Non TSCA LEVELS (Based on 350,000 CY @ 1.5 Tn/CY)**				
	A. Upland CDF - Site 7 (Quantity shown is dewatered volume)				
	- Construction		LS		$8,100,000
	- Transport Sediments to CDF	350,000	CY	$2.65	$927,500
	- CDF Operation	350,000	CY	$1.60	$560,000
	B. Lakefront CDF				
	- Construction		LS		
	- Transport Sediments to CDF	350,000	CY	$1.25	
	- CDF Operation	350,000	CY	$2.00	
	C. Commercial - BFI Landfill	525,000	TON	$30.00	
7	**SAMPLING & ANALYSIS**				
	A. Dredging		LS		$271,000
	B. Transfer Facility		LS		$131,000
	C. Disposal Facility (CDFs)		LS		$2,276,500
8	**WETLANDS MITIGATION**				
	A. Transfer Site		LS		$50,000
	B. Upland TSCA Only Landfill		LS		
	C. Upland TSCA & Non-TSCA Landfill		LS		$400,000
9	**LIABILITY / O & M**				
	A. Non-TSCA Landfill		LS		$2,700,000
	B. TSCA Only Landfill		LS		$3,500,000
	Construction Cost -------				$36,382,600
	25% Contingency -------				$9,117,400
	Project Construction Cost Subtotal -------				$45,500,000
10	**CMP STUDY COSTS**				
	A. CMP/EIS			LS	$1,800,000
	B. Detailed Design			LS	$1,000,000
	C. Plans & Specificiations			LS	$1,000,000
	Subtotal				$3,800,000
11	**ENG. & DESIGN DURING CONSTRUCTION** (1.5% Construction Cost)			LS	$500,000
12	**SUPR. & ADMIN. DURING CONSTRUCTION** (5% of Construction Cost)			LS	$1,779,000
13	**REAL ESTATE**				
	A. Landfill Area				$65,000
	B. Transfer Site/Dewatering Facility				$156,000
	Subtotal				$221,000
	Total Project Cost -------				$51,800,000

TABLE 3

22-Oct-97

TABLE 4: SITE . LANDFILL
POST-CLOSURE MAINTENANCE AND MONITORING
COST ESTIMATE

No.	Description of Item	Quantity	Units	Unit Cost	Total for Item	Remarks
	Post-Closure Maintenance (Annual)					
1	Repair of capping system	581	cy	$ 3.95	$ 2,294.95	two feet of soil over 1% of 18 acres per year
2	Revegetation	0.5	ac	$ 650.00	$ 325.00	0.5 acres per year
3	Sedimentation Basin cleanout	60	cy	$ 11.35	$ 681.00	five tons per acre of cap per year
4	Mowing	20	ac	$ 28.00	$ 1,120.00	two mowings per year
5	Fence repair	20	lf	$ 15.70	$ 414.00	20 feet repaired per year plus $100 for mobilization
6	Monitoring well repair	1	lump sum	$ 500.00	$ 500.00	
7	Quarterly inspections and reports	4	ea	$ 975.00	$ 3,900.00	15 hours per inspection at $65 per hour
8	Leachate management system	1	lump sum	$ 5,000.00	$ 5,000.00	2% of total capital cost of $250,000
9	Leachate transportation and disposal-TSCA	103269	gallon	$ 0.12	$ 12,392.28	13806 cf/yr after closure
10	Leachate transportation and disposal-Non TSCA	95766	gallon	$ 0.06	$ 5,267.13	12803 cf/yr after closure
11	Maintenance of facility roads	1	lump sum	$ 3,000.00	$ 3,000.00	gravel purchase (delivered) and spreading
12	Miscellaneous Maintenance and Contingency	1	lump sum	$ 10,000.00	$ 10,000.00	
	Total for Post Closure Maintenance (Annual)				**$ 44,894.36**	
	Post Closure-Monitoring (Annual)					
13	Groundwater Sampling	4	qtrly event	$ 2,400.00	$ 9,600.00	based on 8 groundwater monitoring wells and bailing
14	Groundwater Laboratory Analysis	32	well-event	$ 800.00	$ 25,600.00	quarterly monitoring of 8 wells
15	Groundwater Statistical Analysis and Reporting	4	qtrly event	$ 2,000.00	$ 8,000.00	based on background statistics previously developed
16	NPDES Sampling	12	month	$ 400.00	$ 4,800.00	includes travel time and shipping charges-one outfall
17	NPDES Monthly Analysis	12	month	$ 120.00	$ 1,440.00	limited analytical parameters-one outfall
18	NPDES Semi-Annual Analysis	2	event	$ 400.00	$ 800.00	one outfall
19	NPDES Annual Organic Analysis	1	event	$ 800.00	$ 800.00	one outfall
20	NPDES Reporting	12	month	$ 375.00	$ 4,500.00	includes preparing and filing MOR's and exceedance rpt.
21	Miscellaneous Monitoring	1	lump sum	$ 1,500.00	$ 1,500.00	
	Total for Post-Closure Monitoring (Annual)				**$ 57,040.00**	

Total Annual Post-Closure Cost **$101,934.36**

Table 5. Derivation Of Average Annual Costs-Recommended Plan

Total Project Construction Costs And First Costs	
Construction Costs	
Dredging Costs	$11,716,000
Dewatering Costs	$ 2,912,400
Landfill Costs-TSCA	$ 3,091,700
Landfill Costs- Non TSCA	$ 8,514,800
Sampling And Analysis	
During Dredging & At The Transfer Facility	$ 321,600
At The Disposal facility- After Construction	$ 437,000
Wetlands Mitigation	$ 167,000
Construction Contingencies	$ 7,714,500
Total Construction Costs	$34,875,000
Aquatic Fishery Shelves Restoration (Habitat Restoration)	$ 860,000
Study Costs	$ 3,800,000
Engineering And Design During Construction	$ 530,000
Construction Management	$ 1,765,000
Real Estate	$ 550,000
Section 312, O&M	($ 370,000)
Section 206	($ 180.000)
First Costs	$42,380,000
Investment Costs	
Project First Costs To Be Average Annualized	$42,380,000
Interest During Construction [1]	$ 6,410,900
Investment Costs To Be Average Annualized	$48,790,900
Average Annual Costs	
Interest (7.625%)	$ 3,720,300
Amortization (.198%)	$ 96,800
Disposal Site	
Post Construction Monitoring [2]	$ 57,100
Annual Maintenance [3]	$ 44,900
Wetland Mitigation Area	
Post Construction Monitoring 4	$ 2,000
Annual Maintenance 5	$ 1,800
Section 206	
Post Construction Monitoring 6	$ 2,000
Annual Maintenance 7	$ 6,600
Average Annual Costs 8	$ 3,931,500
Present Worth Factor for 7.625%	12.78202
Present Worth Of Average Annual Costs	$ 50,252,498
Rounded PW of Average Annual Costs	$ 50,252,500

(1) Interest During Construction Costs are based on total first costs ($42,380,000) less Real Estate costs of $550,000. IDC was based on a four year construction period and monthly compounding using a 7.625 percent annual interest rate.

(2) Disposal Site Post Construction Monitoring.-Based on an annual expenditure of $57,100 over a 50 year period.

(3) Disposal Site Annual Maintenance- Based on an annual expenditure of $44,900 over a 50 year period.

(4) Wetland Mitigation Area Post Construction Monitoring. Based on an annual expenditure of $2,000 over a 50 year period.

(5) Wetland Mitigation Area Annual Maintenance- Based on an expenditure of $10,400 once every five years, for ten cycles.

(6) Section 206 Post Construction Monitoring. Based on an annual expenditure of $2,000 over a 50 year period.

(7) Section 206 Annual Maintenance- Based on an expenditure of $38,300 once every five years, for ten cycles.

(8) Average Annual Costs reflect a 7.625 annual interest rate, a 50 year project life and September 1996 price levels.

TABLE 6: DERIVATION OF "REVISED LINE ITEM COST" ESTIMATE

	Original Line Item Estimated Cost	Cntngncy In Original Estimated Cost	Revised Line Item Cost Estimate	Ft Note	Cntngncy Percent	Cntngncy Value	Revised Estimated Cost Plus Cntngncy
1. MOB DEMOB	$ 580,000	None	$ 580,000	1	25%	$ 145,000	$ 725,000
2. CLAMBSHELL DREDGING	$11,136,000	None	$11,136,000	1	25%	$2,784,000	$13,920,000
3. TRANSFER FACILITY							
A. Dewatering Transfer (Interm Facility)							
Construction	$2,180,000		$1,137,600	3	25%	$ 284,400	$ 1,422,000
Operation	$1,774,800	None	$1,774,800	1	25%	$ 443,700	$ 2,218,500
4. SEDIMENT DISPOSAL- TSCA							
A. Upland CDF (site 7)							
Construction	$3,600,000	35%	$2,666,700	2	35%	$ 933,300	$ 3,600,000
Transport sediments To CDF	$ 265,000	None	$ 265,000	1	25%	$ 66,300	$ 331,300
CDF Operation	$ 160,000	None	$ 160,000	1	25%	$ 40,000	$ 200,000
5. SEDIMENT DISPOSAL- NON TSCA							
A. Upland CDF (site 7)							
Construction	$9,200,000	35%	$6,814,800	2	35%	$2,385,200	$ 9,200,000
Transport sediments To CDF	$1,060,000	None	$1,060,000	1	25%	$ 265,000	$ 1,325,000
CDF Operation	$ 640,000	None	$ 640,000	1	25%	$ 160,000	$ 800,000
6. SAMPLING ANALYSIS							
A. Dredging	$ 271,000	25%	$ 216,800	5	25%	$ 54,200	$ 271,000
B. Transfer Facility	$ 131,000	25%	$ 104,800	5	25%	$ 26,200	$ 131,000
C. Disposal Facility	$2,276,500		$ 437,000	6	25%	$ 109,300	$ 546,300
7. WETLANDS MITIGATION							
Total Mitigation Plan	$ 450,000	None	$ 167,000	14	25%	$ 41,500	$ 208,500
LIABILITY /O&M							
A. Non TSCA Landfill	$2,700,000	None		7	Line Item Deleted		
B. TSCA Only Landfill	$3,500,000	None		8	Line Item Deleted		
Construction Cost	$39,924,300		$27,160,500			$7,738,100	
						$ 23,600	
Contingency	$ 9,975,700					$7,714,500	
Construction Cost Plus Contingency	$49,900,000		$27,160,500			$7,714,500	$34,875,000
8. AQUATIC FISHERY SHELVES RESTORATION (Habitat Rstoration)							
A. CONSTRUCTION COSTS	None	None	$ 662,000	12	16%	$ 103,000	$ 765,000
B. E&D AND S&A	None	None	$ 95,000	13	0%	$ 95,000	
C. LERRD			$ 180,000	4	0%	$ 180,000	
9. CMP STUDY COSTS							
A. CMP/EIS	$1,800,000	None	$ 1,800,000	9	N. A.	N. A.	$ 1,800,000
B. Detailed Design	$1,000,000	None	$ 1,000,000	9	N. A.	N. A.	$ 1,000,000
C. Plans And Specs	$1,000,000	None	$ 1,000,000	9	N. A.	N. A.	$ 1,000,000
10. ENGN & DSGN DRING CONSTRCT	$600,000	N.A.		10	1.52%	Of CCPC	$ 530,000
11. SUP&ADMIN DRING CONSTRCT	$1,979,000	N.A.		11	5.06%	Of CCPC	$ 1,765,000
12 REAL ESTATE							
A. Landfill Area	$65,000	None	$ 245,000	4	N.A.		$ 245,000
B. Transfer/Dewatering Area	$156,000	None	$ 47,000	4	N.A.		$ 47,000
C. Wetland Mitigation	-		$ 78,000	4	N.A.		$ 78,000
Total Costs	$56,500,000		$32,267,500			$7,817,500	$42,380,000

1. All of these line items had no contingencies in "Original Line Item Estimated Cost". Consequently, these values were used in the "Revised Estimate" as "Revised Line Item Cost Estimate". All Of these costs in the "Revised Estimate" were given a 25% contingency factor, the same contingency as used in the "Original Cost Estimate".

2. These line items had a 35% contingency already factored into the "Original LineItem Cost". The "Original Estimate" then added an additional 25% contingency on top of the 35% contingency already in the line item cost. It was decided that the "Original Estimated Cost", with its 35 % contingency, would be the control total for the "Revised Estimate". However, the costs would be broken out into a "Revised Line Cost Estimate" and its "contingency". For Example, construction costs for the upland disposal site for TSCA material came to $3,600,000 in the "Original Line Item Cost Estimate". Since this $3,600,000 already had a 35% contingency included in the Line item cost, the "total revised estimate line cost" for this component would be $3,600,000. this was broken down into a "Revised Line Item Cost Estimate" ($2,666,700) and its corresponding 35% contingency ($933,300).

3. This construction cost of $2,180,000 was based upon a 1985 design brought up to Augst 1997 price levels by an index factor. Information on the index factor was not available. The $2,180,000 construction cost in the "Original Estimate" actually had 2 components: a "construction cost" and a "land cost". However the backup had the following data: A total construction cost of $1,650,000 in Jan 1988 prices and a construction cost component of $861,000 in Jan 1988 prices. The update factor to bring $1.65m to 1997 prices is $2.18m/ $1.65m= 1.3212. this factor was used to determine the construction cost component in 1997 prices given construction costs in Jan 1988 prices equalled $861,000 (1.3212x $861,000= $1,137,563). This was rounded to $1,137,600 and became the amount used in the "revised cost estimate". A 25% contingency ($284,400) was added to this "Revised Line Item Cost Estimate" which resulted in "total Revised Cost" of $1,422,000.

4. Real Estate costs (Lands, Easements, Rights Of Way, Relocations, Dike Disposal Areas (LERRD) were revised based on a reanalysis of requirements as presented in the Real Estate Plan and in accordance with CECW-PC memorandum dated 21 April 1999, Subject:Ashtabula River And Harbor, Ashtabula Ohio- Project Guidance Memorandum,Supplemental Number 1.

5. Sampling And Analysis. The "Original Line Item Cost Estimate" for the Dredging and Transfer Facility line items had a 25% contingency included in them. The "Original estimate" then added and additional 25% contingency on top of the previous built in 25% contingency. It was decided that the original "estimated Cost" with its 25% built in contingency, would be the control total for the "revised estimate". However, the costs would be broken down into a "revised line item cost estimate" and its 25% contingency, just like footnote 2.

6. Sampling & Analysis-Disposal Facility.- The "Original" estimated cost of $2.276,500 included disposal facility sampling and analysis before CDF construction ($86,990), sampling and analysis during filling ($350,000) and sampling and analysis after construction ($1,386,400). There were no contingencies built into the original line item Costs. The "original Estimate" then added a 25% contingency onto these line itemcosts once they were rolled up into construction costs. The costs in the "Original Cost Estimate" is presented below.

Sampling & Analysis	Original Line Item Cost	25 % Conting on Original Line Item Cost	Total cost in Original Estimate"	
Pre Construction	$86,990	$21,748	$108,738	
During Filling	$350,000	$87,500	$437,500	
Post Construction	$1,386,400	$346,600	$1,733,000	$57,767
	$1,823,390	$455,848	$2,279,238	

It was decided that the "Pre-construction" and "During Filling" sampling & analysis costs would remain as line items in the "Revised Line Item" cost estimate. Thus Sampling & Analysis "Revised Line Item Costs" were $437,000 ($86,990+ $350,000= $436,990). A contingency of 25% would be added to this amount ($109,300) to bring the total "Revised line Estimate Cost" to $546,300.

This left Post Construction monitoring costs of $1,733,000 to be considered. At first, all post construction monitoring costs ($1,733,000) was going to be divided into 30 equalpayments. This resulted in a payment of$57,766. These 30 equal payments was then going to be converted to present worth values, summed and then converted to an average annual value given a 50 year project life and a 7.625% annual % rate. However, the life of the project is 50 years. Post Construction Monitoring would need to be performed each year during the sites 50 year life. Therefore, in order to provide monitoring in each year of the projects life, a Reanalysis of Requirements was performed. This Reanalysis of Requirements placed annual post Construction Monitoring costs at $57,100.

7,8. The Comprehensive Management Plan (CMP) cost estimate called for providing liability funding for the project based on constructing a slurry wall around the entire perimeter of the disposal facility. This was based on a worst-case scenario involving failure of theconfinement dike, leachate collection system, facility liner, or/and facility capping systems. Based on mor recent information, it has been determined that this liability contingency is nolonger required for the project.

Discussions with regulatory authorities and engineers involved with the project, review of applicable law and regulation, review of design and construction requirements, and historical performance of like facilities, suggest that any failure that would necessitate the constuction of a slurry wall cannot, within reason, be ever expected to occur. The design of the facility has been performed using conservative factors of safety that provide more than a reasonable level of comfort that the facility will perform as designed. Additionally, conservative estimates of the post-closure maintenance costs have been developed that will provide an adequate level of of funding for any expected failure that typically occurs in similar facilities. Given this determination, the liability funding has been deleted from the cost estimate.

This left Post Construction O&M costs to be considered. The Original Cost Estimate placed O&M costs at $1,104,000 to which was aded a 25% contingency. This resulted in an O&M cost of $1,380,000. This O&M cost was going to be divided into 30 equal installments and spread out over 30 years. This resulted in 30 expenditures of $46,000. These 30 equal expenditures were then going to be converted to present worth values, summed and then converted to an average annual dollar value, given a 50 year project life and a 7.625% annual % rate. However, the life of the project is 50 years. Post Construction Operation And Maintenance costs would need to be performed each year during the sites 50 year life. Therefore, in order to provide maintenance in each year of the projects life, a Reanalysis of Requirements was performed. This Reanalysis of Requirements placed annual post Construction O&M costs at $44,900.

9. CMP Study Costs- Study Costs presented in the "Original Estimate" were retained in the "revised estimate". No contingencies were in the original line items, nor was any contingency added. Consequently, the "revised cost Estimate" also had no contingencies added to these line items.

10. Engineering & Design During Construction. E&DDC was taken as approximately 1.5% of Construction Costs Plus Contingencies in the "Revised Line Item Cost" estimate.

11. Supervision & Administration During Construction. S&ADC was taken as approximately 5.0% of Construction Costs Plus Contingencies in the "Revised Line Item Cost" estimate.

12. Aquatic Fishery Shelf Restoration construction costs had a contingency of approximately 16 percent.

13. There were no contingency costs added to the Aquatic Fishery Shelf Restoration E&D and S&A costs.

14. Overall costs have been revised in accordance with Footnote 4. Revised line item cost ($167,000) reflects costs and requirements to enhance/preserve areas for wetland mitigation.

TABLE 7 BREAKDOWN OF FEDERAL/NON-FEDERAL COST SHARING OF PROJECT FEATURES

PROJECT FEATURES	FEDERAL	NON FEDERAL
DREDGING[1]		
O&M Dredging downstream of the 5th Street Bridge; total of 62,200 CY non-TSCA	$ 2,015,000	$ 0
312(a) Dredging downstream of the 5th Street Bridge; total of 52,800 CY non-TSCA	$ 1,710,000	$ 0
312(b) Dredging upstream of the 5th Street Bridge; total of 581,000 CY of TSCA and non-TSCA sediments	$ 9,413,000	$ 9,413,000
SUBTOTAL	$ 13,133,000	$ 9,413,000
DISPOSAL		
O&M disposal of 62,200 CY of non-TSCA sediments (Section 101, WRDA 86)	$ 1,263,000	$ 316,000
312(a) disposal of 52,800 CY of non-TSCA sediments	$ 0	$ 1,340,000
312(b) disposal of TSCA and non-TSCA sediments – TSCA (150,000 CY) Non-TSCA (431,000 CY)	$ 0 $ 0	$ 4,560,000 $10,940,000
SUBTOTAL	$ 1,263,000	$17,156,000
LERRDs		
Administrative Cost	$ 23,000	$ 50,000
Acquisition Costs	$ 0	$ 297,000
SUBTOTAL	$ 23,000	$ 347,000
TOTAL ENVIRONMENTAL DREDGING	$ 14,424,000	$ 26,916,000
HABITAT RESTORATION		
Aquatic Fisheries Shelves (Section 206 Habitat Restoration (Section 206 WRDA 96)	$ 676,000	$ 364,000
TOTAL COMPREHENSIVE PROJECT COST SHARE	$ 15,100,000	$27,280,000

[1]For purposes of this feasibility report, the costs associated with the dredging, transport and dewatering of TSCA and non-TSCA sediments is the same.

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

SUB-APPENDIX R-1

DETAILED COST ESTIMATES FOR DREDGING ALTERNATIVES

- DEEP DREDGE OPTION
- BANK-TO-BANK/BEDROCK OPTION
- SHALLOW DREDGE OPTION

ASHTABULA UPLAND CDF ESTIMATE
Upland TSCA & Non-TSCA Landfill
for Ashtabula River Dredged
Sediments - Deep Dredging Option*

Designed By: Environmental Eng & Design Sect.
Estimated By: CELRB Cost Engineering Branch

Prepared By: Robert Chapman

Preparation Date: 08/12/97
Effective Date of Pricing: 08/12/97
Est Construction Time: 360 Days

Sales Tax: 0.0%

LABOR ID: CLEV92   EQUIP ID: RG0195   Currency in DOLLARS   CREW ID: CLEV92   UPB ID: NAT95A

This estimate is based on a CONCEPTUAL upland CDF design developed by the Buffalo District's Environmental Engineering & Design Section, and included in the Landfill Design Appendix for the subject project. The upland CDF is being planned for a "DEEP DREDGING CONCEPT PLAN" for PCB-contaminated sediments and polluted sediments that will be dredged as part of the Ashtabula River Partnerships efforts to clean up the upper river between the 5th Street Bridge (starting approximately at the Coast guard Station and ending at the limits of the Federal Channel).

The Partnership Site Selection Committee has narrowed the search to two sites, identified as Site 5 and Site 7. These sites are located along Route 531, east of Ashtabula near the intersection of LaBounty Road. Each site covers a minimum area of 30 acres, a real estate requirement set by the site selection committee during their efforts to locate suitable CDF sites. The Landfill Design Appendix (April 1997) provides details on which this estimate is based. Below is a general description of the CDF features.

The conceptual CDF design covers 46 acres, and is a multi-cell CDF. The larger cell, measuring 1,000 ft x 400 ft (bottom of dike) is sized to permanently contain 400,000 cy of non-TSCA level, but polluted sediments. An adjoining smaller cell will contain 100,000 cy of PCB-contaminated sediments that exceed TSCA levels. This cell measures 200 ft x 75 ft.

The disposal facility contains a double layer leachate collection system in the TSCA cell, and a single layer in the non-TSCA cell leading to a wastewater treatment plant. The treatment plant is not yet designed, but preliminary indications are that there will be sand and coal filters and carbon adsorption equipment. The means of disposal for the water after it is treated also requires better definition. This estimate assumes that the treated water will be trucked off-site to the City's water treatment plant for further treatment.

The construction of the non-TSCA disposal cell requires an 11 foot deep excavation and dikes constructed 9.5 feet high around the excavation. Excavated soil will be used to shape the dikes. The TSCA cell requires a 16 foot excavation and berms built to 27.5 feet above existing grade. Additional soil will need to be acquired to complete the facility berms, and later when the CDF is filled, as vegetation cover over the clay cap.

After placing a 3 foot thick clay liner over the excavated bowl, a double 60-mil HDPE liner with a 24" pea gravel drainage layer will be constructed in the TSCA cell. The non-TSCA cell requires only a 12" pea gravel layer and one 60-mil HDPE liner. 6" diameter Perforated PVC piping joined to a 12" diameter solid PVC collector pipe will be installed in the drainage layer(s) and connect to a decanting manhole. A geonet drainage mat placed over the pea gravel on the sideslopes of both cells will complete the disposal cell.

The caps over both cells are identical. The initial cover is a manufactured Geosynthetic clay liner (GCL) covered by a geonet drainage layer. Completing the cap is a 36" vegetation layer of 32" of soil and 4" of seeded topsoil.

The disposal facility will be surrounded by a 6 foot high security fence around the perimeter of the property line. Within the fence, but outside the

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CDF cells will be spaced six groundwater sampling manholes. Along side one edge of the property line will be a 75 foot wide staging and sediment handling area. Details of this area are also not yet defined, but the estimate assumed a crushed stone paved surface.

The process of transferring and transporting the dredged sediments to the CDF cells also needs to be further developed. Therefore, additional costs may need to be added when these details are defined in more detail. The location near the lake lends itself to pumping the sediments to the CDF directly from the dredge scows. The proximity to the highway heading directly to the harbor area provides for truck transportation as well, pending aquisition of a suitable transfer facility.

SUMMARY REPORTS SUMMARY PAGE

DETAILED ESTIMATE DETAIL PAGE

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DETAILED ESTIMATE DETAIL PAGE

BACKUP REPORTS BACKUP PAGE

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* * * END TABLE OF CONTENTS * * *

Wed 13 Aug 199 Tri-Service Automated Co[illegible] neering System (TRACES) [illegible] 10:27:05
Eff. Date 08/1. PROJECT ASH400: ASHTABULA UPLAND CDF [illegible]ATE - Upland TSCA & Non-TSCA Landfill SUMMARY PAGE 1

ASHTABULA UPLAND CDF - DEEP DREDGING SCENARIO

** PROJECT OWNER SUMMARY - CONTRACT **

		QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
01	Temporary Office Trailers			27,065	9,473	36,537	
02	Clear & Grub	46.00	ACR	1,057,760	370,216	1,427,976	31043
03	Site Improvements			325,824	114,038	439,863	
04	Unclassified Excavation	204063	CY	292,726	102,454	395,180	1.94
05	Construct Landfill Berms	228669	EA CY	216,783	75,874	292,657	1.28
06	Place Imperv. Fill - Clay Layer	81717	CY	1,584,101	554,435	2,138,536	26.17
07	Leachate Collection System	8825.00	LF	242,321	84,812	327,134	37.07
08	Wastewater Treatment Plant	6.00	EA	253,427	88,700	342,127	57021
09	12-Inch Gravel Layer(s)	32190	CY	2,098,140	734,349	2,832,489	87.99
10	Geonet Drainage Layer	122798	SY	1,640,642	574,225	2,214,866	18.04
11	Geosynthetic Clay Liner (GCL)	91316	SY	496,457	173,760	670,217	7.34
12	Vegetation Layer	81170	CY	834,401	292,040	1,126,442	13.88
13	Topsoil & Seeding	30.00	AC	404,328	141,515	545,842	18195
	TOTAL ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	9,473,974	3,315,891	12,789,866	12789866

LABOR ID: CLEV92 EQUIP ID: RG0195 Currency in DOLLARS CREW ID: CLEV92 UPB ID: NAT95A

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
01 Temporary Office Trailers			27,065	9,473	36,537	
02 Clear & Grub	46.00	ACR	1,057,760	370,216	1,427,976	31043
03 Site Improvements						
03_3A Water/Soil Collection & Control			15,574	5,451	21,025	
03_3B Perimeter Security Fence			119,161	41,706	160,868	
03_3C Facility Access Roads & Parking			191,089	66,881	257,970	
TOTAL Site Improvements			325,824	114,038	439,863	
04 Unclassified Excavation						
04_ 5 Tsca Cell	19148	CY	31,086	10,880	41,966	2.19
04_10 Non-Tsca Cell	184915	CY	261,640	91,574	353,214	1.91
TOTAL Unclassified Excavation	204063	CY	292,726	102,454	395,180	1.94
05 Construct Landfill Berms						
05_ 5 TSCA Cell	176344	CY	193,451	67,708	261,159	1.48
05_10 Non-TSCA Cell	52325	CY	23,332	8,166	31,498	0.60
TOTAL Construct Landfill Berms	228669	EA	216,783	75,874	292,657	1.28
06 Place Imperv. Fill - Clay Layer						
06_ 5 TSCA Cell	16916	CY	329,103	115,186	444,289	26.26
06_10 Non-TSCA Cell	64801	CY	1,254,998	439,249	1,694,247	26.15
TOTAL Place Imperv. Fill - Clay Layer	81717	CY	1,584,101	554,435	2,138,536	26.17
07 Leachate Collection System						
07_ 5 TSCA Cell	1600.00	LF	68,459	23,960	92,419	57.76
07_10 Non-TSCA Cell	7225.00	LF	173,863	60,852	234,714	32.49
TOTAL Leachate Collection System	8825.00	LF	242,321	84,812	327,134	37.07
08 Wastewater Treatment Plant	6.00	EA	253,427	88,700	342,127	57021
09 12-Inch Gravel Layer(s)						
09_ 5 TSCA Cell	10766	CY	726,603	254,311	980,914	91.11
09_10 Non-TSCA Cell	21424	CY	1,371,537	480,038	1,851,575	86.43
TOTAL 12-Inch Gravel Layer(s)	32190	CY	2,098,140	734,349	2,832,489	87.99

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	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
10 Geonet Drainage Layer						
10_5 TSCA Cell	33744	SY	450,779	157,773	608,552	18.03
10_10 Non-TSCA Cell	89054	SY	1,189,862	416,452	1,606,314	18.04
TOTAL Geonet Drainage Layer	122798	SY	1,640,642	574,225	2,214,866	18.04
11 Geosynthetic Clay Liner (GCL)						
11_5 TSCA Cell	19644	SY	106,106	37,137	143,243	7.29
11_10 Non-TSCA Cell	71672	SY	390,351	136,623	526,974	7.35
TOTAL Geosynthetic Clay Liner (GCL)	91316	SY	496,457	173,760	670,217	7.34
12 Vegetation Layer						
12_5 TSCA Cell	17461	CY	179,493	62,823	242,316	13.88
12_10 Non-TSCA Cell	63709	CY	654,908	229,218	884,126	13.88
TOTAL Vegetation Layer	81170	CY	834,401	292,040	1,126,442	13.88
13 Topsoil & Seeding						
13_5 TSCA Cell	6.56	AC	99,058	34,670	133,728	20385
13_10 Non-TSCA Cell	16.52	AC	249,408	87,293	336,701	20381
13_15 Disposal Facility Grounds	6.92	AC	55,862	19,552	75,414	10898
TOTAL Topsoil & Seeding	30.00	AC	404,328	141,515	545,842	18195
TOTAL ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	9,473,974	3,315,891	12,789,866	12789866

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ASHTABULA UPLAND CDF - DEEP DREDGING SCENARIO
** PROJECT INDIRECT SUMMARY - CONTRACT **

		QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
01	Temporary Office Trailers			21,441	1,715	1,621	1,858	429	27,065	
02	Clear & Grub	46.00	ACR	837,982	67,039	63,351	72,628	16,760	1,057,760	22995
03	Site Improvements			258,126	20,650	19,514	22,372	5,163	325,824	
04	Unclassified Excavation	204063	CY	231,904	18,552	17,532	20,099	4,638	292,726	1.43
05	Construct Landfill Berms	228669	EA	171,740	13,739	12,984	14,885	3,435	216,783	0.95
06	Place Imperv. Fill - Clay Layer	81717	CY	1,254,962	100,397	94,875	108,768	25,099	1,584,101	19.39
07	Leachate Collection System	8825.00	LF	191,972	15,358	14,513	16,638	3,839	242,321	27.46
08	Wastewater Treatment Plant	6.00	EA	200,771	16,062	15,178	17,401	4,015	253,427	42238
09	12-Inch Gravel Layer(s)	32190	CY	1,662,196	132,976	125,662	144,063	33,244	2,098,140	65.18
10	Geonet Drainage Layer	122798	SY	1,299,755	103,980	98,261	112,650	25,995	1,640,642	13.36
11	Geosynthetic Clay Liner (GCL)	91316	SY	393,305	31,464	29,734	34,088	7,866	496,457	5.44
12	Vegetation Layer	81170	CY	661,032	52,883	49,974	57,292	13,221	834,401	10.28
13	Topsoil & Seeding	30.00	AC	320,318	25,625	24,216	27,762	6,406	404,328	13478
TOTAL	ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	7,505,506	600,440	567,416	650,502	150,110	9,473,974	9473974
	Contingency								3,315,891	
	TOTAL INCL OWNER COSTS								12,789,866	

** PROJECT INDIRECT SUMMARY - FEATURE **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
01 Temporary Office Trailers		21,441	1,715	1,621	1,858	429	27,065	
02 Clear & Grub	46.00 ACR	837,982	67,039	63,351	72,628	16,760	1,057,760	22995
03 Site Improvements								
03_3A Water/Soil Collection & Control		12,338	987	933	1,069	247	15,574	
03_3B Perimeter Security Fence		94,402	7,552	7,137	8,182	1,888	119,161	
03_3C Facility Access Roads & Parking		151,385	12,111	11,445	13,121	3,028	191,089	
TOTAL Site Improvements		258,126	20,650	19,514	22,372	5,163	325,824	
04 Unclassified Excavation								
04_5 Tsca Cell	19148 CY	24,627	1,970	1,862	2,134	493	31,086	1.62
04_10 Non-Tsca Cell	184915 CY	207,277	16,582	15,670	17,965	4,146	261,640	1.41
TOTAL Unclassified Excavation	204063 CY	231,904	18,552	17,532	20,099	4,638	292,726	1.43
05 Construct Landfill Berms								
05_5 TSCA Cell	176344 CY	153,256	12,261	11,586	13,283	3,065	193,451	1.10
05_10 Non-TSCA Cell	52325 CY	18,484	1,479	1,397	1,602	370	23,332	0.45
TOTAL Construct Landfill Berms	228669 EA	171,740	13,739	12,984	14,885	3,435	216,783	0.95
06 Place Imperv. Fill - Clay Layer								
06_5 TSCA Cell	16916 CY	260,723	20,858	19,711	22,597	5,214	329,103	19.46
06_10 Non-TSCA Cell	64801 CY	994,239	79,539	75,164	86,171	19,885	1,254,998	19.37
TOTAL Place Imperv. Fill - Clay Layer	81717 CY	1,254,962	100,397	94,875	108,768	25,099	1,584,101	19.39
07 Leachate Collection System								
07_5 TSCA Cell	1600.00 LF	54,234	4,339	4,100	4,701	1,085	68,459	42.79
07_10 Non-TSCA Cell	7225.00 LF	137,738	11,019	10,413	11,938	2,755	173,863	24.06
TOTAL Leachate Collection System	8825.00 LF	191,972	15,358	14,513	16,638	3,839	242,321	27.46
08 Wastewater Treatment Plant	6.00 EA	200,771	16,062	15,178	17,401	4,015	253,427	42238
09 12-Inch Gravel Layer(s)								
09_5 TSCA Cell	10766 CY	575,632	46,051	43,518	49,890	11,513	726,603	67.49
09_10 Non-TSCA Cell	21424 CY	1,086,564	86,925	82,144	94,172	21,731	1,371,537	64.02
TOTAL 12-Inch Gravel Layer(s)	32190 CY	1,662,196	132,976	125,662	144,063	33,244	2,098,140	65.18

	QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
10 Geonet Drainage Layer									
10_5 TSCA Cell	33744	SY	357,118	28,569	26,998	30,951	7,142	450,779	13.36
10_10 Non-TSCA Cell	89054	SY	942,637	75,411	71,263	81,698	18,853	1,189,862	13.36
TOTAL Geonet Drainage Layer	122798	SY	1,299,755	103,980	98,261	112,650	25,995	1,640,642	13.36
11 Geosynthetic Clay Liner (GCL)									
11_5 TSCA Cell	19644	SY	84,060	6,725	6,355	7,285	1,681	106,106	5.40
11_10 Non-TSCA Cell	71672	SY	309,245	24,740	23,379	26,802	6,185	390,351	5.45
TOTAL Geosynthetic Clay Liner (GCL)	91316	SY	393,305	31,464	29,734	34,088	7,866	496,457	5.44
12 Vegetation Layer									
12_5 TSCA Cell	17461	CY	142,199	11,376	10,750	12,324	2,844	179,493	10.28
12_10 Non-TSCA Cell	63709	CY	518,833	41,507	39,224	44,967	10,377	654,908	10.28
TOTAL Vegetation Layer	81170	CY	661,032	52,883	49,974	57,292	13,221	834,401	10.28
13 Topsoil & Seeding									
13_5 TSCA Cell	6.56	AC	78,476	6,278	5,933	6,801	1,570	99,058	15100
13_10 Non-TSCA Cell	16.52	AC	197,587	15,807	14,938	17,125	3,952	249,408	15097
13_15 Disposal Facility Grounds	6.92	AC	44,255	3,540	3,346	3,836	885	55,862	8072.59
TOTAL Topsoil & Seeding	30.00	AC	320,318	25,625	24,216	27,762	6,406	404,328	13478
TOTAL ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	7,505,506	600,440	567,416	650,502	150,110	9,473,974	9473974
Contingency								3,315,891	
TOTAL INCL OWNER COSTS								12,789,866	

		QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	SUPPLIE	TOTAL COST	UNIT
01	Temporary Office Trailers			0	0	8,241	13,200	21,441	
02	Clear & Grub	46.00	ACR	616,520	221,463	0	0	837,982	18217
03	Site Improvements			77,203	20,238	160,685	0	258,126	
04	Unclassified Excavation	204063	CY	67,539	164,365	0	0	231,904	1.14
05	Construct Landfill Berms	228669	EA	58,791	80,223	32,726	0	171,740	0.75
06	Place Imperv. Fill - Clay Layer	81717	CY	226,529	231,903	796,530	0	1,254,962	15.36
07	Leachate Collection System	8825.00	LF	99,458	30,175	61,169	1,171	191,972	21.75
08	Wastewater Treatment Plant	6.00	EA	14,978	2,726	183,067	0	200,771	33462
09	12-Inch Gravel Layer(s)	32190	CY	454,786	359,594	847,816	0	1,662,196	51.64
10	Geonet Drainage Layer	122798	SY	97,533	62,656	1,139,565	0	1,299,755	10.58
11	Geosynthetic Clay Liner (GCL)	91316	SY	72,672	46,685	273,948	0	393,305	4.31
12	Vegetation Layer	81170	CY	4,408	7,265	649,360	0	661,032	8.14
13	Topsoil & Seeding	30.00	AC	45,818	12,764	261,736	0	320,318	10677
	TOTAL ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	1836234	1,240,058	4,414,843	14,371	7,505,506	7505506
	Prime Contractor's Field Overhead							600,440	
	SUBTOTAL							8,105,946	
	Prime's Home Office Expense							567,416	
	SUBTOTAL							8,673,362	
	Prime Contractor's Profit							650,502	
	SUBTOTAL							9,323,864	
	Prime Contractor's Bond							150,110	
	TOTAL INCL INDIRECTS							9,473,974	
	Contingency							3,315,891	
	TOTAL INCL OWNER COSTS							12,789,866	

	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	SUPPLIE	TOTAL COST	UNIT
01 Temporary Office Trailers			0	0	8,241	13,200	21,441	
02 Clear & Grub	46.00	ACR	616,520	221,463	0	0	837,982	18217
03 Site Improvements								
03_3A Water/Soil Collection & Control			10,550	57	1,731	0	12,338	
03_3B Perimeter Security Fence			13,281	76	81,045	0	94,402	
03_3C Facility Access Roads & Parking			53,371	20,105	77,909	0	151,385	
TOTAL Site Improvements			77,203	20,238	160,685	0	258,126	
04 Unclassified Excavation								
04_5 Tsca Cell	19148	CY	7,212	17,415	0	0	24,627	1.29
04_10 Non-Tsca Cell	184915	CY	60,328	146,950	0	0	207,277	1.12
TOTAL Unclassified Excavation	204063	CY	67,539	164,365	0	0	231,904	1.14
05 Construct Landfill Berms								
05_5 TSCA Cell	176344	CY	53,154	67,376	32,726	0	153,256	0.87
05_10 Non-TSCA Cell	52325	CY	5,637	12,847	0	0	18,484	0.35
TOTAL Construct Landfill Berms	228669	EA	58,791	80,223	32,726	0	171,740	0.75
06 Place Imperv. Fill - Clay Layer								
06_5 TSCA Cell	16916	CY	46,903	48,020	165,800	0	260,723	15.41
06_10 Non-TSCA Cell	64801	CY	179,626	183,883	630,730	0	994,239	15.34
TOTAL Place Imperv. Fill - Clay Layer	81717	CY	226,529	231,903	796,530	0	1,254,962	15.36
07 Leachate Collection System								
07_5 TSCA Cell	1600.00	LF	28,181	10,450	15,435	167	54,234	33.90
07_10 Non-TSCA Cell	7225.00	LF	71,277	19,724	45,733	1,004	137,738	19.06
TOTAL Leachate Collection System	8825.00	LF	99,458	30,175	61,169	1,171	191,972	21.75
08 Wastewater Treatment Plant	6.00	EA	14,978	2,726	183,067	0	200,771	33462
09 12-Inch Gravel Layer(s)								
09_5 TSCA Cell	10766	CY	159,044	125,657	290,931	0	575,632	53.47
09_10 Non-TSCA Cell	21424	CY	295,742	233,937	556,885	0	1,086,564	50.72
TOTAL 12-Inch Gravel Layer(s)	32190	CY	454,786	359,594	847,816	0	1,662,196	51.64

	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	SUPPLIE	TOTAL COST	UNIT
10 Geonet Drainage Layer								
10_5 TSCA Cell	33744	SY	26,774	17,200	313,144	0	357,118	10.58
10_10 Non-TSCA Cell	89054	SY	70,759	45,456	826,421	0	942,637	10.59
TOTAL Geonet Drainage Layer	122798	SY	97,533	62,656	1,139,565	0	1,299,755	10.58
11 Geosynthetic Clay Liner (GCL)								
11_5 TSCA Cell	19644	SY	15,299	9,828	58,932	0	84,060	4.28
11_10 Non-TSCA Cell	71672	SY	57,373	36,857	215,016	0	309,245	4.31
TOTAL Geosynthetic Clay Liner (GCL)	91316	SY	72,672	46,685	273,948	0	393,305	4.31
12 Vegetation Layer								
12_5 TSCA Cell	17461	CY	948	1,563	139,688	0	142,199	8.14
12_10 Non-TSCA Cell	63709	CY	3,459	5,702	509,672	0	518,833	8.14
TOTAL Vegetation Layer	81170	CY	4,408	7,265	649,360	0	661,032	8.14
13 Topsoil & Seeding								
13_5 TSCA Cell	6.56	AC	11,217	3,124	64,135	0	78,476	11963
13_10 Non-TSCA Cell	16.52	AC	28,242	7,867	161,478	0	197,587	11960
13_15 Disposal Facility Grounds	6.92	AC	6,359	1,773	36,124	0	44,255	6395.30
TOTAL Topsoil & Seeding	30.00	AC	45,818	12,764	261,736	0	320,318	10677
TOTAL ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	1836234	1,240,058	4,414,843	14,371	7,505,506	7505506
Prime Contractor's Field Overhead							600,440	
SUBTOTAL							8,105,946	
Prime's Home Office Expense							567,416	
SUBTOTAL							8,673,362	
Prime Contractor's Profit							650,502	
SUBTOTAL							9,323,864	
Prime Contractor's Bond							150,110	
TOTAL INCL INDIRECTS							9,473,974	
Contingency							3,315,891	
TOTAL INCL OWNER COSTS							12,789,866	

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ASHTABULA UPLAND CDF ESTIMATE
Upland TSCA & Non-TSCA Landfill
for Ashtabula River Dredged
Sediments - [redacted]

Designed By: Environmental Eng & Design Sect.
Estimated By: CELRB Cost Engineering Branch

Prepared By: Robert Chapman

Preparation Date: 08/12/97
Effective Date of Pricing: 08/12/97
Est Construction Time: 360 Days

Sales Tax: 0.0%

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This estimate is based on a CONCEPTUAL upland CDF design developed by the Buffalo District's Environmental Engineering & Design Section, and included in the Landfill Design Appendix for the subject project. The upland CDF is being planned for a "BANK-TO-BANK-TO-BEDROCK (BBB) DREDGING CONCEPT PLAN" for PCB-contaminated sediments and polluted sediments that will be dredged as part of the Ashtabula River Partnerships efforts to clean up the upper river between the 5th Street Bridge (starting approximately at the Coast guard Station and ending at the limits of the Federal Channel).

The Partnership Site Selection Committee has narrowed the search to two sites, identified as Site 5 and Site 7. These sites are located along Route 531, east of Ashtabula near the intersection of LaBounty Road. Each site covers a minimum area of 30 acres, a real estate requirement set by the site selection committee during their efforts to locate suitable CDF sites. The Landfill Design Appendix (April 1997) provides details on which this estimate is based. Below is a general description of the CDF features.

The conceptual CDF design covers 46 acres, and is a multi-cell CDF. The larger cell, measuring 1,000 ft x 400 ft (bottom of dike) is sized to permanently contain 700,000 cy of non-TSCA level, but polluted sediments. An adjoining smaller cell will contain 100,000 cy of PCB-contaminated sediments that exceed TSCA levels. This cell measures 200 ft x 75 ft.

The disposal facilty contains a double layer leachate collection system in the TSCA cell, and a single layer in the non-TSCA cell leading to a wastewater treatment plant. The treatment plant is not yet designed, but preliminary indications are that there will be sand and coal filters and carbon adsorption equipment. The means of disposal for the water after it is treated also requires better definition. This estimate assumes that the treated water will be trucked off-site to the City's water treatment plant for further treatment.

The construction of the non-TSCA disposal cell requires an 11 foot deep excavation and dikes constructed 20.5 feet high around the excavation. Excavated soil will be used to shape the dikes. The TSCA cell requires a 16 foot excavation and berms built to 27.5 feet above existing grade. Additional soil will need to be acquired to complete the facility berms, and later when the CDF is filled, as vegetation cover over the clay cap.

After placing a 3 foot thick clay liner over the excavated bowl, a double 60-mil HDPE liner with a 24" pea gravel drainage layer will be constructed in the TSCA cell. The non-TSCA cell requires only a 12" pea gravel layer and one 60-mil HDPE liner. 6" diameter Perforated PVC piping joined to a 12" diameter solid PVC collector pipe will be installed in the drainage layer(s) and connect to a decanting manhole. A geonet drainage mat placed over the pea gravel on the sideslopes of both cells will complete the disposal cell.

The caps over both cells are identical. The initial cover is a manufactured Geosynthetic clay liner (GCL) covered by a geonet drainage layer. Completing the cap is a 36" vegetation layer of 32" of soil and 4" of seeded topsoil.

The disposal facility will be surrounded by a 6 foot high security fence around the perimeter of the property line. Within the fence, but outside the

CDF cells will be spaced six groundwater sampling manholes. Along side one edge of the property line will be a 75 foot wide staging and sediment handling area. Details of this area are also not yet defined, but the estimate assumed a crushed stone paved surface.

The process of transporting the dredged sediments to the CDF cells also need to be further developed. Therefore, additional costs may need to be added when these details are defined in more detail. The location near the lake lends itself to pumping the sediments to the CDF directly from the dredge scows. The proximity to the highway heading directly to the harbor area provides for truck transportation as well, pending aquisition of a suitable transfer facility.

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		QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
01	Temporary Office Trailers			27,065	9,473	36,537	
02	Clear & Grub	46.00	ACR	1,057,760	370,216	1,427,976	31043
03	Site Improvements			325,824	114,038	439,863	
04	Unclassified Excavation	204063	CY	292,726	102,454	395,180	1.94
05	Construct Landfill Berms	368619	EA	1,120,666	392,233	1,512,899	4.10
06	Place Imperv. Fill - Clay Layer	94681	CY	1,839,655	643,879	2,483,534	26.23
07	Leachate Collection System	8825.00	LF	242,321	84,812	327,134	37.07
08	Wastewater Treatment Plant	6.00	EA	253,427	88,700	342,127	57021
09	12-Inch Gravel Layer(s)	36606	CY	2,360,809	826,283	3,187,092	87.06
10	Geonet Drainage Layer	148747	SY	1,984,252	694,488	2,678,741	18.01
11	Geosynthetic Clay Liner (GCL)	104404	SY	565,843	198,045	763,887	7.32
12	Vegetation Layer	92803	CY	1,122,307	392,807	1,515,114	16.33
13	Topsoil & Seeding	34.00	AC	491,804	172,131	663,936	19528
TOTAL	ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	11,684,459	4,089,561	15,774,020	15774020

LABOR ID: CLEV92 EQUIP ID: RG0195 Currency in DOLLARS CREW ID: CLEV92 UPB ID: NAT95A

		QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
01	Temporary Office Trailers			21,441	1,715	1,621	1,858	429	27,065	
02	Clear & Grub	46.00	ACR	837,982	67,039	63,351	72,628	16,760	1,057,760	22995
03	Site Improvements			258,126	20,650	19,514	22,372	5,163	325,824	
04	Unclassified Excavation	204063	CY	231,904	18,552	17,532	20,099	4,638	292,726	1.43
05	Construct Landfill Berms	368619	EA	887,818	71,025	67,119	76,947	17,756	1,120,666	3.04
06	Place Imperv. Fill - Clay Layer	94681	CY	1,457,418	116,593	110,181	126,314	29,148	1,839,655	19.43
07	Leachate Collection System	8825.00	LF	191,972	15,358	14,513	16,638	3,839	242,321	27.46
08	Wastewater Treatment Plant	6.00	EA	200,771	16,062	15,178	17,401	4,015	253,427	42238
09	12-Inch Gravel Layer(s)	36606	CY	1,870,288	149,623	141,394	162,098	37,406	2,360,809	64.49
10	Geonet Drainage Layer	148747	SY	1,571,971	125,758	118,841	136,243	31,439	1,984,252	13.34
11	Geosynthetic Clay Liner (GCL)	104404	SY	448,274	35,862	33,889	38,852	8,965	565,843	5.42
12	Vegetation Layer	92803	CY	889,118	71,129	67,217	77,060	17,782	1,122,307	12.09
13	Topsoil & Seeding	34.00	AC	389,619	31,170	29,455	33,768	7,792	491,804	14465
TOTAL	ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	9,256,704	740,536	699,807	802,278	185,134	11,684,459	11684459
	Contingency								4,089,561	
	TOTAL INCL OWNER COSTS								15,774,020	

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** PROJECT INDIRECT SUMMARY - FEATURE **

		QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
01	Temporary Office Trailers			21,441	1,715	1,621	1,858	429	27,065	
02	Clear & Grub	46.00	ACR	837,982	67,039	63,351	72,628	16,760	1,057,760	22995
03	Site Improvements									
03_3A	Water/Soil Collection & Control			12,338	987	933	1,069	247	15,574	
03_3B	Perimeter Security Fence			94,402	7,552	7,137	8,182	1,888	119,161	
03_3C	Facility Access Roads & Parking			151,385	12,111	11,445	13,121	3,028	191,089	
	TOTAL Site Improvements			258,126	20,650	19,514	22,372	5,163	325,824	
04	Unclassified Excavation									
04_ 5	Tsca Cell	19148	CY	24,627	1,970	1,862	2,134	493	31,086	1.62
04_10	Non-Tsca Cell	184915	CY	207,277	16,582	15,670	17,965	4,146	261,640	1.41
	TOTAL Unclassified Excavation	204063	CY	231,904	18,552	17,532	20,099	4,638	292,726	1.43
05	Construct Landfill Berms									
05_ 5	TSCA Cell	176344	CY	808,264	64,661	61,105	70,052	16,165	1,020,248	5.79
05_10	Non-TSCA Cell	192275	CY	79,554	6,364	6,014	6,895	1,591	100,418	0.52
	TOTAL Construct Landfill Berms	368619	EA	887,818	71,025	67,119	76,947	17,756	1,120,666	3.04
06	Place Imperv. Fill - Clay Layer									
06_ 5	TSCA Cell	16916	CY	260,723	20,858	19,711	22,597	5,214	329,103	19.46
06_10	Non-TSCA Cell	77765	CY	1,196,695	95,736	90,470	103,718	23,934	1,510,552	19.42
	TOTAL Place Imperv. Fill - Clay Layer	94681	CY	1,457,418	116,593	110,181	126,314	29,148	1,839,655	19.43
07	Leachate Collection System									
07_ 5	TSCA Cell	1600.00	LF	54,234	4,339	4,100	4,701	1,085	68,459	42.79
07_10	Non-TSCA Cell	7225.00	LF	137,738	11,019	10,413	11,938	2,755	173,863	24.06
	TOTAL Leachate Collection System	8825.00	LF	191,972	15,358	14,513	16,638	3,839	242,321	27.46
08	Wastewater Treatment Plant	6.00	EA	200,771	16,062	15,178	17,401	4,015	253,427	42238
09	12-Inch Gravel Layer(s)									
09_ 5	TSCA Cell	10766	CY	575,632	46,051	43,518	49,890	11,513	726,603	67.49
09_10	Non-TSCA Cell	25840	CY	1,294,656	103,573	97,876	112,208	25,893	1,634,206	63.24
	TOTAL 12-Inch Gravel Layer(s)	36606	CY	1,870,288	149,623	141,394	162,098	37,406	2,360,809	64.49

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	QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
10 Geonet Drainage Layer									
10_5 TSCA Cell	33744	SY	357,118	28,569	26,998	30,951	7,142	450,779	13.36
10_10 Non-TSCA Cell	115003	SY	1,214,853	97,188	91,843	105,291	24,297	1,533,473	13.33
TOTAL Geonet Drainage Layer	148747	SY	1,571,971	125,758	118,841	136,243	31,439	1,984,252	13.34
11 Geosynthetic Clay Liner (GCL)									
11_5 TSCA Cell	19644	SY	84,060	6,725	6,355	7,285	1,681	106,106	5.40
11_10 Non-TSCA Cell	84760	SY	364,214	29,137	27,535	31,566	7,284	459,736	5.42
TOTAL Geosynthetic Clay Liner (GCL)	104404	SY	448,274	35,862	33,889	38,852	8,965	565,843	5.42
12 Vegetation Layer									
12_5 TSCA Cell	17461	CY	167,289	13,383	12,647	14,499	3,346	211,163	12.09
12_10 Non-TSCA Cell	75342	CY	721,829	57,746	54,570	62,561	14,437	911,143	12.09
TOTAL Vegetation Layer	92803	CY	889,118	71,129	67,217	77,060	17,782	1,122,307	12.09
13 Topsoil & Seeding									
13_5 TSCA Cell	6.56	AC	78,476	6,278	5,933	6,801	1,570	99,058	15100
13_10 Non-TSCA Cell	22.24	AC	266,052	21,284	20,114	23,059	5,321	335,829	15100
13_15 Disposal Facility Grounds	5.20	AC	45,091	3,607	3,409	3,908	902	56,917	10946
TOTAL Topsoil & Seeding	34.00	AC	389,619	31,170	29,455	33,768	7,792	491,804	14465
TOTAL ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	9,256,704	740,536	699,807	802,278	185,134	11,684,459	11684459
Contingency								4,089,561	
TOTAL INCL OWNER COSTS								15,774,020	

** PROJECT DIRECT SUMMARY - CONTRACT **

	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	SUPPLIE	TOTAL COST	UNIT
01 Temporary Office Trailers			0	0	8,241	13,200	21,441	
02 Clear & Grub	46.00	ACR	616,520	221,463	0	0	837,982	18217
03 Site Improvements			77,203	20,238	160,685	0	258,126	
04 Unclassified Excavation	204063	CY	67,539	164,365	0	0	231,904	1.14
05 Construct Landfill Berms	368619	EA	313,661	355,298	218,859	0	887,818	2.41
06 Place Imperv. Fill - Clay Layer	94681	CY	262,501	268,747	926,170	0	1,457,418	15.39
07 Leachate Collection System	8825.00	LF	99,458	30,175	61,169	1,171	191,972	21.75
08 Wastewater Treatment Plant	6.00	EA	14,978	2,726	183,067	0	200,771	33462
09 12-Inch Gravel Layer(s)	36606	CY	500,476	395,877	973,936	0	1,870,288	51.09
10 Geonet Drainage Layer	148747	SY	116,657	74,942	1,380,372	0	1,571,971	10.57
11 Geosynthetic Clay Liner (GCL)	104404	SY	82,234	52,828	313,212	0	448,274	4.29
12 Vegetation Layer	92803	CY	63,449	83,244	742,424	0	889,118	9.58
13 Topsoil & Seeding	34.00	AC	55,626	15,492	318,501	0	389,619	11459
TOTAL ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	2270303	1,685,394	5,286,636	14,371	9,256,704	9256704
Prime Contractor's Field Overhead							740,536	
SUBTOTAL							9,997,240	
Prime's Home Office Expense							699,807	
SUBTOTAL							10,697,047	
Prime Contractor's Profit							802,278	
SUBTOTAL							11,499,325	
Prime Contractor's Bond							185,134	
TOTAL INCL INDIRECTS							11,684,459	
Contingency							4,089,561	
TOTAL INCL OWNER COSTS							15,774,020	

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	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	SUPPLIE	TOTAL COST	UNIT
01 Temporary Office Trailers			0	0	8,241	13,200	21,441	
02 Clear & Grub	46.00	ACR	616,520	221,463	0	0	837,982	18217
03 Site Improvements								
03_3A Water/Soil Collection & Control			10,550	57	1,731	0	12,338	
03_3B Perimeter Security Fence			13,281	76	81,045	0	94,402	
03_3C Facility Access Roads & Parking			53,371	20,105	77,909	0	151,385	
TOTAL Site Improvements			77,203	20,238	160,685	0	258,126	
04 Unclassified Excavation								
04_5 Tsca Cell	19148	CY	7,212	17,415	0	0	24,627	1.29
04_10 Non-Tsca Cell	184915	CY	60,328	146,950	0	0	207,277	1.12
TOTAL Unclassified Excavation	204063	CY	67,539	164,365	0	0	231,904	1.14
05 Construct Landfill Berms								
05_5 TSCA Cell	176344	CY	287,480	311,713	209,071	0	808,264	4.58
05_10 Non-TSCA Cell	192275	CY	26,181	43,584	9,789	0	79,554	0.41
TOTAL Construct Landfill Berms	368619	EA	313,661	355,298	218,859	0	887,818	2.41
06 Place Imperv. Fill - Clay Layer								
06_5 TSCA Cell	16916	CY	46,903	48,020	165,800	0	260,723	15.41
06_10 Non-TSCA Cell	77765	CY	215,598	220,726	760,370	0	1,196,695	15.39
TOTAL Place Imperv. Fill - Clay Layer	94681	CY	262,501	268,747	926,170	0	1,457,418	15.39
07 Leachate Collection System								
07_5 TSCA Cell	1600.00	LF	28,181	10,450	15,435	167	54,234	33.90
07_10 Non-TSCA Cell	7225.00	LF	71,277	19,724	45,733	1,004	137,738	19.06
TOTAL Leachate Collection System	8825.00	LF	99,458	30,175	61,169	1,171	191,972	21.75
08 Wastewater Treatment Plant	6.00	EA	14,978	2,726	183,067	0	200,771	33462
09 12-Inch Gravel Layer(s)								
09_5 TSCA Cell	10766	CY	159,044	125,657	290,931	0	575,632	53.47
09_10 Non-TSCA Cell	25840	CY	341,431	270,220	683,005	0	1,294,656	50.10
TOTAL 12-Inch Gravel Layer(s)	36606	CY	500,476	395,877	973,936	0	1,870,288	51.09

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** PROJECT DIRECT SUMMARY - FEATURE **

	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	SUPPLIE	TOTAL COST	UNIT
10 Geonet Drainage Layer								
10_5 TSCA Cell	33744	SY	26,774	17,200	313,144	0	357,118	10.58
10_10 Non-TSCA Cell	115003	SY	89,884	57,742	1,067,228	0	1,214,853	10.56
TOTAL Geonet Drainage Layer	148747	SY	116,657	74,942	1,380,372	0	1,571,971	10.57
11 Geosynthetic Clay Liner (GCL)								
11_5 TSCA Cell	19644	SY	15,299	9,828	58,932	0	84,060	4.28
11_10 Non-TSCA Cell	84760	SY	66,935	42,999	254,280	0	364,214	4.30
TOTAL Geosynthetic Clay Liner (GCL)	104404	SY	82,234	52,828	313,212	0	448,274	4.29
12 Vegetation Layer								
12_5 TSCA Cell	17461	CY	11,938	15,663	139,688	0	167,289	9.58
12_10 Non-TSCA Cell	75342	CY	51,511	67,582	602,736	0	721,829	9.58
TOTAL Vegetation Layer	92803	CY	63,449	83,244	742,424	0	889,118	9.58
13 Topsoil & Seeding								
13_5 TSCA Cell	6.56	AC	11,217	3,124	64,135	0	78,476	11963
13_10 Non-TSCA Cell	22.24	AC	38,030	10,593	217,429	0	266,052	11963
13_15 Disposal Facility Grounds	5.20	AC	6,380	1,774	36,938	0	45,091	8671.40
TOTAL Topsoil & Seeding	34.00	AC	55,626	15,492	318,501	0	389,619	11459
TOTAL ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	2270303	1,685,394	5,286,636	14,371	9,256,704	9256704
Prime Contractor's Field Overhead							740,536	
SUBTOTAL							9,997,240	
Prime's Home Office Expense							699,807	
SUBTOTAL							10,697,047	
Prime Contractor's Profit							802,278	
SUBTOTAL							11,499,325	
Prime Contractor's Bond							185,134	
TOTAL INCL INDIRECTS							11,684,459	
Contingency							4,089,561	
TOTAL INCL OWNER COSTS							15,774,020	

ASHTABULA UPLAND CDF ESTIMATE
Upland TSCA & Non-TSCA Landfill
for Ashtabula River Dredged
Sediments - [redacted]

Designed By: Environmental Eng & Design Sect.
Estimated By: CELRB Cost Engineering Branch

Prepared By: Robert Chapman

Preparation Date: 08/12/97
Effective Date of Pricing: 08/12/97
Est Construction Time: 360 Days

Sales Tax: 0.0%

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This estimate is based on a CONCEPTUAL upland CDF design developed by the Buffalo District's Environmental Engineering & Design Section, and included in the Landfill Design Appendix for the subject project. The upland CDF is being planned for a "SHALLOW DREDGING CONCEPT PLAN" for PCB-contaminated sediments and polluted sediments that will be dredged as part of the Ashtabula River Partnerships efforts to clean up the upper river between the 5th Street Bridge (starting approximately at the Coast guard Station and ending at the limits of the Federal Channel).

The Partnership Site Selection Committee has narrowed the search to two sites, identified as Site 5 and Site 7. These sites are located along Route 531, east of Ashtabula near the intersection of LaBounty Road. Each site covers a minimum area of 30 acres, a real estate requirement set by the site selection committee during their efforts to locate suitable CDF sites. The Landfill Design Appendix (April 1997) provides details on which this estimate is based. Below is a general description of the CDF features.

The conceptual CDF design covers 46 acres, and is a multi-cell CDF. The larger cell, measuring 1,000 ft x 400 ft (bottom of dike) is sized to permanently contain 350,000 cy of non-TSCA level, but polluted sediments. An adjoining smaller cell will contain 100,000 cy of PCB-contaminated sediments that exceed TSCA levels. This cell measures 200 ft x 75 ft.

The disposal facilty contains a double layer leachate collection system in the TSCA cell, and a single layer in the non-TSCA cell leading to a wastewater treatment plant. The treatment plant is not yet designed, but preliminary indications are that there will be sand and coal filters and carbon adsorption equipment. The means of disposal for the water after it is treated also requires better definition. This estimate assumes that the treated water will be trucked off-site to the City's water treatment plant for further treatment.

The construction of the non-TSCA disposal cell requires an 11 foot deep excavation and dikes constructed 6.8 feet high around the excavation. Excavated soil will be used to shape the dikes. The TSCA cell requires a 16 foot excavation and berms built to 27.5 feet above existing grade. Additional soil will need to be acquired to complete the facility berms, and later when the CDF is filled, as vegetation cover over the clay cap.

After placing a 3 foot thick clay liner over the excavated bowl, a double 60-mil HDPE liner with a 24" pea gravel drainage layer will be constructed in the TSCA cell. The non-TSCA cell requires only a 12" pea gravel layer and one 60-mil HDPE liner. 6" diameter Perforated PVC piping joined to a 12" diameter solid PVC collector pipe will be installed in the drainage layer(s) and connect to a decanting manhole. A geonet drainage mat placed over the pea gravel on the sideslopes of both cells will complete the disposal cell.

The caps over both cells are identical. The initial cover is a manufactured Geosynthetic clay liner (GCL) covered by a geonet drainage layer. Completing the cap is a 36" vegetation layer of 32" of soil and 4" of seeded topsoil.

The disposal facility will be surrounded by a 6 foot high security fence around the perimeter of the property line. Within the fence, but outside the

CDF cells will be spaced six groundwater sampling manholes. Along side one edge of the property line will be a 75 foot wide staging and sediment handling area. Details of this area are also not yet defined, but the estimate assumed a crushed stone paved surface.

The process of transferring and transporting the dredged sediments to the CDF cells also needs to be further developed. Therefore, additional costs may need to be added when these details are defined in more detail. The location near the lake lends itself to pumping the sediments to the CDF directly from the dredge scows. The proximity to the highway heading directly to the harbor area provides for truck transportation as well, pending aquisition of a suitable transfer facility.

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DETAILED ESTIMATE — DETAIL PAGE

BACKUP REPORTS — BACKUP PAGE

* * * END TABLE OF CONTENTS * * *

		QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
01	Temporary Office Trailers			27,065	9,473	36,537	
02	Clear & Grub	46.00	ACR	1,057,760	370,216	1,427,976	31043
03	Site Improvements			325,824	114,038	439,863	
04	Unclassified Excavation	204063	CY	292,726	102,454	395,180	1.94
05	Construct Landfill Berms	207389	EA	73,539	25,739	99,278	0.48
06	Place Imperv. Fill - Clay Layer	78690	CY	685,845	240,046	925,890	11.77
07	Leachate Collection System	8825.00	LF	242,321	84,812	327,134	37.07
08	Wastewater Treatment Plant	6.00	EA	253,427	88,700	342,127	57021
09	12-Inch Gravel Layer(s)	31159	CY	2,059,681	720,888	2,780,569	89.24
10	Geonet Drainage Layer	116720	SY	1,557,551	545,143	2,102,693	18.01
11	Geosynthetic Clay Liner (GCL)	88240	SY	476,879	166,908	643,787	7.30
12	Vegetation Layer	78435	CY	948,548	331,992	1,280,540	16.33
13	Topsoil & Seeding	30.00	AC	430,427	150,650	581,077	19369
TOTAL	ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	8,431,593	2,951,058	11,382,651	11382651

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	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
01 Temporary Office Trailers			27,065	9,473	36,537	
02 Clear & Grub	46.00	ACR	1,057,760	370,216	1,427,976	31043
03 Site Improvements						
03_3A Water/Soil Collection & Control			15,574	5,451	21,025	
03_3B Perimeter Security Fence			119,161	41,706	160,868	
03_3C Facility Access Roads & Parking			191,089	66,881	257,970	
TOTAL Site Improvements			325,824	114,038	439,863	
04 Unclassified Excavation						
04_ 5 Tsca Cell	19148	CY	31,086	10,880	41,966	2.19
04_10 Non-Tsca Cell	184915	CY	261,640	91,574	353,214	1.91
TOTAL Unclassified Excavation	204063	CY	292,726	102,454	395,180	1.94
05 Construct Landfill Berms						
05_ 5 TSCA Cell	176344	CY	60,754	21,264	82,018	0.47
05_10 Non-TSCA Cell	31045	CY	12,785	4,475	17,260	0.56
TOTAL Construct Landfill Berms	207389	EA	73,539	25,739	99,278	0.48
06 Place Imperv. Fill - Clay Layer						
06_ 5 TSCA Cell	16916	CY	147,654	51,679	199,332	11.78
06_10 Non-TSCA Cell	61774	CY	538,191	188,367	726,558	11.76
TOTAL Place Imperv. Fill - Clay Layer	78690	CY	685,845	240,046	925,890	11.77
07 Leachate Collection System						
07_ 5 TSCA Cell	1600.00	LF	68,459	23,960	92,419	57.76
07_10 Non-TSCA Cell	7225.00	LF	173,863	60,852	234,714	32.49
TOTAL Leachate Collection System	8825.00	LF	242,321	84,812	327,134	37.07
08 Wastewater Treatment Plant	6.00	EA	253,427	88,700	342,127	57021
09 12-Inch Gravel Layer(s)						
09_ 5 TSCA Cell	10766	CY	734,494	257,073	991,567	92.10
09_10 Non-TSCA Cell	20393	CY	1,325,187	463,815	1,789,002	87.73
TOTAL 12-Inch Gravel Layer(s)	31159	CY	2,059,681	720,888	2,780,569	89.24

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
10 Geonet Drainage Layer						
10_5 TSCA Cell	33744	SY	450,779	157,773	608,552	18.03
10_10 Non-TSCA Cell	82976	SY	1,106,771	387,370	1,494,141	18.01
TOTAL Geonet Drainage Layer	116720	SY	1,557,551	545,143	2,102,693	18.01
11 Geosynthetic Clay Liner (GCL)						
11_5 TSCA Cell	19644	SY	106,106	37,137	143,243	7.29
11_10 Non-TSCA Cell	68596	SY	370,773	129,771	500,544	7.30
TOTAL Geosynthetic Clay Liner (GCL)	88240	SY	476,879	166,908	643,787	7.30
12 Vegetation Layer						
12_5 TSCA Cell	17461	CY	211,163	73,907	285,071	16.33
12_10 Non-TSCA Cell	60974	CY	737,385	258,085	995,469	16.33
TOTAL Vegetation Layer	78435	CY	948,548	331,992	1,280,540	16.33
13 Topsoil & Seeding						
13_5 TSCA Cell	6.56	AC	99,058	34,670	133,728	20385
13_10 Non-TSCA Cell	15.56	AC	235,005	82,252	317,256	20389
13_15 Disposal Facility Grounds	7.16	AC	96,365	33,728	130,093	18169
TOTAL Topsoil & Seeding	30.00	AC	430,427	150,650	581,077	19369
TOTAL ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	8,431,593	2,951,058	11,382,651	11382651

		QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
01	Temporary Office Trailers			21,441	1,715	1,621	1,858	429	27,065	
02	Clear & Grub	46.00	ACR	837,982	67,039	63,351	72,628	16,760	1,057,760	22995
03	Site Improvements			258,126	20,650	19,514	22,372	5,163	325,824	
04	Unclassified Excavation	204063	CY	231,904	18,552	17,532	20,099	4,638	292,726	1.43
05	Construct Landfill Berms	207389	EA	58,260	4,661	4,404	5,049	1,165	73,539	0.35
06	Place Imperv. Fill - Clay Layer	78690	CY	543,342	43,467	41,077	47,091	10,867	685,845	8.72
07	Leachate Collection System	8825.00	LF	191,972	15,358	14,513	16,638	3,839	242,321	27.46
08	Wastewater Treatment Plant	6.00	EA	200,771	16,062	15,178	17,401	4,015	253,427	42238
09	12-Inch Gravel Layer(s)	31159	CY	1,631,727	130,538	123,359	141,422	32,635	2,059,681	66.10
10	Geonet Drainage Layer	116720	SY	1,233,928	98,714	93,285	106,945	24,679	1,557,551	13.34
11	Geosynthetic Clay Liner (GCL)	88240	SY	377,795	30,224	28,561	32,743	7,556	476,879	5.40
12	Vegetation Layer	78435	CY	751,462	60,117	56,811	65,129	15,029	948,548	12.09
13	Topsoil & Seeding	30.00	AC	340,995	27,280	25,779	29,554	6,820	430,427	14348
TOTAL ASHTABULA UPLAND CDF ESTIMATE		1.00	EA	6,679,707	534,377	504,986	578,930	133,594	8,431,593	8431593
	Contingency								2,951,058	
	TOTAL INCL OWNER COSTS								11,382,651	

		QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
01	Temporary Office Trailers			21,441	1,715	1,621	1,858	429	27,065	
02	Clear & Grub	46.00	ACR	837,982	67,039	63,351	72,628	16,760	1,057,760	22995
03	Site Improvements									
03_3A	Water/Soil Collection & Control			12,338	987	933	1,069	247	15,574	
03_3B	Perimeter Security Fence			94,402	7,552	7,137	8,182	1,888	119,161	
03_3C	Facility Access Roads & Parking			151,385	12,111	11,445	13,121	3,028	191,089	
	TOTAL Site Improvements			258,126	20,650	19,514	22,372	5,163	325,824	
04	Unclassified Excavation									
04_ 5	Tsca Cell	19148	CY	24,627	1,970	1,862	2,134	493	31,086	1.62
04_10	Non-Tsca Cell	184915	CY	207,277	16,582	15,670	17,965	4,146	261,640	1.41
	TOTAL Unclassified Excavation	204063	CY	231,904	18,552	17,532	20,099	4,638	292,726	1.43
05	Construct Landfill Berms									
05_ 5	TSCA Cell	176344	CY	48,131	3,850	3,639	4,172	963	60,754	0.34
05_10	Non-TSCA Cell	31045	CY	10,129	810	766	878	203	12,785	0.41
	TOTAL Construct Landfill Berms	207389	EA	58,260	4,661	4,404	5,049	1,165	73,539	0.35
06	Place Imperv. Fill - Clay Layer									
06_ 5	TSCA Cell	16916	CY	116,975	9,358	8,843	10,138	2,339	147,654	8.73
06_10	Non-TSCA Cell	61774	CY	426,368	34,109	32,233	36,953	8,527	538,191	8.71
	TOTAL Place Imperv. Fill - Clay Layer	78690	CY	543,342	43,467	41,077	47,091	10,867	685,845	8.72
07	Leachate Collection System									
07_ 5	TSCA Cell	1600.00	LF	54,234	4,339	4,100	4,701	1,085	68,459	42.79
07_10	Non-TSCA Cell	7225.00	LF	137,738	11,019	10,413	11,938	2,755	173,863	24.06
	TOTAL Leachate Collection System	8825.00	LF	191,972	15,358	14,513	16,638	3,839	242,321	27.46
08	Wastewater Treatment Plant	6.00	EA	200,771	16,062	15,178	17,401	4,015	253,427	42238
09	12-Inch Gravel Layer(s)									
09_ 5	TSCA Cell	10766	CY	581,883	46,551	43,990	50,432	11,638	734,494	68.22
09_10	Non-TSCA Cell	20393	CY	1,049,844	83,988	79,368	90,990	20,997	1,325,187	64.98
	TOTAL 12-Inch Gravel Layer(s)	31159	CY	1,631,727	130,538	123,359	141,422	32,635	2,059,681	66.10

	QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
10 Geonet Drainage Layer									
10_ 5 TSCA Cell	33744	SY	357,118	28,569	26,998	30,951	7,142	450,779	13.36
10_10 Non-TSCA Cell	82976	SY	876,810	70,145	66,287	75,993	17,536	1,106,771	13.34
TOTAL Geonet Drainage Layer	116720	SY	1,233,928	98,714	93,285	106,945	24,679	1,557,551	13.34
11 Geosynthetic Clay Liner (GCL)									
11_ 5 TSCA Cell	19644	SY	84,060	6,725	6,355	7,285	1,681	106,106	5.40
11_10 Non-TSCA Cell	68596	SY	293,735	23,499	22,206	25,458	5,875	370,773	5.41
TOTAL Geosynthetic Clay Liner (GCL)	88240	SY	377,795	30,224	28,561	32,743	7,556	476,879	5.40
12 Vegetation Layer									
12_ 5 TSCA Cell	17461	CY	167,289	13,383	12,647	14,499	3,346	211,163	12.09
12_10 Non-TSCA Cell	60974	CY	584,174	46,734	44,164	50,630	11,683	737,385	12.09
TOTAL Vegetation Layer	78435	CY	751,462	60,117	56,811	65,129	15,029	948,548	12.09
13 Topsoil & Seeding									
13_ 5 TSCA Cell	6.56	AC	78,476	6,278	5,933	6,801	1,570	99,058	15100
13_10 Non-TSCA Cell	15.56	AC	186,176	14,894	14,075	16,136	3,724	235,005	15103
13_15 Disposal Facility Grounds	7.16	AC	76,343	6,107	5,771	6,617	1,527	96,365	13459
TOTAL Topsoil & Seeding	30.00	AC	340,995	27,280	25,779	29,554	6,820	430,427	14348
TOTAL ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	6,679,707	534,377	504,986	578,930	133,594	8,431,593	8431593
Contingency								2,951,058	
TOTAL INCL OWNER COSTS								11,382,651	

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ASHTABULA UPLAND CDF - SHALLOW DREDGING SCENARIO
** PROJECT DIRECT SUMMARY - CONTRACT **

		QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	SUPPLIE	TOTAL COST	UNIT
01	Temporary Office Trailers			0	0	8,241	13,200	21,441	
02	Clear & Grub	46.00	ACR	616,520	221,463	0	0	837,982	18217
03	Site Improvements			77,203	20,238	160,685	0	258,126	
04	Unclassified Excavation	204063	CY	67,539	164,365	0	0	231,904	1.14
05	Construct Landfill Berms	207389	EA	18,635	35,201	4,424	0	58,260	0.28
06	Place Imperv. Fill - Clay Layer	78690	CY	218,129	223,300	101,913	0	543,342	6.90
07	Leachate Collection System	8825.00	LF	99,458	30,175	61,169	1,171	191,972	21.75
08	Wastewater Treatment Plant	6.00	EA	14,978	2,726	183,067	0	200,771	33462
09	12-Inch Gravel Layer(s)	31159	CY	449,596	350,494	831,637	0	1,631,727	52.37
10	Geonet Drainage Layer	116720	SY	91,796	58,971	1,083,162	0	1,233,928	10.57
11	Geosynthetic Clay Liner (GCL)	88240	SY	68,847	44,228	264,720	0	377,795	4.28
12	Vegetation Layer	78435	CY	53,626	70,356	627,480	0	751,462	9.58
13	Topsoil & Seeding	30.00	AC	48,931	13,640	278,423	0	340,995	11366
	TOTAL ASHTABULA UPLAND CDF ESTIMATE	1.00	EA	1825258	1,235,157	3,604,920	14,371	6,679,707	6679707
	Prime Contractor's Field Overhead							534,377	
	SUBTOTAL							7,214,083	
	Prime's Home Office Expense							504,986	
	SUBTOTAL							7,719,069	
	Prime Contractor's Profit							578,930	
	SUBTOTAL							8,297,999	
	Prime Contractor's Bond							133,594	
	TOTAL INCL INDIRECTS							8,431,593	
	Contingency							2,951,058	
	TOTAL INCL OWNER COSTS							11,382,651	

	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	SUPPLIE	TOTAL COST	UNIT
01 Temporary Office Trailers			0	0	8,241	13,200	21,441	
02 Clear & Grub	46.00	ACR	616,520	221,463	0	0	837,982	18217
03 Site Improvements								
03_3A Water/Soil Collection & Control			10,550	57	1,731	0	12,338	
03_3B Perimeter Security Fence			13,281	76	81,045	0	94,402	
03_3C Facility Access Roads & Parking			53,371	20,105	77,909	0	151,385	
TOTAL Site Improvements			77,203	20,238	160,685	0	258,126	
04 Unclassified Excavation								
04_ 5 Tsca Cell	19148	CY	7,212	17,415	0	0	24,627	1.29
04_10 Non-Tsca Cell	184915	CY	60,328	146,950	0	0	207,277	1.12
TOTAL Unclassified Excavation	204063	CY	67,539	164,365	0	0	231,904	1.14
05 Construct Landfill Berms								
05_ 5 TSCA Cell	176344	CY	15,546	28,162	4,424	0	48,131	0.27
05_10 Non-TSCA Cell	31045	CY	3,089	7,040	0	0	10,129	0.33
TOTAL Construct Landfill Berms	207389	EA	18,635	35,201	4,424	0	58,260	0.28
06 Place Imperv. Fill - Clay Layer								
06_ 5 TSCA Cell	16916	CY	46,903	48,020	22,051	0	116,975	6.92
06_10 Non-TSCA Cell	61774	CY	171,227	175,280	79,861	0	426,368	6.90
TOTAL Place Imperv. Fill - Clay Layer	78690	CY	218,129	223,300	101,913	0	543,342	6.90
07 Leachate Collection System								
07_ 5 TSCA Cell	1600.00	LF	28,181	10,450	15,435	167	54,234	33.90
07_10 Non-TSCA Cell	7225.00	LF	71,277	19,724	45,733	1,004	137,738	19.06
TOTAL Leachate Collection System	8825.00	LF	99,458	30,175	61,169	1,171	191,972	21.75
08 Wastewater Treatment Plant	6.00	EA	14,978	2,726	183,067	0	200,771	33462
09 12-Inch Gravel Layer(s)								
09_ 5 TSCA Cell	10766	CY	165,296	125,657	290,931	0	581,883	54.05
09_10 Non-TSCA Cell	20393	CY	284,300	224,837	540,707	0	1,049,844	51.48
TOTAL 12-Inch Gravel Layer(s)	31159	CY	449,596	350,494	831,637	0	1,631,727	52.37

permanently. Under the counterfactual case with zero cost sharing, there is no net change in the fiscal position of local governments as compared to the current situation. Under 25 percent cost sharing, local governments experience a reduction in annual net revenues of $1.6 million in years 1 and 2. Under 100 cost sharing, the annual reduction is $6.5 million.

Present Value. Shipping operations in the Ashtabula Harbor generate a stream of income for county residents, both employees and business owners. While our results show that harbor activity is a relatively small percentage of total income and employment in the county economy, the impacts of harbor activity add up over time. In present value terms, we estimate that the present value of additional gross regional product (GRP) over the next 50 years would be $49.8 million. This calculation was carried out using a discount rate of 7.6 percent, the rate currently adopted by the Army Corps of Engineers.

The net present value of fiscal benefits to local governments over the next 50 years is estimated to be $270,000 under the zero percent cost share arrangement (Figure 12). Under a 25 percent cost share arrangement, the net present value of fiscal benefits to local governments would be -$2.65 million. In other words, project-related spending by local governments would exceed project-related revenue generated by direct and indirect effects of harbor shipping. Under 100 cost sharing, the net present value to local governments would be -$11.4 million. Thus, we estimate that local governments would experience net revenue losses under the 25 and 100 percent cost share arrangements.

While local governments would experience a net revenue loss under 25 and 100 percent cost sharing arrangements, the county economy (as measured by gross regional product) would benefit from the harbor dredging project under all three cost sharing scenarios. As in any benefit-costs analysis, the important question for Ashtabula County is whether the beneficiaries could

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX R

SUB-APPENDIX R-2

PROJECT COST ESTIMATE

DECEMBER 2000

COST ESTIMATE
ASHTABULA RIVER PARTNERSHIP
SEDIMENT DREDGING/DEWATERING/TRANSPORT/DISPOSAL COSTS

1. Introduction

The purpose of this appendix is to provide the basic assumptions and information on what is behind the cost estimate for the recommended plan. The costs presented are based on feasibility level concepts; future detail design will affect the project costs, possibly increasing costs of various components above that which the applied contingencies attempt to cover. Regulatory requirements, labor, equipment, and material costs, and the construction schedule may also influence on the costs as time passes.

This appendix presents the preliminary cost estimate for the recommended plan developed by the Buffalo District Corps of Engineer's.

2. Basis of Estimate

The project is broken into several components necessary to accomplish the project objective of removing contaminated sediments from the Ashtabula River. The main components are; dredging, transfer of sediments from the river to the landfills, and construction and operation of the Landfill. The estimate was developed to include costs of the features described below.

3. Dredging

Dredging costs are based on the use of a marine operation utilizing a derrick boat, which would excavate the sediments with an environmental or closed clamshell bucket. The sediments would be loaded into dredge scows and transported to a transfer site. The use of this special clamshell bucket will lead to lower daily production, as silt curtains would be placed around the excavation as well. The need to place, maintain, maneuver, and avoid the curtain while dredging are the leading causes of the high unit cost over conventional dredging operations.

4. Transfer Facility

The handling of the sediments after dredging involved unloading and dewatering of the sediments at a specially constructed facility near the river.

4.1 Riverside Dewatering/Transfer Facility

Costs are based on the construction of a facility adjacent to the river on Norfolk Southern property near the Interim CDF. The facility would include diked areas for storing the decanted, untreated water, water treatment equipment, and a diked area for storing sediments during times when carrier transport is slow and the barge is being unloaded, and decon pads for trucks and facility equipment. The operation includes the unloading, water treatment, and transfer of sediments to trucks.

4.2 Transporting Sediments to the Disposal Facility

Costs are based on trucking the dewatered sediments on local roads to the State Rd. disposal facility.

5. Sediment Disposal

Costs for disposing of the dredged sediments were developed for the construction of an upland disposal facility for TSCA and Non-TSCA sediments at the selected State Rd. disposal site.
Costs for an upland disposal facility that would store TSCA and Non-TSCA sediments were based on a feasibility level design developed for the Buffalo District by their engineering consultant Maxim Technologies, Inc.

6. Project Cost Estimate for the Dredging Alternative

A cost estimate was developed for the deep-water cleanup scenario. The volumes of sediments removed in this scenario are calculated to be approximately 696,000 CY, which includes 150,000 CY of Toxic Substance Control Act (TSCA) regulated and 546,000 CY of Non-TSCA regulated sediments.

7. Other Costs

The selected alternative includes costs for sampling and analysis, engineering and design, construction management, real estate and construction contingencies, which are presented in the tables.

8. Recommended Plan Description

Based upon the results of Plan Formulation, the ARP has selected an alternative for each project component. These selected alternatives constitute the Recommended Plan for the ARP project. The Recommended Plan is comprised of the following components and related measures.

1. Dredging (contaminated sediment removal):
    a) Enclosed clamshell bucket technology.
    b) Deep-Dredge alternative.

2. Transfer/Dewatering:
    a) Barge transfer of dredged sediment to dewatering site.
    b) River shoreline transfer/dewatering facility at the Norfolk Southern Railroad site.
    c) Passive sediment dewatering technology.
    d) Multi-media carbon filtration treatment of supernatant.
    e) Truck transport of dewatered sediment to disposal facility.

3. Disposal:
    a) New Upland TSCA and Non-TSCA landfill at the State Road site.

The Recommended Plan involves the use of enclosed clamshell bucket technology to implement the Deep Dredge alternative to remove a total of 696,000 cubic yards of contaminated sediment from the Project Area. Sediment removal by river segment would be as follows:

Segment I (downstream of the 5th Street Bridge): Dredging would remove approximately 115,000 cubic yards of contaminated sediment. Dredging would address PAH contamination, which was considered to be the primary contaminant of concern in this area.

Segment II: (upstream (south) of the 5th Street Bridge): Dredging would remove approximately 581,000 cubic yards of contaminated sediments which includes up to 150,000 cubic yards of significantly PCB contaminated sediment, which will be handled and disposed of in accordance with TSCA regulations.

Dredged sediment would be placed in barges and transported to the recommended shoreline transfer/dewatering facility on the Ashtabula River. At the transfer/dewatering facility passive sediment dewatering methods and multi-media carbon filtration treatment technology would be used to treat the decant (supernatant) water. Once the sediment is sufficiently dewatered, (passes the paint filter test), trucks would be used to transport the dewatered sediment to the disposal site at State Road, where TSCA and Non-TSCA landfill cells would be created for the project.

9. Recommended Plan Costs

The first costs for the Recommended Plan is estimated at $45,005,800 and is provided in Table 1. Average annual costs were computed for the Recommended Plan. Table 1 provides a summary of First Costs, Investment Costs and average Annual Costs associated with the Recommended Plan. First Costs are basically Construction costs, Engineering and Design costs, Construction Management Costs and Real Estate Costs associated with building the Recommended Plan. All costs reflect December 2000 price levels.

Construction Costs associated with polluted sediment remediation came to $37,202,100. This $37,202,100 included: dredging costs ($11,460,200), construction of a dewatering facility and operation thereof ($4,895,600), TSCA related landfill construction costs ($2,834,700), Non-TSCA related landfill construction costs ($10,319,800), sampling and analysis costs for the construction period ($989,700) and contingencies ($6,702,100).

Interest During Construction assumed a 4 year construction period, starting in May of 2002 and ending in September 2005. It was assumed no construction took place in January, February or March. Constructions cost time streams were developed for 16 different construction cost components on a monthly expenditure basis. Interest During Construction came to $5,531,600.

Interest During Construction ($5,531,600) was added to Project First Cost ($45,005,800) to arrive at project Investment costs. Project Investment costs came to $50,537,400.

Disposal Site expenditures would be made after the project was constructed, including post construction monitoring (sampling and laboratory analysis) of the completed disposal facility and operation and maintenance associated with the TSCA and non-TSCA portion of the landfill. Each of these costs would be incurred every year over a 50 year period. Since these costs would be incurred every year, these are averaged annual costs. These averaged annual costs reflect a 6.375 percent annual interest rate and a 50 year evaluation period. These yearly expenditures will now be discussed.

After the project is completed, post construction monitoring will take place at the disposal facility on a yearly basis. Test wells at the disposal site would be inspected and monitored annually for the next 50 years. The Annual Post Construction monitoring costs were placed at $26,000. Post Construction monitoring includes groundwater sampling, groundwater laboratory analysis, groundwater statistical analysis and reporting.

Another annual cost at the disposal site was associated with annual maintenance of the landfills after construction. After the project is completed, the final disposal site would incur some annual maintenance cost for the next 50 years. Annual maintenance costs were placed at $26,200. These costs included such items as: Building Maintenance, mowing, leachate treatment plant maintenance and maintenance of facility roads, and other miscellaneous items.

Cost-sharing is dependent on guidance received from the USACE, Director of Civil Works, in the form of Policy Guidance Letter No. 49 dated 28 January 1998, base upon the Water Resources Development Act of

1996. Cost sharing may be impacted by the classification and volume of sediments regulated by the Toxic Substance Control Act (TSCA), volumes associated with Environmental Dredging (contaminated sediments outside of the Federal channel) and volumes of sediment associated with commercial navigation. An assessment and breakdown of sediment volumes verses pro-rata share of project costs based on sediment classification is presented in Table P2-2.

Cost-sharing is based on quantities associated with the different authorities represented in the recommended plan and is provided on Table 2.

O&M lower river dredging costs of 100 percent Federal $2,299000. Disposal costs are 80 percent Federal $1,538,000 and 20 percent non-Federal (with credit for Lands, Easements, Right-of-Way, Relocations and Disposal Areas (LERRD's)) $384,000.

Dredging outside of and adjacent to the channel Section 312(a) cost 100 percent Federal $1,632,000. Disposal costs 80 percent Federal $1,306,000 and 20 percent non-Federal $326,000.

Environmental Dredging upstream of the 5^{th} street bridge (segment II) cost shared 65 percent Federal $11,673,000 and 35 percent non-Federal $6,286,000.

LERRD's related costs are cost shared $43,000 Federal (for administrative Costs only) and $330,000 for the non-Federal costs (including Administrative and Acquisition Costs).

The total cost-sharing for the comprehensive project is estimated $32,772,000 Federal (68.8%) and $14,843,000 non-Federal (31.2%)

Table 1-Derivation Of Average Annual Costs-Recommended Plan-October 2000 Prices

Total Project Construction Costs And First Costs	
Construction Costs	
Dredging Costs	$11,460,200
Dewatering Costs	$ 4,985 600
Landfill Costs-TSCA	$ 2,834,700
Landfill Costs- Non TSCA	$10,319,800
Sampling And Analysis	
During Dredging & At The Transfer Facility	$ 816,600
At The Disposal facility- After Construction	$ 173,100
Construction Contingencies	$ 6,702,100

Total Construction Costs	$37,202,100
Study Costs And Engineering And Design During Construction	$ 4,876,200
Construction Management	$ 2,555,100
Real Estate- Section 312, O&M	$ 372,400

First Costs [1]	$45,005,800
Investment Costs	
Project First Costs To Be Average Annualized	$45,005,800
Interest During Construction [2]	$ 5,531,600

Investment Costs To Be Average Annualized	$50,537,400
Average Annual Costs	
Interest And Amortization (.06678897)	$ 3,375,400
Disposal Site	
Post Construction Monitoring [3]	$ 26 000
Annual Maintenance [4]	$ 26,200

Average Annual Costs [5]	$ 3,427,600
Present Worth Factor for 6.375%	14.97253
Present Worth Of Average Annual Costs	$51,319,853
Rounded PW of Average Annual Costs	$51,319,900

(1) Project First Costs provided by Cost Estimating came to $47,615,000. Included in these costs were expenditures over the 50 year life of the project for: Disposal Site Post Construction Monitoring ($1,301,300) and Annual Maintenance Expenditures At The Disposal Site ($1,307,900). These type of costs are normally presented as average annual costs. Consequently, these expenditures were subtracted from the $47,615,000 to arrive at a construction cost of $45,005,800. These Post Construction Disposal Site Monitoring Costs ($1,301,300) and Post Construction Disposal Site Maintenance Costs ($1,307,900) were converted to average annual dollars and are reflected in Disposal Site Average Annual Costs.

(2) Construction Costs used to develop Interest During Construction ($44,633,400) were computed by subtracting from Total First Costs ($45,005,800), the projects Real Estate costs ($372,400). IDC was based on 16 different construction cost components, a four year construction period and monthly compounding using a 6.375 percent annual interest rate.

(3) Disposal Site Post Construction Monitoring costs for a 50 year evaluation period were $1,301,300. These costs were converted to an average annual dollar value. This average annual value came to $26,000. This average annual value reflects a 6.375 percent annual interest rate, a 50 year project life and October 2000 price levels.

(4) Disposal Site Maintenance costs for the 50 year evaluation period were $1,307,900. These costs were converted to an average annual dollar value. This average annual value came to $26,200. This average annual value reflects a 6.375 percent annual interest rate, a 50 year project life and October 2000 price levels.

(5) Average Annual Costs reflect a 6.375 annual interest rate, a 50 year project life and October 2000 price levels.

Table 2 reakdo n of Federal and on-Fe eral Cost Sharing of Project Features

PROJECT FEATURES	FEDERAL	NON-FEDERAL
DREDGING		
O&M Dredging downstream of the 5 th Street Bridge; total of 62,200 CY Non-TSCA	$ 2,299,000	$ -
312(a) Dredging downstream of the 5 th Street Bridge; total of 52,800 CY Non-TSCA	$ 1,952,000	
312(b) Dredging upstream of the 5 th Street Bridge; total of 581,000 CY of TSCA and Non-TSCA sediments	$ 13,961,000	$ 7,517,000
SUBTOTAL	$ 18,212,000	$ 7,517,000
DISPOSAL		
O&M disposal of 62,200 CY of Non-TSCA sediments (section 101, WRDA 86)	$ 1,538,000	$ 384,000
312(a) disposal of 52,800 CY of Non-TSCA sediments	$ 1,306,000	$ 326,000
Section 312(b) disposal of TSCA and Non-TSCA sediments		
TSCA (150,000)	$ 3,014,000	$ 1,623,000
Non-TSCA (431,000 CY)	$ 8,659,000	$ 4,663,000
SUBTOTAL	$ 14,517,000	$ 6,996,000
LERRDs		
Administrative Cost	$ -	$ 261,000
Acquisition Costs	$ 43,000	$ 69,000
SUBTOTAL	$ 43,000	$ 330,000
TOTAL PROJECT COST SHARE	$ 32,772,000	$ 14,843,000

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX R

SUB-APPENDIX R-3

DETAILED PROJECT COST ESTIMATE

(RECOMMENDED PLAN FOR ENVIRONMRNTAL DREDGING)

DECEMBER 2000

DETAILED ESTIMATE DETAIL PAGE

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No Backup Reports...

* * * END TABLE OF CONTENTS * * *

** PROJECT OWNER SUMMARY - Contract **

		QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT COST
01	LANDS	1.00	EA	297,900	74,475	372,375	372375.00
12	NAVIGATION	1.00	EA	33,109,220	6,700,940	39,810,161	39810160.58
30	ENGINEERING & DESIGN	1.00	EA	4,700,937	175,234	4,876,172	4876171.55
31	CONSTRUCTION MANAGEMENT	1.00	EA	1,815,509	739,556	2,555,065	2555065.00
TOTAL	Ashtabula River Partnership	1.00	EA	39,923,567	7,690,205	47,613,772	47613772.13

** PROJECT OWNER SUMMARY - Feature **

	QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT COST
01 LANDS						
01_ 1 ACQUISTION	1.00	EA	208,400	52,100	260,500	260500.00
01_ 2 ADMINSTRATION	1.00	EA	89,500	22,375	111,875	111875.00
TOTAL LANDS	1.00	EA	297,900	74,475	372,375	372375.00
12 NAVIGATION						
12_ 1 DREDGING	1.00	EA	17,345,570	4,336,393	21,681,963	21681962.79
12_ 2 DISPOSAL	1.00	EA	15,763,650	2,364,548	18,128,198	18128197.79
TOTAL NAVIGATION	1.00	EA	33,109,220	6,700,940	39,810,161	39810160.58
23 OTHER STUDIES						
30 ENGINEERING & DESIGN						
30_ 5 FS Phase - CMP/EIS	1.00	EA	2,300,000	0	2,300,000	2300000.00
30_10 Pre-Const. Engineering & Design	1.00	EA	1,700,000	0	1,700,000	1700000.00
30_15 Engineering During Construction	1.00	EA	700,937	175,234	876,172	876171.55
TOTAL ENGINEERING & DESIGN	1.00	EA	4,700,937	175,234	4,876,172	4876171.55
31 CONSTRUCTION MANAGEMENT						
31_ 5 CONSTRUCTION MANAGEMENT	1.00	EA	1,815,509	739,556	2,555,065	2555065.00
TOTAL CONSTRUCTION MANAGEMENT	1.00	EA	1,815,509	739,556	2,555,065	2555065.00
TOTAL Ashtabula River Partnership	1.00	EA	39,923,567	7,690,205	47,613,772	47613772.13

** PROJECT INDIRECT SUMMARY - Contract **

		QUANTY	UOM	TOTAL DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
01	LANDS	1.00	EA	297,900	0	0	0	0	297,900	297900.00
12	NAVIGATION	1.00	EA	29,241,140	0	1,573,960	1,777,390	516,730	33,109,220	33109220.48
30	ENGINEERING & DESIGN	1.00	EA	4,700,937	0	0	0	0	4,700,937	4700937.24
31	CONSTRUCTION MANAGEMENT	1.00	EA	1,815,509	0	0	0	0	1,815,509	1815509.00
	Ashtabula River Partnership	1.00	EA	36,055,486	0	1,573,960	1,777,390	516,730	39,923,567	39923566.72
	Contingency								7,690,205	
	TOTAL INCL OWNER COSTS								47,613,772	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY	UOM	TOTAL DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
01 LANDS									
01_ 1 ACQUISTION	1.00	EA	208,400	0	0	0	0	208,400	208400.00
01_ 2 ADMINSTRATION	1.00	EA	89,500	0	0	0	0	89,500	89500.00
TOTAL LANDS	1.00	EA	297,900	0	0	0	0	297,900	297900.00
12 NAVIGATION									
12_ 1 DREDGING	1.00	EA	15,779,049	0	663,114	686,945	216,462	17,345,570	17345570.23
12_ 2 DISPOSAL	1.00	EA	13,462,092	0	910,846	1,090,445	300,268	15,763,650	15763650.25
TOTAL NAVIGATION	1.00	EA	29,241,140	0	1,573,960	1,777,390	516,730	33,109,220	33109220.48
23 OTHER STUDIES									
30 ENGINEERING & DESIGN									
30_ 5 FS Phase - CMP/EIS	1.00	EA	2,300,000	0	0	0	0	2,300,000	2300000.00
30_10 Pre-Const. Engineering & De	1.00	EA	1,700,000	0	0	0	0	1,700,000	1700000.00
30_15 Engineering During Construc	1.00	EA	700,937	0	0	0	0	700,937	700937.24
TOTAL ENGINEERING & DESIGN	1.00	EA	4,700,937	0	0	0	0	4,700,937	4700937.24
31 CONSTRUCTION MANAGEMENT									
31_ 5 CONSTRUCTION MANAGEMENT	1.00	EA	1,815,509	0	0	0	0	1,815,509	1815509.00
TOTAL CONSTRUCTION MANAGEMENT	1.00	EA	1,815,509	0	0	0	0	1,815,509	1815509.00
TOTAL Ashtabula River Partnership	1.00	EA	36,055,486	0	1,573,960	1,777,390	516,730	39,923,567	39923566.72
Contingency								7,690,205	
TOTAL INCL OWNER COSTS								47,613,772	

** PROJECT DIRECT SUMMARY - Feature **

	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
01 LANDS								
01_ 1 ACQUISTION	1.00 EA	0	0	0	0	208,400	208,400	208400.00
01_ 2 ADMINSTRATION	1.00 EA	0	0	0	0	89,500	89,500	89500.00
TOTAL LANDS	1.00 EA	0	0	0	0	297,900	297,900	297900.00
12 NAVIGATION								
12_ 1 DREDGING	1.00 EA	108,774	3,916,118	3,102,618	1,276,022	7484291	15,779,049	15779048.51
12_ 2 DISPOSAL	1.00 EA	105,566	4,371,730	2,823,121	1,861,658	4405582	13,462,092	13462091.65
TOTAL NAVIGATION	1.00 EA	214,340	8,287,847	5,925,740	3,137,680	11889873	29,241,140	29241140.16
23 OTHER STUDIES								
30 ENGINEERING & DESIGN								
30_ 5 FS Phase - CMP/EIS	1.00 EA	0	0	0	0	2300000	2,300,000	2300000.00
30_10 Pre-Const. Engineering & Design	1.00 EA	0	0	0	0	1700000	1,700,000	1700000.00
30_15 Engineering During Construction	1.00 EA	0	700,937	0	0	0	700,937	700937.24
TOTAL ENGINEERING & DESIGN	1.00 EA	0	700,937	0	0	4000000	4,700,937	4700937.24
31 CONSTRUCTION MANAGEMENT								
31_ 5 CONSTRUCTION MANAGEMENT	1.00 EA	0	0	0	0	1815509	1,815,509	1815509.00
TOTAL CONSTRUCTION MANAGEMENT	1.00 EA	0	0	0	0	1815509	1,815,509	1815509.00
TOTAL Ashtabula River Partnership	1.00 EA	214,340	8,988,784	5,925,740	3,137,680	18003282	36,055,486	36055486.40
Prime's Home Office Expense							1,573,960	
SUBTOTAL							37,629,447	
Prime Contractor's Profit							1,777,390	
SUBTOTAL							39,406,837	
Prime Contractor's Bond							516,730	
TOTAL INCL INDIRECTS							39,923,567	
Contingency							7,690,205	
TOTAL INCL OWNER COSTS							47,613,772	

01_ 1. ACQUISTION	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL DREDGING(TRANSFER SITE)		0	0	0	0	37,000	37,000
01_ 1. 2. DISPOSAL SITE							
TOTAL TSCA DISPOSAL SITE		0	0	0	0	39,000	39,000
TOTAL NTSCA DISPOSAL SITE		0	0	0	0	132,400	132,400
TOTAL DISPOSAL SITE		0	0	0	0	171,400	171,400
TOTAL ACQUISTION		0	0	0	0	208,400	208,400

01_ 2. ADMINSTRATION	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL CORPS		0	0	0	0	34,500	34,500
TOTAL LOCAL		0	0	0	0	55,000	55,000
TOTAL ADMINSTRATION		0	0	0	0	89,500	89,500
TOTAL LANDS		0	0	0	0	297,900	297,900

12_ 1. DREDGING	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 1. 1. MOB/DEMOB									
12_ 1. 1.01. Const. Equipment & Facilities									
12_ 1. 1.01_ 1A. Marine Plant ** OVERTIME ** The mob/demob cost was referenced from the bid abstract for dredging of Cuyahoga River, bids opened 11/8/99. The cost shown is for the spring/summer period only.									
USR AA Mobilize Up To 200 Mi.(3				0.00	0.00	0.00	0.00	198348	198348.00
dredging seasons)from dredge est	3.00	EA		0	0	0	0	595,044	595,044
TOTAL Marine Plant				0	0	0	0	595,044	595,044
12_ 1. 1.01_ 1B. Land-Based Construction Equip. ** OVERTIME ** To be used for 4 construction seasons.									
MIL AA Outside Truck Dr. Heavy				0.00	31.72	0.00	0.00	0.00	31.72
	48.00	HR	X-TRKDVRHV	0	1,522	0	0	0	1,522
MIL AA Outside Equip. Op. Heavy				0.00	41.38	0.00	0.00	0.00	41.38
	48.00	HR	X-EQOPRHVY	0	1,986	0	0	0	1,986
MIL AA Laborer (Semi-Skilled)				0.00	28.61	0.00	0.00	0.00	28.61
	96.00	HR	B-LABORER	0	2,746	0	0	0	2,746
UPB AA TRLR,LOWBOY, 75T, 3 AXLE				0.00	0.00	9.24	0.00	0.00	9.24
(ADD TOWING TRUCK)	12.00	HR	T45XX019	0	0	111	0	0	111
MAP AA TRK,HWY, 50,000 GVW, 6X4, 3 AXLE				0.00	0.00	34.32	0.00	0.00	34.32
	32.00	HR	T50KE003	0	0	1,098	0	0	1,098
MAP AA TRK,HWY, 50,000 GVW, 6X4, 3 AXLE				0.00	0.00	35.53	0.00	0.00	35.53
	48.00	HR	T50KE004	0	0	1,705	0	0	1,705
MIL AA DOZER,CWLR, D-6D,PS				0.00	0.00	37.94	0.00	0.00	37.94
(ADD BLADE & ATTACHMENTS)	16.00	HR	T15CA008	0	0	607	0	0	607
UPB AA BLADE, STRAIGHT, HYDR, D-6				0.00	0.00	3.68	0.00	0.00	3.68
(ADD D-6 TRACTOR DOZER)	16.00	HR	T10CA009	0	0	59	0	0	59
MIL AA LDR,FE, WH, 3.00 CY, 4WD ARTIC				0.00	0.00	37.52	0.00	0.00	37.52
	16.00	HR	L40CS008	0	0	600	0	0	600
MIL AA CRANE,DRAG/CLAM, 4.5CY / 95'BOOM				0.00	0.00	127.76	0.00	0.00	127.76
(ADD DRAGLINE OR CLAM BUCKET)	32.00	HR	C85AM003	0	0	4,088	0	0	4,088

12_ 1. DREDGING	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA BKT,CLAM, 4.75CY,GEN PURP/SQNOSE			0.00	0.00	7.60	0.00	0.00	7.60
(CRANE ATTACHMENT& ADD TEETH COS	32.00 HR	B25ES012	0	0	243	0	0	243
TOTAL Land-Based Construction Equip.			0	6,255	8,512	0	0	14,768
12_ 1. 1.01_ 1C. Office/Storage Trailers ** OVERTIME **								
To be used for 4 construction seasons.								
CIV AA Field Office Trailer			0.00	0.00	0.00	281.50	0.00	281.50
	48.00 MOS	N/A	0	0	0	13,512	0	13,512
AF AA Toilet Portable Chemical			0.00	0.00	0.00	100.00	0.00	100.00
	48.00 MO	N/A	0	0	0	4,800	0	4,800
AF AA Temp Const Stor. Van 16 X 8			0.00	0.00	0.00	96.34	0.00	96.34
	48.00 MO	N/A	0	0	0	4,624	0	4,624
AF AA Temp Office Trailer 50' X 12			0.00	0.00	0.00	436.78	0.00	436.78
w/o Hookup	48.00 MO	N/A	0	0	0	20,965	0	20,965
TOTAL Office/Storage Trailers			0	0	0	43,902	0	43,902
TOTAL Const. Equipment & Facilities			0	6,255	8,512	43,902	595,044	653,713
12_ 1. 1.04. Setup/Construct Temp. Facilities								
12_ 1. 1.04_ 4A. Equipment Decon Station ** OVERTIME **								
B MIL AA Graded Crushed Agg Rdwy Base Crs			0.28	9.75	8.84	21.00	0.00	39.58
	30.00 CY	XSABA	8	292	265	630	0	1,187
B MIL AA Slab on Gr Edge Forms, Up to 6"H			0.06	2.20	0.04	1.00	0.00	3.23
(15 cm) High, Based on 4 Uses	160.00 LF	ACARJ	9	351	6	160	0	517
B MIL AA Gr 50 Resteel,Ftgs & Slabs,#3-#6			13.91	644.62	3.61	440.00	0.00	1088.23
	0.60 TON	SIWRC	8	387	2	264	0	653
L MIL AA Pour Slab on Gr,>= 6", Dir Chute			0.30	8.94	0.30	54.00	0.00	63.23
>= (15 cm) Place 3000 PSI Conc	33.00 CY	ALABE	10	295	10	1,782	0	2,087
MIL AA Concrete Floor Finishes, Broom			0.01	0.47	0.02	0.00	0.00	0.49
	1600.00 SF	ACMAC	21	757	30	0	0	787
AF AA 1.75In Od X 2Ft, Stainless Steel			0.00	0.00	0.00	80.00	0.00	80.00
Bailer	120.00 EA	N/A	0	0	0	9,600	0	9,600
HTW AA Pesticides And PCB's (608, 8080)			0.00	0.00	0.00	150.00	0.00	150.00
	120.00 EA	N/A	0	0	0	18,000	0	18,000

12_ 1. DREDGING	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
HTW AA Metals (6010, 7470)			0.00	0.00	0.00	95.00	0.00	95.00
	120.00 EA	N/A	0	0	0	11,400	0	11,400
HTW AA 500 mL (16 Oz) Boston Round			0.00	0.00	0.00	25.25	0.00	25.25
Bottle (Case Of 12)	11.00 EA	N/A	0	0	0	278	0	278
HTW AA Custody Seals (Package Of 10)			0.00	0.00	0.00	1.13	0.00	1.13
	25.00 EA	N/A	0	0	0	28	0	28
HTW AA 48 Quart Ice Chest			0.00	0.00	0.00	20.65	0.00	20.65
	5.00 EA	N/A	0	0	0	103	0	103
AF AA Bag Ice			0.00	0.00	0.00	1.00	0.00	1.00
	100.00 EA	N/A	0	0	0	100	0	100
HTW AA Blue Ice Soft Packs			0.00	0.00	0.00	5.02	0.00	5.02
Equivalent To 4 Lbs Of Ice	10.00 EA	N/A	0	0	0	50	0	50
TOTAL Equipment Decon Station			57	2,082	313	42,395	0	44,791

12_ 1. 1.04_ 4C. Facility Access Roads
Work Statement: Construct temporary access roads, parking, and facility foundation areas at the outset and maintain during the course of the project. Provide a geotextile separation layer.
Assume 2000 LF of access rd 20' wide made of gravel 9" thick = 1,111 cy.

12_ 1. 1.04_ 4C_ 01. CONSTRUCT ROADS AND PARKING (USER) ** OVERTIME **

	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA Equip. Operator, Foreman			0.00	40.30	0.00	0.00	0.00	40.30
(1 ea)	70.00 HR	X-EQOPRMED	0	2,821	0	0	0	2,821
MIL AA Outside Equip. Operators, Light			0.00	38.36	0.00	0.00	0.00	38.36
(1 ea)	70.00 HR	X-EQOPRLT	0	2,685	0	0	0	2,685
MIL AA Outside Equip. Operators, Medium			0.00	39.75	0.00	0.00	0.00	39.75
(2 ea)	140.00 HR	X-EQOPRMED	0	5,565	0	0	0	5,565
MIL AA Outside Laborers, (Semi-Skilled)			0.00	32.38	0.00	0.00	0.00	32.38
(2 ea)	140.00 HR	X-LABORER	0	4,534	0	0	0	4,534
MIL AA Outside Truck Drivers, Heavy			0.00	31.72	0.00	0.00	0.00	31.72
(1 ea)	70.00 HR	X-TRKDVRHV	0	2,220	0	0	0	2,220
UPB AA GRADER,MOTOR, ARTIC, CAT 140-G			0.00	0.00	35.65	0.00	0.00	35.65
(1 ea)	70.00 HR	G15CA004	0	0	2,495	0	0	2,495

REF. EP 1110-1-8
ARTICULATED FRAME, POWERSHIFT

12_ 1. DREDGING	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
UPB AA PUMP,SUBM, 6"D,1950GPM/40'HD, EL			0.00	0.00	6.49	0.00	0.00	6.49
(1 ea)	70.00 HR	P55GR004	0	0	454	0	0	454
REF. EP 1110-1-8 6" - 1,950 GPM AT 40' HEAD								
UPB AA ROLLER,VIB,SD,S/P,13.0T,66"W,PAD			0.00	0.00	32.69	0.00	0.00	32.69
(1 ea)	70.00 HR	R50DY002	0	0	2,289	0	0	2,289
REF. EP 1110-1-8 66" WIDE X 48" DIA., 13 TON,TAMP FT								
UPB AA WATER TANK, 3000 GAL			0.00	0.00	3.21	0.00	0.00	3.21
(ADD 40,000 GVW TRUCK)	70.00 HR	T40XX033	0	0	225	0	0	225
UPB AA TRK,HWY, 41,000 GVW, 6X4, 3 AXLE			0.00	0.00	22.10	0.00	0.00	22.10
(1 ea)	70.00 HR	T50GM016	0	0	1,547	0	0	1,547
REF. EP 1110-1-8 6X4, 3 AXLE, 41000 GVW								
UPB AA SMALL TOOLS (2 ea)			0.00	0.00	1.53	0.00	0.00	1.53
	140.00 HR	XMIXX020	0	0	214	0	0	214
USR AA Material Cost for Gravel			0.00	0.00	0.00	22.00	0.00	22.00
Includes delivery to site	1111.00 CY		0	0	0	24,442	0	24,442
TOTAL CONSTRUCT ROADS AND PARKING			0	17,825	7,224	24,442	0	49,491
12_ 1. 1.04_ 4C_ 02. PLACE GEOTEXTILE FABRIC				** OVERTIME **				
L CIV AA Geotextile Fabric, 55 Mils Thick			0.02	0.50	0.02	0.65	0.00	1.17
Non-Woven Polypropylene	4500.00 SY	ULABJ	78	2,253	89	2,914	0	5,256
Level D protection is required for this activity. Normal productivity of 187.5 sy/crew hr (MCACES UPB) has been reduced by a factor of .92 (Productivity Study for HTRW Remedial Action Projects pg 24). Note that manual work is considered "Heavy" work.								
TOTAL PLACE GEOTEXTILE FABRIC			78	2,253	89	2,914	0	5,256

12_ 1. DREDGING	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Facility Access Roads			78	20,078	7,313	27,356	0	54,747
12_ 1. 1.04_ 4D. Misc. Temporary Facilities					** OVERTIME **			
B MIL SC Galv H-Beam Line Post,6'Fence Ht			0.43	12.52	2.34	20.00	0.00	34.86
1-7/8"(4.8cm)OD Post,Set in Conc	318.00 EA	ULABL	138	4,827	902	7,712	0	13,442
L MIL SC Galv Stl Corner Post,6'Fence Hgt			0.50	14.44	2.70	26.87	0.00	44.01
4"(10cm)OD Stl Post, Set in Conc	6.00 EA	ULABL	3	105	20	195	0	320
L MIL SC 6'(1.8M) FH Fabric Chain Link			0.09	2.68	0.50	2.63	0.00	5.81
#9 Ga, 1.2 Oz Coating, 2" Mesh	3180.00 LF	ULABL	296	10,344	1,933	10,142	0	22,419
L MIL SC Galv Barbed Wire, Per Strand			0.01	0.31	0.06	0.04	0.00	0.41
	3180.00 LF	ULABL	35	1,207	226	154	0	1,586
L MIL SC 1-5/8"(4.1cm) Galv Stl Top Rail			0.03	0.78	0.15	0.38	0.00	1.31
Includes Tie Wires	3180.00 LF	ULABL	86	3,017	564	1,452	0	5,033
MIL SC 12'W x 6'H Double Swing Gate			0.00	0.00	0.00	130.95	0.00	130.95
Chain Link	1.00 EA	N/A	0	0	0	159	0	159
TOTAL Misc. Temporary Facilities			559	19,500	3,645	19,815	0	42,959
TOTAL Setup/Construct Temp. Facilities			694	41,660	11,271	89,566	0	142,497
12_ 1. 1.05. Construct Temporary Utilities								
12_ 1. 1.05_ 3A. Power Connection/Distribution								
MIL EL Outside Electrician - Foreman			0.00	39.21	0.00	0.00	0.00	39.21
(1 ea)	40.00 HR	X-ELECTRN	0	1,902	0	0	0	1,902
MIL EL Outside Electricians (2 ea)			0.00	38.71	0.00	0.00	0.00	38.71
	80.00 HR	X-ELECTRN	0	3,756	0	0	0	3,756
MIL EL TRENCHR,CHN, 35"DP,8"W,4WD,W/BL			0.00	0.00	6.52	0.00	0.00	6.52
	40.00 HR	T30DW002	0	0	316	0	0	316
USR EL Material/Supply Allowance			0.00	0.00	0.00	500.00	0.00	500.00
	5.00 EA		0	0	0	3,032	0	3,032
TOTAL Power Connection/Distribution			0	5,658	316	3,032	0	9,006

12_ 1. DREDGING	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 1. 1.05_ 3B. Water/Sewer Connections				** OVERTIME **				
MIL PL Outside Plumbers (2 ea)			0.00	45.60	0.00	0.00	0.00	45.60
	16.00 HR	X-PLUMBER	0	885	0	0	0	885
MIL PL Outside Plumber - Foreman			0.00	46.15	0.00	0.00	0.00	46.15
(1 ea)	8.00 HR	X-PLUMBER	0	448	0	0	0	448
MIL PL Outside Equip. Operators, Light			0.00	38.36	0.00	0.00	0.00	38.36
(1 ea)	8.00 HR	X-EQOPRLT	0	372	0	0	0	372
EP PL LDR,BH,WH, 1.50CY FE BKT, 36"DIP			0.00	0.00	20.70	0.00	0.00	20.70
4X4	8.00 HR	L50JC006	0	0	201	0	0	201
USR PL Material/Supply Allowance			0.00	0.00	0.00	500.00	0.00	500.00
	1.00 LS		0	0	0	606	0	606
TOTAL Water/Sewer Connections			0	1,705	201	606	0	2,512
12_ 1. 1.05_ 3C. Monitoring Well Construction				** OVERTIME **				
MIL Foreman			0.00	40.30	0.00	0.00	0.00	40.30
(1 ea)	85.71 HR	X-EQOPRMED	0	3,454	0	0	0	3,454
MIL Civil Engineer			0.00	0.00	0.00	4000.00	0.00	4000.00
	85.71 MON	N/A	0	0	0	342,857	0	342,857
MIL Outside Equip. Operators, Medium			0.00	39.75	0.00	0.00	0.00	39.75
(1 ea)	85.71 HR	X-EQOPRMED	0	3,407	0	0	0	3,407
MIL Outside Laborers, (Semi-Skilled)			0.00	32.38	0.00	0.00	0.00	32.38
(3 ea)	257.14 HR	X-LABORER	0	8,327	0	0	0	8,327
UPB DRILL,ROTARY, 16" WATER WELL,TRK			0.00	0.00	100.27	0.00	0.00	100.27
(ADD DRILL STEEL, BITS,&STR BAR)	85.71 HR	D35IN003	0	0	8,595	0	0	8,595
UPB SMALL TOOLS (2 ea)			0.00	0.00	1.53	0.00	0.00	1.53
	171.43 HR	XMIXX020	0	0	262	0	0	262
USR 2" dia Schedule 40 PVC Casing			0.00	0.00	0.00	1.00	0.00	1.00
	180.00 LF		0	0	0	180	0	180
USR 2" dia Sched 40 PVC Preslotted			0.00	0.00	0.00	1.50	0.00	1.50
Screen	40.00 LF		0	0	0	60	0	60
USR 2" dia Sched 40 PVC Thread Plug			0.00	0.00	0.00	3.00	0.00	3.00
	4.00 EA		0	0	0	12	0	12
USR Vented PVC Well Cap			0.00	0.00	0.00	10.00	0.00	10.00
	4.00 EA		0	0	0	40	0	40

12_ 1. DREDGING	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR Grained Sand Filter Pack		0.00	0.00	0.00	11.11	0.00	11.11
	15.00 CF	0	0	0	167	0	167
USR Cement-Bentonite Seal		0.00	0.00	0.00	10.00	0.00	10.00
	47.00 CF	0	0	0	470	0	470
USR Bentonite Pellets		0.00	0.00	0.00	40.00	0.00	40.00
	2.00 CF	0	0	0	80	0	80
USR Protective Casing w/ Lock Cap		0.00	0.00	0.00	300.00	0.00	300.00
	4.00 EA	0	0	0	1,200	0	1,200
TOTAL Monitoring Well Construction		0	15,189	8,856	345,066	0	369,111
TOTAL Construct Temporary Utilities		0	22,551	9,373	348,704	0	380,628
TOTAL MOB/DEMOB		694	70,466	29,156	482,172	595,044	1,176,838
12_ 1. 2. CONSTRUCT TRANSFER							
12_ 1. 2. 1. CLEAR & GRUB			** OVERTIME **				
MIL AA Clear and Grub Lt Trees to 6" D		68.57	2095.30	1087.38	0.00	0.00	3182.68
(15cm) Dia, Cut and Chip	5.00 ACR COMCA	343	10,476	5,437	0	0	15,913
TOTAL CLEAR & GRUB		343	10,476	5,437	0	0	15,913
12_ 1. 2. 2. CONSTRUCT SETTLING BASIN			** OVERTIME **				
MIL AA Exc & Fill, D-6D Dozer w/S-Blade		0.03	1.00	1.02	0.00	0.00	2.02
140 HP, Move 150' and Stockpile	6250.00 CY CODTE	156	6,228	6,389	0	0	12,617
USR AA RIPRAP		0.16	5.21	0.96	25.00	0.00	31.17
	300.00 TON CODEJ	49	1,564	288	7,500	0	9,352
B MIL AA Sprd Dumped SAND, 6" Layers		0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	590.00 CY CODTG	15	588	884	8,850	0	10,322
MIL AA Compaction, 6" Layers w/Air Tamp		0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	590.00 CY CLACA	59	1,694	59	0	0	1,754
USR AA Sprd Dumped CLAY, 6" Layers		0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	2130.00 CY CODTG	53	2,123	3,190	31,950	0	37,262
USR AA Compaction, 6" Layers w/Air Tamp		0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	2130.00 CY CLACA	213	6,117	214	0	0	6,331

12_ 1. DREDGING	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
HTW AA 60 Mil VLDPE		0.43	12.36	0.91	4.77	0.00	18.05
	2500.00 SY USKCF	1,078	30,909	2,284	11,925	0	45,118
MIL AA Furn & Pl Imported Topsoil, 4"Dp		0.09	3.19	1.92	17.50	0.00	22.61
	70.00 CY CODLA	6	223	134	1,225	0	1,583
MIL AA Mechanical Seeding, 50#/MSY		0.00	0.00	0.00	0.08	0.00	0.08
	600.00 SY ULABE	0	1	0	47	0	48
M AF AA 18.36 Lb/1000 SF Fertilizer,		0.00	0.01	0.01	0.05	0.00	0.07
Sprayed from Truck	600.00 SY COFWK	0	4	5	30	0	40
TOTAL CONSTRUCT SETTLING BASIN		1,629	49,451	13,448	61,527	0	124,426
12_ 1. 2. 3. DREDGING MATERIAL STORAGE AREA		** OVERTIME **					
MIL AA Exc & Fill, D-6D Dozer w/S-Blade		0.03	1.00	1.02	0.00	0.00	2.02
140 HP, Move 150' and Stockpile	1650.00 CY CODTE	41	1,644	1,687	0	0	3,331
USR AA Sprd Dumped CLAY, 6" Layers		0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	1860.00 CY CODTG	47	1,853	2,786	27,900	0	32,539
USR AA Compaction, 6" Layers w/Air Tamp		0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	1860.00 CY CLACA	186	5,342	187	0	0	5,529
B MIL AA Sprd Dumped SAND, 6" Layers		0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	910.00 CY CODTG	23	907	1,363	13,650	0	15,920
MIL AA Compaction, 6" Layers w/Air Tamp		0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	910.00 CY CLACA	91	2,613	92	0	0	2,705
HTW AA 60 Mil VLDPE		0.43	12.36	0.91	4.77	0.00	18.05
	2730.00 SY USKCF	1,177	33,752	2,494	13,022	0	49,269
USR AA CRUSHED STONE		0.16	5.21	0.96	25.00	0.00	31.17
	650.00 TON CODEJ	106	3,388	624	16,250	0	20,263
MIL AA 6" Dia Perf PVC Pipe, Underdrain		0.13	3.98	1.63	0.87	0.00	6.49
(15cm) Diameter	660.00 LF CODEX	84	2,629	1,077	575	0	4,282
MIL AA Bituminous Hot Mix Intrm Course		0.48	16.72	5.57	17.68	0.00	39.96
3954#/CY (2349Kg/M3),Ctrl Plant	380.00 TON XASPA	182	6,353	2,115	6,717	0	15,185
MIL AA Furn & Pl Imported Topsoil, 4"Dp		0.09	3.19	1.92	17.50	0.00	22.61
	83.00 CY CODLA	7	265	159	1,453	0	1,876
MIL AA Mechanical Seeding, 50#/MSY		0.00	0.00	0.00	0.08	0.00	0.08
	750.00 SY ULABE	0	1	0	58	0	60

12_ 1. DREDGING	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
M AF AA 18.36 Lb/1000 SF Fertilizer,				0.00	0.01	0.01	0.05	0.00	0.07
Sprayed from Truck	750.00	SY	COFWK	0	6	7	38	0	50
TOTAL DREDGING MATERIAL STORAGE AREA				1,944	58,754	12,591	79,663	0	151,007
12_ 1. 2. 4. LOADING AREA ACCESS ROAD				** OVERTIME **					
MIL AA Exc & Fill, D-6D Dozer w/S-Blade				0.03	1.00	1.02	0.00	0.00	2.02
140 HP, Move 150' and Stockpile	1060.00	CY	CODTE	27	1,056	1,084	0	0	2,140
USR AA Sprd Dumped CLAY, 6" Layers				0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	365.00	CY	CODTG	9	364	547	5,475	0	6,385
USR AA Compaction, 6" Layers w/Air Tamp				0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	365.00	CY	CLACA	37	1,048	37	0	0	1,085
B MIL AA Sprd Dumped SAND, 6" Layers				0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	940.00	CY	CODTG	24	937	1,408	14,100	0	16,444
MIL AA Compaction, 6" Layers w/Air Tamp				0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	940.00	CY	CLACA	94	2,699	95	0	0	2,794
M MIL AA 6" ASPHALT				0.48	16.72	5.57	18.00	0.00	40.28
	570.00	TON	XASPA	274	9,529	3,172	10,260	0	22,962
USR AA 1 1/2" ASPHALT				0.48	16.72	5.57	18.00	0.00	40.28
	180.00	TON	XASPA	86	3,009	1,002	3,240	0	7,251
USR AA 3 1/2" ASPHALT				0.48	16.72	5.57	18.00	0.00	40.28
	430.00	TON	XASPA	206	7,189	2,393	7,740	0	17,322
MIL AA 6" Dia Perf PVC Pipe, Underdrain				0.13	3.98	1.63	0.87	0.00	6.49
(15cm) Diameter	420.00	LF	CODEX	54	1,673	685	366	0	2,725
HTW AA 60 Mil VLDPE				0.43	12.36	0.91	4.77	0.00	18.05
	3300.00	SY	USKCF	1,423	40,800	3,015	15,741	0	59,556
USR AA CURB				0.48	16.72	5.57	5.00	0.00	27.28
	700.00	LF	XASPA	336	11,703	3,896	3,500	0	19,099
MIL AA Mechanical Seeding, 50#/MSY				0.00	0.00	0.00	0.08	0.00	0.08
	750.00	SY	ULABE	0	1	0	58	0	60
M AF AA 18.36 Lb/1000 SF Fertilizer,				0.00	0.01	0.01	0.05	0.00	0.07
Sprayed from Truck	750.00	SY	COFWK	0	6	7	38	0	50
TOTAL LOADING AREA ACCESS ROAD				2,568	80,014	17,340	60,518	0	157,872

12_ 1. DREDGING	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 1. 2. 5. SETTLING BASIN ACCESS ROAD								
12_ 1. 2. 5_ 1. SECTION F - F				** OVERTIME **				
MIL AA Exc & Fill, D-6D Dozer w/S-Blade			0.03	1.00	1.02	0.00	0.00	2.02
140 HP, Move 150' and Stockpile	50.00 CY	CODTE	1	50	51	0	0	101
USR AA Sprd Dumped CLAY, 6" Layers			0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	50.00 CY	CODTG	1	50	75	750	0	875
USR AA Compaction, 6" Layers w/Air Tamp			0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	50.00 CY	CLACA	5	144	5	0	0	149
B MIL AA Sprd Dumped SAND, 6" Layers			0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	165.00 CY	CODTG	4	164	247	2,475	0	2,887
MIL AA Compaction, 6" Layers w/Air Tamp			0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	165.00 CY	CLACA	17	474	17	0	0	490
HTW AA 60 Mil VLDPE			0.43	12.36	0.91	4.77	0.00	18.05
	790.00 SY	USKCF	341	9,767	722	3,768	0	14,257
M MIL AA 6" ASPHALT			0.48	16.72	5.57	18.00	0.00	40.28
	72.00 TON	XASPA	35	1,204	401	1,296	0	2,900
USR AA 3 1/2" ASPHALT			0.48	16.72	5.57	18.00	0.00	40.28
	84.00 TON	XASPA	40	1,404	468	1,512	0	3,384
USR AA 1 1/2" ASPHALT			0.48	16.72	5.57	18.00	0.00	40.28
	36.00 TON	XASPA	17	602	200	648	0	1,450
MIL AA 6" Dia Perf PVC Pipe, Underdrain			0.13	3.98	1.63	0.87	0.00	6.49
(15cm) Diameter	320.00 LF	CODEX	41	1,275	522	279	0	2,076
MIL AA 12"(31cm) ABS Plastic Drain Pipe			0.19	6.91	0.93	8.45	0.00	16.29
Truss Type	320.00 LF	XXPLB	60	2,211	297	2,705	0	5,214
MIL AA Exc & Fill, D-6D Dozer w/S-Blade			0.03	1.00	1.02	0.00	0.00	2.02
140 HP, Move 150' and Stockpile	110.00 CY	CODTE	3	110	112	0	0	222
TOTAL SECTION F - F			564	17,454	3,117	13,434	0	34,005
12_ 1. 2. 5_ 2. SECTION G - G				** OVERTIME **				
MIL AA Exc & Fill, D-6D Dozer w/S-Blade			0.03	1.00	1.02	0.00	0.00	2.02
140 HP, Move 150' and Stockpile	150.00 CY	CODTE	4	149	153	0	0	303
USR AA Sprd Dumped CLAY, 6" Layers			0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	165.00 CY	CODTG	4	164	247	2,475	0	2,887

12_ 1. DREDGING	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Compaction, 6" Layers w/Air Tamp		0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	165.00 CY CLACA	17	474	17	0	0	490
B MIL AA Sprd Dumped SAND, 6" Layers		0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	295.00 CY CODTG	7	294	442	4,425	0	5,161
MIL AA Compaction, 6" Layers w/Air Tamp		0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	295.00 CY CLACA	30	847	30	0	0	877
HTW AA 60 Mil VLDPE		0.43	12.36	0.91	4.77	0.00	18.05
	1080.00 SY USKCF	466	13,353	987	5,152	0	19,491
USR AA 3 1/2" ASPHALT		0.48	16.72	5.57	18.00	0.00	40.28
	176.00 TON XASPA	84	2,942	980	3,168	0	7,090
USR AA 1 1/2" ASPHALT		0.48	16.72	5.57	18.00	0.00	40.28
	74.00 TON XASPA	36	1,237	412	1,332	0	2,981
M MIL AA 6" ASPHALT		0.48	16.72	5.57	18.00	0.00	40.28
	34.00 TON XASPA	16	568	189	612	0	1,370
MIL AA 2"Dia Perf PVC Pipe, Underdrain		0.13	3.98	1.63	0.35	0.00	5.96
(10cm) Diameter	264.00 LF CODEX	34	1,052	431	92	0	1,575
MIL AA Exc & Fill, D-6D Dozer w/S-Blade		0.03	1.00	1.02	0.00	0.00	2.02
140 HP, Move 150' and Stockpile	110.00 CY CODTE	3	110	112	0	0	222
TOTAL SECTION G - G		700	21,191	3,999	17,256	0	42,446
TOTAL SETTLING BASIN ACCESS ROAD		1,264	38,645	7,116	30,689	0	76,450
12_ 1. 2. 6. DECONTAMINATION PAD			** OVERTIME **				
MIL AA Exc & Fill, D-6D Dozer w/S-Blade		0.03	1.00	1.02	0.00	0.00	2.02
140 HP, Move 150' and Stockpile	130.00 CY CODTE	3	130	133	0	0	262
B MIL AA Sprd Dumped SAND, 6" Layers		0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	270.00 CY CODTG	7	269	404	4,050	0	4,723
MIL AA Compaction, 6" Layers w/Air Tamp		0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	270.00 CY CLACA	27	775	27	0	0	803
HTW AA 60 Mil VLDPE		0.05	1.37	0.10	0.53	0.00	2.01
	360.00 SF USKCF	17	495	37	191	0	722
M MIL AA Pour Slab on Gr, < 6", Dir Chute		0.37	11.07	0.37	85.00	0.00	96.44
< (15 cm) Place 3000 PSI Conc	50.00 CY ALABE	18	553	19	4,250	0	4,822

12_ 1. DREDGING	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA Weld Wire Fab in Slabs, 6x6x#6			0.06	2.87	0.01	0.97	0.00	3.86
42 #/CSF, (W 2.9 x W 2.9),< 5 To	280.00 SY	SIWRB	17	805	4	272	0	1,081
MIL AA 4" Dia Perf PVC Pipe, Underdrain			0.13	3.98	1.63	0.87	0.00	6.49
(15cm) Diameter	45.00 LF	CODEX	6	179	73	39	0	292
MIL AA 2'Dia x 6'Deep Precast Manhole			8.67	278.01	51.23	233.65	0.00	562.89
8"(20cm)Tk, (1.2M)Dia x (1.8M)Dp	2.00 EA	CODEJ	17	556	102	467	0	1,126
CIV SS HD Trench Drain Grate,30"Trench			0.35	12.85	0.08	53.70	0.00	66.63
Welded Steel Grating	76.00 LF	ACARI	26	1,184	7	4,949	0	6,141
MIL AA Straight Dowels,3/4"Dia x 24"L			0.02	0.91	0.01	1.09	0.00	2.01
(19mm) Dia x (61cm) Long	175.00 EA	ACARB	4	159	2	191	0	352
TOTAL DECONTAMINATION PAD			143	5,105	808	14,410	0	20,324
12_ 1. 2. 7. SUMP WELLS			** OVERTIME **					
MIL AA 4'Dia x 6'Deep Precast Manhole			8.67	278.01	51.23	233.65	0.00	562.89
8"(20cm)Tk, (1.2M)Dia x (1.8M)Dp	1.00 EA	CODEJ	9	278	51	234	0	563
MIL PL 300GPM CI Sump Pump, 4"Discharge			20.00	872.21	8.79	2954.10	0.00	3835.10
Single Stage, 70' Head, 10 HP	2.00 EA	MSPFB	40	2,115	21	7,165	0	9,301
TOTAL SUMP WELLS			49	2,393	73	7,398	0	9,864
12_ 1. 2. 8. FILTER CELL CONTAINMENT AREA & T			** OVERTIME **					
MIL AA Exc & Fill, D-6D Dozer w/S-Blade			0.03	1.00	1.02	0.00	0.00	2.02
140 HP, Move 150' and Stockpile	150.00 CY	CODTE	4	149	153	0	0	303
USR AA Sprd Dumped CLAY, 6" Layers			0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	190.00 CY	CODTG	5	189	285	2,850	0	3,324
USR AA Compaction, 6" Layers w/Air Tamp			0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	190.00 CY	CLACA	19	546	19	0	0	565
B MIL AA Sprd Dumped SAND, 6" Layers			0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	140.00 CY	CODTG	4	140	210	2,100	0	2,449
MIL AA Compaction, 6" Layers w/Air Tamp			0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	140.00 CY	CLACA	14	402	14	0	0	416
M MIL AA 6" ASPHALT			0.48	16.72	5.57	18.00	0.00	40.28
	50.00 TON	XASPA	24	836	278	900	0	2,014

12_ 1. DREDGING	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
HTW AA 60 Mil VLDPE				0.43	12.36	0.91	4.77	0.00	18.05
	540.00	SY	USKCF	233	6,676	493	2,576	0	9,745
MIL AA 2"Dia Perf PVC Pipe, Underdrain				0.13	3.98	1.63	0.35	0.00	5.96
(10cm) Diameter	72.00	LF	CODEX	9	287	118	25	0	429
USR AA Water Treatment Facilities -				0.00	0.00	0.00	0.00	500000	500000.00
Pricing information from Harding ESE of Denver Co. for two system simular to the Fields Brook Superfund Site.	1.00	LS		0	0	0	0	500,000	500,000
TOTAL FILTER CELL CONTAINMENT AREA & T				311	9,225	1,570	8,451	500,000	519,246
12_ 1. 2. 9. CONTAINMENT CONTROL BASIN					** OVERTIME **				
MIL AA Exc & Fill, D-6D Dozer w/S-Blade				0.03	1.00	1.02	0.00	0.00	2.02
140 HP, Move 150' and Stockpile	160.00	CY	CODTE	4	159	164	0	0	323
USR AA Sprd Dumped CLAY, 6" Layers				0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	100.00	CY	CODTG	3	100	150	1,500	0	1,749
USR AA Compaction, 6" Layers w/Air Tamp				0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	100.00	CY	CLACA	10	287	10	0	0	297
B MIL AA Sprd Dumped SAND, 6" Layers				0.03	1.00	1.50	15.00	0.00	17.49
Without Compaction	70.00	CY	CODTG	2	70	105	1,050	0	1,225
MIL AA Compaction, 6" Layers w/Air Tamp				0.10	2.87	0.10	0.00	0.00	2.97
By Hand, (15cm) Layers	70.00	CY	CLACA	7	201	7	0	0	208
HTW AA 60 Mil VLDPE				0.43	12.36	0.91	4.77	0.00	18.05
	220.00	SY	USKCF	95	2,720	201	1,049	0	3,970
MIL AA 6" Dia Perf PVC Pipe, Underdrain				0.13	3.98	1.63	0.87	0.00	6.49
(15cm) Diameter	100.00	LF	CODEX	13	398	163	87	0	649
MIL AA Furn & Pl Imported Topsoil, 4"Dp				0.09	3.19	1.92	17.50	0.00	22.61
	10.00	CY	CODLA	1	32	19	175	0	226
MIL AA Mechanical Seeding, 50#/MSY				0.00	0.00	0.00	0.08	0.00	0.08
	70.00	SY	ULABE	0	0	0	5	0	6
M AF AA 18.36 Lb/1000 SF Fertilizer,				0.00	0.01	0.01	0.05	0.00	0.07
Sprayed from Truck	70.00	SY	COFWK	0	1	1	4	0	5
TOTAL CONTAINMENT CONTROL BASIN				134	3,968	819	3,870	0	8,658

12_ 1. DREDGING	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 1. 2.10. FENCING				** OVERTIME **				
MIL SC 7'(2.1M)H Fabric Security Fence			0.06	1.67	0.01	12.44	0.00	14.13
Standard FE-7	1800.00 LF	ULABC	105	3,653	22	27,164	0	30,839
TOTAL FENCING			105	3,653	22	27,164	0	30,839
TOTAL CONSTRUCT TRANSFER			8,490	261,685	59,225	293,689	500,000	1,114,599
12_ 1. 4. DREDGING								
12_ 1. 4. 1. DREDGING (312B TSCA)								
USR AL The dredging unit price used			0.00	0.00	0.00	0.00	8.53	8.53
had been estimated using the	150000 CY		0	0	0	0	1279500	1,279,500
CORPS Cost Engineering Dredge								
Estimating Program (CEDEP).								
TOTAL DREDGING (312B TSCA)			0	0	0	0	1279500	1,279,500
12_ 1. 4. 2. DREDGING (312B NTSCA)								
USR AL The dredging unit price used had			0.00	0.00	0.00	0.00	8.53	8.53
been estimated using the CORPS	431000 CY		0	0	0	0	3676430	3,676,430
Cost Engineering Dredge								
Estimating Program (CEDEP).								
TOTAL DREDGING (312B NTSCA)			0	0	0	0	3676430	3,676,430
12_ 1. 4. 3. DREDGING (O & M NTSCA)								
USR AL The dredging unit price used had			0.00	0.00	0.00	0.00	8.53	8.53
been estimated using the CORPS	62200 CY		0	0	0	0	530,566	530,566
Cost Engineering Dredge								
Estimating Program (CEDEP).								
TOTAL DREDGING (O & M NTSCA)			0	0	0	0	530,566	530,566
12_ 1. 4. 4. DREDGING (312A NTSCA)								
USR AL The dredging unit price used had			0.00	0.00	0.00	0.00	8.53	8.53
been estimated using the CORPS	52800 CY		0	0	0	0	450,384	450,384
Cost Engineering Dredge								
Estimating Program (CEDEP).								
TOTAL DREDGING (312A NTSCA)			0	0	0	0	450,384	450,384

12_ 1. DREDGING	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL DREDGING				0	0	0	0	5936880	5,936,880

12_ 1. 5. OPERATE TRANSFER FACILITY

It is estimated that 1500 CY will be dredged per day, therfore the operation of the transfer facility is based on production of 150 CY/HR working 10 HR/DAY.

12_ 1. 5. 1. DREDGING (312B TSCA) ** OVERTIME **

12_ 1. DREDGING	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Transfer Sediment from Scow to storage area. The dredge material would be transfered from the barges and placed into the initial settling basin at a rate of 150 cy/hr. Crane cycle = 1.0 min. @ 50 min/hr = 150 cy when 3 cy are unloaded each cycle.	150000	CY	UOEHJ	0.01 1,995	0.49 73,440	0.63 94,050	0.00 0	0.00 0	1.12 167,490
USR AA Pump water and slurry into secondary settling basin	150000	CY	COFWG	0.01 1,500	0.35 53,220	0.04 6,495	0.00 0	0.00 0	0.40 59,715
USR AA Move dredge material towards loading area to consolidate	150000	CY	CODTC	0.02 2,505	0.66 99,645	0.36 53,355	0.00 0	0.00 0	1.02 153,000
USR AA Load consolidated sediments on trucks for transport to disposal	150000	CY	CODEU	0.02 3,000	0.68 102,060	0.90 135,630	0.00 0	0.00 0	1.58 237,690
USR AA Run water treatment facility	150000	CY	HTESA	0.01 1,005	0.20 29,745	0.01 1,530	0.02 3,000	0.02 3,000	0.25 37,275
TOTAL DREDGING (312B TSCA)				10,005	358,110	291,060	3,000	3,000	655,170

12_ 1. 5. 2. DREDGING (312B NTSCA) ** OVERTIME **

12_ 1. DREDGING	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Transfer Sediment from Scow to storage area. The dredge material would be transfered from the barges and placed into the initial settling basin at a rate of 150 cy/hr. Crane cycle = 1.0 min. @ 50 min/hr = 150 cy when 3 cy are unloaded each cycle.	431000	CY	UOEHJ	0.01 5,732	0.49 211,018	0.63 270,237	0.00 0	0.00 0	1.12 481,255
USR AA Pump water and slurry into secondary settling basin	431000	CY	COFWG	0.01 4,310	0.35 152,919	0.04 18,662	0.00 0	0.00 0	0.40 171,581

12_ 1. DREDGING	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Move dredge material towards				0.02	0.66	0.36	0.00	0.00	1.02
loading area to consolidate	431000	CY	CODTC	7,198	286,313	153,307	0	0	439,620
USR AA Load consolidated sediments on				0.02	0.68	0.90	0.00	0.00	1.58
trucks for transport to disposal	431000	CY	CODEU	8,620	293,252	389,710	0	0	682,963
USR AA Run water treatment facility				0.01	0.20	0.01	0.02	0.02	0.25
	431000	CY	HTESA	2,888	85,467	4,396	8,620	8,620	107,104
TOTAL DREDGING (312B NTSCA)				28,748	1,028,969	836,312	8,620	8,620	1,882,522
12_ 1. 5. 3. DREDGING (O & M NTSCA)				** OVERTIME **					
USR AA Transfer Sediment from Scow to				0.01	0.49	0.63	0.00	0.00	1.12
storage area. The dredge material would be transfered from the barges and placed into the initial settling basin at a rate of 150 cy/hr. Crane cycle = 1.0 min. @ 50 min/hr = 150 cy when 3 cy are unloaded each cycle.	62200	CY	UOEHJ	827	30,453	38,999	0	0	69,453
USR AA Pump water and slurry into				0.01	0.35	0.04	0.00	0.00	0.40
secondary settling basin	62200	CY	COFWG	622	22,069	2,693	0	0	24,762
USR AA Move dredge material towards				0.02	0.66	0.36	0.00	0.00	1.02
loading area to consolidate	62200	CY	CODTC	1,039	41,319	22,125	0	0	63,444
USR AA Load consolidated sediments on				0.02	0.68	0.90	0.00	0.00	1.58
trucks for transport to disposal	62200	CY	CODEU	1,244	42,321	56,241	0	0	98,562
USR AA Run water treatment facility				0.01	0.20	0.01	0.02	0.02	0.25
	62200	CY	HTESA	417	12,334	634	1,244	1,244	15,457
TOTAL DREDGING (O & M NTSCA)				4,149	148,496	120,693	1,244	1,244	271,677
12_ 1. 5. 4. DREDGING (312A NTSCA)				** OVERTIME **					
USR AA Transfer Sediment from Scow to				0.01	0.49	0.63	0.00	0.00	1.12
storage area. The dredge material would be transfered from the barges and placed into the initial settling basin at a rate of 150 cy/hr. Crane cycle = 1.0 min. @ 50	52800	CY	UOEHJ	702	25,851	33,106	0	0	58,956

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
0_ 5. 5. 0. Overhead Items - SC												
0_ 5.10. 0. Overhead Items - ME												
0_ 5.15. 0. Overhead Items - EL												
0_ 5.20. 0. Overhead Items - SW												
0_ 5.25. 0. Overhead Items - LS												
0_ 5.30. 0. Overhead Items - GW												
0_ 5.35. 0. Overhead Items - PS												
0_ 5.40. 0. Overhead Items - AT												
0_ 5.45. 0. Overhead Items - RF												
0_ 5.50. 0. Overhead Items - PL												
0_ 5.55. 0. Overhead Items - HV												
0_ 5.60. 0. Overhead Items - FP												
0_ 5.65. 0. Overhead Items - MC												
0_ 5.70. 0. Overhead Items - SS												
0_ 5.75. 0. Overhead Items - LR												
0_ 5.80. 0. Overhead Items - SG												
0_ 5.85. 0. Overhead Items - MB												
01_ 1. 2. 5. TSCA DISPOSAL SITE												
01_ 1. 2.10. NTSCA DISPOSAL SITE												
12_ 1. 1.01. Const. Equipment & Facilities												
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	96
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	31.61	48
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	48
12_ 1. 1.04. Setup/Construct Temp. Facilities												
MIL	B-CARPNTER	Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	33.22	7
MIL	B-CEMTFINR	Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	30.23	22
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	647
MIL	B-RODMAN	Rodmen, (Reinforcing)	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	39.15	8
MIL	X-EQOPRLT	Outside Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	27.95	70
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	213
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	143
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	70
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	17.74	0.0%	30.3%	6.22	0.00	29.33	HR	12/30/99	23.24	2
12_ 1. 1.05. Construct Temporary Utilities												
MIL	X-ELECTRN	Outside Electricians	24.03	0.0%	22.9%	9.19	0.00	38.71	HR	12/30/99	33.15	120
MIL	X-EQOPRLT	Outside Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	27.95	8
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	171
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	257
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	24
12_ 1. 2. 1. CLEAR & GRUB				** OVERTIME **								
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	57
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	286
12_ 1. 2. 2. CONSTRUCT SETTLING BASIN				** OVERTIME **								
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	0
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	243
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	1116
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	269

12_ 1. DREDGING	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL DREDGING (312B TSCA)				9,840	373,251	338,019	75,000	0	786,270
12_ 1. 6. 2. DREDGING (312B NTSCA) ** OVERTIME **									
USR SC TRUCK TO LANDFILL				0.05	1.63	1.85	0.00	0.00	3.48
ASSUMING A LINED 12 CY DUMP TRUCK WOULD TRANSPORT THE DREDGE MATERIAL TO AREA 7 (3.5 MILES) FROM THE RIVER. THEREFORE THE PRODUCTION RATE IS CALCULATED AS FOLLOWS: 7 MILES ROUND @ 20 MPH = 21 MINUTES LOAD TRUCKS ASSUME 4 MINUTES UNLOAD TRAUKS ASSUME 4 MINUTES ------------------------------ ------------------------------ ---------- TOTAL THEREFORE IS 29 MINUTES SAY 30 MINUTES X 10 CY /TRUCK = 20 CY PER HR	431000	CY	COEID	21,550	854,216	966,846	0	0	1,821,062
USR AA LINE TRUCK				0.02	0.51	0.01	0.50	0.00	1.02
	431000	CY	XLABB	6,724	218,258	4,396	215,500	0	438,155
TOTAL DREDGING (312B NTSCA)				28,274	1,072,474	971,242	215,500	0	2,259,216
12_ 1. 6. 3. DREDGING (O & M NTSCA) ** OVERTIME **									
USR SC TRUCK TO LANDFILL				0.05	1.63	1.85	0.00	0.00	3.48
ASSUMING A LINED 12 CY DUMP TRUCK WOULD TRANSPORT THE DREDGE MATERIAL TO AREA 7 (3.5 MILES) FROM THE RIVER. THEREFORE THE PRODUCTION RATE IS CALCULATED AS FOLLOWS: 7 MILES ROUND @ 20 MPH = 21 MINUTES LOAD TRUCKS ASSUME 4 MINUTES UNLOAD TRAUKS ASSUME 4	62200	CY	COEID	3,110	123,277	139,531	0	0	262,808

12_ 1. DREDGING	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MINUTES ----------------------------- ----------------------------- ---------- TOTAL THEREFORE IS 29 MINUTES SAY 30 MINUTES X 10 CY /TRUCK = 20 CY PER HR									
USR AA LINE TRUCK				0.02	0.51	0.01	0.50	0.00	1.02
	62200	CY	XLABB	970	31,498	634	31,100	0	63,233
TOTAL DREDGING (O & M NTSCA)				4,080	154,775	140,165	31,100	0	326,040
12_ 1. 6. 4. DREDGING (312A NTSCA)				** OVERTIME **					
USR SC TRUCK TO LANDFILL				0.05	1.63	1.85	0.00	0.00	3.48
ASSUMING A LINED 12 CY DUMP TRUCK WOULD TRANSPORT THE DREDGE MATERIAL TO AREA 7 (3.5 MILES) FROM THE RIVER. THEREFORE THE PRODUCTION RATE IS CALCULATED AS FOLLOWS: 7 MILES ROUND @ 20 MPH = 21 MINUTES LOAD TRUCKS ASSUME 4 MINUTES UNLOAD TRAUKS ASSUME 4 MINUTES ----------------------------- ----------------------------- ---------- TOTAL THEREFORE IS 29 MINUTES SAY 30 MINUTES X 10 CY /TRUCK = 20 CY PER HR	52800	CY	COEID	2,640	104,646	118,444	0	0	223,091
USR AA LINE TRUCK				0.02	0.51	0.01	0.50	0.00	1.02
	52800	CY	XLABB	824	26,738	539	26,400	0	53,676
TOTAL DREDGING (312A NTSCA)				3,464	131,384	118,983	26,400	0	276,767
TOTAL TRANSPORT TO LANDFILL				45,658	1,731,884	1,568,410	348,000	0	3,648,294

12_ 1. DREDGING	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 1. 7. SAMPLING & ANALYSIS									
12_ 1. 7. 1. DREDGING									
12_ 1. 7. 1_ 1. DREDGING (312B TSCA)									
12_ 1. 7. 1_ 1_ 1. Predredging data collection ** OVERTIME ** Total suspended Solids (TSS) and Turbidity sampling will be conducted to establish a action level during the dredging operation. Additionally, air monitoring will be conducted to determine the baseline condition of PCB's in the ambient air.									
USR AA BATHYMETRIC SURVEY				120.00	1993.57	2165.91	0.00	0.00	4159.48
	1.00	LS	ZA	120	1,994	2,166	0	0	4,159
USR SC WATER QUALITY BENCH SCALE				120.00	2265.99	921.36	0.00	0.00	3187.35
TESTING	1.00	LS	ZCHEMIST	120	2,748	1,117	0	0	3,865
USR SC BASELINE AMBIENT AIR				120.00	4363.76	1810.48	0.00	0.00	6174.24
	1.00	LS	ZAIRSAMPLE	120	5,292	2,195	0	0	7,487
TOTAL Predredging data collection				360	10,033	5,479	0	0	15,512
12_ 1. 7. 1_ 1_ 2. Monitoring during dredging ** OVERTIME **									
USR SC TURBIDITY MONITORING ASSUME 2				2.00	29.05	15.55	0.00	0.00	44.60
HRS OF EFFORT EACH DAY.	100.00	DAY	ZH2OSAMPLE	200	3,523	1,885	0	0	5,408
USR SC WATER COLUMN SAMPLING & ANALYSIS				2.00	29.05	15.55	0.00	240.00	284.60
ASSUME 2 HRS OF EFFORT AND 2 ANALYSIS ($120) FOR PCB PERFORMED AT THE LAB EACH DAY.	100.00	DAY	ZH2OSAMPLE	200	3,523	1,885	0	29,103	34,512
USR SC TREATED WATER EFFLUENT ASSUME 1				1.00	14.53	7.77	0.00	120.00	142.30
HR OF EFFORT PER DAY AND 1 WATER EFFLUENT SAMPLE SENT TO A LAB EACH DAY.	100.00	DAY	ZH2OSAMPLE	100	1,761	943	0	14,552	17,256
USR SC PERIMETER AIR MONITORING &				3.00	109.09	45.26	0.00	240.00	394.36
ANALYSIS ASSUME 2 HRS OF EFFORT PLUS 6 BIOASSAY SAMPLES ($40) SENT TO THE LAB EACH DAY.	100.00	DAY	ZAIRSAMPLE	300	13,229	5,489	0	29,103	47,821
TOTAL Monitoring during dredging				800	22,036	10,202	0	72,758	104,997

12_ 1. DREDGING	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 1. 7. 1_ 1_ 3. Post dredging monitoring ** OVERTIME **							
USR SC OBTAIN SEDIMENT SAMPLES ASSUMED IS THAT ONE SEDIMENT SAMPLE IS TAKEN FOR EACH DAY OF WORK AND SENT TO THE LAB FOR PCB ANALYSIS.		3.00	56.65	23.03	0.00	180.00	259.68
	100.00 DAY ZCHEMIST	300	6,870	2,793	0	21,828	31,490
USR AA BATHYMETRIC SURVEY		120.00	1993.57	2165.91	0.00	0.00	4159.48
	1.00 LS ZA	120	1,994	2,166	0	0	4,159
TOTAL Post dredging monitoring		420	8,863	4,959	0	21,828	35,650
TOTAL DREDGING (312B TSCA)		1,580	40,933	20,640	0	94,586	156,159
12_ 1. 7. 1_ 2. DREDGING (312B NTSCA)							
12_ 1. 7. 1_ 2_ 1. Predredging data collection ** OVERTIME ** Total suspended Solids (TSS) and Turbidity sampling will be conducted to establish a action level during the dredging operation. Additionally, air monitoring will be conducted to determine the baseline condition of PCB's in the ambient air.							
USR AA BATHYMETRIC SURVEY		120.00	1993.57	2165.91	0.00	0.00	4159.48
	1.00 LS ZA	120	1,994	2,166	0	0	4,159
USR SC WATER QUALITY BENCH SCALE TESTING		120.00	2265.99	921.36	0.00	0.00	3187.35
	1.00 LS ZCHEMIST	120	2,748	1,117	0	0	3,865
USR SC BASELINE AMBIENT AIR		120.00	4363.76	1810.48	0.00	0.00	6174.24
	1.00 LS ZAIRSAMPLE	120	5,292	2,195	0	0	7,487
TOTAL Predredging data collection		360	10,033	5,479	0	0	15,512
12_ 1. 7. 1_ 2_ 2. Monitoring during dredging ** OVERTIME **							
USR SC TURBIDITY MONITORING ASSUME 2 HRS OF EFFORT EACH DAY.		2.00	29.05	15.55	0.00	0.00	44.60
	287.00 DAY ZH2OSAMPLE	574	10,111	5,411	0	0	15,522
USR SC WATER COLUMN SAMPLING & ANALYSIS ASSUME 2 HRS OF EFFORT AND 2 ANALYSIS ($120) FOR PCB PERFORMED AT THE LAB EACH DAY.		2.00	29.05	15.55	0.00	240.00	284.60
	287.00 DAY ZH2OSAMPLE	574	10,111	5,411	0	83,527	99,049
USR SC TREATED WATER EFFLUENT ASSUME 1 HR OF EFFORT PER DAY AND 1 WATER EFFLUENT SAMPLE SENT TO A LAB EACH DAY.		1.00	14.53	7.77	0.00	120.00	142.30
	287.00 DAY ZH2OSAMPLE	287	5,055	2,706	0	41,763	49,524

12_ 1. DREDGING	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR SC PERIMETER AIR MONITORING & ANALYSIS ASSUME 2 HRS OF EFFORT PLUS 6 BIOASSAY SAMPLES ($40) SENT TO THE LAB EACH DAY.			3.00	109.09	45.26	0.00	240.00	394.36
	287.00 DAY	ZAIRSAMPLE	861	37,968	15,752	0	83,527	137,247
TOTAL Monitoring during dredging			2,296	63,245	29,280	0	208,817	301,342
12_ 1. 7. 1_ 2_ 3. Post dredging monitoring ** OVERTIME **								
USR SC OBTAIN SEDIMENT SAMPLES ASSUMED IS THAT ONE SEDIMENT SAMPLE IS TAKEN FOR EACH DAY OF WORK AND SENT TO THE LAB FOR PCB ANALYSIS.			3.00	56.65	23.03	0.00	180.00	259.68
	287.00 DAY	ZCHEMIST	861	19,716	8,016	0	62,645	90,377
USR AA BATHYMETRIC SURVEY			120.00	1993.57	2165.91	0.00	0.00	4159.48
	1.00 LS	ZA	120	1,994	2,166	0	0	4,159
TOTAL Post dredging monitoring			981	21,709	10,182	0	62,645	94,537
TOTAL DREDGING (312B NTSCA)			3,637	94,987	44,941	0	271,462	411,390
12_ 1. 7. 1_ 3. DREDGING (O & M NTSCA)								
12_ 1. 7. 1_ 3_ 1. Predredging data collection ** OVERTIME ** Total suspended Solids (TSS) and Turbidity sampling will be conducted to establish a action level during the dredging operation. Additionally, air monitoring will be conducted to determine the baseline condition of PCB's in the ambient air.								
USR AA BATHYMETRIC SURVEY			120.00	1993.57	2165.91	0.00	0.00	4159.48
	1.00 LS	ZA	120	1,994	2,166	0	0	4,159
USR SC WATER QUALITY BENCH SCALE TESTING			120.00	2265.99	921.36	0.00	0.00	3187.35
	1.00 LS	ZCHEMIST	120	2,748	1,117	0	0	3,865
USR SC BASELINE AMBIENT AIR			120.00	4363.76	1810.48	0.00	0.00	6174.24
	1.00 LS	ZAIRSAMPLE	120	5,292	2,195	0	0	7,487
TOTAL Predredging data collection			360	10,033	5,479	0	0	15,512

12_ 1. DREDGING	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 1. 7. 1_ 3_ 2. Monitoring during dredging ** OVERTIME **							
USR SC TURBIDITY MONITORING ASSUME 2		2.00	29.05	15.55	0.00	0.00	44.60
HRS OF EFFORT EACH DAY.	42.00 DAY ZH2OSAMPLE	84	1,480	792	0	0	2,271
USR SC WATER COLUMN SAMPLING & ANALYSIS		2.00	29.05	15.55	0.00	240.00	284.60
ASSUME 2 HRS OF EFFORT AND 2 ANALYSIS ($120) FOR PCB PERFORMED AT THE LAB EACH DAY.	42.00 DAY ZH2OSAMPLE	84	1,480	792	0	12,223	14,495
USR SC TREATED WATER EFFLUENT ASSUME 1		1.00	14.53	7.77	0.00	120.00	142.30
HR OF EFFORT PER DAY AND 1 WATER EFFLUENT SAMPLE SENT TO A LAB EACH DAY.	42.00 DAY ZH2OSAMPLE	42	740	396	0	6,112	7,247
USR SC PERIMETER AIR MONITORING &		3.00	109.09	45.26	0.00	240.00	394.36
ANALYSIS ASSUME 2 HRS OF EFFORT PLUS 6 BIOASSAY SAMPLES ($40) SENT TO THE LAB EACH DAY.	42.00 DAY ZAIRSAMPLE	126	5,556	2,305	0	12,223	20,085
TOTAL Monitoring during dredging		336	9,255	4,285	0	30,559	44,099
12_ 1. 7. 1_ 3_ 3. Post dredging monitoring ** OVERTIME **							
USR SC OBTAIN SEDIMENT SAMPLES ASSUMED		3.00	56.65	23.03	0.00	180.00	259.68
IS THAT ONE SEDIMENT SAMPLE IS TAKEN FOR EACH DAY OF WORK AND SENT TO THE LAB FOR PCB ANALYSIS.	42.00 DAY ZCHEMIST	126	2,885	1,173	0	9,168	13,226
USR AA BATHYMETRIC SURVEY		120.00	1993.57	2165.91	0.00	0.00	4159.48
	1.00 LS ZA	120	1,994	2,166	0	0	4,159
TOTAL Post dredging monitoring		246	4,879	3,339	0	9,168	17,385
TOTAL DREDGING (O & M NTSCA)		942	24,167	13,103	0	39,726	76,996

12_ 1. 7. 1_ 4. DREDGING (312A NTSCA)

12_ 1. 7. 1_ 4_ 1. Predredging data collection ** OVERTIME **

Total suspended Solids (TSS) and Turbidity sampling will be conducted to establish a action level during the dredging operation. Additionally, air monitoring will be conducted to determine the baseline condition of PCB's in the ambient air.

	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA BATHYMETRIC SURVEY		120.00	1993.57	2165.91	0.00	0.00	4159.48
	1.00 LS ZA	120	1,994	2,166	0	0	4,159

12_ 1. DREDGING	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR SC WATER QUALITY BENCH SCALE			120.00	2265.99	921.36	0.00	0.00	3187.35
TESTING	1.00 LS	ZCHEMIST	120	2,748	1,117	0	0	3,865
USR SC BASELINE AMBIENT AIR			120.00	4363.76	1810.48	0.00	0.00	6174.24
	1.00 LS	ZAIRSAMPLE	120	5,292	2,195	0	0	7,487
TOTAL Predredging data collection			360	10,033	5,479	0	0	15,512
12_ 1. 7. 1_ 4_ 2. Monitoring during dredging ** OVERTIME **								
USR SC TURBIDITY MONITORING ASSUME 2			2.00	29.05	15.55	0.00	0.00	44.60
HRS OF EFFORT EACH DAY.	36.00 DAY	ZH2OSAMPLE	72	1,268	679	0	0	1,947
USR SC WATER COLUMN SAMPLING & ANALYSIS			2.00	29.05	15.55	0.00	240.00	284.60
ASSUME 2 HRS OF EFFORT AND 2 ANALYSIS ($120) FOR PCB PERFORMED AT THE LAB EACH DAY.	36.00 DAY	ZH2OSAMPLE	72	1,268	679	0	10,477	12,424
USR SC TREATED WATER EFFLUENT ASSUME 1			1.00	14.53	7.77	0.00	120.00	142.30
HR OF EFFORT PER DAY AND 1 WATER EFFLUENT SAMPLE SENT TO A LAB EACH DAY.	36.00 DAY	ZH2OSAMPLE	36	634	339	0	5,239	6,212
USR SC PERIMETER AIR MONITORING &			3.00	109.09	45.26	0.00	240.00	394.36
ANALYSIS ASSUME 2 HRS OF EFFORT PLUS 6 BIOASSAY SAMPLES ($40) SENT TO THE LAB EACH DAY.	36.00 DAY	ZAIRSAMPLE	108	4,763	1,976	0	10,477	17,216
TOTAL Monitoring during dredging			288	7,933	3,673	0	26,193	37,799
12_ 1. 7. 1_ 4_ 3. Post dredging monitoring ** OVERTIME **								
USR AA OBTAIN SEDIMENT SAMPLES ASSUMED			3.00	56.65	23.03	0.00	180.00	259.68
IS THAT ONE SEDIMENT SAMPLE IS TAKEN FOR EACH DAY OF WORK AND SENT TO THE LAB FOR PCB ANALYSIS.	36.00 DAY	ZCHEMIST	108	2,039	829	0	6,480	9,349
USR AA BATHYMETRIC SURVEY			120.00	1993.57	2165.91	0.00	0.00	4159.48
	1.00 LS	ZA	120	1,994	2,166	0	0	4,159
TOTAL Post dredging monitoring			228	4,033	2,995	0	6,480	13,508
TOTAL DREDGING (312A NTSCA)			876	21,999	12,147	0	32,673	66,819
TOTAL DREDGING			7,035	182,086	90,830	0	438,447	711,363

12_ 1. DREDGING	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 1. 7. 2. TRANSFER FACILITY									
12_ 1. 7. 2_ 1. DREDGING (312B TSCA)					** OVERTIME **				
AF SC Pesticides/PCBs (8080)				0.00	0.00	0.00	210.00	0.00	210.00
	100.00	EA	N/A	0	0	0	25,465	0	25,465
AF SC Paint Filter Liquids Test (9095)				0.00	0.00	0.00	15.00	0.00	15.00
	200.00	EA	N/A	0	0	0	3,638	0	3,638
USR SC OBTAIN SEDIMENT SAMPLES ASSUMED				1.00	14.53	7.77	0.00	0.00	22.30
IS THAT TWO SEDIMENT SAMPLE IS TAKEN FOR EACH DAY OF WORK AND SENT TO THE LAB FOR PCB ANALYSIS.	100.00	DAY	ZH2OSAMPLE	100	1,761	943	0	0	2,704
TOTAL DREDGING (312B TSCA)				100	1,761	943	29,103	0	31,808
12_ 1. 7. 2_ 2. DREDGING (312B NTSCA)					** OVERTIME **				
AF SC Pesticides/PCBs (8080)				0.00	0.00	0.00	210.00	0.00	210.00
	290.00	EA	N/A	0	0	0	73,850	0	73,850
AF SC Paint Filter Liquids Test (9095)				0.00	0.00	0.00	15.00	0.00	15.00
	580.00	EA	N/A	0	0	0	10,550	0	10,550
USR SC OBTAIN SEDIMENT SAMPLES ASSUMED				1.00	14.53	7.77	0.00	0.00	22.30
IS THAT TWO SEDIMENT SAMPLE IS TAKEN FOR EACH DAY OF WORK AND SENT TO THE LAB FOR PCB ANALYSIS.	290.00	DAY	ZH2OSAMPLE	290	5,108	2,734	0	0	7,842
TOTAL DREDGING (312B NTSCA)				290	5,108	2,734	84,400	0	92,242
12_ 1. 7. 2_ 3. DREDGING (O & M NTSCA)					** OVERTIME **				
AF SC Pesticides/PCBs (8080)				0.00	0.00	0.00	210.00	0.00	210.00
	45.00	EA	N/A	0	0	0	11,459	0	11,459
AF SC Paint Filter Liquids Test (9095)				0.00	0.00	0.00	15.00	0.00	15.00
	90.00	EA	N/A	0	0	0	1,637	0	1,637
USR SC OBTAIN SEDIMENT SAMPLES ASSUMED				1.00	14.53	7.77	0.00	0.00	22.30
IS THAT TWO SEDIMENT SAMPLE IS TAKEN FOR EACH DAY OF WORK AND SENT TO THE LAB FOR PCB ANALYSIS.	45.00	DAY	ZH2OSAMPLE	45	793	424	0	0	1,217

12_ 1. DREDGING	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL DREDGING (O & M NTSCA)		45	793	424	13,097	0	14,313
12_ 1. 7. 2_ 4. DREDGING (312A NTSCA)				** OVERTIME **			
AF SC Pesticides/PCBs (8080)		0.00	0.00	0.00	210.00	0.00	210.00
	40.00 EA N/A	0	0	0	10,186	0	10,186
AF SC Paint Filter Liquids Test (9095)		0.00	0.00	0.00	15.00	0.00	15.00
	80.00 EA N/A	0	0	0	1,455	0	1,455
USR SC OBTAIN SEDIMENT SAMPLES ASSUMED		1.00	14.53	7.77	0.00	0.00	22.30
IS THAT TWO SEDIMENT SAMPLE IS TAKEN FOR EACH DAY OF WORK AND SENT TO THE LAB FOR PCB ANALYSIS.	40.00 DAY ZH2OSAMPLE	40	705	377	0	0	1,082
TOTAL DREDGING (312A NTSCA)		40	705	377	11,641	0	12,723
TOTAL TRANSFER FACILITY		475	8,367	4,478	138,241	0	151,086
TOTAL SAMPLING & ANALYSIS		7,510	190,453	95,308	138,241	438,447	862,449
TOTAL DREDGING		108,774	3,916,118	3,102,618	1,276,022	7484291	15,779,049

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 2. 1. CONSTRUCT TSCA CELL									
TOTAL CONSTRUCT TSCA CELL				0	0	0	0	0	0
12_ 2. 2. CONSTRUCT NTSCA CELL									
TOTAL CONSTRUCT NTSCA CELL				0	0	0	0	0	0
12_ 2. 3. WETLAND MIT. - DISPOSAL FACILITY									
TOTAL WETLAND MIT. - DISPOSAL FACILITY				0	0	0	0	0	0
12_ 2. 4. OPERATE CDF									
TOTAL OPERATE CDF				0	0	0	0	0	0
12_ 2. 5. SAMPLE & ANALYSIS(DISPOSAL FAC)									
TOTAL SAMPLE & ANALYSIS(DISPOSAL FAC)				0	0	0	0	0	0
12_ 2.10. CONSTRUCT LANDFILL									
12_ 2.10.01. Landfill Support Services/Facil.									
12_ 2.10.01_ 01. Landfill Site Security									
12_ 2.10.01_ 01_ 1. Landfill Guard House									
MIL AA Pier/Foundation Exc, Normal Soil				1.00	26.47	0.16	0.00	0.00	26.63
Hand Piled to 2' Deep	16.00	CY	ULABA	16	424	3	0	0	426
MIL AA Trim Slopes/Sides of Excavation				0.02	0.44	0.02	0.00	0.00	0.46
Hand Labor	36.00	SF	ULABE	1	16	1	0	0	17
MIL AA Clmn Spread Footing Forms,4 Uses				0.07	2.61	0.05	0.53	0.00	3.19
Plywd Forms, Form & Strip w/Acc	48.00	SF	ACARJ	4	125	2	26	0	153
MIL AA Pour Sprd Ftg,< 5CY,Direct Chute				0.87	24.12	0.88	54.00	0.00	79.01
< (5M3) Place 3000 PSI Conc Fdns	1.32	CY	ALABE	1	32	1	71	0	104
MIL AA Conc Curing, Sprayed Membrane				0.00	0.06	0.00	0.04	0.00	0.10
Curing Compound	36.00	SF	ULABB	0	2	0	1	0	4
MIL AA Concrete Floor Finishes, Screed				0.01	0.37	0.00	0.00	0.00	0.37
	36.00	SF	ACMAA	0	13	0	0	0	13
MIL AA Backfill Trenches by Hand				0.77	20.36	0.13	0.00	0.00	20.49
Without Compaction	14.80	CY	ULABA	11	301	2	0	0	303

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA Compaction, 6" Layers w/Air Tamp				0.10	2.65	0.10	0.00	0.00	2.75
By Hand, (15cm) Layers	14.80	CY	CLACA	1	39	2	0	0	41
MIL AA Gr 60 Resteel,Ftgs & Slabs,#3-#6				0.01	0.28	0.00	0.25	0.00	0.53
	200.00	LB	SIWRC	1	55	0	51	0	106
MIL AA Trm & Shpe f/Slab on Grd by Hand				0.02	0.44	0.00	0.00	0.00	0.44
Finish Grade	300.00	SF	ULABA	5	132	1	0	0	133
MIL AA Soil Poisoning				0.00	0.06	0.00	0.07	0.00	0.13
	300.00	SF	ULABA	1	18	0	21	0	39
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	9.00	SF	ACARJ	1	30	1	6	0	36
MIL AA 4"(10cm) Capillary Water Barrier				0.11	3.01	0.36	10.32	0.00	13.69
Compacted Thickness	3.00	CY	CODEK	0	9	1	31	0	41
MIL AA Fine Grd Gravel Bedding by Hand				0.01	0.22	0.00	0.00	0.00	0.22
Finish Grade	300.00	SF	ULABA	2	66	0	0	0	67
MIL AA 6 Mil Polyethylene Vapor Barrier				0.00	0.10	0.00	0.03	0.00	0.14
	300.00	SF	ACARA	1	31	0	10	0	41
MIL AA Weld Wire Fab in Slabs, 6x6x#6				0.01	0.30	0.00	0.11	0.00	0.41
42 #/CSF, (W 2.9 x W 2.9),< 5 To	300.00	SF	SIWRB	2	89	1	32	0	122
MIL AA 24 Ga Galv Stl Keyed Jnt, 3-1/2"				0.05	1.89	0.05	0.30	0.00	2.24
(8.8 cm) Cold Expan or Ctrl Jnt	18.00	LF	ACARC	1	34	1	5	0	40
MIL AA Pour Slab on Gr,>= 6", Dir Chute				0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	6.00	CY	ALABE	2	45	2	324	0	371
MIL AA Concrete Floor Finishes, Screed				0.01	0.37	0.00	0.00	0.00	0.37
	300.00	SF	ACMAA	3	112	1	0	0	112
MIL AA Conc Floor Finishes, Stl Trowel				0.02	0.54	0.02	0.00	0.00	0.56
	300.00	SF	ACMAC	5	161	7	0	0	168
MIL AA Conc Curing, Sprayed Membrane				0.00	0.06	0.00	0.04	0.00	0.10
Curing Compound	300.00	SF	ULABB	1	17	0	12	0	29
MIL AA Aluminum Double Hung Windows				0.10	3.86	0.02	8.22	0.00	12.09
Standard Brush Finish	40.00	SF	AGLAB	4	154	1	329	0	484
MIL AA 1"Tinted Insul Glass,30 to 50 SF				0.27	10.29	0.04	9.81	0.00	20.14
(2.8-4 6M2)1/4"Lites,1/2"Air Sp	40.00	SF	AGLAB	11	411	2	393	0	806
30 Sf (2.8M2) To 50 Sf (4.6M2)									

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA Oil Base Caulk&Seal,1/4"x1/4" Jt		4.65	192.14	1.17	4.36	0.00	197.67
	2.00 CLF ARFCA	9	384	2	9	0	395
AF AT 6" Vinyl Backed R-19 Blanket		0.01	0.39	0.01	0.30	0.00	0.69
Insulation	700.00 SF MSHMG	7	329	4	255	0	588
MIL MB Aluminum Gutter Custom Fab		0.17	7.53	0.07	2.20	0.00	9.80
w/Gravel Stop	40.00 LF MSHMA	7	365	3	107	0	476
MIL MB Alum Downspout, 3"x4",.024" Thk		0.08	3.62	0.03	2.11	0.00	5.77
Enameled	56.00 LF MSHMA	4	246	2	144	0	392
MIL AA Prec Conc Splash Blocks,Std Size		0.10	2.65	0.02	1.88	0.00	4.54
	4.00 EA ULABB	0	11	0	8	0	18
MIL RF Solid Color Vinyl Comp Tile		0.02	0.67	0.00	0.51	0.00	1.19
1/8" Thick	300.00 SF ATIFA	6	243	1	187	0	431
AF AT 9" Vinyl Faced, R-30 Fiberglass		0.01	0.32	0.00	0.61	0.00	0.93
Batt Ins	300.00 SF ACARA	2	115	1	222	0	338
AF AA Cooling Capacity 8.5 MBH, Sup.		3.33	141.08	1.44	797.00	0.00	939.52
Heat 10.2 MBH Thru Wall Pkgd Walk-In	1.00 EA MSHMD	3	141	1	797	0	940
USR EL Electrical Power		0.00	1000.00	0.00	2000.00	0.00	3000.00
	1.00 EA	0	1,213	0	2,425	0	3,638
USR EL Electrical Lighting		0.00	500.00	0.00	1000.00	0.00	1500.00
	1.00 EA	0	606	0	1,213	0	1,819
USR AA Communications		0.00	500.00	0.00	1000.00	0.00	1500.00
	1.00 EA	0	500	0	1,000	0	1,500
USR AA Security System		0.00	250.00	0.00	500.00	0.00	750.00
	1.00 EA	0	250	0	500	0	750
USR AA Fire Alarm		0.00	250.00	0.00	500.00	0.00	750.00
	1.00 EA	0	250	0	500	0	750
L MIL AA 15' x 20, Guard House		134.73	4576.21	1081.84	0.00	0.00	5658.06
Disassembly,Temp Bldg,1-6Yr Life	1.00 EA ACARU	135	4,576	1,082	0	0	5,658
TOTAL Landfill Guard House		248	11,545	1,125	8,677	0	21,348

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 2.10.01_ 01_ 2. Site Fencing								
MIL AA 6' Galvanized Chain Link Fence			0.15	3.98	0.82	5.35	0.00	10.14
Set in Conc, Top Rail, Line Post	8000.00 LF	ULABL	1,200	31,845	6,527	42,786	0	81,158
AF AA Barbed Wire Extension Arms			0.16	4.25	0.87	1.75	0.00	6.87
3 Strands	1000.00 EA	ULABL	160	4,246	870	1,750	0	6,866
MIL AA Galv Barbed Wire, Per Strand			0.01	0.27	0.05	0.04	0.00	0.36
3 Strands	24000 LF	ULABL	240	6,370	1,306	960	0	8,635
TOTAL Site Fencing			1,600	42,460	8,703	45,496	0	96,659

12_ 2.10.01_ 01_ 3. Security Guard

Assumes Security contractor will be hired to provide on-site security. The estimated burdened (quoted) rate for a security guard is estimated at $17.50/hr. The effective hourly rate for a 12 hour day is included at $20.42, allowing for 4 hours @ 1.5 * Base rate (1.5*4 + 1*8)/12 = 1.1667, $17.5 x 1.1667 = $20.42.

(1 person for one 12 hours shift daily) during 8 months of operation, then eight hours/day for 4 months of site down-time.

```
                                3 years
12 * 5 * 4.2 * 8 = 2016 hrs      6048
 8 * 5 * 4.2 * 4 =  672 hrs      2016
         Total   = 2672 hrs
hrs/year for 3 years = 8016 hrs
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	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR SG Security Guard			0.00	0.00	0.00	0.00	20.42	20.42
	6048.00 HR		0	0	0	0	149,761	149,761
USR SG Security Guard			0.00	0.00	0.00	0.00	17.50	17.50
	2016.00 HR		0	0	0	0	42,782	42,782
TOTAL Security Guard			0	0	0	0	192,543	192,543

12_ 2.10.01_ 01_ 03. Landfill Entrance Gate

Main gate is motor operated, remaining 3 gates are manual swing gates. All gates are 30' wide.

	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA 6'(1.8M) High Sliding Gate			1.10	31.75	13.41	30.53	0.00	75.70
	30.00 LF	ULABN	33	953	402	916	0	2,271
MIL AA Motor Opr, Sliding Gate to 45'L			28.00	740.38	290.83	2150.00	0.00	3181.21
Pairs	1.00 EA	ULABF	28	740	291	2,150	0	3,181
MIL AA 30'(9.1M)W x 6'(1.8M)H Dbl Gate			5.33	153.47	64.81	491.75	0.00	710.03
Vinyl Coated w/o Barbed Wire Arm	3.00 EA	ULABN	16	460	194	1,475	0	2,130

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Landfill Entrance Gate			77	2,153	888	4,541	0	7,582
12_ 2.10.01_ 01_ 16. Site Security System								
USR AL Security System			0.00	0.00	0.00	0.00	50000.00	50000.00
	1.00 EA		0	0	0	0	50,000	50,000
TOTAL Site Security System			0	0	0	0	50,000	50,000
TOTAL Landfill Site Security			1,925	56,159	10,716	58,714	242,543	368,132
12_ 2.10.01_ 02. Site Buildings								
12_ 2.10.01_ 02_ 1. Office Building								
MIL AA 4"(10cm) Capillary Water Barrier			0.11	3.01	0.36	10.32	0.00	13.69
Compacted Thickness	15.40 CY	CODEK	2	46	5	159	0	211
MIL AA Fine Grd Gravel Bedding by Hand			0.01	0.22	0.00	0.00	0.00	0.22
Finish Grade	1200.00 SF	ULABA	10	265	2	0	0	266
MIL PL Flush Vlv H20 Closet, Wall Hung			5.12	184.68	2.16	506.28	0.00	693.12
Elongated,Vit China w/Siphon Jet	0.36 EA	MPLUE	2	81	1	221	0	303
MIL PL Rough-In Water Closet, Wall Mtd			10.00	360.49	4.21	196.65	0.00	561.35
Not Including Fixture	0.36 EA	MPLUE	4	157	2	86	0	245
MIL PL Sgl Closet Carrier,CI Hub&Spigot			1.59	57.22	0.67	150.13	0.00	208.02
Vert Ftng w/Ext& Crm Plated Trim	0.36 EA	MPLUE	1	25	0	66	0	91
AF AA V. China 18" X 15" Lavatory,			2.67	96.08	1.12	128.00	0.00	225.20
Recessed	0.24 EA	MPLUE	1	23	0	31	0	54
MIL PL Rough-In Lavatory, Wall Mtd			5.00	180.25	2.10	46.02	0.00	228.38
Not Including Fixture	0.24 EA	MPLUE	1	52	1	13	0	66
MIL PL Sgl Sink Carrier, Floor Mounted			1.16	41.92	0.49	77.77	0.00	120.18
w/Hanger Plate	0.24 EA	MPLUE	0	12	0	23	0	35
MIL PL Blowout, Wall Hung Urinal			4.26	153.40	1.79	689.51	0.00	844.70
w/Flush Valve,Vitreous China	0.12 EA	MPLUE	1	22	0	100	0	123
MIL PL Rough-In Urinal, Wall Mounted			5.00	180.25	2.10	92.05	0.00	274.40
Not Including Fixture	0.12 EA	MPLUE	1	26	0	13	0	40
MIL PL Sgl Urinal Carrier, Floor Mtd			1.16	41.92	0.49	79.12	0.00	121.53
w/Support Plate	0.12 EA	MPLUE	0	6	0	12	0	18

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL Floor Stand'g Water Cooler,14GPH			3.23	116.29	1.36	967.52	0.00	1085.17
	0.12 EA	MPLUE	0	17	0	141	0	158
MIL PL Rough-In H20 Cooler (Free Stand)			5.00	180.25	2.10	82.22	0.00	264.57
Not Including Fixture	0.12 EA	MPLUE	1	26	0	12	0	38
MIL PL Svce Sink,En CI,Fl Type 28"x 28"			4.25	153.27	1.79	348.17	0.00	503.23
	0.06 EA	MPLUE	0	11	0	25	0	37
MIL PL 21"x24"x7"Kit Sink,SST Sgl Bowl			3.77	135.93	1.59	11.01	0.00	148.53
	0.12 EA	MPLUE	0	20	0	2	0	22
MIL PL Rough-In Service Sink, Wall Mtd			5.00	180.25	2.10	234.94	0.00	417.29
Not Including Fixture	0.18 EA	MPLUE	1	39	0	51	0	91
MIL PL 1/2"(12mm) Cu Pipe/Tubing Type L			0.04	1.81	0.02	0.50	0.00	2.34
	4.80 LF	MPLUA	0	11	0	3	0	14
MIL PL 3/4"(20mm) Cu Pipe/Tubing Type L			0.05	2.27	0.02	0.79	0.00	3.08
	5.10 LF	MPLUA	0	14	0	5	0	19
MIL PL 1"(25mm) Cu Pipe/Tubing Type L			0.06	2.72	0.03	1.09	0.00	3.84
	7.20 LF	MPLUA	0	24	0	10	0	34
MIL PL 1/2" 90 Degree Elbow, Copper			0.16	6.84	0.07	0.12	0.00	7.03
	1.08 EA	MPLUA	0	9	0	0	0	9
MIL PL 3/4" 90 Degree Elbow, Copper			0.21	9.03	0.09	0.27	0.00	9.39
	0.72 EA	MPLUA	0	8	0	0	0	8
MIL PL 1" 90 Degree Elbow, Copper			0.27	11.47	0.12	0.66	0.00	12.24
	0.72 EA	MPLUA	0	10	0	1	0	11
MIL PL 1" Copper Tee - Straight Sweat			0.43	18.45	0.19	1.50	0.00	20.14
	0.72 EA	MPLUA	0	16	0	1	0	18
MIL PL 3/4" Copper Tee - Straight Sweat			0.32	13.69	0.14	0.51	0.00	14.34
	0.72 EA	MPLUA	0	12	0	0	0	13
MIL PL 1/2"D Pipe,1"Thk Fib Pipe Cover			0.06	2.43	0.03	0.63	0.00	3.09
w/Fire Retardant Jackets	6.60 LF	AASBC	0	19	0	5	0	25
MIL PL 3/4"D Pipe,1"Thk Fib Pipe Cover			0.06	2.43	0.03	0.73	0.00	3.18
w/Fire Retardant Jackets	7.20 LF	AASBC	0	21	0	6	0	28
MIL PL 1"D Pipe,1"Thk Fib Pipe Cover			0.06	2.43	0.03	0.75	0.00	3.21
w/Fire Retardant Jackets	10.08 LF	AASBC	1	30	0	9	0	39
MIL PL 1-1/4"(32mm) Cu Pipe/Tubing Tp L			0.07	3.17	0.03	1.48	0.00	4.68
	10.80 LF	MPLUA	1	41	0	19	0	61

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 1-1/4"D Pipe,1"Thk Fib Pipe Cvr			0.06	2.43	0.03	0.85	0.00	3.30
w/Fire Retardant Jackets	15.12 LF	AASBC	1	44	1	16	0	61
MIL PL 1-1/4" 90 Degree Elbow, Copper			0.37	15.72	0.16	1.03	0.00	16.90
	0.60 EA	MPLUA	0	11	0	1	0	12
MIL PL 1-1/4" Copper Tee-Reducing Sweat			0.53	22.33	0.22	2.29	0.00	24.85
	0.36 EA	MPLUA	0	10	0	1	0	11
MIL PL 3/4" Hose Thrd Outlet Wl Hydrant			1.67	70.73	0.71	178.67	0.00	250.10
Cast Brz,3/4"NPTF Out&1"NPTM In	0.24 EA	MPLUA	0	21	0	52	0	73
MIL PL Shock Absorb,3/4" f/11 Fixt Unit			0.83	35.36	0.36	11.16	0.00	46.88
Bellows Type (NPTF)	0.12 EA	MPLUA	0	5	0	2	0	7
MIL PL Shock Absorb, 1" f/32 Fixt Unit			0.91	38.58	0.39	28.02	0.00	66.98
Bellows Type (NPTF)	0.12 EA	MPLUA	0	6	0	4	0	10
MIL PL Hyd Test,250-500LF of 1"-4" Pipe			12.50	540.02	5.65	0.00	0.00	545.67
	0.06 EA	MSPFA	1	39	0	0	0	40
MIL PL 2" VTR,4# Lead Roof Flashing-BUR			0.53	22.33	0.22	15.55	0.00	38.10
	0.18 EA	MPLUA	0	5	0	3	0	8
MIL PL 4"(10cm)Cast Iron Pipe & Fitting			0.18	6.55	0.08	4.43	0.00	11.06
	12.00 LF	MPLUE	2	95	1	64	0	161
MIL PL 2"(50mm)Cast Iron Pipe & Fitting			0.10	3.43	0.04	2.78	0.00	6.25
	6.00 LF	MPLUE	1	25	0	20	0	45
MIL PL 2" (1/4 Bend) Cast Iron Fitting			0.43	15.47	0.18	7.59	0.00	23.24
	0.60 EA	MPLUE	0	11	0	6	0	17
MIL PL 2" P-Trap, Deep Seal, CI Fitting			0.43	15.50	0.18	9.24	0.00	24.92
	0.36 EA	MPLUE	0	7	0	4	0	11
MIL PL 2" Riser Clamp Type 8			0.42	16.59	0.18	1.48	0.00	18.25
	0.48 EA	MPLUB	0	10	0	1	0	11
MIL PL 4" Wye Cast Iron Fitting			1.38	49.71	0.58	13.38	0.00	63.67
	0.60 EA	MPLUE	1	36	0	10	0	46
MIL PL 4" (1/4 Bend) Cast Iron Fitting			0.64	23.18	0.27	20.64	0.00	44.09
	1.08 EA	MPLUE	1	30	0	27	0	58
MIL PL 4" P-Trap, Deep Seal, CI Fitting			0.72	25.93	0.30	22.94	0.00	49.18
	0.24 EA	MPLUE	0	8	0	7	0	14
MIL PL 4" CI Cleanout Tee, No Hub			0.65	25.69	0.27	8.83	0.00	34.79
	0.24 EA	MPLUB	0	7	0	3	0	10

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 4" CI Cleanout Plug, No Hub			0.65	25.69	0.27	3.96	0.00	29.93
	0.24 EA	MPLUB	0	7	0	1	0	9
MIL PL 4" CI Comb,Dbl Reducing, No Hub			1.90	68.64	0.80	17.06	0.00	86.50
	0.24 EA	MPLUE	0	20	0	5	0	25
MIL PL 3"(80mm)Cast Iron Pipe & Fitting			0.14	5.15	0.06	3.40	0.00	8.61
	7.20 LF	MPLUE	1	45	1	30	0	75
MIL PL 2"(50mm)Cast Iron Pipe & Fitting			0.10	3.43	0.04	2.78	0.00	6.25
	6.00 LF	MPLUE	1	25	0	20	0	45
MIL PL 2" Wye Cast Iron Fitting			0.96	34.66	0.40	5.37	0.00	40.43
	0.24 EA	MPLUE	0	10	0	2	0	12
MIL PL 3" Wye Cast Iron Fitting			1.05	37.95	0.44	10.05	0.00	48.44
	0.36 EA	MPLUE	0	17	0	4	0	21
MIL PL 3" Riser Clamp Type 8			0.42	16.59	0.18	1.65	0.00	18.42
	0.24 EA	MPLUB	0	5	0	0	0	5
MIL PL 3" P-Trap, Deep Seal, CI Fitting			0.54	19.49	0.23	14.74	0.00	34.45
	0.24 EA	MPLUE	0	6	0	4	0	10
MIL PL 2" P-Trap, Deep Seal, CI Fitting			0.43	15.51	0.18	9.24	0.00	24.92
	0.24 EA	MPLUE	0	5	0	3	0	7
MIL PL Sq Top Floor Drain w/3" Outlet			2.67	96.13	1.12	88.84	0.00	186.10
Satin Bronze, Incl Shower Drains	0.24 EA	MPLUE	1	28	0	26	0	54
L MIL PL 3"D SST Wall Cleanout Cover			0.63	26.52	0.27	3.91	0.00	30.69
	0.24 EA	MPLUA	0	8	0	1	0	9
MIL PL Pnue Test,250-500LF, 1"-4" Pipe			29.00	1175.87	13.11	0.55	0.00	1189.54
Includes Soaping Joints	0.06 EA	MSPFB	2	86	1	0	0	87
HTW AA 8" x 7.5" Manhole Cover -			1.50	45.00	51.66	25.58	0.00	122.24
Non-Locking	0.06 EA	ULADB	0	3	3	2	0	7
MIL AA 5,000 Gal Precast Septic Tank			16.47	611.38	85.98	2005.97	0.00	2703.33
No Excavation or Piping	0.06 EA	MPLUS	1	37	5	120	0	162
AF AA Clay Backfill			0.00	0.00	0.00	3.70	0.00	3.70
	0.30 CY	N/A	0	0	0	1	0	1
MIL AA Compact Backfill w/Vib Plate			0.20	5.40	0.19	0.00	0.00	5.58
Around Structures and Trenches	0.30 CY	CLACC	0	2	0	0	0	2
MIL AA Bulk Site Excavation, Heavy Clay			0.06	2.18	2.06	0.00	0.00	4.23
1-1/2 CY Bucket Drag Line	1.80 CY	UOEHE	0	4	4	0	0	8

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 67Gal Comm Water Htr,Gas 109GPH				4.00	169.74	1.71	2568.27	0.00	2739.72
Fast Recovery & GPM/100F Rise	0.06	EA	MPLUD	0	12	0	187	0	199
MIL PL 1-1/2"Screwed Backflow Preventer				1.79	75.78	0.76	436.40	0.00	512.94
w/2Gate&2CK Vlv&Auto Dif Rlf Vlv	0.06	EA	MPLUA	0	6	0	32	0	37
AF AA Flow Thru With 1/2" Strainer				0.50	18.02	0.21	34.00	0.00	52.24
	0.24	EA	MPLUE	0	4	0	8	0	13
MIL PL 1/4" Refrig Tubing Copper Dehyd				0.04	1.73	0.02	0.20	0.00	1.95
	14.40	LF	MSPFA	1	30	0	4	0	34
USR FP Wet Sys,Ord Haz Fire Sprinkler				0.00	0.27	0.00	1.02	0.00	1.29
	1200.00	SF	N/A	0	393	0	1,484	0	1,877
MIL AA Trench 1/2 CY Hyd Exc, Hvy Soil				0.04	1.25	0.86	0.00	0.00	2.11
51 CY/Hr (40M3)/Hr	0.36	CY	CODEA	0	0	0	0	0	1
MIL AA Backfill Trench w/Sm FEnd Loader				0.02	0.72	0.48	0.00	0.00	1.20
Without Compaction	0.30	CY	CODLB	0	0	0	0	0	0
MIL AA Compaction, 6" Layers, Vib Plate				0.07	1.97	0.07	0.00	0.00	2.03
(15cm) Layers	0.36	CY	CLACC	0	1	0	0	0	1
MIL AA Sand Bedding w/Sm FEnd Loader				0.03	1.06	0.71	17.14	0.00	18.91
Without Compaction	0.06	CY	CODLB	0	0	0	1	0	1
MIL PL 3/4"(20mm) Cu Pipe/Tubing Type L				0.05	2.27	0.02	0.79	0.00	3.08
	3.60	LF	MPLUA	0	10	0	3	0	13
MIL PL 1"(25mm) Cu Pipe/Tubing Type L				0.06	2.72	0.03	1.09	0.00	3.84
	2.40	LF	MPLUA	0	8	0	3	0	11
MIL PL 3/4" Copper Tee-Reducing Sweat				0.32	13.69	0.14	0.48	0.00	14.30
	0.36	EA	MPLUA	0	6	0	0	0	6
MIL PL 1" Copper Tee-Reducing Sweat				0.43	18.45	0.19	1.58	0.00	20.21
	0.36	EA	MPLUA	0	8	0	1	0	9
MIL PL 1/2" 90 Degree Elbow, Copper				0.16	6.84	0.07	0.12	0.00	7.03
	0.48	EA	MPLUA	0	4	0	0	0	4
MIL PL 3/4" 90 Degree Elbow, Copper				0.21	9.03	0.09	0.27	0.00	9.39
	0.48	EA	MPLUA	0	5	0	0	0	5
MIL PL 1" 90 Degree Elbow, Copper				0.27	11.47	0.12	0.66	0.00	12.24
	0.36	EA	MPLUA	0	5	0	0	0	5
MIL HV 5 Ton Air Cooled Condensing Unit				10.53	426.78	4.76	899.76	0.00	1331.30
w/Compressor,Condenser,Fan&Motor	0.06	EA	MSPFB	1	31	0	65	0	97

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL HV 10Ton Air Cooled Condensing Unit				15.38	623.75	6.96	1975.00	0.00	2605.71
w/Compressor,Condenser,Fan&Motor	0.24	EA	MSPFB	4	182	2	575	0	758
MIL HV LP/Nat Gas Dir Drive Furn,200MBH				7.14	308.58	3.23	1910.88	0.00	2222.69
	0.06	EA	MSPFC	0	22	0	139	0	162
MIL HV LP/Nat Gas Dir Drive Furn,300MBH				8.33	360.02	3.77	1910.88	0.00	2274.66
	0.24	EA	MSPFC	2	105	1	556	0	662
MIL HV 6"x 5' Round Flue/Vent Pipe				0.91	38.48	0.39	2.45	0.00	41.32
Galv Dbl Wall Breech/Smoke Pipe	1.20	EA	MSHMB	1	56	1	4	0	60
MIL HV 6" Round Flue/Vent Top Caps				0.32	13.65	0.14	1.49	0.00	15.29
Galv Dbl Wall Breech/Smoke Pipe	0.24	EA	MSHMB	0	4	0	0	0	4
MIL HV 6"Rnd Flue/Vent Adj Roof Flash				0.32	13.65	0.14	1.16	0.00	14.95
Galv Dbl Wall Breech/Smoke Pipe	0.24	EA	MSHMB	0	4	0	0	0	4
MIL HV 4"x 5' Round Flue/Vent Pipe				0.80	33.86	0.35	1.84	0.00	36.04
Galv Dbl Wall Breech/Smoke Pipe	0.12	EA	MSHMB	0	5	0	0	0	5
MIL HV 4" Round Flue/Vent Top Caps				0.24	10.20	0.10	0.83	0.00	11.13
Galv Dbl Wall Breech/Smoke Pipe	0.06	EA	MSHMB	0	1	0	0	0	1
M AF AA 10 Ton Refrigerant Line Set				1.61	68.26	0.70	250.00	0.00	318.96
25'	0.24	EA	MSHMD	0	16	0	60	0	77
AF AA 4-5 Ton Refrigerant Line Set				2.46	104.14	1.07	95.43	0.00	200.64
	0.06	EA	MSHMD	0	6	0	6	0	12
MIL PL 0.006" Alum Insul Jacket w/Bands				0.14	5.39	0.06	0.16	0.00	5.61
	468.00	SF	AASBC	67	3,059	35	89	0	3,183
MIL HV Sht Mtl Duct,Low Press,Field Fab				0.10	3.71	0.05	0.33	0,00	4.09
Galv,Field Assemble & Install	719.99	LB	MSHMF	71	3,239	40	291	0	3,570
MIL HV 12x12"Prl Blade Louver Fire Dmpr				0.50	22.60	0.21	91.50	0.00	114.32
Galv Stl Cons, UL ,1-1/2Hr Rated	0.06	EA	MSHMA	0	2	0	7	0	8
MIL HV 20x20"Prl Blade Louver Fire Dmpr				1.00	45.21	0.43	124.28	0.00	169.91
Galv Stl Cons, UL ,1-1/2Hr Rated	0.24	EA	MSHMA	0	13	0	36	0	49
AF AA 18 X 22 2 HR Fire Damper,				0.45	20.55	0.19	30.00	0.00	50.74
Curtain Type	0.24	EA	MSHMA	0	5	0	7	0	12
AF AA 42 X 30 2 HR Fire Damper,				1.67	75.35	0.71	55.00	0.00	131.06
Curtain Type	0.24	EA	MSHMA	0	18	0	13	0	31
MIL HV 12x12"Sgl Deflt Ret/Exh Register				0.51	23.23	0.23	35.13	0.00	58.59
Al,Opposed Blade Dmpr,Wall/Ceil	0.24	EA	MSHMC	0	7	0	10	0	17

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL HV 24x24"Sgl Deflt Ret/Exh Register			0.90	40.65	0.40	97.08	0.00	138.13
Al,Opposed Blade Dmpr,Wall/Ceil	1.20 EA	MSHMC	1	59	1	141	0	201
MIL HV 12"x12"Adj Curved Blade Register			0.51	23.03	0.23	20.53	0.00	43.78
Adj,Ceil Mtd,Alum Cons,4-Way Pat	0.60 EA	MSHMC	0	17	0	15	0	32
MIL HV 12"x12" Duct Access Doors			0.56	25.40	0.25	12.29	0.00	37.95
Insulated Factory Fabrication	0.24 EA	MSHMC	0	7	0	4	0	11
MIL HV 24"x18" Duct Access Doors			1.13	50.81	0.50	21.85	0.00	73.16
Insulated Factory Fabrication	0.24 EA	MSHMC	0	15	0	6	0	21
MIL HV 6"x 6" Ceil Diffuser,Louver Face			0.51	23.23	0.23	19.42	0.00	42.87
Adj Pat,Surf Mt,Al Cons w/Damper	0.60 EA	MSHMC	0	17	0	14	0	31
MIL HV 8"x 8" Ceil Diffuser,Louver Face			0.51	23.23	0.23	67.49	0.00	90.95
Adj Pat,Surf Mt,Al Cons w/Damper	0.72 EA	MSHMC	0	20	0	59	0	79
MIL HV 10"x10"Ceil Diffuser,Louver Face			0.62	28.03	0.28	93.38	0.00	121.69
Adj Pat,Surf Mt,Al Cons w/Damper	0.72 EA	MSHMC	0	24	0	82	0	106
MIL HV 10"Dia Flexible Duct,Factory Fab			0.13	5.81	0.06	2.51	0.00	8.38
(250mm) Preinsulated	3.60 LF	MSHMC	0	25	0	11	0	37
MIL HV 8"Dia Flexible Duct, Factory Fab			0.10	4.52	0.04	2.17	0.00	6.73
(205mm) Preinsulated	4.80 LF	MSHMC	0	26	0	13	0	39
MIL HV 6"Dia Flexible Duct, Factory Fab			0.07	3.13	0.03	1.85	0.00	5.01
(150mm) Preinsulated	6.00 LF	MSHMC	0	23	0	13	0	36
MIL HV 10"D Radial Opposed Blade Damper			0.46	20.84	0.21	13.93	0.00	34.98
(25cm)Rnd,Stl Const,Manual Oper	0.72 EA	MSHMC	0	18	0	12	0	31
MIL HV 8"D Radial Opposed Blade Damper			0.42	18.91	0.19	13.11	0.00	32.20
(21cm)Rnd,Stl Const,Manual Oper	0.72 EA	MSHMC	0	17	0	11	0	28
MIL HV 6"D Radial Opposed Blade Damper			0.31	14.02	0.14	13.11	0.00	27.27
(15cm)Rnd,Stl Const,Manual Oper	0.72 EA	MSHMC	0	12	0	11	0	24
MIL MC 20"x20"Moduflow Galv Ctrl Damper			0.59	26.59	0.25	81.94	0.00	108.79
Parallel or Opposed Blade Action	0.24 EA	MSHMA	0	8	0	24	0	32
MIL MC 10"x10"Moduflow Galv Ctrl Damper			0.37	16.74	0.16	42.34	0.00	59.24
Parallel or Opposed Blade Action	0.24 EA	MSHMA	0	5	0	12	0	17
MIL MC 8"x 8" Moduflow Galv Ctrl Damper			0.25	11.30	0.11	42.34	0.00	53.75
Parallel or Opposed Blade Action	0.24 EA	MSHMA	0	3	0	12	0	16
MIL MC 12"x12"Moduflow Galv Ctrl Damper			0.43	19.66	0.19	42.34	0.00	62.18
Parallel or Opposed Blade Action	0.24 EA	MSHMA	0	6	0	12	0	18

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL MC Modutrol Mtr,Low/Line Volt Appl			2.00	84.65	0.87	206.29	0.00	291.80
f/Damper or Vlv Ctrl, Reversible	0.72 EA	MSHMD	1	74	1	180	0	255
M MIL EL 7/c#18 300V Tstat Cable,Low Volt			3.55	128.70	0.54	819.59	0.00	948.83
Cable For HVAC System Controls	0.03 MLF	EELEF	0	5	0	30	0	35
MIL MC Room Tstat,Low Volt Clk Ht&Cool			1.69	65.79	0.00	154.72	0.00	220.50
	0.30 EA	EELEA	1	24	0	56	0	80
MIL PL Balancing Centrifugal Fans			12.65	571.96	5.40	0.00	0.00	577.36
	0.06 EA	MSHMA	1	42	0	0	0	42
MIL PL Balancing Central A/C Station			28.15	1141.44	12.73	0.00	0.00	1154.17
	0.30 EA	MSPFB	8	415	5	0	0	420
MIL PL HVAC Duct Sys, Avg Ceiling,Hgt			1.69	76.62	0.72	0.00	0.00	77.35
Supply,Return,Exh,Register&Diff	2.70 EA	MSHMA	5	251	2	0	0	253
USR HV HVAC Commissioning			0.00	0.20	0.00	0.25	0.00	0.45
	1167.48 SF		0	283	0	354	0	637
USR EL Electrical Power			0.00	22600.00	0.00	45200.00	0.00	67800.00
	0.06 EA		0	1,644	0	3,289	0	4,933
USR EL Electrical Lighting			0.00	28270.00	0.00	56540.00	0.00	84810.00
	0.06 EA		0	2,057	0	4,114	0	6,171
USR AA Communications			0.00	18200.00	0.00	36400.00	0.00	54600.00
	0.06 EA		0	1,092	0	2,184	0	3,276
USR AA Security System			0.00	3070.00	0.00	6140.00	0.00	9210.00
	0.06 EA		0	184	0	368	0	553
USR AA Fire Alarm			0.00	2750.00	0.00	5500.00	0.00	8250.00
	0.06 EA		0	165	0	330	0	495
L USR AA Setup and Breakdown Trailers			72.00	2445.53	578.14	0.00	0.00	3023.67
	2.00 EA	ACARU	144	4,891	1,156	0	0	6,047
L USR AA 12'x 50', Office Trailer Rental			0.00	0.00	0.00	0.00	600.00	600.00
Disassembly,Temp Bldg,1-6Yr	36.00 MO		0	0	0	0	21,600	21,600
Life								
Covers 2 trailers for 36 months								
rental @ $300/month/trailer.								
USR PL 275Gal Stl Stor Tank for L.P.			8.68	375.02	3.93	699.90	0.00	1078.84
Gas	0.06 EA	MSPFC	1	27	0	51	0	78
Abv Gnd w/Supp,Coating&Fittings								
From Quote Previous job.								

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA 1-1/4"(3.2cm)Gas Press Regulator			0.74	31.42	0.32	38.50	0.00	70.24
Screwed End	0.06 EA	MPLUA	0	2	0	2	0	4
MIL PL 1/2"(12mm) A-53 Pipe, Sch 40			0.06	2.18	0.03	0.62	0.00	2.83
Not Incl Hangers or Fittings	2.40 LF	MPLUE	0	6	0	2	0	8
MIL AA 250 CF/Hr Gas Diaphram Meter			2.70	97.43	1.14	66.55	0.00	165.12
@ 5 #s, Direct Digital, Threaded	0.06 EA	MPLUE	0	6	0	4	0	10
MIL PL 1/2" 90 Deg Ell, 150# MI Black			0.27	9.61	0.11	0.93	0.00	10.66
	0.48 EA	MPLUE	0	6	0	1	0	6
TOTAL Office Building			358	20,465	1,283	16,455	21,600	59,804
12_ 2.10.01_ 02_ 2. Maint/Storage/Support Building								
MIL AA Trm & Shpe f/Slab on Grd by Hand			0.02	0.44	0.00	0.00	0.00	0.44
Finish Grade	480.00 SF	ULABA	8	211	1	0	0	212
MIL AA Soil Poisoning			0.00	0.06	0.00	0.07	0.00	0.13
	3200.00 SF	ULABA	7	188	1	224	0	413
MIL AA Slab on Gr Edge Forms, Over 12"H			0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	240.00 SF	ACARJ	23	803	15	156	0	973
MIL AA 4"(10cm) Capillary Water Barrier			0.11	3.01	0.36	10.32	0.00	13.69
Compacted Thickness	42.00 CY	CODEK	4	126	15	434	0	575
MIL AA Fine Grd Gravel Bedding by Hand			0.01	0.22	0.00	0.00	0.00	0.22
Finish Grade	3200.00 SF	ULABA	27	706	4	0	0	710
MIL AA 6 Mil Polyethylene Vapor Barrier			0.00	0.10	0.00	0.03	0.00	0.14
	3200.00 SF	ACARA	9	327	4	102	0	432
MIL AA Weld Wire Fab in Slabs, 6x6x#6			0.01	0.30	0.00	0.11	0.00	0.41
42 #/CSF, (W 2.9 x W 2.9),< 5 To	3200.00 SF	SIWRB	22	950	5	346	0	1,301
MIL AA 24 Ga Galv Stl Keyed Jnt, 3-1/2"			0.05	1.89	0.05	0.30	0.00	2.24
(8.8 cm) Cold Expan or Ctrl Jnt	240.00 LF	ACARC	12	454	11	73	0	538
MIL AA Pour Slab on Gr,>= 6", Dir Chute			0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	62.22 CY	ALABE	17	472	17	3,360	0	3,849
MIL AA Conc Floor Finishes, Stl Trowel			0.02	0.54	0.02	0.00	0.00	0.56
	3200.00 SF	ACMAC	51	1,717	76	0	0	1,793
MIL AA Conc Curing, Sprayed Membrane			0.00	0.06	0.00	0.04	0.00	0.10
Curing Compound	3200.00 SF	ULABB	7	178	1	133	0	312

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL MB Aluminum Double Hung Windows				0.10	3.86	0.02	8.22	0.00	12.09
Standard Brush Finish	120.00	SF	AGLAB	12	561	2	1,196	0	1,759
MIL MB 1"Tinted Insul Glass,30 to 50 SF				0.27	10.29	0.04	9.81	0.00	20.14
(2.8-4 6M2)1/4"Lites,1/2"Air Sp	120.00	SF	AGLAB	32	1,497	6	1,428	0	2,930
30 Sf (2.8M2) To 50 Sf (4.6M2)									
MIL MB Oil Base Caulk&Seal,1/4"x1/4" Jt				4.65	192.14	1.17	4.36	0.00	197.67
	3.30	CLF	ARFCA	15	769	5	17	0	791
MIL AT 6"Vinyl F. Batt,R19 Fbgs Insul				0.01	0.32	0.00	0.45	0.00	0.76
(For Exterior Walls)	3360.00	SF	ACARA	28	1,284	13	1,818	0	3,115
MIL MB Aluminum Gutter Custom Fab				0.17	7.53	0.07	2.20	0.00	9.80
w/Gravel Stop	160.00	LF	MSHMA	27	1,462	14	426	0	1,902
MIL MB Alum Downspout, 3"x4",.024" Thk				0.08	3.62	0.03	2.11	0.00	5.77
Enameled	64.00	LF	MSHMA	5	281	3	164	0	447
MIL AA Prec Conc Splash Blocks,Std Size				0.10	2.65	0.02	1.88	0.00	4.54
	4.00	EA	ULABB	0	11	0	8	0	18
MIL GW 4" Metal Framing Stud - 25 Ga				0.03	0.99	0.01	0.17	0.00	1.17
(10 cm) w/Tracks & Runners	200.00	SF	ALATA	5	241	2	41	0	284
MIL GW 5/8" Drywall,One Layer, One Face				0.01	0.45	0.00	0.20	0.00	0.65
On Metal Studs or Furring,(16mm)	440.00	SF	ACARB	5	237	3	107	0	347
MIL PS Paint Ext Door & Frame(HM or Wd)				2.50	95.27	0.85	0.27	0.00	96.39
	2.00	EA	APTRA	5	231	2	1	0	234
MIL GW Oil Base Caulk&Seal,1/4"x1/4" Jt				4.65	192.14	1.17	4.36	0.00	197.67
	1.10	CLF	ARFCA	5	256	2	6	0	264
MIL GW 16 Ga x 5-1/2" Dovetail Anchor				0.01	0.41	0.00	0.15	0.00	0.57
	12.00	EA	AMABA	0	6	0	2	0	8
MIL GW 3'x 7'x 1-3/4"x 18Ga Metal Door				2.22	84.07	0.92	183.63	0.00	268.62
(Unrated)	2.00	EA	ACARB	4	204	2	445	0	651
MIL GW 3'x7'x6-3/4"DP Steel Door Frame				3.33	126.10	1.38	67.50	0.00	194.98
16 Ga Frame for 1-3/4"Door	2.00	EA	ACARB	7	306	3	164	0	473
MIL PS Interior Roller Work				0.01	0.41	0.00	0.27	0.00	0.68
One Coat Primer-Two Coats Paint	440.00	SF	APTRA	5	219	2	144	0	365
MIL RF Solid Color Vinyl Comp Tile				0.02	0.67	0.00	0.51	0.00	1.19
1/8" Thick	400.00	SF	ATIFA	7	323	2	250	0	575

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
AF AT 9" Vinyl Faced, R-30 Fiberglass				0.01	0.32	0.00	0.61	0.00	0.93
Batt Ins	400.00	SF	ACARA	3	153	2	296	0	450
(At Underside Of Roof Panels)									
MIL PL Flush Vlv H20 Closet, Wall Hung				5.13	184.87	2.16	506.28	0.00	693.31
Elongated,Vit China w/Siphon Jet	0.16	EA	MPLUE	1	36	0	98	0	135
MIL PL Rough-In Water Closet, Wall Mtd				10.00	360.49	4.21	196.65	0.00	561.35
Not Including Fixture	0.16	EA	MPLUE	2	70	1	38	0	109
MIL PL Sgl Closet Carrier,CI Hub&Spigot				1.59	57.22	0.67	150.13	0.00	208.02
Vert Ftng w/Ext& Crm Plated Trim	0.16	EA	MPLUE	0	11	0	29	0	40
AF PL V. China 18" X 15" Lavatory,				2.67	96.13	1.12	128.00	0.00	225.25
Recessed	0.16	EA	MPLUE	0	19	0	25	0	44
MIL PL Rough-In Lavatory, Wall Mtd				5.00	180.25	2.10	46.02	0.00	228.38
Not Including Fixture	0.16	EA	MPLUE	1	35	0	9	0	44
MIL PL Sgl Sink Carrier, Floor Mounted				1.16	41.92	0.49	77.77	0.00	120.18
w/Hanger Plate	0.16	EA	MPLUE	0	8	0	15	0	23
MIL PL Blowout, Wall Hung Urinal				4.26	153.40	1.79	689.51	0.00	844.70
w/Flush Valve,Vitreous China	0.16	EA	MPLUE	1	30	0	134	0	164
MIL PL Rough-In Urinal, Wall Mounted				5.00	180.25	2.10	92.05	0.00	274.40
Not Including Fixture	0.16	EA	MPLUE	1	35	0	18	0	53
MIL PL Sgl Urinal Carrier, Floor Mtd				1.16	41.92	0.49	79.12	0.00	121.53
w/Support Plate	0.16	EA	MPLUE	0	8	0	15	0	24
MIL PL 1/2"(12mm) Cu Pipe/Tubing Type L				0.04	1.81	0.02	0.50	0.00	2.34
	2.40	LF	MPLUA	0	5	0	1	0	7
MIL PL 3/4"(20mm) Cu Pipe/Tubing Type L				0.05	2.27	0.02	0.79	0.00	3.08
	4.80	LF	MPLUA	0	13	0	5	0	18
MIL PL 1"(25mm) Cu Pipe/Tubing Type L				0.06	2.72	0.03	1.09	0.00	3.84
	6.40	LF	MPLUA	0	21	0	8	0	30
MIL PL 1/2" 90 Degree Elbow, Copper				0.16	6.84	0.07	0.12	0.00	7.03
	0.96	EA	MPLUA	0	8	0	0	0	8
MIL PL 3/4" 90 Degree Elbow, Copper				0.21	9.03	0.09	0.27	0.00	9.39
	1.28	EA	MPLUA	0	14	0	0	0	15
MIL PL 1" 90 Degree Elbow, Copper				0.27	11.47	0.12	0.66	0.00	12.24
	0.96	EA	MPLUA	0	13	0	1	0	14

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 1" Copper Tee - Straight Sweat		0.43	18.45	0.19	1.50	0.00	20.14
	0.96 EA MPLUA	0	21	0	2	0	23
MIL PL 3/4" Copper Tee - Straight Sweat		0.32	13.69	0.14	0.51	0.00	14.34
	0.64 EA MPLUA	0	11	0	0	0	11
MIL PL 1/2"D Pipe,1"Thk Fib Pipe Cover		0.06	2.43	0.03	0.63	0.00	3.09
w/Fire Retardant Jackets	3.52 LF AASBC	0	10	0	3	0	13
MIL PL 3/4"D Pipe,1"Thk Fib Pipe Cover		0.06	2.43	0.03	0.73	0.00	3.18
w/Fire Retardant Jackets	6.72 LF AASBC	0	20	0	6	0	26
MIL PL 1"D Pipe,1"Thk Fib Pipe Cover		0.06	2.43	0.03	0.75	0.00	3.21
w/Fire Retardant Jackets	8.96 LF AASBC	1	26	0	8	0	35
MIL PL 1-1/4"(32mm) Cu Pipe/Tubing Tp L		0.07	3.17	0.03	1.48	0.00	4.68
	9.60 LF MPLUA	1	37	0	17	0	55
MIL PL 1-1/4" Copper Tee-Reducing Sweat		0.53	22.33	0.22	2.29	0.00	24.85
	0.48 EA MPLUA	0	13	0	1	0	14
MIL PL 1-1/4" 90 Degree Elbow, Copper		0.37	15.72	0.16	1.03	0.00	16.90
	0.96 EA MPLUA	0	18	0	1	0	20
MIL PL 1-1/4"D Pipe,1"Thk Fib Pipe Cvr		0.06	2.43	0.03	0.85	0.00	3.30
w/Fire Retardant Jackets	13.44 LF AASBC	1	40	0	14	0	54
MIL PL Hyd Test, 0-250 LF of 1"-4" Pipe		15.86	685.31	7.17	0.00	0.00	692.48
	0.16 EA MSPFA	3	133	1	0	0	134
MIL PL 3/4" Hose Thrd Outlet Wl Hydrant		1.67	70.73	0.71	178.67	0.00	250.10
Cast Brz,3/4"NPTF Out&1"NPTM In	0.32 EA MPLUA	1	27	0	69	0	97
MIL PL Shock Absorb,3/4" f/11 Fixt Unit		0.83	35.36	0.36	11.16	0.00	46.88
Bellows Type (NPTF)	0.32 EA MPLUA	0	14	0	4	0	18
MIL PL 2" VTR,4# Lead Roof Flashing-BUR		0.53	22.33	0.22	15.55	0.00	38.10
	0.16 EA MPLUA	0	4	0	3	0	7
MIL PL 4"(10cm)Cast Iron Pipe & Fitting		0.18	6.55	0.08	4.43	0.00	11.06
	1.60 LF MPLUE	0	13	0	9	0	21
MIL PL 2"(50mm)Cast Iron Pipe & Fitting		0.10	3.43	0.04	2.78	0.00	6.25
	1.60 LF MPLUE	0	7	0	5	0	12
MIL PL 2" (1/4 Bend) Cast Iron Fitting		0.43	15.47	0.18	7.59	0.00	23.24
	0.16 EA MPLUE	0	3	0	1	0	5
MIL PL 2" P-Trap, Deep Seal, CI Fitting		0.43	15.51	0.18	9.24	0.00	24.92
	0.16 EA MPLUE	0	3	0	2	0	5

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 2" Riser Clamp Type 8				0.42	16.59	0.18	1.48	0.00	18.25
	0.32	EA	MPLUB	0	6	0	1	0	7
MIL PL 4" Wye Cast Iron Fitting				1.38	49.71	0.58	13.38	0.00	63.67
	0.80	EA	MPLUE	1	48	1	13	0	62
MIL PL 4" (1/4 Bend) Cast Iron Fitting				0.64	23.18	0.27	20.64	0.00	44.09
	1.28	EA	MPLUE	1	36	0	32	0	68
MIL PL 4" P-Trap, Deep Seal, CI Fitting				0.72	25.93	0.30	22.94	0.00	49.18
	0.32	EA	MPLUE	0	10	0	9	0	19
MIL PL 4" CI Cleanout Tee, No Hub				0.65	25.69	0.27	8.83	0.00	34.79
	0.32	EA	MPLUB	0	10	0	3	0	14
MIL PL 4" CI Cleanout Plug, No Hub				0.65	25.69	0.27	3.96	0.00	29.93
	0.32	EA	MPLUB	0	10	0	2	0	12
MIL PL 4" CI Comb,Dbl Reducing, No Hub				1.90	68.64	0.80	17.06	0.00	86.50
	0.32	EA	MPLUE	1	27	0	7	0	34
MIL PL Fl Drain w/Sed Bkt,4" Bot Outlet				2.67	96.08	1.12	336.44	0.00	433.64
Round Satin Bronze Top, w/o Trap	0.48	EA	MPLUE	1	56	1	196	0	252
MIL PL Pneu Test, 0-250LF, 1"-4" Pipe				17.86	771.46	8.07	0.55	0.00	780.08
Includes Soaping Joints	0.16	EA	MSPFA	3	150	2	0	0	151
MIL AA Bulk Site Excavation, Heavy Clay				0.06	2.18	2.06	0.00	0.00	4.23
1-1/2 CY Bucket Drag Line	4.80	CY	UOEHE	0	10	10	0	0	20
MIL AA Compact Backfill w/Vib Plate				0.20	5.40	0.19	0.00	0.00	5.58
Around Structures and Trenches	0.80	CY	CLACC	0	4	0	0	0	4
AF AA Clay Backfill				0.00	0.00	0.00	3.70	0.00	3.70
	0.80	CY	N/A	0	0	0	3	0	3
MIL AA 5,000 Gal Precast Septic Tank				16.47	611.38	85.98	2005.97	0.00	2703.33
No Excavation or Piping	0.16	EA	MPLUS	3	98	14	321	0	433
HTW AA 8" x 7.5" Manhole Cover -				1.50	45.00	51.66	25.58	0.00	122.24
Non-Locking	0.16	EA	ULADB	0	7	8	4	0	20
MIL PL 40 Cup Instant Hot Water Disp				1.10	46.62	0.30	179.49	0.00	226.40
115 Volt & 190 Degree Water	0.16	EA	MPLUC	0	9	0	35	0	44
MIL PL Wall Mounted Water Cooler, 8 GPH				4.26	153.40	1.79	868.38	0.00	1023.57
	0.16	EA	MPLUE	1	30	0	168	0	199
MIL PL Rough-In H20 Cooler (Free Stand)				5.00	180.25	2.10	82.22	0.00	264.57
Not Including Fixture	0.16	EA	MPLUE	1	35	0	16	0	51

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
AF AA Flow Thru With 1/2" Strainer			0.50	18.02	0.21	34.00	0.00	52.24
	0.48 EA	MPLUE	0	9	0	16	0	25
MIL PL 1/4" Refrig Tubing Copper Dehyd			0.04	1.73	0.02	0.20	0.00	1.95
	28.80 LF	MSPFA	1	60	1	7	0	68
MIL PL Emergency Shower w/Eye Wash			6.45	232.58	2.71	2073.03	0.00	2308.32
	0.16 EA	MPLUE	1	45	1	402	0	448
MIL PL Rough-In Shower (Free Stand)			5.00	180.25	2.10	82.22	0.00	264.57
Not Including Fixture	0.16 EA	MPLUE	1	35	0	16	0	51
MIL PL 1-1/2"Screwed Backflow Preventer			1.79	75.78	0.76	436.40	0.00	512.94
w/2Gate&2CK Vlv&Auto Dif Rlf Vlv	0.16 EA	MPLUA	0	15	0	85	0	100
USR FP Wet Sys,Ord Haz Fire Sprinkler			0.00	0.27	0.00	1.02	0.00	1.29
	3200.00 SF	N/A	0	1,048	0	3,958	0	5,006
AF AA Cooling Capacity 8.5 MBH, Sup.			3.33	141.08	1.44	797.00	0.00	939.52
Heat 10.2 MBH Thru Wall Pkgd	0.16 EA	MSHMD	1	23	0	128	0	150
Walk-In								
AF AA 30 MBH, Infrared Gas Fired			2.41	104.05	1.09	296.68	0.00	401.82
	0.64 EA	MSPFC	2	67	1	190	0	257
MIL AA Trench 1/2 CY Hyd Exc, Hvy Soil			0.04	1.25	0.86	0.00	0.00	2.11
51 CY/Hr (40M3)/Hr	0.96 CY	CODEA	0	1	1	0	0	2
MIL AA Backfill Trench w/Sm FEnd Loader			0.02	0.72	0.48	0.00	0.00	1.20
Without Compaction	0.80 CY	CODLB	0	1	0	0	0	1
MIL AA Compaction, 6" Layers, Vib Plate			0.07	1.97	0.07	0.00	0.00	2.03
(15cm) Layers	0.96 CY	CLACC	0	2	0	0	0	2
MIL AA Sand Bedding w/Sm FEnd Loader			0.03	1.06	0.71	17.14	0.00	18.91
Without Compaction	0.16 CY	CODLB	0	0	0	3	0	3
MIL HV Exhaust Fan,Wall Mtd,170 CFM			2.00	84.65	0.87	84.36	0.00	169.87
Light Duty	0.16 EA	MSHMD	0	16	0	16	0	33
MIL PL 3/4"(20mm) Cu Pipe/Tubing Type L			0.05	2.27	0.02	0.79	0.00	3.08
	9.60 LF	MPLUA	1	26	0	9	0	36
MIL PL 1"(25mm) Cu Pipe/Tubing Type L			0.06	2.72	0.03	1.09	0.00	3.84
	6.40 LF	MPLUA	0	21	0	8	0	30
MIL PL 3/4" Copper Tee-Reducing Sweat			0.32	13.69	0.14	0.48	0.00	14.30
	0.96 EA	MPLUA	0	16	0	1	0	17

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 1" Copper Tee-Reducing Sweat		0.43	18.45	0.19	1.58	0.00	20.21
	0.96 EA MPLUA	0	21	0	2	0	24
MIL PL 1/2" 90 Degree Elbow, Copper		0.16	6.84	0.07	0.12	0.00	7.03
	1.28 EA MPLUA	0	11	0	0	0	11
MIL PL 3/4" 90 Degree Elbow, Copper		0.21	9.03	0.09	0.27	0.00	9.39
	1.28 EA MPLUA	0	14	0	0	0	15
MIL PL 1" 90 Degree Elbow, Copper		0.27	11.47	0.12	0.66	0.00	12.24
	0.96 EA MPLUA	0	13	0	1	0	14
MIL HV 20" Belt Driven Roof Exhaust Fan		4.76	201.54	2.06	1166.20	0.00	1369.80
Temp to 250 F,4205 CFM, 3/4 HP	0.16 EA MSHMD	1	39	0	226	0	266
MIL HV Bathrm Exh Fan,180CFM-225 SF Max		1.27	53.57	0.55	102.56	0.00	156.69
120V 60 Hz, Anodized Alum Finish	0.16 EA MSHMD	0	10	0	20	0	30
USR EL Electrical Power		0.00	9800.00	0.00	19600.00	0.00	29400.00
	0.16 EA	0	1,901	0	3,803	0	5,704
USR EL Electrical Lighting		0.00	8900.00	0.00	17800.00	0.00	26700.00
	0.16 EA	0	1,727	0	3,454	0	5,180
USR AA Communications		0.00	11900.00	0.00	23800.00	0.00	35700.00
	0.16 EA	0	1,904	0	3,808	0	5,712
USR AA Security System		0.00	2200.00	0.00	4400.00	0.00	6600.00
	0.16 EA	0	352	0	704	0	1,056
USR AA Fire Alarm		0.00	1950.00	0.00	3900.00	0.00	5850.00
	0.16 EA	0	312	0	624	0	936
L USR MB 40 x 80 - 3200 SF		350.00	14118.56	2254.34	6957.29	0.00	23330.19
Metal Buildings,14'Eave Hgt,26Ga	1.00 EA SIWSI	350	17,121	2,734	8,437	0	28,291
USR PL 275Gal Stl Stor Tank for L.P.		8.68	375.02	3.93	699.90	0.00	1078.84
Gas	0.16 EA MSPFC	1	73	1	136	0	209
Abv Gnd w/Supp,Coating&Fittings							
From Quote Previous job.							
MIL AA 1-1/4"(3.2cm)Gas Press Regulator		0.74	31.42	0.32	38.50	0.00	70.24
Screwed End	0.16 EA MPLUA	0	5	0	6	0	11
MIL PL 1/2"(12mm) A-53 Pipe, Sch 40		0.06	2.18	0.03	0.62	0.00	2.83
Not Incl Hangers or Fittings	6.40 LF MPLUE	0	17	0	5	0	22
MIL AA 250 CF/Hr Gas Diaphram Meter		2.70	97.43	1.14	66.55	0.00	165.12
@ 5 #s, Direct Digital, Threaded	0.16 EA MPLUE	0	16	0	11	0	26

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 1/2" 90 Deg Ell, 150# MI Black				0.27	9.61	0.11	0.93	0.00	10.66
	1.28	EA	MPLUE	0	15	0	1	0	17
TOTAL Maint/Storage/Support Building				743	40,381	2,999	38,768	0	82,148
12_ 2.10.01_ 02_ 3. Leachate Treatment Sys & Bldg.									
MIL AA Pier/Foundation Exc, Normal Soil				1.00	26.47	0.16	0.00	0.00	26.63
Hand Piled to 2' Deep	40.00	CY	ULABA	40	1,059	7	0	0	1,065
MIL AA Trim Slopes/Sides of Excavation				0.02	0.44	0.02	0.00	0.00	0.46
Hand Labor	90.00	SF	ULABE	2	40	2	0	0	42
MIL AA Clmn Spread Footing Forms,4 Uses				0.07	2.61	0.05	0.53	0.00	3.19
Plywd Forms, Form & Strip w/Acc	120.00	SF	ACARJ	9	313	6	64	0	382
MIL AA Pour Sprd Ftg,< 5CY,Direct Chute				0.87	24.12	0.88	54.00	0.00	79.01
< (5M3) Place 3000 PSI Conc Fdns	3.30	CY	ALABE	3	80	3	178	0	261
MIL AA Conc Curing, Sprayed Membrane				0.00	0.06	0.00	0.04	0.00	0.10
Curing Compound	90.00	SF	ULABB	0	5	0	4	0	9
MIL AA Concrete Floor Finishes, Screed				0.01	0.37	0.00	0.00	0.00	0.37
	90.00	SF	ACMAA	1	34	0	0	0	34
MIL AA Backfill Trenches by Hand				0.77	20.36	0.13	0.00	0.00	20.49
Without Compaction	37.00	CY	ULABA	28	753	5	0	0	758
MIL AA Compaction, 6" Layers w/Air Tamp				0.10	2.65	0.10	0.00	0.00	2.75
By Hand, (15cm) Layers	37.00	CY	CLACA	4	98	4	0	0	102
MIL AA Gr 60 Resteel,Ftgs & Slabs,#3-#6				0.01	0.28	0.00	0.25	0.00	0.53
	500.00	LB	SIWRC	3	138	1	127	0	266
MIL AA Trm & Shpe f/Slab on Grd by Hand				0.02	0.44	0.00	0.00	0.00	0.44
Finish Grade	3200.00	SF	ULABA	53	1,405	9	0	0	1,413
MIL AA Soil Poisoning				0.00	0.06	0.00	0.07	0.00	0.13
	3200.00	SF	ULABA	7	188	1	224	0	413
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	96.00	SF	ACARJ	9	321	6	62	0	389
MIL AA 4"(10cm) Capillary Water Barrier				0.11	3.01	0.36	10.32	0.00	13.69
Compacted Thickness	32.00	CY	CODEK	3	96	11	330	0	438
MIL AA Fine Grd Gravel Bedding by Hand				0.01	0.22	0.00	0.00	0.00	0.22
Finish Grade	3200.00	SF	ULABA	27	706	4	0	0	710

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA 6 Mil Polyethylene Vapor Barrier				0.00	0.10	0.00	0.03	0.00	0.14
	3200.00	SF	ACARA	9	327	4	102	0	432
MIL AA Weld Wire Fab in Slabs, 6x6x#6				0.01	0.30	0.00	0.11	0.00	0.41
42 #/CSF, (W 2.9 x W 2.9),< 5 To	3200.00	SF	SIWRB	22	950	5	346	0	1,301
MIL AA 24 Ga Galv Stl Keyed Jnt, 3-1/2"				0.05	1.89	0.05	0.30	0.00	2.24
(8.8 cm) Cold Expan or Ctrl Jnt	192.00	LF	ACARC	10	363	9	59	0	431
MIL AA Pour Slab on Gr,>= 6", Dir Chute				0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	64.00	CY	ALABE	18	485	18	3,456	0	3,959
MIL AA Concrete Floor Finishes, Screed				0.01	0.37	0.00	0.00	0.00	0.37
	3200.00	SF	ACMAA	36	1,194	5	0	0	1,200
MIL AA Conc Floor Finishes, Stl Trowel				0.02	0.54	0.02	0.00	0.00	0.56
	3200.00	SF	ACMAC	51	1,717	76	0	0	1,793
MIL AA Conc Curing, Sprayed Membrane				0.00	0.06	0.00	0.04	0.00	0.10
Curing Compound	3200.00	SF	ULABB	7	178	1	133	0	312
MIL MB Aluminum Double Hung Windows				0.10	3.86	0.02	8.22	0.00	12.09
Standard Brush Finish	120.00	SF	AGLAB	12	561	2	1,196	0	1,759
MIL MB 1"Tinted Insul Glass,30 to 50 SF				0.27	10.29	0.04	9.81	0.00	20.14
(2.8-4 6M2)1/4"Lites,1/2"Air Sp	120.00	SF	AGLAB	32	1,497	6	1,428	0	2,930
30 Sf (2.8M2) To 50 Sf (4.6M2)									
MIL MB Oil Base Caulk&Seal,1/4"x1/4" Jt				4.65	192.00	1.17	4.36	0.00	197.53
	3.30	CLF	ARFCA	15	768	5	17	0	790
MIL AT 6"Vinyl F,R19 Fbgs Insul				0.01	0.32	0.00	0.45	0.00	0.76
(For Exterior Walls)	3360.00	SF	ACARA	28	1,284	13	1,818	0	3,115
MIL MB Aluminum Gutter Custom Fab				0.17	7.53	0.07	2.20	0.00	9.80
w/Gravel Stop	160.00	LF	MSHMA	27	1,462	14	426	0	1,902
MIL MB Alum Downspout, 3"x4",.024" Thk				0.08	3.62	0.03	2.11	0.00	5.77
Enameled	64.00	LF	MSHMA	5	281	3	164	0	447
MIL AA Prec Conc Splash Blocks,Std Size				0.10	2.65	0.02	1.88	0.00	4.54
	4.00	EA	ULABB	0	11	0	8	0	18
MIL GW 4" Metal Framing Stud - 25 Ga				0.03	0.99	0.01	0.17	0.00	1.17
(10 cm) w/Tracks & Runners	1000.00	SF	ALATA	26	1,205	10	204	0	1,419
MIL GW 5/8" Drywall,One Layer, One Face				0.01	0.45	0.00	0.20	0.00	0.65
On Metal Studs or Furring,(16mm)	2000.00	SF	ACARB	24	1,079	12	485	0	1,576

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PS Paint Ext Door & Frame(HM or Wd)				2.50	95.27	0.85	0.27	0.00	96.39
	8.00	EA	APTRA	20	924	8	3	0	935
MIL GW Oil Base Caulk&Seal,1/4"x1/4" Jt				4.65	192.00	1.17	4.36	0.00	197.53
	4.40	CLF	ARFCA	20	1,024	6	23	0	1,054
MIL GW 16 Ga x 5-1/2" Dovetail Anchor				0.01	0.41	0.00	0.15	0.00	0.57
	48.00	EA	AMABA	1	24	0	9	0	33
MIL GW 3'x 7'x 1-3/4"x 18Ga Metal Door				2.22	84.07	0.92	183.63	0.00	268.62
(Unrated)	8.00	EA	ACARB	18	816	9	1,781	0	2,606
MIL GW 3'x7'x6-3/4"DP Steel Door Frame				3.33	126.10	1.38	67.50	0.00	194.98
16 Ga Frame for 1-3/4"Door	8.00	EA	ACARB	27	1,223	13	655	0	1,892
MIL GW Laminated Toilet Partition				3.33	126.10	1.38	406.11	0.00	533.59
w/Door & Side Divider, Floor Mtd	4.00	EA	ACARB	13	612	7	1,819	0	2,588
Mod For Single Toilet Paper Holder							78		
Mod For Oversized (Wheelchair) Unit							73		
MIL PS Interior Roller Work				0.01	0.41	0.00	0.27	0.00	0.68
One Coat Primer-Two Coats Paint	2000.00	SF	APTRA	22	994	9	655	0	1,657
MIL RF Solid Color Vinyl Comp Tile				0.02	0.67	0.00	0.51	0.00	1.19
1/8" Thick	3200.00	SF	ATIFA	59	2,588	14	1,997	0	4,599
MIL RF 1/8"Vinyl Plastic Base,Gp 1, 4"H				0.03	1.20	0.01	0.42	0.00	1.63
Black, Russet and Umber	180.00	LF	ATIFA	6	262	1	92	0	355
MIL AT 2'x 2'x 3/4" Fbgs Acous Ceil Pnl				0.01	0.43	0.00	0.54	0.00	0.98
(Suspension System Not Included	1000.00	SF	ACARA	11	521	5	658	0	1,184
) (For Other Special Function									
Areas)									
MIL AT T Bar Ceil Susp System 2'x 2'				0.01	0.47	0.00	0.59	0.00	1.07
(For Other Special Function	1000.00	SF	ACARA	13	573	6	717	0	1,296
Area).									
AF AT 9"Vinyl F, R-30 Fiberglass				0.01	0.32	0.00	0.61	0.00	0.93
Batt Ins	3200.00	SF	ACARA	27	1,223	12	2,367	0	3,603
(For Underside Of Roof Panels)									
MIL PL Flush Vlv H20 Closet, Wall Hung				5.12	184.68	2.16	506.28	0.00	693.12
Elongated,Vit China w/Siphon Jet	0.64	EA	MPLUE	3	143	2	393	0	538
MIL PL Rough-In Water Closet, Wall Mtd				10.00	360.49	4.21	196.65	0.00	561.35
Not Including Fixture	0.64	EA	MPLUE	6	280	3	153	0	436
MIL PL Sgl Closet Carrier,CI Hub&Spigot				1.59	57.22	0.67	150.13	0.00	208.02
Vert Ftng w/Ext& Crm Plated Trim	0.64	EA	MPLUE	1	44	1	117	0	161

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
AF AA V. China 18" X 15" Lavatory,		2.67	96.08	1.12	128.00	0.00	225.20
Recessed	0.43 EA MPLUE	1	41	0	55	0	96
MIL PL Rough-In Lavatory, Wall Mtd		5.00	180.25	2.10	46.02	0.00	228.38
Not Including Fixture	0.43 EA MPLUE	2	93	1	24	0	118
MIL PL Sgl Sink Carrier, Floor Mounted		1.16	41.92	0.49	77.77	0.00	120.18
w/Hanger Plate	0.43 EA MPLUE	0	22	0	40	0	62
MIL PL Blowout, Wall Hung Urinal		4.26	153.40	1.79	689.51	0.00	844.70
w/Flush Valve,Vitreous China	0.21 EA MPLUE	1	40	0	178	0	218
MIL PL Rough-In Urinal, Wall Mounted		5.00	180.25	2.10	92.05	0.00	274.40
Not Including Fixture	0.21 EA MPLUE	1	47	1	24	0	71
MIL PL Sgl Urinal Carrier, Floor Mtd		1.16	41.92	0.49	79.12	0.00	121.53
w/Support Plate	0.21 EA MPLUE	0	11	0	20	0	31
MIL PL Floor Stand'g Water Cooler,14GPH		3.23	116.29	1.36	967.52	0.00	1085.17
	0.21 EA MPLUE	1	30	0	250	0	281
MIL PL Rough-In H20 Cooler (Free Stand)		5.00	180.25	2.10	82.22	0.00	264.57
Not Including Fixture	0.21 EA MPLUE	1	47	1	21	0	68
MIL PL Svce Sink,En CI,Fl Type 28"x 28"		4.25	153.27	1.79	348.17	0.00	503.23
	0.11 EA MPLUE	0	20	0	45	0	65
MIL PL 21"x24"x7"Kit Sink,SST Sgl Bowl		3.77	136.04	1.59	11.01	0.00	148.64
	0.11 EA MPLUE	0	18	0	1	0	19
MIL PL Rough-In Service Sink, Wall Mtd		5.00	180.25	2.10	234.94	0.00	417.29
Not Including Fixture	0.21 EA MPLUE	1	47	1	61	0	108
MIL PL Svce Sink,En CI,Fl Type 28"x 28"		4.25	153.27	1.79	348.17	0.00	503.23
	0.11 EA MPLUE	0	20	0	45	0	65
MIL PL 1/2"(12mm) Cu Pipe/Tubing Type L		0.04	1.81	0.02	0.50	0.00	2.34
	1.07 LF MPLUA	0	2	0	1	0	3
MIL PL 3/4"(20mm) Cu Pipe/Tubing Type L		0.05	2.27	0.02	0.79	0.00	3.08
	1.60 LF MPLUA	0	4	0	2	0	6
MIL PL 1"(25mm) Cu Pipe/Tubing Type L		0.06	2.72	0.03	1.09	0.00	3.84
	1.60 LF MPLUA	0	5	0	2	0	7
MIL PL 1/2" 90 Degree Elbow, Copper		0.16	6.84	0.07	0.12	0.00	7.03
	0.21 EA MPLUA	0	2	0	0	0	2
MIL PL 3/4" 90 Degree Elbow, Copper		0.21	9.03	0.09	0.27	0.00	9.39
	0.43 EA MPLUA	0	5	0	0	0	5

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 1" 90 Degree Elbow, Copper		0.27	11.47	0.12	0.66	0.00	12.24
	0.21 EA MPLUA	0	3	0	0	0	3
MIL PL 1" Copper Tee - Straight Sweat		0.43	18.45	0.19	1.50	0.00	20.14
	0.21 EA MPLUA	0	5	0	0	0	5
MIL PL 3/4" Copper Tee - Straight Sweat		0.32	13.69	0.14	0.51	0.00	14.34
	0.21 EA MPLUA	0	4	0	0	0	4
MIL PL 1/2"D Pipe,1"Thk Fib Pipe Cover		0.06	2.43	0.03	0.63	0.00	3.09
w/Fire Retardant Jackets	1.49 LF AASBC	0	4	0	1	0	6
MIL PL 3/4"D Pipe,1"Thk Fib Pipe Cover		0.06	2.43	0.03	0.73	0.00	3.18
w/Fire Retardant Jackets	2.35 LF AASBC	0	7	0	2	0	9
MIL PL 1"D Pipe,1"Thk Fib Pipe Cover		0.06	2.43	0.03	0.75	0.00	3.21
w/Fire Retardant Jackets	2.35 LF AASBC	0	7	0	2	0	9
MIL PL 1/2"(12mm) Cu Pipe/Tubing Type L		0.04	1.81	0.02	0.50	0.00	2.34
	6.93 LF MPLUA	0	15	0	4	0	20
MIL PL 3/4"(20mm) Cu Pipe/Tubing Type L		0.05	2.27	0.02	0.79	0.00	3.08
	9.07 LF MPLUA	0	25	0	9	0	34
MIL PL 1"(25mm) Cu Pipe/Tubing Type L		0.06	2.72	0.03	1.09	0.00	3.84
	12.80 LF MPLUA	1	42	0	17	0	60
MIL PL 1/2" 90 Degree Elbow, Copper		0.16	6.84	0.07	0.12	0.00	7.03
	1.92 EA MPLUA	0	16	0	0	0	16
MIL PL 3/4" 90 Degree Elbow, Copper		0.21	9.03	0.09	0.27	0.00	9.39
	1.28 EA MPLUA	0	14	0	0	0	15
MIL PL 1" 90 Degree Elbow, Copper		0.27	11.47	0.12	0.66	0.00	12.24
	1.28 EA MPLUA	0	18	0	1	0	19
MIL PL 1" Copper Tee - Straight Sweat		0.43	18.45	0.19	1.50	0.00	20.14
	1.28 EA MPLUA	1	29	0	2	0	31
MIL PL 3/4" Copper Tee - Straight Sweat		0.32	13.69	0.14	0.51	0.00	14.34
	1.28 EA MPLUA	0	21	0	1	0	22
MIL PL 1/2"D Pipe,1"Thk Fib Pipe Cover		0.06	2.43	0.03	0.63	0.00	3.09
w/Fire Retardant Jackets	9.71 LF AASBC	1	29	0	7	0	36
MIL PL 3/4"D Pipe,1"Thk Fib Pipe Cover		0.06	2.43	0.03	0.73	0.00	3.18
w/Fire Retardant Jackets	12.80 LF AASBC	1	38	0	11	0	49
MIL PL 1"D Pipe,1"Thk Fib Pipe Cover		0.06	2.43	0.03	0.75	0.00	3.21
w/Fire Retardant Jackets	17.92 LF AASBC	1	53	1	16	0	70

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 1-1/4"(32mm) Cu Pipe/Tubing Tp L			0.07	3.17	0.03	1.48	0.00	4.68
	19.20 LF	MPLUA	1	74	1	35	0	109
MIL PL 1-1/4"D Pipe,1"Thk Fib Pipe Cvr			0.06	2.43	0.03	0.85	0.00	3.30
w/Fire Retardant Jackets	26.88 LF	AASBC	2	79	1	28	0	108
MIL PL 1-1/4" 90 Degree Elbow, Copper			0.37	15.72	0.16	1.03	0.00	16.90
	1.07 EA	MPLUA	0	20	0	1	0	22
MIL PL 1-1/4" Copper Tee-Reducing Sweat			0.53	22.33	0.22	2.29	0.00	24.85
	0.64 EA	MPLUA	0	17	0	2	0	19
MIL PL 3/4" Hose Thrd Outlet Wl Hydrant			1.67	70.73	0.71	178.67	0.00	250.10
Cast Brz,3/4"NPTF Out&1"NPTM In	0.11 EA	MPLUA	0	9	0	23	0	32
MIL PL Shock Absorb,3/4" f/11 Fixt Unit			0.83	35.36	0.36	11.16	0.00	46.88
Bellows Type (NPTF)	0.11 EA	MPLUA	0	5	0	1	0	6
MIL PL 3/4" Hose Thrd Outlet Wl Hydrant			1.67	70.73	0.71	178.67	0.00	250.10
Cast Brz,3/4"NPTF Out&1"NPTM In	0.43 EA	MPLUA	1	37	0	92	0	129
MIL PL Shock Absorb,3/4" f/11 Fixt Unit			0.83	35.36	0.36	11.16	0.00	46.88
Bellows Type (NPTF)	0.21 EA	MPLUA	0	9	0	3	0	12
MIL PL Shock Absorb, 1" f/32 Fixt Unit			0.91	38.58	0.39	28.02	0.00	66.98
Bellows Type (NPTF)	0.21 EA	MPLUA	0	10	0	7	0	17
MIL PL Hyd Test,250-500LF of 1"-4" Pipe			12.50	540.02	5.65	0.00	0.00	545.67
	0.11 EA	MSPFA	1	70	1	0	0	71
MIL PL 2" VTR,4# Lead Roof Flashing-BUR			0.53	22.33	0.22	15.55	0.00	38.10
	0.32 EA	MPLUA	0	9	0	6	0	15
MIL PL 4"(10cm)Cast Iron Pipe & Fitting			0.18	6.55	0.08	4.43	0.00	11.06
	21.33 LF	MPLUE	4	170	2	115	0	286
MIL PL 2"(50mm)Cast Iron Pipe & Fitting			0.10	3.43	0.04	2.78	0.00	6.25
	10.67 LF	MPLUE	1	44	1	36	0	81
MIL PL 2" (1/4 Bend) Cast Iron Fitting			0.43	15.47	0.18	7.59	0.00	23.24
	1.07 EA	MPLUE	0	20	0	10	0	30
MIL PL 2" P-Trap, Deep Seal, CI Fitting			0.43	15.50	0.18	9.24	0.00	24.92
	0.43 EA	MPLUE	0	8	0	5	0	13
MIL PL 2" Riser Clamp Type 8			0.42	16.59	0.18	1.48	0.00	18.25
	0.85 EA	MPLUB	0	17	0	2	0	19
MIL PL 4" Wye Cast Iron Fitting			1.38	49.71	0.58	13.38	0.00	63.67
	1.07 EA	MPLUE	1	64	1	17	0	82

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 4" (1/4 Bend) Cast Iron Fitting		0.64	23.18	0.27	20.64	0.00	44.09
	1.92 EA MPLUE	1	54	1	48	0	103
MIL PL 4" P-Trap, Deep Seal, CI Fitting		0.72	25.93	0.30	22.94	0.00	49.18
	0.43 EA MPLUE	0	13	0	12	0	25
MIL PL 4" CI Cleanout Tee, No Hub		0.65	25.69	0.27	8.83	0.00	34.79
	0.43 EA MPLUB	0	13	0	5	0	18
MIL PL 4" CI Cleanout Plug, No Hub		0.65	25.69	0.27	3.96	0.00	29.93
	0.43 EA MPLUB	0	13	0	2	0	15
MIL PL 4" CI Comb,Dbl Reducing, No Hub		1.90	68.64	0.80	17.06	0.00	86.50
	0.43 EA MPLUE	1	36	0	9	0	45
MIL PL 3"(80mm)Cast Iron Pipe & Fitting		0.14	5.15	0.06	3.40	0.00	8.61
	12.80 LF MPLUE	2	80	1	53	0	134
MIL PL 2"(50mm)Cast Iron Pipe & Fitting		0.10	3.43	0.04	2.78	0.00	6.25
	10.67 LF MPLUE	1	44	1	36	0	81
MIL PL 2" Wye Cast Iron Fitting		0.96	34.66	0.40	5.37	0.00	40.43
	0.43 EA MPLUE	0	18	0	3	0	21
MIL PL 3" Wye Cast Iron Fitting		1.05	37.95	0.44	10.05	0.00	48.44
	0.64 EA MPLUE	1	29	0	8	0	38
MIL PL 3" Riser Clamp Type 8		0.42	16.59	0.18	1.65	0.00	18.42
	0.43 EA MPLUB	0	9	0	1	0	10
MIL PL 3" P-Trap, Deep Seal, CI Fitting		0.54	19.49	0.23	14.74	0.00	34.45
	0.43 EA MPLUE	0	10	0	8	0	18
MIL PL 2" P-Trap, Deep Seal, CI Fitting		0.43	15.51	0.18	9.24	0.00	24.92
	0.43 EA MPLUE	0	8	0	5	0	13
MIL PL Sq Top Floor Drain w/3" Outlet		2.67	96.13	1.12	88.84	0.00	186.10
Satin Bronze, Incl Shower Drains	0.43 EA MPLUE	1	50	1	46	0	96
L MIL PL 3"D SST Wall Cleanout Cover		0.63	26.52	0.27	3.91	0.00	30.69
	0.43 EA MPLUA	0	14	0	2	0	16
MIL PL Pnue Test,250-500LF, 1"-4" Pipe		29.00	1175.87	13.11	0.55	0.00	1189.54
Includes Soaping Joints	0.11 EA MSPFB	3	152	2	0	0	154
HTW AA 8" x 7.5" Manhole Cover -		1.50	45.00	51.66	25.58	0.00	122.24
Non-Locking	0.11 EA ULADB	0	5	6	3	0	13
MIL AA 5,000 Gal Precast Septic Tank		16.47	611.38	85.98	2005.97	0.00	2703.33
No Excavation or Piping	0.11 EA MPLUS	2	65	9	214	0	288

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
AF AA Clay Backfill				0.00	0.00	0.00	3.70	0.00	3.70
	0.53	CY	N/A	0	0	0	2	0	2
MIL AA Compact Backfill w/Vib Plate				0.20	5.40	0.19	0.00	0.00	5.58
Around Structures and Trenches	0.53	CY	CLACC	0	3	0	0	0	3
MIL AA Bulk Site Excavation, Heavy Clay				0.06	2.18	2.06	0.00	0.00	4.23
1-1/2 CY Bucket Drag Line	3.20	CY	UOEHE	0	7	7	0	0	14
MIL PL 67Gal Comm Water Htr,Gas 109GPH				4.00	169.74	1.71	2568.27	0.00	2739.72
Fast Recovery & GPM/100F Rise	0.11	EA	MPLUD	0	22	0	332	0	354
MIL PL 1-1/2"Screwed Backflow Preventer				1.79	75.78	0.76	436.40	0.00	512.94
w/2Gate&2CK Vlv&Auto Dif Rlf Vlv	0.11	EA	MPLUA	0	10	0	56	0	66
AF AA Flow Thru With 1/2" Strainer				0.50	18.02	0.21	34.00	0.00	52.24
	0.43	EA	MPLUE	0	8	0	15	0	22
MIL PL 1/4" Refrig Tubing Copper Dehyd				0.04	1.73	0.02	0.20	0.00	1.95
	25.60	LF	MSPFA	1	54	1	6	0	60
MIL AA 1"(2.5cm) Gas Press Regulator				0.65	27.74	0.28	38.50	0.00	66.51
Screwed End	0.11	EA	MPLUA	0	3	0	4	0	7
AF AA 100 SCFM, Duplex				14.00	510.92	6.66	11260.00	0.00	11777.58
	0.11	EA	MSPFI	1	55	1	1,201	0	1,257
MIL MC Refr Air Dryers,10 SCFM Capacity				2.00	72.99	0.95	883.75	0.00	957.69
w/Ambient Air Filters	0.11	EA	MSPFI	0	9	0	114	0	124
MIL PL 1/2"(12mm) Cu Pipe/Tubing Type L				0.04	1.81	0.02	0.50	0.00	2.34
	3.20	LF	MPLUA	0	7	0	2	0	9
MIL PL 3/4"(20mm) Cu Pipe/Tubing Type L				0.05	2.27	0.02	0.79	0.00	3.08
	2.13	LF	MPLUA	0	6	0	2	0	8
MIL PL 1"(25mm) Cu Pipe/Tubing Type L				0.06	2.72	0.03	1.09	0.00	3.84
	4.27	LF	MPLUA	0	14	0	6	0	20
MIL PL 3/4" Copper Tee-Reducing Sweat				0.32	13.69	0.14	0.48	0.00	14.30
	0.43	EA	MPLUA	0	7	0	0	0	7
MIL PL 1' Copper Tee-Reducing Sweat				0.43	18.45	0.19	1.58	0.00	20.21
	0.21	EA	MPLUA	0	5	0	0	0	5
MIL PL 1/2" 90 Degree Elbow, Copper				0.16	6.84	0.07	0.12	0.00	7.03
	0.85	EA	MPLUA	0	7	0	0	0	7
MIL PL 3/4" 90 Degree Elbow, Copper				0.21	9.03	0.09	0.27	0.00	9.39
	0.64	EA	MPLUA	0	7	0	0	0	7

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 1" 90 Degree Elbow, Copper				0.27	11.47	0.12	0.66	0.00	12.24
	0.43	EA	MPLUA	0	6	0	0	0	6
MIL PL 1/2" Copper Adapter, Male				0.11	4.51	0.05	0.27	0.00	4.83
	0.85	EA	MPLUA	0	5	0	0	0	5
MIL PL 1/2" Copper Adapter, Female				0.11	4.51	0.05	0.40	0.00	4.96
	0.85	EA	MPLUA	0	5	0	0	0	5
MIL PL 1/2"Comb Stl & Brs Disconn Valve				0.38	16.32	0.16	3.47	0.00	19.95
Single Seated w/Arm Ball & Brkt	0.85	EA	MPLUA	0	17	0	4	0	21
MIL PL 1/2"Globe Valve,Bronze,Thrd 125#				0.32	13.69	0.14	19.06	0.00	32.89
	0.85	EA	MPLUA	0	14	0	20	0	34
MIL MC Oil/H2O Air Compr Fil,0-90 SCFM				0.63	27.00	0.28	1054.67	0.00	1081.96
Alum,1/2"NPT In & Outl,Mnl Drain	0.85	EA	MSPFA	1	28	0	1,091	0	1,120
USR FP Wet Sys,Ord Haz Fire Sprinkler				0.00	0.27	0.00	1.02	0.00	1.29
	3200.00	SF	N/A	0	1,048	0	3,958	0	5,006
MIL AA Trench 1/2 CY Hyd Exc, Hvy Soil				0.04	1.25	0.86	0.00	0.00	2.11
51 CY/Hr (40M3)/Hr	0.64	CY	CODEA	0	1	1	0	0	1
MIL AA Backfill Trench w/Sm FEnd Loader				0.02	0.72	0.48	0.00	0.00	1.20
Without Compaction	0.53	CY	CODLB	0	0	0	0	0	1
MIL AA Compaction, 6" Layers, Vib Plate				0.07	1.97	0.07	0.00	0.00	2.03
(15cm) Layers	0.64	CY	CLACC	0	1	0	0	0	1
MIL AA Sand Bedding w/Sm FEnd Loader				0.03	1.06	0.71	17.14	0.00	18.91
Without Compaction	0.11	CY	CODLB	0	0	0	2	0	2
MIL HV 10Ton Air Cooled Condensing Unit				15.34	621.84	6.94	1975.00	0.00	2603.78
w/Compressor,Condenser,Fan&Motor	0.11	EA	MSPFB	2	80	1	256	0	337
MIL HV LP/Nat Gas Dir Drive Furn,300MBH				8.33	360.02	3.77	1910.88	0.00	2274.66
	0.11	EA	MSPFC	1	47	0	247	0	294
MIL HV 6"x 5' Round Flue/Vent Pipe				0.91	38.48	0.39	2.45	0.00	41.32
Galv Dbl Wall Breech/Smoke Pipe	0.21	EA	MSHMB	0	10	0	1	0	11
MIL HV 6" Round Flue/Vent Top Caps				0.32	13.65	0.14	1.49	0.00	15.29
Galv Dbl Wall Breech/Smoke Pipe	0.11	EA	MSHMB	0	2	0	0	0	2
MIL HV 6"Rnd Flue/Vent Adj Roof Flash				0.32	13.65	0.14	1.16	0.00	14.95
Galv Dbl Wall Breech/Smoke Pipe	0.11	EA	MSHMB	0	2	0	0	0	2
M AF AA 10 Ton Refrigerant Line Set				1.61	68.26	0.70	250.00	0.00	318.96
25'	0.11	EA	MSHMD	0	7	0	27	0	34

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 0.006" Alum Insul Jacket w/Bands			0.14	5.39	0.06	0.16	0.00	5.61
	192.00 SF	AASBC	27	1,255	14	37	0	1,306
MIL HV Sht Mtl Duct,Low Press,Field Fab			0.10	3.71	0.05	0.33	0.00	4.09
Galv,Field Assemble & Install	277.33 LB	MSHMF	27	1,248	15	112	0	1,375
MIL HV 12x12"Prl Blade Louver Fire Dmpr			0.50	22.60	0.21	91.50	0.00	114.32
Galv Stl Cons, UL ,1-1/2Hr Rated	0.11 EA	MSHMA	0	3	0	12	0	15
AF AA 18 X 22 2 HR Fire Damper,			0.45	20.55	0.19	30.00	0.00	50.74
Curtain Type	0.11 EA	MSHMA	0	2	0	3	0	5
MIL HV 12x12"Sgl Deflt Ret/Exh Register			0.51	23.23	0.23	35.13	0.00	58.59
Al,Opposed Blade Dmpr,Wall/Ceil	0.21 EA	MSHMC	0	6	0	9	0	15
MIL HV 24x24"Sgl Deflt Ret/Exh Register			0.90	40.65	0.40	97.08	0.00	138.13
Al,Opposed Blade Dmpr,Wall/Ceil	0.64 EA	MSHMC	1	32	0	75	0	107
MIL HV 12"x12"Adj Curved Blade Register			0.51	23.03	0.23	20.53	0.00	43.78
Adj,Ceil Mtd,Alum Cons,4-Way Pat	0.21 EA	MSHMC	0	6	0	5	0	11
MIL HV 12"x12" Duct Access Doors			0.56	25.40	0.25	12.29	0.00	37.95
Insulated Factory Fabrication	0.11 EA	MSHMC	0	3	0	2	0	5
MIL HV 24"x18" Duct Access Doors			1.13	50.81	0.50	21.85	0.00	73.16
Insulated Factory Fabrication	0.11 EA	MSHMC	0	7	0	3	0	9
MIL HV 6"x 6" Ceil Diffuser,Louver Face			0.51	23.23	0.23	19.42	0.00	42.87
Adj Pat,Surf Mt,Al Cons w/Damper	0.11 EA	MSHMC	0	3	0	3	0	6
MIL HV 8"x 8" Ceil Diffuser,Louver Face			0.51	23.23	0.23	67.49	0.00	90.95
Adj Pat,Surf Mt,Al Cons w/Damper	0.11 EA	MSHMC	0	3	0	9	0	12
MIL HV 10"x10"Ceil Diffuser,Louver Face			0.62	28.03	0.28	93.38	0.00	121.69
Adj Pat,Surf Mt,Al Cons w/Damper	0.43 EA	MSHMC	0	15	0	48	0	63
MIL HV 10"Dia Flexible Duct,Factory Fab			0.13	5.81	0.06	2.51	0.00	8.38
(250mm) Preinsulated	2.13 LF	MSHMC	0	15	0	6	0	22
MIL HV 8"Dia Flexible Duct, Factory Fab			0.10	4.52	0.04	2.17	0.00	6.73
(205mm) Preinsulated	2.13 LF	MSHMC	0	12	0	6	0	17
MIL HV 6"Dia Flexible Duct, Factory Fab			0.07	3.13	0.03	1.85	0.00	5.01
(150mm) Preinsulated	2.13 LF	MSHMC	0	8	0	5	0	13
MIL HV 10"D Radial Opposed Blade Damper			0.46	20.84	0.21	13.93	0.00	34.98
(25cm)Rnd,Stl Const,Manual Oper	0.21 EA	MSHMC	0	5	0	4	0	9
MIL HV 8"D Radial Opposed Blade Damper			0.42	18.91	0.19	13.11	0.00	32.20
(21cm)Rnd,Stl Const,Manual Oper	0.43 EA	MSHMC	0	10	0	7	0	17

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL HV 6"D Radial Opposed Blade Damper			0.31	14.02	0.14	13.11	0.00	27.27
(15cm)Rnd,Stl Const,Manual Oper	0.43 EA	MSHMC	0	7	0	7	0	14
MIL MC 10"x10"Moduflow Galv Ctrl Damper			0.37	16.74	0.16	42.34	0.00	59.24
Parallel or Opposed Blade Action	0.21 EA	MSHMA	0	4	0	11	0	15
MIL MC Modutrol Mtr,Low/Line Volt Appl			2.00	84.65	0.87	206.29	0.00	291.80
f/Damper or Vlv Ctrl, Reversible	0.21 EA	MSHMD	0	22	0	53	0	75
M MIL EL 7/c#18 300V Tstat Cable,Low Volt			3.55	128.66	0.54	819.59	0.00	948.78
Cable For HVAC System Controls	0.02 MLF	EELEF	0	3	0	21	0	25
MIL MC Room Tstat,Low Volt Clk Ht&Cool			1.69	65.74	0.00	154.72	0.00	220.46
	0.11 EA	EELEA	0	9	0	20	0	29
MIL PL Balancing Centrifugal Fans			12.65	571.96	5.40	0.00	0.00	577.36
	0.11 EA	MSHMA	1	74	1	0	0	75
MIL PL Balancing Central A/C Station			28.09	1138.88	12.70	0.00	0.00	1151.58
	0.11 EA	MSPFB	3	147	2	0	0	149
MIL PL HVAC Duct Sys, Avg Ceiling,Hgt			1.69	76.57	0.72	0.00	0.00	77.29
Supply,Return,Exh,Register&Diff	1.28 EA	MSHMA	2	119	1	0	0	120
USR HV HVAC Commissioning			0.00	0.20	0.00	0.25	0.00	0.45
	26.67 SF		0	6	0	8	0	15
MIL HV Lab Exhaust Fan,V-Belt Drive			20.00	846.46	8.67	2431.41	0.00	3286.53
26000 CFM, 2 HP, w/Wall Shutter	0.11 EA	MSHMD	2	110	1	315	0	425
MIL HV Stain Stl Sht Mtl Duct,Low Press			0.17	6.41	0.08	13.78	0.00	20.26
Type 304	53.33 LB	MSHMF	9	414	5	891	0	1,310
MIL HV Laboratory Exh Hood,10 Ga			1.33	50.35	0.62	15.28	0.00	66.25
U.S. Gauge	4.27 SF	MSHMF	6	261	3	79	0	343
USR EL Electrical Power			0.00	14600.00	0.00	29200.00	0.00	43800.00
	0.11 EA		0	1,889	0	3,778	0	5,667
USR EL Electrical Lighting			0.00	13300.00	0.00	16600.00	0.00	29900.00
	0.11 EA		0	1,721	0	2,148	0	3,869
USR AA Communications			0.00	17900.00	0.00	35800.00	0.00	53700.00
	0.11 EA		0	1,910	0	3,820	0	5,730
USR AA Security System			0.00	3300.00	0.00	6600.00	0.00	9900.00
	0.11 EA		0	352	0	704	0	1,056
USR AA Fire Alarm			0.00	2900.00	0.00	5800.00	0.00	8700.00
	0.11 EA		0	309	0	619	0	928

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 2" (50mm) A53 Pipe, T&C Sch 40			0.31	11.27	0.13	2.13	0.00	13.53
Incl Hanger & 125# CI Fitting	220.00 LF	MPLUE	69	3,005	35	568	0	3,609
MIL PL 30GPM Brz Cntrf Pump 1-1/2"Disch			3.23	116.29	1.36	400.00	0.00	517.65
Booster Pump w/2' Head & 1/8 HP	2.00 EA	MPLUE	6	282	3	970	0	1,255
MIL AA Pour Slab on Gr,>= 6", Dir Chute			0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	2.00 CY	ALABE	1	15	1	108	0	124
MIL AA Slab on Gr Edge Forms, Over 12"H			0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	40.00 SF	ACARJ	4	134	2	26	0	162
MIL AA Conc Floor Finishes, Stl Trowel			0.02	0.54	0.02	0.00	0.00	0.56
	100.00 SF	ACMAC	2	54	2	0	0	56
MIL AA Concrete Floor Finishes, Screed			0.01	0.37	0.00	0.00	0.00	0.37
	100.00 SF	ACMAA	1	37	0	0	0	37
USR AA 12' DIA, 45 GPM WASTE FLOW,			687.50	27209.59	5754.70	58884.50	0.00	91848.79
PURCHASE AND INSTALL ONLY Racer	1.00 EA	SIWSO	688	27,210	5,755	58,885	0	91,849
Software generated costs								
MIL AA Pour Slab on Gr,>= 6", Dir Chute			0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	12.00 CY	ALABE	3	91	3	648	0	742
MIL AA Concrete Floor Finishes, Screed			0.01	0.37	0.00	0.00	0.00	0.37
	300.00 SF	ACMAA	3	112	1	0	0	112
MIL AA Conc Floor Finishes, Stl Trowel			0.02	0.54	0.02	0.00	0.00	0.56
	300.00 SF	ACMAC	5	161	7	0	0	168
MIL AA Slab on Gr Edge Forms, Over 12"H			0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	70.00 LF	ACARJ	7	234	4	45	0	284
USR AA 100 CF Filter Press System			360.00	13432.70	1563.42	85000.00	0.00	99996.11
Budget quote obtained from Star	1.00 EA	MSPFS	360	13,433	1,563	85,000	0	99,996
Systems Filtration,								
800-845-5381, Scott Thomas.								
MIL PL 2" (50mm) A53 Pipe, T&C Sch 40			0.31	11.27	0.13	2.13	0.00	13.53
Incl Hanger & 125# CI Fitting	220.00 LF	MPLUE	69	3,005	35	568	0	3,609
B AF AA 50' X 6" Brown Gum Rubber,			5.59	236.60	2.42	1090.00	0.00	1329.02
Chemical Resistant Flexible Hose	2.00 EA	MSHMD	11	473	5	2,180	0	2,658
MIL AA Pour Slab on Gr,>= 6", Dir Chute			0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	18.00 CY	ALABE	5	136	5	972	0	1,113
MIL AA Concrete Floor Finishes, Screed			0.01	0.37	0.00	0.00	0.00	0.37
	400.00 SF	ACMAA	4	149	1	0	0	150

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA Conc Floor Finishes, Stl Trowel				0.02	0.54	0.02	0.00	0.00	0.56
	400.00	SF	ACMAC	6	215	9	0	0	224
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	100.00	LF	ACARJ	10	334	6	65	0	405
MIL AA Pour Slab on Gr,>= 6", Dir Chute				0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	18.00	CY	ALABE	5	136	5	972	0	1,113
MIL AA Concrete Floor Finishes, Screed				0.01	0.37	0.00	0.00	0.00	0.37
	440.00	SF	ACMAA	5	164	1	0	0	165
MIL AA Conc Floor Finishes, Stl Trowel				0.02	0.54	0.02	0.00	0.00	0.56
	440.00	SF	ACMAC	7	236	10	0	0	247
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	90.00	LF	ACARJ	9	301	6	58	0	365
MIL PL 2" (50mm) A53 Pipe, T&C Sch 40				0.31	11.27	0.13	2.13	0.00	13.53
Incl Hanger & 125# CI Fitting	240.00	LF	MPLUE	75	3,279	38	620	0	3,937
AF AA Pump C.I. Close Coupling 3 HP				0.00	0.00	0.00	1097.00	0.00	1097.00
90 GPM	2.00	EA	N/A	0	0	0	2,194	0	2,194
B MIL PL 5000Gal Stl Stor Tk,w/3/16"Shell				50.47	1884.48	146.80	3775.80	0.00	5807.08
Abv Gnd w/Supp,Coating&Fittings	2.00	EA	MSPFP	101	4,570	356	9,157	0	14,084
B MIL PL 5000Gal Stl Stor Tk,w/3/16"Shell				50.47	1884.48	146.80	3775.80	0.00	5807.08
Abv Gnd w/Supp,Coating&Fittings	1.00	EA	MSPFP	50	2,285	178	4,579	0	7,042
MIL PL 2" (50mm) A53 Pipe, T&C Sch 40				0.31	11.27	0.13	2.13	0.00	13.53
Incl Hanger & 125# CI Fitting	80.00	LF	MPLUE	25	1,093	13	207	0	1,312
MIL AA Pour Slab on Gr,>= 6", Dir Chute				0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	12.00	CY	ALABE	3	91	3	648	0	742
MIL AA Concrete Floor Finishes, Screed				0.01	0.37	0.00	0.00	0.00	0.37
	300.00	SF	ACMAA	3	112	1	0	0	112
MIL AA Conc Floor Finishes, Stl Trowel				0.02	0.54	0.02	0.00	0.00	0.56
	300.00	SF	ACMAC	5	161	7	0	0	168
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	70.00	LF	ACARJ	7	234	4	45	0	284
USR AA solid contact clarifier				363.04	14368.10	3038.79	15000.00	0.00	32406.89
PURCHASE AND INSTALL ONLY	1.00	EA	SIWSO	363	14,368	3,039	15,000	0	32,407
MIL PL 2" (50mm) A53 Pipe, T&C Sch 40				0.31	11.27	0.13	2.13	0.00	13.53
Incl Hanger & 125# CI Fitting	220.00	LF	MPLUE	69	3,005	35	568	0	3,609

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA Concrete Floor Finishes, Screed				0.01	0.37	0.00	0.00	0.00	0.37
	440.00	SF	ACMAA	5	164	1	0	0	165
MIL AA Conc Floor Finishes, Stl Trowel				0.02	0.54	0.02	0.00	0.00	0.56
	440.00	SF	ACMAC	7	236	10	0	0	247
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	90.00	LF	ACARJ	9	301	6	58	0	365
MIL AA Pour Slab on Gr,>= 6", Dir Chute				0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	18.00	CY	ALABE	5	136	5	972	0	1,113
USR AA 3" DIA Elec Automatic Fill				62.41	2330.30	181.53	9998.52	0.00	12510.36
Costs generated by RACER Software	1.00	EA	MSPFQ	62	2,330	182	9,999	0	12,510
MIL AA Pour Slab on Gr,>= 6", Dir Chute				0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	12.00	CY	ALABE	3	91	3	648	0	742
MIL AA Concrete Floor Finishes, Screed				0.01	0.37	0.00	0.00	0.00	0.37
	300.00	SF	ACMAA	3	112	1	0	0	112
MIL AA Conc Floor Finishes, Stl Trowel				0.02	0.54	0.02	0.00	0.00	0.56
	300.00	SF	ACMAC	5	161	7	0	0	168
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	70.00	LF	ACARJ	7	234	4	45	0	284
MIL AA Pour Slab on Gr,>= 6", Dir Chute				0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	12.00	CY	ALABE	3	91	3	648	0	742
MIL AA Concrete Floor Finishes, Screed				0.01	0.37	0.00	0.00	0.00	0.37
	300.00	SF	ACMAA	3	112	1	0	0	112
MIL AA Conc Floor Finishes, Stl Trowel				0.02	0.54	0.02	0.00	0.00	0.56
	300.00	SF	ACMAC	5	161	7	0	0	168
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	70.00	LF	ACARJ	7	234	4	45	0	284
HTW AA 35 GPM, 660# Fill, HDPE Lined				7.00	259.84	36.54	4600.00	0.00	4896.38
Steel , Permanent	1.00	EA	MPLUS	7	260	37	4,600	0	4,896
USR PL 35GPM 1 H. P. Transfer Pump w/				19.14	776.11	8.66	1875.21	0.00	2659.98
Motor, Valves, & piping Costs Generated by RACER Software	1.00	EA	MSPFB	19	941	10	2,274	0	3,226
B MIL PL 5000Gal Stl Stor Tk,w/3/16"Shell				50.47	1884.48	146.80	3775.80	0.00	5807.08
Abv Gnd w/Supp,Coating&Fittings	1.00	EA	MSPFP	50	2,285	178	4,579	0	7,042

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL PL 2" (50mm) A53 Pipe, T&C Sch 40				0.31	11.27	0.13	2.13	0.00	13.53
Incl Hanger & 125# CI Fitting	80.00	LF	MPLUE	25	1,093	13	207	0	1,312
MIL AA Pour Slab on Gr,>= 6", Dir Chute				0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	12.00	CY	ALABE	3	91	3	648	0	742
MIL AA Concrete Floor Finishes, Screed				0.01	0.37	0.00	0.00	0.00	0.37
	300.00	SF	ACMAA	3	112	1	0	0	112
MIL AA Conc Floor Finishes, Stl Trowel				0.02	0.54	0.02	0.00	0.00	0.56
	300.00	SF	ACMAC	5	161	7	0	0	168
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	70.00	LF	ACARJ	7	234	4	45	0	284
L USR MB 40 x 80 - 3200 SF				350.00	14118.56	2254.34	6957.29	0.00	23330.19
Metal Buildings,14'Eave Hgt,26Ga	1.00	EA	SIWSI	350	17,121	2,734	8,437	0	28,291
USR AA Intake Structure				0.00	0.00	0.00	0.00	15000.00	15000.00
	4.00	EA		0	0	0	0	60,000	60,000
USR PL 275Gal Stl Stor Tank for L.P.				8.68	375.02	3.93	699.90	0.00	1078.84
Gas	0.11	EA	MSPFC	1	49	1	91	0	140
Abv Gnd w/Supp,Coating&Fittings									
From Quote Previous job.									
USR PL 4" Dia HDPE,SDR 21 Pipe				0.08	2.88	0.03	1.62	0.00	4.54
Incl Hanger & 125# CI Fitting	500.00	LF	MPLUE	40	1,749	20	982	0	2,752
MIL AA 1-1/4"(3.2cm)Gas Press Regulator				0.74	31.42	0.32	38.50	0.00	70.24
Screwed End	0.11	EA	MPLUA	0	3	0	4	0	7
MIL PL 200GPM CI Cntrf Pump,1-1/2"Disch				16.67	675.73	7.54	4795.99	0.00	5479.26
Two Stage, Horz Split Case,50 HP	2.00	EA	MSPFB	33	1,639	18	11,632	0	13,289
MIL PL 1/2"(12mm) A-53 Pipe, Sch 40				0.06	2.18	0.03	0.62	0.00	2.83
Not Incl Hangers or Fittings	4.27	LF	MPLUE	0	11	0	3	0	15
MIL AA Pour Slab on Gr,>= 6", Dir Chute				0.27	7.58	0.28	54.00	0.00	61.86
>= (15 cm) Place 3000 PSI Conc	2.00	CY	ALABE	1	15	1	108	0	124
MIL AA 250 CF/Hr Gas Diaphram Meter				2.70	97.43	1.14	66.55	0.00	165.12
@ 5 #s, Direct Digital, Threaded	0.11	EA	MPLUE	0	10	0	7	0	18
MIL AA Slab on Gr Edge Forms, Over 12"H				0.10	3.34	0.06	0.65	0.00	4.05
(Over 31cm)High, Based on 4 Uses	40.00	SF	ACARJ	4	134	2	26	0	162
MIL PL 1/2" 90 Deg Ell, 150# MI Black				0.27	9.61	0.11	0.93	0.00	10.66
	0.85	EA	MPLUE	0	10	0	1	0	11

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA Conc Floor Finishes, Stl Trowel			0.02	0.54	0.02	0.00	0.00	0.56
	100.00 SF	ACMAC	2	54	2	0	0	56
MIL AA Concrete Floor Finishes, Screed			0.01	0.37	0.00	0.00	0.00	0.37
	100.00 SF	ACMAA	1	37	0	0	0	37
MIL AA Trench 1/2 CY Hyd Exc, Hvy Soil			0.04	1.25	0.86	0.00	0.00	2.11
51 CY/Hr (40M3)/Hr	250.00 CY	CODEA	10	313	215	0	0	528
MIL AA Backfill Trench w/Sm FEnd Loader			0.02	0.72	0.48	0.00	0.00	1.20
Without Compaction	225.00 CY	CODLB	5	162	108	0	0	270
MIL AA Compaction, 6" Layers, Vib Plate			0.07	1.97	0.07	0.00	0.00	2.03
(15cm) Layers	250.00 CY	CLACC	19	491	17	0	0	508
MIL AA Sand Bedding w/Sm FEnd Loader			0.03	1.06	0.71	17.14	0.00	18.91
Without Compaction	25.00 CY	CODLB	1	27	18	429	0	473
TOTAL Leachate Treatment Sys & Bldg.			3,581	153,875	15,189	274,837	60,000	503,902
TOTAL Site Buildings			4,683	214,722	19,471	330,060	81,600	645,854
12_ 2.10.01_ 04. Sediment Truck & HED Stations								
12_ 2.10.01_ 04_ 01. Blast Zone								
MIL PL 2" (50mm) A53 Pipe, T&C Sch 40			0.31	11.27	0.13	2.13	0.00	13.53
Incl Hanger & 125# CI Fitting	400.00 LF	MPLUE	125	5,464	64	1,033	0	6,561
AF ME 90 GPM Pump C.I. Close Coupling			7.41	300.33	3.35	936.00	0.00	1239.68
3 HP	1.00 EA	MSPFB	7	364	4	1,135	0	1,503
MIL FP 1-1/2" High Pressure Nozzle			0.40	17.28	0.18	44.68	0.00	62.14
	16.00 EA	MSPIA	6	335	4	867	0	1,206
MIL SS > 6"W Strl Tube,Heavy Rect Sect			6.85	268.30	64.73	1379.85	0.00	1712.89
A-36 Misc Steel Items	8.00 TON	SIWSM	40	1,914	462	13,373	0	16,617
Mod For Heavy Construction Add To			15	689	166	13		
MIL ME 4"(10cm) Capillary Water Barrier			0.11	3.01	0.36	10.32	0.00	13.69
Compacted Thickness	8.00 CY	CODEK	1	29	3	100	0	133
TOTAL Blast Zone			194	8,796	703	16,521	0	26,020

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 2.10.01_ 04_ 02. Rinse Zone							
MIL PL 2" (50mm) A53 Pipe, T&C Sch 40		0.31	11.27	0.13	2.13	0.00	13.53
Incl Hanger & 125# CI Fitting	400.00 LF MPLUE	125	5,464	64	1,033	0	6,561
0 ME 50 GPM Pump C.I. Close Coupling		6.25	253.40	2.83	706.00	0.00	962.23
2 HP	1.00 EA MSPFB	6	307	3	856	0	1,167
MIL FP 1-1/2" High Pressure Nozzle		0.40	17.28	0.18	44.68	0.00	62.14
	16.00 EA MSPIA	6	335	4	867	0	1,206
TOTAL Rinse Zone		138	6,107	71	2,756	0	8,934
12_ 2.10.01_ 04_ 03. Deflector Structure Allowance for 15' high wall to deflect high pressure and wash water.							
USR AL Deflector Structure Allowance		0.00	0.00	0.00	0.00	50000.00	50000.00
	1.00 JOB	0	0	0	0	50,000	50,000
TOTAL Deflector Structure		0	0	0	0	50,000	50,000
12_ 2.10.01_ 04_ 05. Truck Decontamination Pad							
MIL AA Crushed Stone Paving, Large Area		0.03	1.07	0.50	0.34	0.00	1.90
Prepare and Roll Subbase	444.44 SY XSGRA	14	473	220	149	0	843
L MIL AA 8"(20cm) Concrete Pavement		0.08	2.58	0.12	1.77	0.00	4.47
	4000.00 SF XCMAA	308	10,305	483	7,075	0	17,863
MIL AA Crushed Base 9 In Depth (23 Cm)		0.06	1.84	1.83	4.16	0.00	7.83
	444.44 SY XSABA	25	818	815	1,847	0	3,480
MIL AA 24"x 24" Underground Trench Drn		0.43	12.83	2.60	296.32	0.00	311.75
	200.00 LF CODEJ	87	2,566	521	59,263	0	62,350
MIL PL 10000Gal Ugnd Dbl Wall Stl Tank		53.75	2006.97	156.34	8546.46	0.00	10709.77
Coated,In Place w/Hold Down Bars	1.00 EA MSPFP	54	2,434	190	10,364	0	12,987
MIL AA 8" Dia SDR 21 PVC Pressure Pipe		0.08	3.07	0.21	4.52	0.00	7.80
(20cm) Dia, Class 200	60.00 LF XPLUD	5	184	13	271	0	468
MIL AA 6" Dia SDR 21 PVC Pressure Pipe		0.08	2.73	0.04	2.67	0.00	5.44
(15cm) Dia, Class 200	200.00 LF XPLUC	16	546	8	534	0	1,088
L MIL AA Trench 1/2 CY Hyd Exc, Hvy Soil		0.08	2.58	1.78	0.00	0.00	4.36
51 CY/Hr (40M3)/Hr	150.00 CY CODEA	12	388	267	0	0	655
L MIL AA Backfill Trench w/Sm FEnd Loader		0.05	1.68	1.12	0.00	0.00	2.80
Without Compaction	70.00 CY CODLB	4	118	78	0	0	196

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
L MIL AA Compaction, 6" Layers, Vib Plate			0.10	2.65	0.09	0.00	0.00	2.75
(15cm) Layers	70.00 CY	CLACC	7	186	6	0	0	192
TOTAL Truck Decontamination Pad			531	18,017	2,601	79,504	0	100,122
TOTAL Sediment Truck & HED Stations			863	32,920	3,375	98,781	50,000	185,076
12_ 2.10.01_ 05. Soil/Borrow Stockpile Area								
L MIL AA Rough Grade Large Area w/Dozer			0.00	0.17	0.45	0.00	0.00	0.63
300 HP	20300 SY	CODTK	91	3,538	9,198	0	0	12,736
TOTAL Soil/Borrow Stockpile Area			91	3,538	9,198	0	0	12,736
12_ 2.10.01_ 07. Groundwater Monitoring Well N W								
Assume 15 wells 100 feet deep.								
B MIL AA 4"(10cm) to 6"(15cm) Water Well			83.33	2205.90	1894.12	2750.00	0.00	6850.02
Drilled and Cased, Incl Casing	8.00 EA	CLADM	667	17,647	15,153	22,000	0	54,800
TOTAL Groundwater Monitoring Well N W			667	17,647	15,153	22,000	0	54,800
12_ 2.10.01_ 10. Exterior Facility Lighting								
12_ 2.10.01_ 10_ 01. Site Lighting								
USR AA Site Lighting Fixture			0.00	0.00	0.00	1800.00	0.00	1800.00
	40.00 EA		0	0	0	72,000	0	72,000
TOTAL Site Lighting			0	0	0	72,000	0	72,000
TOTAL Exterior Facility Lighting			0	0	0	72,000	0	72,000
TOTAL Landfill Support Services/Facil.			8,229	324,987	57,912	581,556	374,143	1,338,598
12_ 2.10.02. Landfill Construction								
12_ 2.10.02_ 01. TSCA Cell								

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST

12_ 2.10.02_ 01_ 01. Cell Excavation

Estimated as 60% of the cell top layer area x 35' depth.

Excavated materials are being placed in cell berms and roadway embankments. 3' of these excavated materials are also placed as temporary frost protection for the liner material. Therefore, it will be required to be stockpiled and re-loaded/hauled to cover the liner.

The costs in this area include only those to excavate the material and haul for either the berm/roadway placement or to the stockpile area.

	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
L CIV AA Exc & Load,3 CY Hyd Exc,Med Matl				0.02	0.49	0.69	0.00	0.00	1.18
147 CY/Hr (112M3)	99500	CY	XXQHK	1,493	48,665	68,595	0	0	117,261
USR AA Haul 25LCY Truckload, Off-Road				0.01	0.24	0.63	0.00	0.00	0.87
1.6 Cycles/Hr .	127360	CY	COETK	1,019	30,872	79,906	0	0	110,778

224,000-119,000 = 105,000 cy

	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Cell Excavation	2,511	79,538	148,501	0	0	228,038

12_ 2.10.02_ 01_ 02. Cell Liner System

	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
L HTW AA 40 Mil HDPE				0.02	0.42	0.03	0.42	0.00	0.88
	140530	SF	USKCF	2,248	59,430	4,820	59,023	0	123,273
B HTW AA 60 Mil HDPE				0.03	0.70	0.06	0.56	0.00	1.32
	140530	SF	USKCF	3,752	99,060	8,038	78,697	0	185,795
USR AA Load & Haul Onsite Clay Material				0.02	0.49	0.69	0.00	0.87	2.05
from stockpiled excavated	17380	CY	XXQHK	261	8,500	11,982	0	15,120	35,603

material.
If offsite borrow source required, clay source assumed as Nelson Sand and Gravel, North Kingsville, OH.
1x10-7 clay material.
Quote of $14.00/cy delivered obtained from Tom Nelson, (440) 224-0198.

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Geotextile Drainage Net			0.00	0.00	0.00	0.00	0.45	0.45
Quote obtained from GSE Lining Technologies, 19103 Gundle Road, Houston, TX, 800-435-2008 $0.45/sf furnished and installed excluding earthwork. Allowing 15% for overlap and waste of material.	421590 SF		0	0	0	0	189,716	189,716
USR AA Imported Sand Material			0.00	0.00	0.00	0.00	8.00	8.00
Sand source assumed as Nelson Sand and Gravel, North Kingsville, OH. Quote obtained from Tom Nelson, (440) 224-0198.	1994.24 CY		0	0	0	0	15,954	15,954
L MIL AA Sprd Dumped Fill/Grvl, 6" Layers			0.01	0.37	0.61	0.00	0.00	0.98
Without Compaction	17380 CY	CODTG	174	6,404	10,557	0	0	16,961
L MIL AA Rough Grade Large Area w/Dozer			0.00	0.17	0.45	0.00	0.00	0.63
300 HP	13578 CY	CODTK	61	2,367	6,152	0	0	8,519
L USR AA Sprd Dumped Fill/Grvl, 6" Layers			0.01	0.46	0.76	0.00	0.00	1.22
Without Compaction	1994.24 CY	CODTG	25	919	1,514	0	0	2,433
L MIL AA Finish Grade w/Grader			0.01	0.36	0.20	0.00	0.00	0.56
	4674.00 SY	COFGA	53	1,699	930	0	0	2,630
L USR AA Compaction by Sheepsfoot Roller			0.02	0.64	0.80	0.00	0.05	1.49
8" Lifts	17380 CY	COFCP	318	11,123	13,822	0	869	25,814
USR AA Compaction by 10 Ton Steel Wheel			0.01	0.40	0.23	0.00	0.00	0.63
Tandem Roller Finished surface compaction prior to placement of Geotextile fabric.	13578 SY	COFCK	163	5,424	3,085	0	0	8,509
USR AA Compaction by 10 Ton Steel Wheel			0.01	0.25	0.14	0.00	0.00	0.39
Tandem Roller Finished surface compaction prior to placement of Geotextile fabric.	4674.00 SY	COFCK	35	1,167	664	0	0	1,831
L MIL AA Finish Grade Clay Surface			0.02	0.51	0.28	0.00	0.00	0.79
Base or Leveling Courses	13578 SY	COFGA	217	6,911	3,783	0	0	10,694
TOTAL Cell Liner System			7,308	203,005	65,347	137,719	221,659	627,730

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST

12_ 2.10.02_ 01_ 03. Temp Down Ramp to Non-TSCA Cell

Temporary ramp will provide access to the TSCA cell via the Non-TSCA cell. Assume the contractor will, through the course of his excavation, construct a temporary ramp roadway within the boundaries of the Non-TSCA cell. The only additional work that will be required is the shaping, compaction, and gravelling of the temporary ramp. The excavation is already covered in the total quantity of cell excavation. Maintenance of the ramp will also be required. Assumes a 30' wide gravel access ramp from the north side of hte Non-TSCA cell to the north face of the TSCA cell (about 500' long).

Item	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
L USR AA Compaction by Sheepsfoot Roller				0.02	0.64	0.80	0.00	0.05	1.49
Scarify and compact the top 2' of the temporary ramp.	2680.00	CY	COFCP	49	1,715	2,131	0	134	3,981
USR AA Compaction by 10 Ton Steel Wheel				0.01	0.40	0.23	0.00	0.00	0.63
Tandem Roller Compact the top 6" of subgrade for gravel placement.	664.00	SY	COFCK	8	265	151	0	0	416
L MIL AA Subgrade Preparation				0.02	0.64	0.35	0.00	0.00	0.98
Base or Leveling Courses	4000.00	SY	COFGA	80	2,545	1,393	0	0	3,938
CIV AA Geotextile Fabric, 90 Mils Thick				0.02	0.53	0.02	1.00	0.00	1.55
Non-Woven Polypropylene Overlap and waste factor - 7%	4280.00	SY	ULABJ	86	2,271	99	4,283	0	6,654
MIL AA 6"(15cm) Crushed Agg Base Course				0.04	1.38	1.38	2.77	0.00	5.53
Grader, Roller and Water Truck	4000.00	SY	XSABA	171	5,522	5,504	11,080	0	22,106
L USR AA Gravel Surface Maintenance				0.02	0.64	0.35	0.50	0.00	1.48
Base or Leveling Courses	16000	SY	COFGA	320	10,179	5,571	8,000	0	23,750
TOTAL Temp Down Ramp to Non-TSCA Cell				713	22,498	14,849	23,363	134	60,844

12_ 2.10.02_ 01_ 04. Cell Cap System

Item	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
L HTW AA 40 Mil HDPE				0.02	0.42	0.03	0.42	0.00	0.88
	140530	SF	USKCF	2,248	59,430	4,820	59,023	0	123,273
L CIV AA Exc & Load,3 CY Hyd Exc,Med Matl				0.02	0.49	0.69	0.00	0.00	1.18
147 CY/Hr (112M3)	17380	CY	XXQHK	261	8,500	11,982	0	0	20,482
USR AA Haul 25LCY Truckload, Off-Road				0.01	0.24	0.63	0.00	0.00	0.87
1.6 Cycles/Hr	22246	CY	COETK	178	5,392	13,957	0	0	19,350
USR AA Geotextile Drainage Net				0.00	0.00	0.00	0.00	0.45	0.45
Quote obtained from GSE Lining Technologies, 19103 Gundle Road, Houston, TX, 800-435-2008 @ $0.45/sf furnished and	332810	SF		0	0	0	0	149,765	149,765

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
installed excluding earthwork. Allowing 15% for overlap and waste of material.								
M AF AA Spread Borrow w/Dozer			0.01	0.51	0.58	0.00	0.00	1.09
	17380 CY	CODTE	242	8,897	10,004	0	0	18,901
M MIL AA Furn & Pl Site Topsoil, 4"Dp			0.09	2.95	1.95	0.00	0.00	4.89
	1508.52 CY	CODLA	132	4,443	2,941	0	0	7,384
USR AA Rough Grade Large Area w/Dozer			0.00	0.16	0.41	0.00	0.00	0.56
300 HP	13578 SY	CODTK	56	2,120	5,511	0	0	7,631
B MIL AA Mechanical Seeding, 50#/MSY			0.08	2.21	0.10	5.50	0.00	7.81
	1222.02 CSF	ULABE	102	2,696	126	6,721	0	9,543
TOTAL Cell Cap System			3,218	91,478	49,341	65,744	149,765	356,328

12_ 2.10.02_ 01_ 06. Gas Venting Structures

-----Original Message-----
From:Robert Bessent [mailto:rbessent@maximusa.com]
Sent:February 17, 2000 12:11 PM
To:'randy.reiner@ptcinc.com'
Subject:RE: Ashtabula Landfill

Randy: I am in the process of reviewing the narrative; so far it looks good. Also, the design team has modified the number of gas vents in the cell caps. The new numbers are as follows:

GAS VENTS

-TSCA CELL: 3 TOTAL

-NON-TSCA CELL: 10 TOTAL

	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA 4" Dia HDPE Gas Vent			0.00	1200.00	1200.00	500.00	0.00	2900.00
	3.00 EA		0	3,600	3,600	1,500	0	8,700
TOTAL Gas Venting Structures			0	3,600	3,600	1,500	0	8,700

12_ 2.10.02_ 01_ 07. Leachate Collection System

	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA 10" Dia HDPE Slotted Pipe			0.22	7.60	1.45	7.75	0.00	16.80
	547.38 LF	XXPLA	120	4,159	796	4,242	0	9,197
USR AA 10" Dia HDPE Solid Pipe			0.22	7.60	1.45	7.75	0.00	16.80
	252.63 LF	XXPLA	56	1,919	367	1,958	0	4,245

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Imported Sand Material			0.12	3.18	0.11	0.00	12.00	15.29
Sand source assumed as Nelson Sand and Gravel, North Kingsville, OH. Quote obtained from Tom Nelson, (440) 224-0198.	80.00 CY	CLACC	10	255	9	0	960	1,224
L MIL AA Trench 1/2 CY Hyd Exc, Hvy Soil			0.07	2.15	1.48	0.00	0.00	3.64
Excavation for the bottom pipe run in the clay.	80.00 CY	CODEA	5	172	119	0	0	291
TOTAL Leachate Collection System			191	6,505	1,291	6,200	960	14,956
12_ 2.10.02_ 01_ 10. Temporary Frost Protection — Place temporary frost protection from stockpiled materials.								
L CIV AA Exc & Load,3 CY Hyd Exc,Med Matl			0.02	0.49	0.69	0.00	0.00	1.18
147 CY/Hr (112M3)	13577 CY	XXQHK	204	6,641	9,360	0	0	16,000
USR AA Haul 25LCY Truckload, Off-Road			0.01	0.24	0.63	0.00	0.00	0.87
1.6 Cycles/Hr	17379 CY	COETK	139	4,213	10,903	0	0	15,116
L MIL AA Sprd Dumped Fill/Grvl, 6" Layers			0.01	0.37	0.61	0.00	0.00	0.98
Without Compaction	17379 CY	CODTG	174	6,404	10,556	0	0	16,960
TOTAL Temporary Frost Protection			516	17,257	30,819	0	0	48,076
TOTAL TSCA Cell			14,458	423,881	313,748	234,527	372,517	1,344,673

12_ 2.10.02_ 02. Non-TSCA Cell

12_ 2.10.02_ 02_ 10. Cell Excavation

Estimated as 60% of the cell top layer area x 35' depth.

Excavated materials are being placed in cell berms and roadway embankments. 3' of these excavated materials are also placed as temporary frost protection for the liner material. Therefore, it will be required to be stockpiled and re-loaded/hauled to cover the liner.

The costs in this area include only those to excavate the material and haul for either the berm/roadway placement or to the stockpile area.

	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
L CIV AA Exc & Load,3 CY Hyd Exc,Med Matl			0.02	0.49	0.69	0.00	0.00	1.18
147 CY/Hr (112M3)	291410 CCY	XXQHK	4,371	142,529	200,898	0	0	343,427
USR AA Haul 25LCY Truckload, Off-Road			0.01	0.24	0.63	0.00	0.00	0.87
1.6 Cycles/Hr Quantity developed as 291,410cy	123005 LCY	COETK	984	29,816	77,173	0	0	106,990

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
excavated and swelled to 373,005 using swell factor of 1.28. Then, subtracting the portion of excess material generated by cell excavation (250,000 lcy)							
373,005-250,000 = 123,005lcy							
B AF AA 6 Mi, 16.5 LCY Truckload, 35 MPH		0.05	1.53	2.15	0.00	0.00	3.68
1.2 Cycles/Hr	250000 LCY COETH	12,625	382,625	537,650	0	0	920,275
TOTAL Cell Excavation		17,980	554,970	815,721	0	0	1,370,691
12_ 2.10.02_ 02_ 12. Cell Liner System							
B HTW AA 60 Mil HDPE		0.03	0.70	0.06	0.56	0.00	1.32
	401120 SF USKCF	10,710	282,749	22,944	224,627	0	530,321
USR AA Load & Haul Onsite Clay Material		0.02	0.49	0.69	0.00	0.87	2.05
from stockpiled excavated material. If offsite borrow source required, clay source assumed as Nelson Sand and Gravel, North Kingsville, OH. 1x10-7 clay material. Quote of $14.00/cy delivered obtained from Tom Nelson, (440) 224-0198.	45510 CY XXQHK	683	22,259	31,375	0	39,594	93,228
USR AA Geotextile Drainage Net		0.00	0.00	0.00	0.00	0.45	0.45
Quote obtained from GSE Lining Technologies, 19103 Gundle Road, Houston, TX, 800-435-2008 @ $0.45/sf furnished and installed excluding earthwork. Allowing 15% for overlap and waste of material.	802240 SF	0	0	0	0	361,008	361,008
USR AA Imported Sand Material		0.00	0.00	0.00	0.00	8.00	8.00
Sand source assumed as Nelson Sand and Gravel, North Kingsville, OH. Quote obtained from Tom Nelson, (440) 224-0198.	5995.52 CY	0	0	0	0	47,964	47,964
L MIL AA Sprd Dumped Fill/Grvl, 6" Layers		0.01	0.37	0.61	0.00	0.00	0.98
Without Compaction	45510 CY CODTG	455	16,771	27,643	0	0	44,414

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
L MIL AA Rough Grade Large Area w/Dozer				0.00	0.17	0.45	0.00	0.00	0.63
300 HP	35555	CY	CODTK	160	6,197	16,110	0	0	22,307
L USR AA Sprd Dumped Fill/Grvl, 6" Layers				0.01	0.46	0.76	0.00	0.00	1.22
Without Compaction	5995.52	CY	CODTG	75	2,762	4,552	0	0	7,315
L MIL AA Finish Grade w/Grader				0.01	0.36	0.20	0.00	0.00	0.56
	14052	SY	COFGA	160	5,109	2,796	0	0	7,906
L USR AA Compaction by Sheepsfoot Roller				0.02	0.64	0.80	0.00	0.05	1.49
8" Lifts	45510	CY	COFCP	833	29,127	36,194	0	2,276	67,597
USR AA Compaction by 10 Ton Steel Wheel				0.01	0.40	0.23	0.00	0.00	0.63
Tandem Roller	35555	SY	COFCK	427	14,204	8,078	0	0	22,282
Finished surface compaction prior to placement of Geotextile fabric.									
USR AA Compaction by 10 Ton Steel Wheel				0.01	0.25	0.14	0.00	0.00	0.39
Tandem Roller	14052	SY	COFCK	105	3,509	1,995	0	0	5,504
Finished surface compaction prior to placement of Geotextile fabric.									
L MIL AA Finish Grade Clay Surface				0.02	0.51	0.28	0.00	0.00	0.79
Base or Leveling Courses	35555	SY	COFGA	569	18,097	9,906	0	0	28,003
TOTAL Cell Liner System				14,177	400,785	161,594	224,627	450,842	1,237,848
12_ 2.10.02_ 02_ 14. Cell Cap System									
L HTW AA 40 Mil HDPE				0.02	0.42	0.03	0.42	0.00	0.88
	409400	SF	USKCF	6,550	173,135	14,042	171,948	0	359,126
L CIV AA Exc & Load,3 CY Hyd Exc,Med Matl				0.02	0.49	0.69	0.00	0.00	1.18
147 CY/Hr (112M3)	45510	CY	XXQHK	683	22,259	31,375	0	0	53,634
USR AA Haul 25LCY Truckload, Off-Road				0.01	0.24	0.63	0.00	0.00	0.87
1.6 Cycles/Hr	58253	CY	COETK	466	14,121	36,548	0	0	50,669
USR AA Geotextile Drainage Net				0.00	0.00	0.00	0.00	0.45	0.45
Quote obtained from GSE Lining	818800	SF		0	0	0	0	368,460	368,460
Technologies, 19103 Gundle Road, Houston, TX, 800-435-2008 @ $0.45/sf furnished and installed excluding earthwork. Allowing 15% for overlap and waste of material.									

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
M AF AA Spread Borrow w/Dozer			0.01	0.51	0.58	0.00	0.00	1.09
	45510 CY	CODTE	633	23,297	26,196	0	0	49,493
M MIL AA Furn & Pl Site Topsoil, 4"Dp			0.09	2.95	1.95	0.00	0.00	4.89
	3950.16 CY	CODLA	346	11,634	7,701	0	0	19,335
MIL AA Rough Grade Large Area w/Dozer			0.00	0.16	0.41	0.00	0.00	0.56
300 HP	35555 SY	CODTK	146	5,550	14,432	0	0	19,982
B MIL AA Mechanical Seeding, 50#/MSY			0.08	2.21	0.10	5.50	0.00	7.81
	3199.95 CSF	ULABE	267	7,059	331	17,600	0	24,989
TOTAL Cell Cap System			9,090	257,055	130,624	189,548	368,460	945,687

12_ 2.10.02_ 02_ 16. Gas Venting Structures

-----Original Message-----
From:Robert Bessent [mailto:rbessent@maximusa.com]
Sent:February 17, 2000 12:11 PM
To:'randy.reiner@ptcinc.com'
Subject:RE: Ashtabula Landfill

Randy: I am in the process of reviewing the narrative; so far it looks good. Also, the design team has modified the number of gas vents in the cell caps. The new numbers are as follows:

GAS VENTS

-TSCA CELL: 3 TOTAL

-NON-TSCA CELL: 10 TOTAL

	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA 4" Dia HDPE Gas Vent			0.00	1200.00	1200.00	500.00	0.00	2900.00
	10.00 EA		0	12,000	12,000	5,000	0	29,000
TOTAL Gas Venting Structures			0	12,000	12,000	5,000	0	29,000

12_ 2.10.02_ 02_ 17. Leachate Collection Sytem

	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA 10" Dia HDPE Slotted Pipe			0.22	7.60	1.45	7.75	0.00	16.80
	1404.12 LF	XXPLA	309	10,668	2,042	10,882	0	23,591
USR AA 10" Dia HDPE Solid Pipe			0.22	7.60	1.45	7.75	0.00	16.80
	195.86 LF	XXPLA	43	1,488	285	1,518	0	3,291
USR AA Imported Sand Material			0.12	3.18	0.11	0.00	12.00	15.29
Sand source assumed as Nelson Sand and Gravel, North Kingsville, OH.	160.00 CY	CLACC	19	510	18	0	1,920	2,447

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
Quote obtained from Tom Nelson, (440) 224-0198.							
L MIL AA Trench 1/2 CY Hyd Exc, Hvy Soil		0.07	2.15	1.48	0.00	0.00	3.64
Excavation for the bottom pipe run in the clay.	160.00 CY CODEA	11	345	237	0	0	582
TOTAL Leachate Collection Sytem		382	13,010	2,581	12,400	1,920	29,911
12_ 2.10.02_ 02_ 20. Temporary Frost Protection — Place temporary frost protection from stockpiled materials.							
L CIV AA Exc & Load,3 CY Hyd Exc,Med Matl		0.02	0.49	0.69	0.00	0.00	1.18
147 CY/Hr (112M3)	35555 CY XXQHK	533	17,390	24,512	0	0	41,902
USR AA Haul 25LCY Truckload, Off-Road		0.01	0.24	0.63	0.00	0.00	0.87
1.6 Cycles/Hr	45510 CY COETK	364	11,032	28,553	0	0	39,585
L MIL AA Sprd Dumped Fill/Grvl, 6" Layers		0.01	0.37	0.61	0.00	0.00	0.98
Without Compaction	45510 CY CODTG	455	16,771	27,643	0	0	44,414
TOTAL Temporary Frost Protection		1,353	45,192	80,708	0	0	125,900
TOTAL Non-TSCA Cell		42,981	1,283,012	1,203,229	431,575	821,222	3,739,038
TOTAL Landfill Construction		57,439	1,706,893	1,516,977	666,101	1193739	5,083,711
12_ 2.10.03. Site Improvements							
12_ 2.10.03_ 02. Clear & Grub							
12_ 2.10.03_ 02_ 01. Clearing							
MIL SW Clear and Grub Hvy Trees to 16"D		90.91	2562.24	1459.04	0.00	0.00	4021.28
(41cm) Dia, Cut and Chip	28.40 ACR COMCA	2,582	88,241	50,248	0	0	138,489
TOTAL Clearing		2,582	88,241	50,248	0	0	138,489
12_ 2.10.03_ 02_ 04. Chipping							
USR SW Chipping - Hvy. Brush		38.46	1084.02	617.29	0.00	0.00	1701.31
	28.40 ACR COMCA	1,092	37,333	21,259	0	0	58,591
L USR SW Machine Load Spoils, On-site		0.03	1.01	0.94	0.00	0.00	1.95
haul to stockpile berms	9940.00 CY COETL	341	12,190	11,280	0	0	23,470
TOTAL Chipping		1,433	49,523	32,539	0	0	82,061

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Clear & Grub		4,015	137,763	82,786	0	0	220,550
12_ 2.10.03_ 11. Erosion Control							
12_ 2.10.03_ 11_ 01. Silt Fence							
USR AA Silt Fence		0.03	0.97	0.20	0.40	0.00	1.57
	5000.00 LF XLABF	150	4,844	986	2,000	0	7,829
TOTAL Silt Fence		150	4,844	986	2,000	0	7,829
12_ 2.10.03_ 11_ 02. Dust Control							
USR AA Temporary Dust Control		0.44	14.34	10.31	5.00	0.00	29.66
Assumes 2 loads/day during excavation operations to suppress dust. Each load @ 3000 gal = 6 Mgal/day for 3 months (22 days/month) = 66 x 6 = 396 MGal / excavation operation x 2 = 800 MGal	800.00 MGL COFWI	350	11,472	8,252	4,000	0	23,724
TOTAL Dust Control		350	11,472	8,252	4,000	0	23,724
12_ 2.10.03_ 11_ 03. Temporary Bale Checks Allow for one per acre.							
USR AA Temporary Bale Checks		1.00	32.29	6.57	25.00	0.00	63.86
Haybale anchorages in ditches to control erosion/runoff during construction.	80.00 EA XLABF	80	2,583	526	2,000	0	5,109
TOTAL Temporary Bale Checks		80	2,583	526	2,000	0	5,109
12_ 2.10.03_ 11_ 04. Temporary Mulch Berms Use chippings/mulch from cleared trees.							
USR AA Sprd Dumped Mulch, 12" Layers		0.01	0.26	0.43	0.00	0.00	0.70
Construct temporary erosion control berms.	17500 CY CODTG	124	4,606	7,593	0	0	12,199
TOTAL Temporary Mulch Berms		124	4,606	7,593	0	0	12,199
TOTAL Erosion Control		704	23,505	17,356	8,000	0	48,861

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 2.10.03_ 12. Non-Contact Stormwater Basin									
12_ 2.10.03_ 12_ 01. NC Stormwater Basin Excavation									
L MIL AA Shape Embankment/Slope w/Machine				0.05	1.58	0.69	0.00	0.00	2.27
Up to 1 on 4 Slope	1481.04	SY	COFCF	69	2,340	1,027	0	0	3,367
MIL AA Remove Topsoil, 4"(10cm) Deep				0.03	0.93	1.54	2.92	0.00	5.39
Stockpile on Site	1652.40	CY	CODTG	42	1,542	2,541	4,820	0	8,902
MIL AA Spread Topsoil by Loader				0.06	2.06	1.36	5.10	0.00	8.53
From Stockpile	1652.40	CY	CODLA	101	3,402	2,252	8,434	0	14,088
M MIL AA Mechanical Seeding, 450#/Acre				32.89	870.75	40.77	2325.00	0.00	3236.52
	3.06	ACR	ULABE	101	2,664	125	7,115	0	9,904
L CIV AA Exc & Load,3 CY Hyd Exc,Med Matl				0.02	0.49	0.69	0.00	0.00	1.18
147 CY/Hr (112M3)	84973	CY	XXQHK	1,275	41,560	58,580	0	0	100,141
USR AA Haul 25LCY Truckload, Off-Road				0.01	0.24	0.63	0.00	0.00	0.87
1.6 Cycles/Hr	108766	CY	COETK	870	26,365	68,240	0	0	94,604
TOTAL NC Stormwater Basin Excavation				2,457	77,873	132,765	20,368	0	231,006
12_ 2.10.03_ 12_ 02. NC Stormwater Basin Pump Station							** ADJUSTED **		
USR AA NCSW Basin Pump Station				0.00	0.00	0.00	0.00	10000.00	10000.00
	1.00	LS		0	0	0	0	10,000	10,000
MIL PL 1700GPM Press Booster Sys,6"Disc				20.71	762.59	94.87	10037.91	0.00	10895.37
w/30 HP Triplex & 100' Head	1.00	EA	MPLUQ	21	925	115	12,172	0	13,212
TOTAL NC Stormwater Basin Pump Station				21	925	115	12,172	10,000	23,212
12_ 2.10.03_ 12_ 03. NCSB Transfer Piping - Lake Erie									
USR AA 8" Dia HDPE Solid Pipe				0.28	9.50	1.82	5.65	2.00	18.96
	500.00	LF	XXPLA	138	4,748	909	2,825	1,000	9,482
L MIL AA Trench, 2-1/2 CY Hyd Excavator				0.12	3.78	5.52	0.00	0.00	9.29
113 CY/Hr (86M3)/Hr	625.00	CY	CODEU	75	2,359	3,447	0	0	5,806
L MIL AA Backfill Trench w/Sm FEnd Loader				0.08	2.52	1.68	0.00	0.00	4.20
Without Compaction	600.00	CY	CODLB	45	1,513	1,005	0	0	2,518
L MIL AA Compaction, 6" Layers, Vib Plate				0.15	3.98	0.14	0.00	0.00	4.12
(15cm) Layers	600.00	CY	CLACC	90	2,388	83	0	0	2,471

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
B MIL AA Sand Bedding w/Sm FEnd Loader		0.15	5.04	3.35	0.00	12.00	20.39
Without Compaction	25.00 CY CODLB	4	126	84	0	300	510
USR AA Lake Erie Outlet Structure		0.08	2.52	1.68	0.00	75000.00	75004.20
	1.00 JOB CODLB	0	3	2	0	75,000	75,004
USR AA Jack & Bore Under Lake Road		0.00	0.00	0.00	0.00	250.00	250.00
	100.00 LF	0	0	0	0	25,000	25,000
TOTAL NCSB Transfer Piping - Lake Erie		351	11,138	5,529	2,825	101,300	120,792
12_ 2.10.03_ 12_ 04. NCSB Transfer Piping - LTB							
USR AA 8" Dia HDPE Solid Pipe		0.22	7.60	1.45	5.25	1.00	15.30
	140.00 LF XXPLA	31	1,064	204	735	140	2,142
L MIL AA Trench, 2-1/2 CY Hyd Excavator		0.08	2.36	3.45	0.00	0.00	5.81
113 CY/Hr (86M3)/Hr	175.00 CY CODEU	13	413	603	0	0	1,016
L MIL AA Backfill Trench w/Sm FEnd Loader		0.05	1.68	1.12	0.00	0.00	2.80
Without Compaction	168.00 CY CODLB	8	282	188	0	0	470
L MIL AA Compaction, 6" Layers, Vib Plate		0.10	2.65	0.09	0.00	0.00	2.75
(15cm) Layers	168.00 CY CLACC	17	446	15	0	0	461
B MIL AA Sand Bedding w/Sm FEnd Loader		0.08	2.52	1.68	0.00	12.00	16.20
Without Compaction	7.00 CY CODLB	1	18	12	0	84	113
TOTAL NCSB Transfer Piping - LTB		70	2,222	1,022	735	224	4,203
TOTAL Non-Contact Stormwater Basin		2,899	92,158	139,430	36,101	111,524	379,213
12_ 2.10.03_ 13. Contact Stormwater Basin 1							
12_ 2.10.03_ 13_ 01. Contact Stormwater Basin Excav							
L MIL AA Shape Embankment/Slope w/Machine		0.02	0.59	0.26	0.00	0.00	0.85
Up to 1 on 4 Slope	284.45 SY COFCF	5	169	74	0	0	243
MIL AA Remove Topsoil, 4"(10cm) Deep		0.03	0.93	1.54	2.92	0.00	5.39
Stockpile on Site	317.36 CY CODTG	8	296	488	926	0	1,710
MIL AA Spread Topsoil by Loader		0.06	2.06	1.36	5.10	0.00	8.53
From Stockpile	317.36 CY CODLA	19	653	432	1,620	0	2,706
M MIL AA Mechanical Seeding, 450#/Acre		32.89	870.75	40.77	2325.00	0.00	3236.52
	0.59 ACR ULABE	19	512	24	1,366	0	1,902

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
L CIV AA Exc & Load,3 CY Hyd Exc,Med Matl			0.02	0.49	0.69	0.00	0.00	1.18
147 CY/Hr (112M3)	15197 CY	XXQHK	228	7,433	10,477	0	0	17,909
USR AA Haul 25LCY Truckload, Off-Road			0.01	0.24	0.63	0.00	0.00	0.87
1.6 Cycles/Hr	19452 CY	COETK	156	4,715	12,204	0	0	16,919
TOTAL Contact Stormwater Basin Excav			435	13,778	23,699	3,912	0	41,389
12_ 2.10.03_ 13_ 02. Contact Stormwater Basin Liner								
L HTW AA 40 Mil HDPE			0.02	0.42	0.03	0.42	0.00	0.88
	29440 SF	USKCF	471	12,450	1,010	12,365	0	25,825
B HTW AA 60 Mil HDPE			0.03	0.70	0.06	0.56	0.00	1.32
	29440 SF	USKCF	786	20,752	1,684	16,487	0	38,923
USR AA Geotextile Drainage Net			0.00	0.00	0.00	0.00	0.45	0.45
Quote obtained from GSE Lining Technologies @ $0.45/sf furnished and installed excluding earthwork. Allowing 15% for overlap and waste of material.	29440 SF		0	0	0	0	13,248	13,248
TOTAL Contact Stormwater Basin Liner			1,257	33,203	2,694	28,851	13,248	77,996
12_ 2.10.03_ 13_ 03. Contact SW Basin Transfer Piping								
USR AA 8" Dia HDPE Solid Pipe			0.22	7.60	1.45	5.25	1.00	15.30
	410.00 LF	XXPLA	90	3,115	596	2,153	410	6,274
L MIL AA Trench, 2-1/2 CY Hyd Excavator			0.08	2.36	3.45	0.00	0.00	5.81
113 CY/Hr (86M3)/Hr	512.50 CY	CODEU	38	1,209	1,767	0	0	2,976
L MIL AA Backfill Trench w/Sm FEnd Loader			0.05	1.68	1.12	0.00	0.00	2.80
Without Compaction	492.00 CY	CODLB	25	827	550	0	0	1,377
L MIL AA Compaction, 6" Layers, Vib Plate			0.10	2.65	0.09	0.00	0.00	2.75
(15cm) Layers	492.00 CY	CLACC	49	1,306	45	0	0	1,351
B MIL AA Sand Bedding w/Sm FEnd Loader			0.08	2.52	1.68	0.00	12.00	16.20
Without Compaction	20.50 CY	CODLB	2	52	34	0	246	332
TOTAL Contact SW Basin Transfer Piping			204	6,509	2,992	2,153	656	12,309
TOTAL Contact Stormwater Basin 1			1,896	53,489	29,385	34,916	13,904	131,693

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 2.10.03_ 14. Contact Stormwater Basin 2									
12_ 2.10.03_ 14_ 01. Contact Stormwater Basin Excav									
L MIL AA Shape Embankment/Slope w/Machine				0.02	0.59	0.26	0.00	0.00	0.85
Up to 1 on 4 Slope	626.63	SY	COFCF	11	371	163	0	0	534
MIL AA Remove Topsoil, 4"(10cm) Deep				0.03	0.93	1.54	2.92	0.00	5.39
Stockpile on Site	699.14	CY	CODTG	18	652	1,075	2,039	0	3,767
MIL AA Spread Topsoil by Loader				0.06	2.06	1.36	5.10	0.00	8.53
From Stockpile	699.14	CY	CODLA	43	1,439	953	3,569	0	5,961
M MIL AA Mechanical Seeding, 450#/Acre				32.89	870.75	40.77	2325.00	0.00	3236.52
	1.29	ACR	ULABE	43	1,127	53	3,010	0	4,190
L CIV AA Exc & Load,3 CY Hyd Exc,Med Matl				0.02	0.49	0.69	0.00	0.00	1.18
147 CY/Hr (112M3)	30000	CY	XXQHK	450	14,673	20,682	0	0	35,355
USR AA Haul 25LCY Truckload, Off-Road				0.01	0.24	0.63	0.00	0.00	0.87
1.6 Cycles/Hr	38400	CY	COETK	307	9,308	24,092	0	0	33,400
TOTAL Contact Stormwater Basin Excav				871	27,571	47,018	8,618	0	83,207
12_ 2.10.03_ 14_ 02. Contact Stormwater Basin Liner									
L HTW AA 40 Mil HDPE				0.02	0.42	0.03	0.42	0.00	0.88
	64857	SF	USKCF	1,038	27,428	2,225	27,240	0	56,892
TOTAL Contact Stormwater Basin Liner				1,038	27,428	2,225	27,240	0	56,892
12_ 2.10.03_ 14_ 03. Contact SW Basin Transfer Piping									
USR AA 8" Dia HDPE Solid Pipe				0.22	7.60	1.45	5.25	1.00	15.30
	410.00	LF	XXPLA	90	3,115	596	2,153	410	6,274
L MIL AA Trench, 2-1/2 CY Hyd Excavator				0.08	2.36	3.45	0.00	0.00	5.81
113 CY/Hr (86M3)/Hr	512.50	CY	CODEU	38	1,209	1,767	0	0	2,976
L MIL AA Backfill Trench w/Sm FEnd Loader				0.05	1.68	1.12	0.00	0.00	2.80
Without Compaction	492.00	CY	CODLB	25	827	550	0	0	1,377
L MIL AA Compaction, 6" Layers, Vib Plate				0.10	2.65	0.09	0.00	0.00	2.75
(15cm) Layers	492.00	CY	CLACC	49	1,306	45	0	0	1,351
B MIL AA Sand Bedding w/Sm FEnd Loader				0.08	2.52	1.68	0.00	12.00	16.20
Without Compaction	20.50	CY	CODLB	2	52	34	0	246	332

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Contact SW Basin Transfer Piping			204	6,509	2,992	2,153	656	12,309
TOTAL Contact Stormwater Basin 2			2,113	61,508	52,234	38,010	656	152,408
12_ 2.10.03_ 17. Truck Staging Area								
CIV AA Geotextile Fabric, 90 Mils Thick			0.02	0.53	0.02	1.00	0.00	1.55
Non-Woven Polypropylene	3210.00 SY	ULABJ	64	1,704	74	3,213	0	4,990
Overlap and waste factor - 7%								
MIL AA Crushed Stone Paving, Large Area			0.03	1.07	0.50	0.34	0.00	1.90
Prepare and Roll Subbase	3000.00 SY	XSGRA	96	3,195	1,487	1,007	0	5,689
MIL AA Crushed Base 9 In Depth (23 Cm)			0.06	1.84	1.83	4.16	0.00	7.83
	3000.00 SY	XSABA	171	5,522	5,504	12,465	0	23,491
TOTAL Truck Staging Area			331	10,421	7,064	16,685	0	34,170
12_ 2.10.03_ 20. Site Utilities								
12_ 2.10.03_ 20_ 1. Electrical Service								
USR AL Flectrical Service			0.00	0.00	0.00	0.00	350000	350000.00
	1.00 EA		0	0	0	0	350,000	350,000
TOTAL Electrical Service			0	0	0	0	350,000	350,000
12_ 2.10.03_ 20_ 2. Water Service								
L MIL AA Trench, 1 CY Hyd Excav, Lt Soil			0.07	2.15	2.17	0.00	0.00	4.32
4' To 6' Deep, 155 CY/HR	2250.00 CY	CODEO	150	4,846	4,879	0	0	9,725
L MIL AA Backfill Trench w/Sm FEnd Loader			0.05	1.68	1.12	0.00	0.00	2.80
Without Compaction	1950.00 CY	CODLB	98	3,279	2,178	0	0	5,456
L MIL AA Compaction, 6" Layers, Vib Plate			0.10	2.65	0.09	0.00	0.00	2.75
(15cm) Layers	2100.00 CY	CLACC	210	5,573	193	0	0	5,765
B MIL AA Sand Bedding w/Sm FEnd Loader			0.08	2.52	1.68	0.00	12.00	16.20
Without Compaction	150.00 CY	CODLB	11	378	251	0	1,800	2,430
L MIL AA 4"Dia PVC SDR 18, Class 150 Pipe			0.14	4.75	0.91	1.77	0.00	7.43
(10cm) Diameter, AWWA, C900	3000.00 LF	XXPLA	413	14,245	2,726	5,316	0	22,287
USR AA Fittings Allowance			0.22	7.60	1.45	3.00	0.00	12.05
	150.00 EA	XXPLA	33	1,140	218	450	0	1,808

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Water Meter Allowance			0.22	7.60	1.45	0.00	7500.00	7509.05
	1.00 JOB	XXPLA	0	8	1	0	7,500	7,509
USR AA Backflow Preventer Allowance			0.22	7.60	1.45	0.00	5000.00	5009.05
	1.00 JOB	XXPLA	0	8	1	0	5,000	5,009
TOTAL Water Service			915	29,475	10,448	5,766	14,300	59,989

12_ 2.10.03_ 20_ 3. Sanitary Sewer

There was no information available detailing the sanitary sewer system. Therefore, the type of system, pipe size, and pipe quantity was assumed.

	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA 2,000 Gal Precast Septic Tank			5.60	207.87	29.23	539.00	0.00	776.10
No Excavation or Piping	3.00 EA	MPLUS	17	624	88	1,617	0	2,328
L MIL AA Trench, 2 CY Hyd Excav, Med Soil			0.06	2.04	2.89	0.00	0.00	4.93
192 CY/Hr (147M3)	450.00 CY	CODET	28	916	1,302	0	0	2,218
L MIL AA Trench 1/2 CY Hyd Exc, Hvy Soil			0.08	2.58	1.78	0.00	0.00	4.36
51 CY/Hr (40M3)/Hr	198.00 CY	CODEA	16	512	352	0	0	864
L MIL AA Backfill Trench w/Sm FEnd Loader			0.05	1.68	1.12	0.00	0.00	2.80
Without Compaction	200.00 CY	CODLB	10	336	223	0	0	560
[Assumed that the excess excavated material will be backfilled in the surrounding area.]								
L MIL AA Backfill Trench w/Sm FEnd Loader			0.05	1.68	1.12	0.00	0.00	2.80
Without Compaction	180.00 CY	CODLB	9	303	201	0	0	504
L MIL AA Compaction, 6" Layers, Vib Plate			0.10	2.65	0.09	0.00	0.00	2.75
(15cm) Layers	210.00 CY	CLACC	21	557	19	0	0	577
L MIL AA Compaction, 6" Layers, Vib Plate			0.10	2.65	0.09	0.00	0.00	2.75
(15cm) Layers	198.00 CY	CLACC	20	525	18	0	0	544
B MIL AA Sand Bedding w/Sm FEnd Loader			0.08	2.52	1.68	0.00	12.00	16.20
Without Compaction	10.00 CY	CODLB	1	25	17	0	120	162
B MIL AA Sand Bedding w/Sm FEnd Loader			0.08	2.52	1.68	0.00	12.00	16.20
Without Compaction	18.00 CY	CODLB	1	45	30	0	216	292
MIL AA 6" Dia PVC Schedule 40 Pipe			0.08	2.73	0.04	2.23	0.00	5.00
(15cm) Diameter	600.00 LF	XPLUC	48	1,638	24	1,339	0	3,001

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Fittings Allowance				0.22	7.60	1.45	3.00	0.00	12.05
	30.00	EA	XXPLA	7	228	44	90	0	362
TOTAL Sanitary Sewer				177	5,710	2,318	3,046	336	11,410
12_ 2.10.03_ 20_ 5. Storm Sewer									
USR AA 12" Dia HDPE Solid Pipe				0.22	7.60	1.45	10.00	0.00	19.05
	8500.00	LF	XXPLA	1,870	64,577	12,360	85,000	0	161,937
MIL AA 3'-8"x3'-8"x6'Dp CIP Grate Inlet				33.09	1066.17	20.64	784.52	0.00	1871.32
6" Thick Wall, Storm Drainage	40.00	EA	ALABM	1,324	42,647	825	31,381	0	74,853
L MIL AA Trench 1/2 CY Hyd Exc, Hvy Soil				0.07	2.15	1.48	0.00	0.00	3.64
Excavation for the bottom pipe run in the clay.	3230.00	CY	CODEA	215	6,956	4,790	0	0	11,747
L MIL AA Backfill Trench w/Sm FEnd Loader				0.05	1.68	1.12	0.00	0.00	2.80
Without Compaction	2550.00	CY	CODLB	128	4,287	2,848	0	0	7,135
L MIL AA Compaction, 6" Layers, Vib Plate				0.10	2.65	0.09	0.00	0.00	2.75
(15cm) Layers	2805.00	CY	CLACC	281	7,444	257	0	0	7,701
B MIL AA Sand Bedding w/Sm FEnd Loader				0.08	2.52	1.68	0.00	12.00	16.20
Without Compaction	255.00	CY	CODLB	19	643	427	0	3,060	4,130
TOTAL Storm Sewer				3,836	126,554	21,508	116,381	3,060	267,503
TOTAL Site Utilities				4,928	161,739	34,274	125,192	367,696	688,902
12_ 2.10.03_ 24. Site Roadways & Lots									
12_ 2.10.03_ 24_ 05. Roadbed Construction Quantity of 2' thick roadbed placement calculated as 33,333sy * 2/3 = 22,333 cy									
L MIL AA Sprd Dumped Fill/Grvl, 6" Layers				0.01	0.37	0.61	0.00	0.00	0.98
Without Compaction	28586	CY	CODTG	286	10,534	17,363	0	0	27,897
L MIL AA Rough Grade Large Area w/Dozer				0.01	0.38	1.00	0.00	0.00	1.38
300 HP	33333	SY	CODTK	333	12,780	33,230	0	0	46,010
L USR AA Compaction by Sheepsfoot Roller				0.02	0.64	0.80	0.00	0.05	1.49
8" Lifts	11000	CY	COFCP	201	7,040	8,748	0	550	16,338
USR AA Compaction by 10 Ton Steel Wheel				0.01	0.20	0.11	0.00	0.00	0.31
Tandem Roller	33333	SY	COFCK	200	6,660	3,787	0	0	10,447

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
L MIL AA Finish Grade Surface				0.01	0.35	0.19	0.00	0.00	0.55
Base or Leveling Courses	33333	SY	COFGA	370	11,783	6,450	0	0	18,233
TOTAL Roadbed Construction				1,390	48,797	69,578	0	550	118,925
12_ 2.10.03_ 24_ 10. Gravel Access Road									
USR AA Scarify & Recompact Subgrade				0.03	1.07	0.50	0.00	0.00	1.56
	31871	SY	XSGRA	1,020	33,946	15,792	0	0	49,738
MIL AA Crushed Stone Paving, Large Area				0.03	1.07	0.50	0.34	0.00	1.90
Prepare and Roll Subbase	31871	SY	XSGRA	1,020	33,946	15,792	10,702	0	60,440
MIL AA Crushed Base 9 In Depth (23 Cm)				0.06	1.84	1.83	4.16	0.00	7.83
	31871	SY	XSABA	1,813	58,665	58,471	132,424	0	249,559
TOTAL Gravel Access Road				3,853	126,557	90,055	143,126	0	359,738
12_ 2.10.03_ 24_ 15. Existing Road Improvement									
USR AA Scarify & Recompact Subgrade				0.03	1.07	0.50	0.00	0.00	1.56
	1162.00	SY	XSGRA	37	1,238	576	0	0	1,813
MIL AA Crushed Stone Paving, Large Area				0.03	1.07	0.50	0.34	0.00	1.90
Prepare and Roll Subbase	1162.00	SY	XSGRA	37	1,238	576	390	0	2,204
MIL AA Crushed Base 9 In Depth (23 Cm)				0.06	1.84	1.83	4.16	0.00	7.83
	1162.00	SY	XSABA	66	2,139	2,132	4,828	0	9,099
MIL AA Bituminous Hot Mix Intrm Course				0.48	15.42	5.63	17.68	0.00	38.73
3954#/CY (2349Kg/M3),Ctrl Plant	132.47	TON	XASPA	64	2,043	746	2,342	0	5,130
Assume 2 inches									
MIL AA Tack Coat, .1 Gal/SY (.5L/M2)				0.03	0.92	0.57	1.27	0.00	2.75
	209.16	CSF	COKBD	7	192	118	265	0	575
MIL AA Bituminous Hot Mix Surf Course				0.48	15.42	5.63	22.98	0.00	44.03
3774#/CY (2242Kg/M3),Ctrl Plant	98.77	TON	XASPA	47	1,523	556	2,270	0	4,349
Assume 1.5 inches									
L MIL AA 6" x 24" Conc Gutter w/6" Curb				0.16	5.57	0.38	2.03	0.00	7.98
Formwork, Rebar, and Finishing	1266.00	LF	XCBGA	203	7,052	477	2,570	0	10,099
TOTAL Existing Road Improvement				461	15,424	5,180	12,665	0	33,270

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 2.10.03_ 24_ 20. Gravel Parking at Office							
USR AA Scarify & Recompact Subgrade		0.03	1.07	0.50	0.00	0.00	1.56
	300.00 SY XSGRA	10	320	149	0	0	468
MIL AA Crushed Stone Paving, Large Area		0.03	1.07	0.50	0.34	0.00	1.90
Prepare and Roll Subbase	300.00 SY XSGRA	10	320	149	101	0	569
MIL AA Crushed Base 9 In Depth (23 Cm)		0.06	1.84	1.83	4.16	0.00	7.83
	300.00 SY XSABA	17	552	550	1,247	0	2,349
TOTAL Gravel Parking at Office		36	1,191	848	1,347	0	3,386
TOTAL Site Roadways & Lots		5,741	191,969	165,660	157,139	550	515,318
12_ 2.10.03_ 42. Site Restoration							
M MIL AA Mechanical Seeding, 450#/Acre		32.89	870.75	40.77	2325.00	0.00	3236.52
	6.00 ACR ULABE	197	5,225	245	13,950	0	19,419
TOTAL Site Restoration		197	5,225	245	13,950	0	19,419
TOTAL Site Improvements		22,825	737,777	528,435	429,992	494,330	2,190,535

12_ 2.10.05. General Conditions

12_ 2.10.05_ 1. Mobilization / De-mobilization

12_ 2.10.05_ 1_ 01. Mobilization

All major equipment to be used on the project is covered for 8 hours operating time to account for loading, transportation, offloading, and fit-up.

An operator, laborer and mechanic are covered for 8 hours each per piece of equipment. Lowboy and truck driver are covered for 16 hours per major piece of equipment.

Estimate includes moving 23 major pieces of equipment. Minor pieces of equipment are anticipated to be included on loads carrying major pieces of equipment and are therefore incidental to the major equipment moves.

	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA Outside Equip. Oilers		1.00	29.77	0.00	0.00	0.00	29.77
	184.00 HR X-EQOPROIL	184	5,478	0	0	0	5,478
MIL AA Outside Equip. Operators, Heavy		0.00	38.24	0.00	0.00	0.00	38.24
	184.00 HR X-EQOPRHVY	0	7,036	0	0	0	7,036
MIL AA Outside Laborers, (Semi-Skilled)		0.00	29.81	0.00	0.00	0.00	29.81
	184.00 HR X-LABORER	0	5,485	0	0	0	5,485

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA Outside Truck Drivers, Heavy				0.00	29.40	0.00	0.00	0.00	29.40
	368.00	HR	X-TRKDVRHV	0	10,819	0	0	0	10,819
UPB AA TRLR,LOWBOY,120T, 4 AXLE				0.00	0.00	15.03	0.00	0.00	15.03
(ADD TOWING TRUCK)	368.00	HR	T45XX023	0	0	5,530	0	0	5,530
MAP AA TRK,HWY, 50,000 GVW, 6X4, 3 AXLE				0.00	0.00	35.93	0.00	0.00	35.93
	368.00	HR	T50KE004	0	0	13,224	0	0	13,224
MIL AA COMPACTOR, RAMMER, 11"X13" SHOE				0.00	0.00	2.39	0.00	0.00	2.39
	8.00	HR	C10WC003	0	0	19	0	0	19
MIL AA CRANE,HYD,S/P,RT,4WD,20T/70'BOOM				0.00	0.00	34.78	0.00	0.00	34.78
	8.00	HR	C75GV002	0	0	278	0	0	278
MIL AA CRANE,HYD,S/P,RT,4WD,30T/80'BOOM				0.00	0.00	48.63	0.00	0.00	48.63
	8.00	HR	C75GV011	0	0	389	0	0	389
MIL AA CRANE,HYD,TRK MTD, 75T /114'BOOM				0.00	0.00	76.41	0.00	0.00	76.41
	8.00	HR	C80GV008	0	0	611	0	0	611
MIL AA GRADER,MOTOR, ARTIC, CAT 120-G				0.00	0.00	28.71	0.00	0.00	28.71
	8.00	HR	G15CA001	0	0	230	0	0	230
UPB AA GRADER,MOTOR, ARTIC, CAT 12-G				0.00	0.00	34.82	0.00	0.00	34.82
	8.00	HR	G15CA003	0	0	279	0	0	279
MIL AA HYD EXCAV, CRWLR, 1.05 CY BKT				0.00	0.00	35.06	0.00	0.00	35.06
	8.00	HR	H25KO003	0	0	281	0	0	281
EP AA HYD EXCAV, CRWLR, 23,540 LBS,				0.00	0.00	27.54	0.00	0.00	27.54
0.60 CY BKT	8.00	HR	H25HI001	0	0	220	0	0	220
EP AA HYD EXCAV, CRWLR,146,080 LBS,				0.00	0.00	143.66	0.00	0.00	143.66
3.79 CY BKT	8.00	HR	H25HI019	0	0	1,149	0	0	1,149
EP AA HYD EXCAV, CRWLR, 60,500 LBS,				0.00	0.00	56.64	0.00	0.00	56.64
1.50 CY BKT,LC	8.00	HR	H25HI010	0	0	453	0	0	453
EP AA LANDCLR,ROTRY CUTTR, 5'W-SIDE MT				0.00	0.00	2.56	0.00	0.00	2.56
(ADD FARM 50HP TRACTOR)	8.00	HR	L10BU005	0	0	20	0	0	20
UPB AA LDR,FE, CRWLR, 1.50 CY				0.00	0.00	33.51	0.00	0.00	33.51
	8.00	HR	L35CA004	0	0	268	0	0	268
UPB AA LDR,FE, CRWLR, 3.75 CY				0.00	0.00	88.47	0.00	0.00	88.47
	8.00	HR	L35CA007	0	0	708	0	0	708
MIL AA LDR,FE, WH, 3.25 CY, ARTIC, 950E				0.00	0.00	43.45	0.00	0.00	43.45
	8.00	HR	L40CA005	0	0	348	0	0	348

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
UPB AA LDR,BH,WH, 1.38CY FE BKT, 30"DIP			0.00	0.00	19.32	0.00	0.00	19.32
	8.00 HR	L50CA003	0	0	155	0	0	155
MIL AA ROLLR,STATIC,S/P,24T,68"W, 9TIRE			0.00	0.00	18.05	0.00	0.00	18.05
	8.00 HR	R30CA002	0	0	144	0	0	144
MIL AA LNDFL COMP,SHPSFT,S/P 22T, 76"W			0.00	0.00	51.58	0.00	0.00	51.58
	8.00 HR	R30CA003	0	0	413	0	0	413
MIL AA ROLLER,VIB,DD,S/P, 6.9T, 55"W			0.00	0.00	28.39	0.00	0.00	28.39
	8.00 HR	R45BO002	0	0	227	0	0	227
UPB AA DOZER,CWLR, D-6H,PS			0.00	0.00	47.64	0.00	0.00	47.64
(ADD BLADE & ATTACHMENTS)	8.00 HR	T15CA010	0	0	381	0	0	381
MAP AA DOZER,CWLR, D7R PS,W/BLADE			0.00	0.00	64.41	0.00	0.00	64.41
(ADD ATTACHMENTS)	8.00 HR	T15CA012	0	0	515	0	0	515
MAP AA DOZER,CWLR, D-8R PS,W/BLADE			0.00	0.00	77.69	0.00	0.00	77.69
(ADD ATTACHMENTS)	8.00 HR	T15CA016	0	0	622	0	0	622
MIL AA TRACTOR,WH,FARM, 65-75HP, 2WD			0.00	0.00	9.72	0.00	0.00	9.72
	8.00 HR	T25JD003	0	0	78	0	0	78
UPB AA HYDR CRANE 8.0T,W/ 85'BOOM			0.00	0.00	12.48	0.00	0.00	12.48
(ADD TRUCK & FLATBED)	8.00 HR	T40XX003	0	0	100	0	0	100
MAP AA BLADE, UNIVERSAL, HYDR, D-8			0.00	0.00	7.66	0.00	0.00	7.66
(ADD D-8 TRACTOR)	8.00 HR	T10CA017	0	0	61	0	0	61
MIL AA LDR,FE, WH, 3.25 CY, ARTIC, 950E			0.00	0.00	43.45	0.00	0.00	43.45
	8.00 HR	L40CA005	0	0	348	0	0	348
UPB AA HYD EXCAV, CRWLR, 3.125CY BKT			0.00	0.00	137.70	0.00	0.00	137.70
	8.00 HR	H25CA008	0	0	1,102	0	0	1,102
UPB AA DOZER,CWLR, D-6H,PS			0.00	0.00	47.64	0.00	0.00	47.64
(ADD BLADE & ATTACHMENTS)	8.00 HR	T15CA010	0	0	381	0	0	381
MIL AA ROLLER,VIB,DD,S/P, 6.9T, 55"W			0.00	0.00	28.39	0.00	0.00	28.39
	8.00 HR	R45BO002	0	0	227	0	0	227
MAP AA DOZER,CWLR, D-8R PS,W/BLADE			0.00	0.00	77.69	0.00	0.00	77.69
(ADD ATTACHMENTS)	8.00 HR	T15CA016	0	0	622	0	0	622
UPB AA TRLR,LOWBOY,120T, 4 AXLE			0.00	0.00	15.03	0.00	0.00	15.03
(ADD TOWING TRUCK)	80.00 HR	T45XX023	0	0	1,202	0	0	1,202
MIL AA Outside Truck Drivers, Heavy			0.00	29.40	0.00	0.00	0.00	29.40
	80.00 HR	X-TRKDVRHV	0	2,352	0	0	0	2,352

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL AA Outside Equip. Operators, Heavy			0.00	38.24	0.00	0.00	0.00	38.24
	40.00 HR	X-EQOPRHVY	0	1,530	0	0	0	1,530
MIL AA Outside Equip. Oilers			1.00	29.77	0.00	0.00	0.00	29.77
	40.00 HR	X-EQOPROIL	40	1,191	0	0	0	1,191
MIL AA Outside Laborers, (Semi-Skilled)			0.00	29.81	0.00	0.00	0.00	29.81
	40.00 HR	X-LABORER	0	1,192	0	0	0	1,192
MAP AA BLADE, UNIVERSAL, HYDR, D-8			0.00	0.00	7.66	0.00	0.00	7.66
(ADD D-8 TRACTOR)	8.00 HR	T10CA017	0	0	61	0	0	61
TOTAL Mobilization			224	35,082	30,645	0	0	65,726
12_ 2.10.05_ 1_ 02. Demobilization								
MIL AA Outside Equip. Oilers			1.00	29.77	0.00	0.00	0.00	29.77
	184.00 HR	X-EQOPROIL	184	5,478	0	0	0	5,478
MIL AA Outside Equip. Operators, Heavy			0.00	38.24	0.00	0.00	0.00	38.24
	184.00 HR	X-EQOPRHVY	0	7,036	0	0	0	7,036
MIL AA Outside Laborers, (Semi-Skilled)			0.00	29.81	0.00	0.00	0.00	29.81
	184.00 HR	X-LABORER	0	5,485	0	0	0	5,485
MIL AA Outside Truck Drivers, Heavy			0.00	29.40	0.00	0.00	0.00	29.40
	368.00 HR	X-TRKDVRHV	0	10,819	0	0	0	10,819
UPB AA TRLR,LOWBOY,120T, 4 AXLE			0.00	0.00	15.03	0.00	0.00	15.03
(ADD TOWING TRUCK)	368.00 HR	T45XX023	0	0	5,530	0	0	5,530
EP AA TRK,HWY, 43,000 GVW, 6X4, 3 AXLE			0.00	0.00	33.06	0.00	0.00	33.06
	368.00 HR	T50F0019	0	0	12,167	0	0	12,167
MIL AA COMPACTOR, RAMMER, 11"X13" SHOE			0.00	0.00	2.39	0.00	0.00	2.39
	8.00 HR	C10WC003	0	0	19	0	0	19
MIL AA CRANE,HYD,S/P,RT,4WD,20T/70'BOOM			0.00	0.00	34.78	0.00	0.00	34.78
	8.00 HR	C75GV002	0	0	278	0	0	278
EP AA CRANE,HYD,S/P,RT,4WD,60T/110'BM,			0.00	0.00	82.47	0.00	0.00	82.47
W/HOOK & BALL	8.00 HR	C75GV014	0	0	660	0	0	660
MAP AA CRANE,HYD,TRK MTD, 90T /114'BOOM			0.00	0.00	84.75	0.00	0.00	84.75
	8.00 HR	C80GV010	0	0	678	0	0	678
MIL AA GRADER,MOTOR, ARTIC, CAT 120-G			0.00	0.00	28.71	0.00	0.00	28.71
	8.00 HR	G15CA001	0	0	230	0	0	230

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
UPB AA GRADER,MOTOR, ARTIC, CAT 12-G				0.00	0.00	34.82	0.00	0.00	34.82
	8.00	HR	G15CA003	0	0	279	0	0	279
MIL AA HYD EXCAV, CRWLR, 1.00 CY BKT				0.00	0.00	40.81	0.00	0.00	40.81
	8.00	HR	H25CA012	0	0	327	0	0	327
UPB AA HYD EXCAV, CRWLR, 2.00 CY BKT				0.00	0.00	91.72	0.00	0.00	91.72
	8.00	HR	H25CA007	0	0	734	0	0	734
UPB AA HYD EXCAV, CRWLR, 3.125CY BKT				0.00	0.00	137.70	0.00	0.00	137.70
	8.00	HR	H25CA008	0	0	1,102	0	0	1,102
MIL AA HYD EXCAV, CRWLR, 1.75 CY BKT				0.00	0.00	72.65	0.00	0.00	72.65
	8.00	HR	H25CA018	0	0	581	0	0	581
EP AA LANDCLR,ROTRY CUTTR, 5'W-SIDE MT				0.00	0.00	2.56	0.00	0.00	2.56
(ADD FARM 50HP TRACTOR)	8.00	HR	L10BU005	0	0	20	0	0	20
UPB AA LDR,FE, CRWLR, 1.50 CY				0.00	0.00	33.51	0.00	0.00	33.51
	8.00	HR	L35CA004	0	0	268	0	0	268
UPB AA LDR,FE, CRWLR, 3.75 CY				0.00	0.00	88.47	0.00	0.00	88.47
	8.00	HR	L35CA007	0	0	708	0	0	708
MAP AA LDR,FE, WH, 3.25 CY, ARTIC, 950F				0.00	0.00	43.45	0.00	0.00	43.45
	8.00	HR	L40CA005	0	0	348	0	0	348
UPB AA LDR,BH,WH, 1.38CY FE BKT, 30"DIP				0.00	0.00	19.32	0.00	0.00	19.32
	8.00	HR	L50CA003	0	0	155	0	0	155
MIL AA ROLLR,STATIC,S/P,13T,68"W, 9TIRE				0.00	0.00	14.67	0.00	0.00	14.67
	8.00	HR	R30BO001	0	0	117	0	0	117
MIL AA LNDFL COMP,SHPSFT,S/P 22T, 76"W				0.00	0.00	51.58	0.00	0.00	51.58
	8.00	HR	R30CA003	0	0	413	0	0	413
MIL AA ROLLER,VIB,DD,S/P, 6.9T, 55"W				0.00	0.00	28.39	0.00	0.00	28.39
	8.00	HR	R45BO002	0	0	227	0	0	227
UPB AA DOZER,CWLR, D-6H,PS				0.00	0.00	47.64	0.00	0.00	47.64
(ADD BLADE & ATTACHMENTS)	8.00	HR	T15CA010	0	0	381	0	0	381
MAP AA DOZER,CWLR, D7R PS,W/BLADE				0.00	0.00	64.41	0.00	0.00	64.41
(ADD ATTACHMENTS)	8.00	HR	T15CA012	0	0	515	0	0	515
MAP AA DOZER,CWLR, D-8R PS,W/BLADE				0.00	0.00	77.69	0.00	0.00	77.69
(ADD ATTACHMENTS)	8.00	HR	T15CA016	0	0	622	0	0	622
MIL AA TRACTOR,WH,FARM, 65-75HP, 2WD				0.00	0.00	9.72	0.00	0.00	9.72
	8.00	HR	T25JD003	0	0	78	0	0	78

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
UPB AA HYDR CRANE 8.0T,W/ 85'BOOM				0.00	0.00	12.48	0.00	0.00	12.48
(ADD TRUCK & FLATBED)	8.00	HR	T40XX003	0	0	100	0	0	100
MAP AA BLADE, UNIVERSAL, HYDR, D-8				0.00	0.00	7.66	0.00	0.00	7.66
(ADD D-8 TRACTOR)	8.00	HR	T10CA017	0	0	61	0	0	61
UPB AA HYDR CRANE 8.0T,W/ 85'BOOM				0.00	0.00	12.48	0.00	0.00	12.48
(ADD TRUCK & FLATBED)	1.00	HR	T40XX003	0	0	12	0	0	12
MAP AA LDR,FE, WH, 3.25 CY, ARTIC, 950F				0.00	0.00	43.45	0.00	0.00	43.45
	8.00	HR	L40CA005	0	0	348	0	0	348
UPB AA HYD EXCAV, CRWLR, 3.125CY BKT				0.00	0.00	137.70	0.00	0.00	137.70
	8.00	HR	H25CA008	0	0	1,102	0	0	1,102
UPB AA DOZER,CWLR, D-6H,PS				0.00	0.00	47.64	0.00	0.00	47.64
(ADD BLADE & ATTACHMENTS)	8.00	HR	T15CA010	0	0	381	0	0	381
MIL AA ROLLER,VIB,DD,S/P, 6.9T, 55"W				0.00	0.00	28.39	0.00	0.00	28.39
	8.00	HR	R45BO002	0	0	227	0	0	227
MAP AA DOZER,CWLR, D-8R PS,W/BLADE				0.00	0.00	77.69	0.00	0.00	77.69
(ADD ATTACHMENTS)	8.00	HR	T15CA016	0	0	622	0	0	622
UPB AA TRLR,LOWBOY,120T, 4 AXLE				0.00	0.00	15.03	0.00	0.00	15.03
(ADD TOWING TRUCK)	80.00	HR	T45XX023	0	0	1,202	0	0	1,202
MIL AA Outside Truck Drivers, Heavy				0.00	29.40	0.00	0.00	0.00	29.40
	80.00	HR	X-TRKDVRHV	0	2,352	0	0	0	2,352
MIL AA Outside Equip. Operators, Heavy				0.00	38.24	0.00	0.00	0.00	38.24
	40.00	HR	X-EQOPRHVY	0	1,530	0	0	0	1,530
MIL AA Outside Equip. Oilers				1.00	29.77	0.00	0.00	0.00	29.77
	40.00	HR	X-EQOPROIL	40	1,191	0	0	0	1,191
MIL AA Outside Laborers, (Semi-Skilled)				0.00	29.81	0.00	0.00	0.00	29.81
	40.00	HR	X-LABORER	0	1,192	0	0	0	1,192
MAP AA BLADE, UNIVERSAL, HYDR, D-8				0.00	0.00	7.66	0.00	0.00	7.66
(ADD D-8 TRACTOR)	8.00	HR	T10CA017	0	0	61	0	0	61
TOTAL Demobilization				224	35,082	30,551	0	0	65,632
TOTAL Mobilization / De-mobilization				448	70,163	61,195	0	0	131,358

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
12_ 2.10.05_ 2. Temporary Facilities							
USR AA Office Trailer (2 each)		0.00	0.00	0.00	0.00	500.00	500.00
	36.00 MON	0	0	0	0	18,000	18,000
USR AA Employee (Break) Trailer		0.00	0.00	0.00	0.00	250.00	250.00
	36.00 MON	0	0	0	0	9,000	9,000
USR AA Storage & Tool Shed		0.00	0.00	0.00	0.00	200.00	200.00
	36.00 MON	0	0	0	0	7,200	7,200
USR AA Office Supplies		0.00	0.00	0.00	250.00	0.00	250.00
	36.00 MON	0	0	0	9,000	0	9,000
USR AA Portable Toilets		0.00	0.00	0.00	0.00	200.00	200.00
(2 Ea)	36.00 MON	0	0	0	0	7,200	7,200
TOTAL Temporary Facilities		0	0	0	9,000	41,400	50,400
12_ 2.10.05_ 3. Temporary Utilities							
USR AA Temporary Power Per Trailer		0.00	0.00	0.00	0.00	100.00	100.00
	72.00 MON	0	0	0	0	7,200	7,200
USR AA Temporary Water Per Trailer		0.00	0.00	0.00	50.00	0.00	50.00
	72.00 MON	0	0	0	3,600	0	3,600
USR AA Temporary Telephone Per Trailer		0.00	0.00	0.00	0.00	200.00	200.00
	72.00 MON	0	0	0	0	14,400	14,400
USR AA Temporary Lighting Per Trailer		0.00	0.00	0.00	0.00	60.00	60.00
	72.00 MON	0	0	0	0	4,320	4,320
TOTAL Temporary Utilities		0	0	0	3,600	25,920	29,520
12_ 2.10.05_ 4. On-site Personnel Construction will take place from April through October (7 months) in each of 3 construction seasons (2001, 2002, & 2003). Full time supervision is considered to be 8 months/year. Therefore, 3 construction seasons equals 24 months of supervision.							
USR AA Project Superintendent		0.00	6250.00	0.00	0.00	0.00	6250.00
	36.00 MON	0	225,000	0	0	0	225,000
USR AA Survey/Layout Crew		0.00	320.00	0.00	0.00	0.00	320.00
	180.00 DAY	0	57,600	0	0	0	57,600
USR AA Quality Control Manager		0.00	6200.00	0.00	0.00	0.00	6200.00
	9.00 MON	0	55,800	0	0	0	55,800

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Medical Consultant			0.00	5000.00	0.00	0.00	0.00	5000.00
On a As Needed Basis	3.60 MON		0	18,000	0	0	0	18,000
USR AA Secretary/Clerk			0.00	3200.00	0.00	0.00	0.00	3200.00
	36.00 MON		0	115,200	0	0	0	115,200
USR AA Quality Control Technician			0.00	5700.00	0.00	0.00	0.00	5700.00
2 People	24.12 MON		0	137,484	0	0	0	137,484
USR AA Health and Safety Officer			0.00	6250.00	0.00	0.00	0.00	6250.00
	9.00 MON		0	56,250	0	0	0	56,250
USR AA Chemical Quality Control Officer			0.00	5500.00	0.00	0.00	0.00	5500.00
	3.00 MON		0	16,500	0	0	0	16,500
TOTAL On-site Personnel			0	681,834	0	0	0	681,834
12_ 2.10.05_ 5. Submittals								
USR AA Schedule Set-Up			0.00	4000.00	0.00	750.00	0.00	4750.00
	1.00 EA		0	4,000	0	750	0	4,750
USR AA Schedule Updates			0.00	600.00	0.00	0.00	0.00	600.00
	35.00 MON		0	21,000	0	0	0	21,000
USR AA Dust, Vapor and Odor Control			0.00	480.00	0.00	0.00	0.00	480.00
Plan (8hrsx$60/hr)	1.00 EA		0	480	0	0	0	480
USR AA Accident Prevention Plan			0.00	960.00	0.00	0.00	0.00	960.00
(16hrsx$60/hr)	1.00 EA		0	960	0	0	0	960
USR AA Traffic Control Plan			0.00	480.00	0.00	0.00	0.00	480.00
(8hrsx$60/hr)	1.00 EA		0	480	0	0	0	480
USR AA Demolition/Debris Handling Plan			0.00	4800.00	0.00	0.00	0.00	4800.00
	1.00 EA		0	4,800	0	0	0	4,800
USR AA Plan of Operations for Soil			0.00	4800.00	0.00	0.00	0.00	4800.00
Excavation/Stockpiling/Handling	1.00 EA		0	4,800	0	0	0	4,800
(80hrsx$60/hr)								
USR AA Liquid Removal Plan			0.00	2400.00	0.00	0.00	0.00	2400.00
(40hrsx$60/hr)	1.00 EA		0	2,400	0	0	0	2,400
USR AA Site Safety and Health Plan			0.00	7200.00	0.00	0.00	0.00	7200.00
Includes Several Miscellaneous	1.00 EA		0	7,200	0	0	0	7,200
"Sub-Plans"								
(120hrx$60/hr)								

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Chemical Quality Control Plan			0.00	2400.00	0.00	0.00	0.00	2400.00
(40hrsx$60/hr)	1.00 EA		0	2,400	0	0	0	2,400
USR AA General Quality Control Plan			0.00	2160.00	0.00	0.00	0.00	2160.00
(36hrsx$60/hr)	1.00 EA		0	2,160	0	0	0	2,160
USR AA Security Plan			0.00	480.00	0.00	0.00	0.00	480.00
(8hrsx$60/hr)	1.00 EA		0	480	0	0	0	480
USR AA Sampling and Analysis Plan			0.00	3360.00	0.00	0.00	0.00	3360.00
(56hrs x $60/hr)	1.00 EA		0	3,360	0	0	0	3,360
USR AA Activity Hazard Analysis			0.00	960.00	0.00	0.00	0.00	960.00
(required prior to eack major phase) (16hrs x $60/hr)	4.00 EA		0	3,840	0	0	0	3,840
USR AA Flood/Erosion Control Plan			0.00	2400.00	0.00	0.00	0.00	2400.00
(40hr x $60/hr)	1.00 EA		0	2,400	0	0	0	2,400
TOTAL Submittals			0	60,760	0	750	0	61,510
12_ 2.10.05_ 6. Permits								
USR AA Permits & Licenses Allowance			0.00	0.00	0.00	0.00	20000.00	20000.00
That Most Permit/Licenses Fees Will Be Waived By Local Government Agencies	1.00 LS		0	0	0	0	20,000	20,000
TOTAL Permits			0	0	0	0	20,000	20,000
12_ 2.10.05_ 7. Meeting / Conferences								
USR AA Pre-Construction Conference			0.00	0.00	0.00	0.00	4800.00	4800.00
Assumed 10 Contractor Personnel In Attendance For One Day (10 people X 8 hr/day X $60/hr)	1.00 EA		0	0	0	0	4,800	4,800
USR AA Pre-Work Conference			0.00	0.00	0.00	0.00	2400.00	2400.00
Assumed 5 Contractor Personnel In Attendance For One Day (5 people X 8hr/day X $60/hr)	1.00 EA		0	0	0	0	2,400	2,400
USR AA Weekly Progress Meetings			0.00	100.00	0.00	0.00	0.00	100.00
	144.00 EA		0	14,400	0	0	0	14,400

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Meeting / Conferences			0	14,400	0	0	7,200	21,600
12_ 2.10.05_ 8. Personal Protective Equipment								
USR AA Safety Eyewear			0.00	0.00	0.00	3.00	0.00	3.00
For Daily Workers and Visitors (2/Pr/Person). Replace each year for 3 years. (25 + 5) * 2 * 3 = 180	180.00 EA		0	0	0	540	0	540
HTW AA Ear Muffs			0.00	0.00	0.00	10.34	0.00	10.34
For Occasional Use Only	10.00 EA	N/A	0	0	0	103	0	103
USR AA Ear Plugs, Disposable			0.00	0.00	0.00	0.75	0.00	0.75
For Field Personnel and Government Personnel/Visitors (1pr/day x 25 people) * 3 yrs = 25*250*3 = 18750	19800 EA	N/A	0	0	0	14,850	0	14,850
USR AA Employee Alarm System			0.00	0.00	0.00	5000.00	0.00	5000.00
	1.00 EA		0	0	0	5,000	0	5,000
HTW AA Boot Covers, Tyvek (Bag Of 10Pr)			0.00	0.00	0.00	11.55	0.00	11.55
Assumes required for one year, 25 people, 1 pair/day. 250 days * 25 pair = 6250 pair	625.00 EA	N/A	0	0	0	7,219	0	7,219
HTW AA Coveralls, Tyvek (Case Of 25)			0.00	0.00	0.00	147.62	0.00	147.62
	250.00 EA	N/A	0	0	0	36,905	0	36,905
TOTAL Personal Protective Equipment			0	0	0	64,617	0	64,617
12_ 2.10.05_ 9. Medical Exams								
USR AA Medical Exams			0.00	0.00	0.00	0.00	580.00	580.00
	60.00 EA		0	0	0	0	34,800	34,800
TOTAL Medical Exams			0	0	0	0	34,800	34,800
12_ 2.10.05_ 10. Training								
USR AA Training 40 Hour			0.00	0.00	0.00	0.00	700.00	700.00
HAZWOPPER refresher course.	20.00 EA		0	0	0	0	14,000	14,000
USR AA Training Weekly Follow Up			0.00	0.00	0.00	0.00	600.00	600.00
(1hr/week)	36.00 WK		0	0	0	0	21,600	21,600

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Site Specific Training		0.00	0.00	0.00	0.00	420.00	420.00
	30.00 EA	0	0	0	0	12,600	12,600
USR AA Training 8 Hour		0.00	0.00	0.00	0.00	150.00	150.00
	30.00 EA	0	0	0	0	4,500	4,500
TOTAL Training		0	0	0	0	52,700	52,700
12_ 2.10.05_ 11. Health & Safety Monitoring							
USR AA Contaminant Monitoring, Includes		0.00	0.00	0.00	0.00	2500.00	2500.00
Exposure Monitoring / Air	36.00 MON	0	0	0	0	90,000	90,000
Sampling Program / Equipment							
TOTAL Health & Safety Monitoring		0	0	0	0	90,000	90,000
12_ 2.10.05_ 12. Emergency Equipment							
USR AA First Aid Kit		0.00	0.00	0.00	100.00	0.00	100.00
	12.00 EA	0	0	0	1,200	0	1,200
USR AA Emergency Eye Wash		0.00	0.00	0.00	535.00	0.00	535.00
	12.00 EA	0	0	0	6,420	0	6,420
USR AA Fire Extinguisher		0.00	0.00	0.00	55.00	0.00	55.00
	12.00 EA	0	0	0	660	0	660
USR AA Self-Contained Breathing		0.00	0.00	0.00	1595.00	0.00	1595.00
Apparatus	2.00 EA	0	0	0	3,190	0	3,190
USR AA Five Minute Escape Mask		0.00	0.00	0.00	286.00	0.00	286.00
(1/Person)	20.00 EA	0	0	0	5,720	0	5,720
TOTAL Emergency Equipment		0	0	0	17,190	0	17,190
12_ 2.10.05_ 14. Miscellaneous Field Overhead							
USR AA Construction Photographs		0.00	0.00	0.00	200.00	0.00	200.00
	36.00 MON	0	0	0	7,200	0	7,200
USR AA Identification Tags		0.00	0.00	0.00	10.00	0.00	10.00
	30.00 EA	0	0	0	300	0	300
USR AA Flat Bed Truck		0.00	0.00	0.00	0.00	450.00	450.00
2 ea	72.00 MON	0	0	0	0	32,400	32,400

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Pickup Truck		0.00	0.00	0.00	0.00	350.00	350.00
3 ea	108.00 MON	0	0	0	0	37,800	37,800
USR AA Project Sign		0.00	0.00	0.00	0.00	300.00	300.00
	2.00 EA	0	0	0	0	600	600
USR AA Miscellaneous Signage/Barracades		0.00	0.00	0.00	0.00	2500.00	2500.00
(Health, Safety & Warning Signs)	1.00 LS	0	0	0	0	2,500	2,500
USR AA Bulletin Board		0.00	0.00	0.00	0.00	250.00	250.00
	1.00 EA	0	0	0	0	250	250
USR AA Continuous Clean-Up		0.00	0.00	0.00	0.00	500.00	500.00
(Includes Dumpster)	36.00 MON	0	0	0	0	18,000	18,000
USR AA Contract Closeout		0.00	5000.00	5000.00	5000.00	0.00	15000.00
	1.00 LS	0	5,000	5,000	5,000	0	15,000
USR AA Protect Miscellaneous Structures		0.00	2500.00	2500.00	2500.00	0.00	7500.00
	1.00 LS	0	2,500	2,500	2,500	0	7,500
TOTAL Miscellaneous Field Overhead		0	7,500	7,500	15,000	91,550	121,550

12_ 2.10.05_ 15. Materials Testing
Includes allowance for Independent Testing Laboratory to test soil samples and density testing.

		MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Materials Testing		0.00	0.00	0.00	0.00	15000.00	15000.00
	1.00 JOB	0	0	0	0	15,000	15,000
TOTAL Materials Testing		0	0	0	0	15,000	15,000
TOTAL General Conditions		448	834,657	68,695	110,157	378,570	1,392,080

12_ 2.10.08. Operations

12_ 2.10.08_ 01. TSCA Cell

12_ 2.10.08_ 01_ 08. Sediment Placement
Total sediment disposal estimated as 696,000 cy for total SDF Landfill broken down as:
TSCA Cell - 150,000 cy
Non-TSCA Cell - 546,000 cy

		MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
L USR AA Sprd Dumped Fill/Grvl, 6" Layers		0.01	0.31	0.51	0.00	0.00	0.81
Without Compaction	150000 CY CODTG	1,245	46,065	75,930	0	0	121,995

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
L USR AA Compaction by Sheepsfoot Roller				0.01	0.30	0.37	0.00	0.05	0.71
8" Lifts	150000	CY	COFCP	1,275	44,310	55,065	0	7,500	106,875
USR AA Compaction by 10 Ton Steel Wheel				0.01	0.40	0.23	0.00	0.00	0.63
Tandem Roller	25000	SY	COFCK	300	9,988	5,680	0	0	15,668
Finished surface compaction prior to placement of Geotextile fabric.									
L MIL AA Finish Grade Sediment Surface				0.02	0.51	0.28	0.00	0.00	0.79
Base or Leveling Courses	25000	SY	COFGA	400	12,725	6,965	0	0	19,690
TOTAL Sediment Placement				3,220	113,088	143,640	0	7,500	264,228
TOTAL TSCA Cell				3,220	113,088	143,640	0	7,500	264,228

12_ 2.10.08_ 02. Non-TSCA Cell

12_ 2.10.08_ 02_ 18. Sediment Placement

Total sediment disposal estimated as 696,000 cy for total SDF Landfill broken down as:

TSCA Cell - 150,000 cy
Non-TSCA Cell - 546,000 cy

696,000 cy

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
L USR AA Sprd Dumped Fill/Grvl, 6" Layers				0.01	0.31	0.51	0.00	0.00	0.81
Without Compaction	546000	CY	CODTG	4,532	167,677	276,385	0	0	444,062
L USR AA Compaction by Sheepsfoot Roller				0.01	0.30	0.37	0.00	0.05	0.71
8" Lifts	546000	CY	COFCP	4,641	161,288	200,437	0	27,300	389,025
USR AA Compaction by 10 Ton Steel Wheel				0.01	0.40	0.23	0.00	0.00	0.63
Tandem Roller	53000	SY	COFCK	636	21,174	12,042	0	0	33,215
L MIL AA Finish Grade Sediment Surface				0.02	0.51	0.28	0.00	0.00	0.79
Base or Leveling Courses	53000	SY	COFGA	848	26,977	14,766	0	0	41,743
TOTAL Sediment Placement				10,657	377,116	503,629	0	27,300	908,045
TOTAL Non-TSCA Cell				10,657	377,116	503,629	0	27,300	908,045

12_ 2.10.08_ 03. Leachate System Operation

12_ 2. DISPOSAL	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Operator				0.00	6000.00	0.00	0.00	0.00	6000.00
	30.00	MO		0	180,000	0	0	0	180,000

12_ 2. DISPOSAL	QUANTY UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AA Power			0.00	0.00	0.00	0.00	4000.00	4000.00
	30.00 MO		0	0	0	0	120,000	120,000
USR AA Filter Replacement, etc.			0.00	0.00	0.00	2000.00	0.00	2000.00
	30.00 MO		0	0	0	60,000	0	60,000
TOTAL Leachate System Operation			0	180,000	0	60,000	120,000	360,000
TOTAL Operations			13,877	670,203	647,269	60,000	154,800	1,532,272
12_ 2.10.10. Post-Closure Operation/Maint.								
12_ 2.10.10_ 06. Gravel Road Maintenance								
L MIL PC Crushed Stone Paving, Large Area			0.01	0.20	0.09	0.34	0.00	0.63
Maintenance	41250 SY	XSGRA	248	8,238	3,832	13,852	0	25,922
TOTAL Gravel Road Maintenance			248	8,238	3,832	13,852	0	25,922
12_ 2.10.10_ 07. Lawn Maintenance								
USR PC Mowing			1.25	44.49	0.00	0.00	0.00	44.49
Mowing tops of landfill cells approximately 4 times/yr. @ 10 hours/visit. 4*10*50 = 2000 hrs	2000.00 HR	COELA	2,500	88,975	0	0	0	88,975
TOTAL Lawn Maintenance			2,500	88,975	0	0	0	88,975
12_ 2.10.10_ 09. Leach Treatment System Maint.								
USR PC Maintenance allowance			0.00	0.00	0.00	0.00	50000.00	50000.00
	1.00 LS		0	0	0	0	50,000	50,000
USR PC Operation			0.00	0.00	0.00	0.00	15000.00	15000.00
	50.00 YR		0	0	0	0	750,000	750,000
TOTAL Leach Treatment System Maint.			0	0	0	0	800,000	800,000
12_ 2.10.10_ 10. Monitoring Well Sampling								
USR PC Sampling and Analysis			0.00	0.00	0.00	0.00	1500.00	1500.00
Assume quarterly for the first 10 years and yearly for the next 40 years. 8x4x10=320	640.00 EA		0	0	0	0	960,000	960,000

12_ 2. DISPOSAL	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
8x1x40=320							
TOTAL Monitoring Well Sampling		0	0	0	0	960,000	960,000
12_ 2.10.10_ 12. Building Maintenance							
USR PC Building Maintenance/Operation		0.00	0.00	0.00	0.00	1000.00	1000.00
	50.00 YR	0	0	0	0	50,000	50,000
TOTAL Building Maintenance		0	0	0	0	50,000	50,000
TOTAL Post-Closure Operation/Maint.		2,748	97,212	3,832	13,852	1810000	1,924,896
TOTAL CONSTRUCT LANDFILL		105,566	4,371,730	2,823,121	1,861,658	4405582	13,462,092
TOTAL DISPOSAL		105,566	4,371,730	2,823,121	1,861,658	4405582	13,462,092
TOTAL NAVIGATION		214,340	8,287,847	5,925,740	3,137,680	11889873	29,241,140

23_ 1. CMP	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL CMP		0	0	0	0	0	0
TOTAL OTHER STUDIES		0	0	0	0	0	0

30_ 5. FS Phase - CMP/EIS	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL FS Phase - CMP/EIS				0	0	0	0	2300000	2,300,000

30_10. Pre-Const. Engineering & Design	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
USR AL Spent Costs on the Maxium		0.00	0.00	0.00	0.00	500000	500000.00
Technologies, Inc Landfill and	1.00 LS	0	0	0	0	500,000	500,000
Transfer design							
USR AL Remaining Budgeted E & D costs		0.00	0.00	0.00	0.00	1200000	1200000.00
	1.00 LS	0	0	0	0	1200000	1,200,000
TOTAL Pre-Const. Engineering & Design		0	0	0	0	1700000	1,700,000

30_15. Engineering During Construction	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
30_15. 1. Project Engineer Assuming a GS 12-5 Engineer working 1/4 time for 4 yrs at 2,087 hrs/yr = 2,087 hrs.							
TOTAL Project Engineer		0	148,490	0	0	0	148,490
30_15. 2. Project Manager Assuming a GS 12-5 Engineer working 1/4 time for 4 yrs at 2,087 hrs/yr = 2,087 hrs.							
TOTAL Project Manager		0	148,490	0	0	0	148,490
30_15. 3. Environmental Engineering Assuming a GS 11-5 Engineer working 1/4 time for 4 yrs at 2,087 hrs/yr = 2,087 hrs.							
TOTAL Environmental Engineering		0	123,884	0	0	0	123,884
30_15. 4. Geotechnical Engineering Assuming a GS 11-5 Engineer working 1/4 time for the first year at 2,087 hrs/yr = 522 hrs.							
TOTAL Geotechnical Engineering		0	30,986	0	0	0	30,986
30_15. 5. Environmental Health Team Assuming a GS 12-5 Industrial hygenist working 1/8 time for 4 yrs at 2,087 hrs/yr = 1,044 hrs.							
TOTAL Environmental Health Team		0	74,281	0	0	0	74,281
30_15. 6. Cost Engineering Assuming a GS 11-5 Cost Engineer working 5 wk/yr x 4 yr x 40 hr/wk = 800 hrs.							
TOTAL Cost Engineering		0	47,488	0	0	0	47,488
30_15. 7. General Design Assuming a GS 11-5 Design Engineer working 5 wk/yr x 4 yr x 40 hr/wk = 800 hrs.							
TOTAL General Design		0	47,488	0	0	0	47,488
30_15. 8. Civil/Structural Design Assuming a GS 12-5 Engineer working 1/4 time for the 1st yrs and 5 wk/yr for the remainibg 3 yr Therefore: 1/4 x 2,087 hrs/yr plus 3 yr x 5 wk x 40 hrs = 1,122 hrs.							
TOTAL Civil/Structural Design		0	79,830	0	0	0	79,830

30_15. Engineering During Construction	QUANTY UOM CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Engineering During Construction		0	700,937	0	0	0	700,937
TOTAL ENGINEERING & DESIGN		0	700,937	0	0	4000000	4,700,937

Ashtabula River Partnership
Comprehensive Management Plan

Designed By: BUFFALO DISTRICT COE
Estimated By: COST ENGINEERING BRANCH

Prepared By: Paul Polanski

Preparation Date: 12/22/00
Effective Date of Pricing: 12/22/00

Sales Tax: 0.00%

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	AASBC	2 B-asbtswkr + Small Tools			PROD =	100%			CREW HOURS =	41
MIL	B-ASBTSWKRL	Asbestos Workers	2.00	HR	37.63	2.00	75.26			75.26
MIL	B-ASBTSWKRF	Asbestos Workers	0.50	HR	38.13	0.50	19.07			19.07
MIL	XMIXX020 E	Small Tools	0.68	HR	1.57			0.68	1.07	1.07
	TOTAL					2.50	94.33	0.68	1.07	95.40
	ACARA	1 B-carpnter + Small Tools			PROD =	100%			CREW HOURS =	104
MIL	B-CARPNTERL	Carpenters	1.00	HR	37.73	1.00	37.73			37.73
MIL	B-CARPNTERF	Carpenters	0.25	HR	38.23	0.25	9.56			9.56
MIL	XMIXX020 E	Small Tools	0.31	HR	1.57			0.31	0.49	0.49
	TOTAL					1.25	47.29	0.31	0.49	47.77
	ACARB	2 B-carpnter + Small Tools			PROD =	100%			CREW HOURS =	41
MIL	B-CARPNTERF	Carpenters	0.50	HR	38.23	0.50	19.11			19.11
MIL	B-CARPNTERL	Carpenters	2.00	HR	37.73	2.00	75.46			75.46
MIL	XMIXX020 E	Small Tools	0.66	HR	1.57			0.66	1.04	1.04
	TOTAL					2.50	94.57	0.66	1.04	95.61
	ACARC	1 B-carpnter + Misc Power Tools			PROD =	100%			CREW HOURS =	18
MIL	B-CARPNTERF	Carpenters	0.25	HR	38.23	0.25	9.56			9.56
MIL	B-CARPNTERL	Carpenters	1.00	HR	37.73	1.00	37.73			37.73
MIL	XMIXX010 E	Misc. Power Tools	0.10	HR	6.40			0.10	0.64	0.64
MIL	XMIXX020 E	Small Tools	0.33	HR	1.57			0.33	0.52	0.52
	TOTAL					1.25	47.29	0.43	1.16	48.45
	ACARI	2 B-carpntr/labr(semi-skld) + Sm.Tools			PROD =	100%			CREW HOURS =	8
MIL	B-CARPNTERF	Carpenters	0.25	HR	38.23	0.25	9.56			9.56
MIL	B-CARPNTERL	Carpenters	2.00	HR	37.73	2.00	75.46			75.46
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
MIL	XMIXX020 E	Small Tools	0.48	HR	1.57			0.48	0.75	0.75
	TOTAL					3.25	111.39	0.48	0.75	112.14
	ACARJ	3 B-carpntr/labr(semi-skld) + MiscPowrTools			PROD =	100%			CREW HOURS =	31
MIL	B-CARPNTERF	Carpenters	1.00	HR	38.23	1.00	38.23			38.23
MIL	B-CARPNTERL	Carpenters	2.00	HR	37.73	2.00	75.46			75.46
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
MIL	XMIXX010 E	Misc. Power Tools	0.25	HR	6.40			0.25	1.60	1.60
MIL	XMIXX020 E	Small Tools	0.63	HR	1.57			0.63	0.99	0.99
	TOTAL					4.00	140.06	0.88	2.59	142.65
	ACARU	6 B-carpnter + 1 40 Ton Crane, Hydraulic R/T			PROD =	100%			CREW HOURS =	31
MIL	B-CARPNTERF	Carpenters	1.00	HR	38.23	1.00	38.23			38.23
MIL	B-CARPNTERA	Carpenters	2.00	HR	31.65	2.00	63.29			63.29
MIL	B-CARPNTERL	Carpenters	3.00	HR	37.73	3.00	113.19			113.19
MIL	B-LABORER L	Laborers, (Semi-Skilled)	2.00	HR	26.37	2.00	52.74			52.74

SRC	ITEM ID	DESCRIPTION	NO. UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00 HR	38.24	1.00	38.24			38.24
MIL	C75GV012 E	CRANE,HYD,S/P,RT,4WD,40T/84'BOO	1.00 HR	64.05			1.00	64.05	64.05
MIL	G10HO004 E	GENERATOR, 5.5 KW, 120/240V,POR	1.00 HR	1.82			1.00	1.82	1.82
MIL	XMIXX010 E	Misc. Power Tools	1.00 HR	6.40			1.00	6.40	6.40
	TOTAL				9.00	305.69	3.00	72.27	377.96
	ACMAA	1 B-cemtfinr + Small Tools		PROD =	100%			CREW HOURS =	59
MIL	B-CEMTFINRF	Cement Finishers	0.25 HR	33.99	0.25	8.50			8.50
MIL	B-CEMTFINRL	Cement Finishers	1.00 HR	33.49	1.00	33.49			33.49
MIL	XMIXX020 E	Small Tools	0.12 HR	1.57			0.12	0.19	0.19
	TOTAL				1.25	41.99	0.12	0.19	42.18
	ACMAC	1 B-cemtfinr + Misc Power Tools		PROD =	100%			CREW HOURS =	160
MIL	B-CEMTFINRF	Cement Finishers	0.10 HR	33.99	0.10	3.40			3.40
MIL	B-CEMTFINRL	Cement Finishers	1.00 HR	33.49	1.00	33.49			33.49
MIL	XMIXX010 E	Misc. Power Tools	0.21 HR	6.40			0.21	1.34	1.34
MIL	XMIXX020 E	Small Tools	0.18 HR	1.57			0.18	0.28	0.28
	TOTAL				1.10	36.89	0.39	1.63	38.52
	AGLAB	2 B-glazier + Small Tools		PROD =	100%			CREW HOURS =	41
MIL	B-GLAZIER F	Glaziers	0.50 HR	38.97	0.50	19.49			19.49
MIL	B-GLAZIER L	Glaziers	2.00 HR	38.47	2.00	76.94			76.94
MIL	XMIXX020 E	Small Tools	0.24 HR	1.57			0.24	0.38	0.38
	TOTAL				2.50	96.43	0.24	0.38	96.80
	ALABE	4 B-laborer + 2 Concrete Vibrators		PROD =	100%			CREW HOURS =	17
MIL	B-CEMTFINRL	Cement Finishers	1.00 HR	33.49	1.00	33.49			33.49
MIL	B-LABORER L	Laborers, (Semi-Skilled)	4.00 HR	26.37	4.00	105.48			105.48
MIL	B-LABORER F	Laborers, (Semi-Skilled)	1.00 HR	26.87	1.00	26.87			26.87
MIL	C65WC002 E	CONC VIBRATOR, 2.50D, EL,HI-FRE	2.00 HR	1.59			2.00	3.19	3.19
MIL	XMIXX020 E	Small Tools	0.68 HR	1.57			0.68	1.07	1.07
MIL	G10HO004 E	GENERATOR, 5.5 KW, 120/240V,POR	1.00 HR	1.82			1.00	1.82	1.82
	TOTAL				6.00	165.85	3.68	6.07	171.92
	ALABM	3 B-laborer/0.5 rodmen + MiscPwrTools		PROD =	100%			CREW HOURS =	221
MIL	B-CARPNTERL	Carpenters	1.00 HR	37.73	1.00	37.73			37.73
MIL	B-CARPNTERF	Carpenters	1.00 HR	38.23	1.00	38.23			38.23
MIL	B-CEMTFINRL	Cement Finishers	0.50 HR	33.49	0.50	16.75			16.75
MIL	B-RODMAN L	Rodmen, (Reinforcing)	0.50 HR	42.96	0.50	21.48			21.48
MIL	B-LABORER L	Laborers, (Semi-Skilled)	3.00 HR	26.37	3.00	79.11			79.11
MIL	XMIXX010 E	Misc. Power Tools	0.30 HR	6.40			0.30	1.92	1.92
MIL	XMIXX020 E	Small Tools	1.16 HR	1.57			1.16	1.82	1.82
	TOTAL				6.00	193.30	1.46	3.74	197.04

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	ALATA	1 B-lathers + Small Tools			PROD =	100%			CREW HOURS =	25
MIL	B-LATHERS L	Lathers	1.00	HR	38.66	1.00	38.66			38.66
MIL	B-LATHERS F	Lathers	0.25	HR	39.16	0.25	9.79			9.79
MIL	XMIXX020 E	Small Tools	0.25	HR	1.57			0.25	0.39	0.39
	TOTAL					1.25	48.45	0.25	0.39	48.85
	AMABA	1 B-brklayr + Small Tools			PROD =	100%			CREW HOURS =	1
MIL	B-BRKLAYR F	Bricklayers	0.25	HR	37.33	0.25	9.33			9.33
MIL	B-BRKLAYR L	Bricklayers	1.00	HR	36.83	1.00	36.83			36.83
MIL	XMIXX020 E	Small Tools	0.20	HR	1.57			0.20	0.31	0.31
	TOTAL					1.25	46.16	0.20	0.31	46.48
	APTRA	1 B-paintord + Small Tools			PROD =	100%			CREW HOURS =	41
MIL	B-PAINTORDL	Painters, Ordinary	1.00	HR	38.01	1.00	38.01			38.01
MIL	B-PAINTORDF	Painters, Ordinary	0.25	HR	38.51	0.25	9.63			9.63
MIL	XMIXX020 E	Small Tools	0.27	HR	1.57			0.27	0.42	0.42
	TOTAL					1.25	47.63	0.27	0.42	48.06
	ARFCA	1 B-roofer + Small Tools			PROD =	100%			CREW HOURS =	52
MIL	B-ROOFER L	Roofers, Composition	1.00	HR	41.22	1.00	41.22			41.22
MIL	B-ROOFER F	Roofers, Composition	0.25	HR	41.72	0.25	10.43			10.43
MIL	XMIXX020 E	Small Tools	0.20	HR	1.57			0.20	0.31	0.31
	TOTAL					1.25	51.65	0.20	0.31	51.96
	ATIFA	1 B-tilelyr + Small Tools			PROD =	100%			CREW HOURS =	63
MIL	B-TILELYR F	Tile Layers, (Floor)	0.25	HR	36.41	0.25	9.10			9.10
MIL	B-TILELYR L	Tile Layers, (Floor)	1.00	HR	35.91	1.00	35.91			35.91
MIL	XMIXX020 E	Small Tools	0.16	HR	1.57			0.16	0.25	0.25
	TOTAL					1.25	45.01	0.16	0.25	45.27
	CLACA	5 B-laborer + 2 Hand Compaction Rammer			PROD =	100%			CREW HOURS =	166
MIL	C10WC003 E	COMPACTOR, RAMMER, 13"X11" SHOE	2.00	HR	2.39			2.00	4.78	4.78
MIL	B-LABORER F	Laborers, (Semi-Skilled)	1.00	HR	26.87	1.00	26.87			26.87
MIL	B-LABORER L	Laborers, (Semi-Skilled)	4.00	HR	26.37	4.00	105.48			105.48
MIL	XMIXX020 E	Small Tools	0.19	HR	1.57			0.19	0.30	0.30
	TOTAL					5.00	132.35	2.19	5.08	137.43
	CLACC	3 B-laborer + 1 Hand Compaction Rammer			PROD =	100%			CREW HOURS =	264
MIL	B-LABORER F	Laborers, (Semi-Skilled)	1.00	HR	26.87	1.00	26.87			26.87
MIL	B-LABORER L	Laborers, (Semi-Skilled)	2.00	HR	26.37	2.00	52.74			52.74
MIL	C10WC003 E	COMPACTOR, RAMMER, 13"X11" SHOE	1.00	HR	2.39			1.00	2.39	2.39
MIL	XMIXX020 E	Small Tools	0.23	HR	1.57			0.23	0.36	0.36
	TOTAL					3.00	79.61	1.23	2.75	82.36

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	LABOR HOURS	LABOR COST	EQUIP HOURS	EQUIP COST	TOTAL COST
	CLADM	5 B-laborer + 1 Truck & Drill Rig, 335 Hp			PROD =	100%			CREW HOURS =	133
MIL	B-LABORER	F Laborers, (Semi-Skilled)	1.00	HR	26.87	1.00	26.87			26.87
MIL	B-LABORER	L Laborers, (Semi-Skilled)	4.00	HR	26.37	4.00	105.48			105.48
MIL	D35RO002	E DRILL,R-BLASTH, 6.75"-9.88",TRK	1.00	HR	113.05			1.00	113.05	113.05
MIL	XMIXX020	E Small Tools	0.38	HR	1.57			0.38	0.60	0.60
	TOTAL					5.00	132.35	1.38	113.65	246.00
	CODEA	1 B-eqoprcrn + 1 1 Cy Hydr. Excavator			PROD =	100%			CREW HOURS =	134
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	38.24	1.00	38.24			38.24
MIL	H25CA004	E HYD EXCAV,CRWLR, 1.00CY BKT,LON	1.00	HR	44.32			1.00	44.32	44.32
MIL	XMIXX020	E Small Tools	0.11	HR	1.57			0.11	0.17	0.17
MIL	B-LABORER	L Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
	TOTAL					2.00	64.61	1.11	44.49	109.10
	CODEJ	2 B-laborer + 1 Loader/Backhoe			PROD =	100%			CREW HOURS =	82
MIL	B-LABORER	F Laborers, (Semi-Skilled)	0.25	HR	26.87	0.25	6.72			6.72
MIL	B-LABORER	L Laborers, (Semi-Skilled)	2.00	HR	26.37	2.00	52.74			52.74
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	36.75	1.00	36.75			36.75
MIL	L50CA003	E LDR,BH,WH, 1.38CY FE BKT, 30"DI	1.00	HR	19.32			1.00	19.32	19.32
MIL	XMIXX020	E Small Tools	0.13	HR	1.57			0.13	0.20	0.20
	TOTAL					3.25	96.21	1.13	19.52	115.74
	CODEK	5 B-laborer + 1 Loader/Backhoe			PROD =	100%			CREW HOURS =	2
MIL	B-LABORER	L Laborers, (Semi-Skilled)	4.00	HR	26.37	4.00	105.48			105.48
MIL	B-LABORER	F Laborers, (Semi-Skilled)	1.00	HR	26.87	1.00	26.87			26.87
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	36.75	1.00	36.75			36.75
MIL	L50CA003	E LDR,BH,WH, 1.38CY FE BKT, 30"DI	1.00	HR	19.32			1.00	19.32	19.32
MIL	XMIXX020	E Small Tools	0.48	HR	1.57			0.48	0.75	0.75
	TOTAL					6.00	169.11	1.48	20.07	189.18
	CODEO	1 B-eqoprcrn + 1 1.5 Cy Hydr. Excavator, Cwlr			PROD =	100%			CREW HOURS =	75
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	38.24	1.00	38.24			38.24
MIL	B-LABORER	L Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
MIL	H25CA016	E HYD EXCAV, CRWLR, 1.50 CY BKT	1.00	HR	64.88			1.00	64.88	64.88
MIL	XMIXX020	E Small Tools	0.11	HR	1.57			0.11	0.17	0.17
	TOTAL					2.00	64.61	1.11	65.05	129.66
	CODET	1 B-eqoprcrn + 1 2.0 Cy Hydr. Excavator, Cwlr			PROD =	100%			CREW HOURS =	14
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	38.24	1.00	38.24			38.24
MIL	B-LABORER	L Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
MIL	H25CA007	E HYD EXCAV, CRWLR, 2.00 CY BKT	1.00	HR	91.72			1.00	91.72	91.72
MIL	XMIXX020	E Small Tools	0.11	HR	1.57			0.11	0.17	0.17
	TOTAL					2.00	64.61	1.11	91.89	156.50

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	LABOR HOURS	LABOR COST	EQUIP HOURS	EQUIP COST	TOTAL COST
	CODEU	1 B-eqoprcrn + 1 3.0 Cy Hydr. Excavator, Cwlr			PROD =	100%			CREW HOURS =	4695
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	38.24	1.00	38.24			38.24
MIL	B-EQOPROILL	Equip. Operators, Oilers	1.00	HR	29.77	1.00	29.77			29.77
MIL	H25CA008 E	HYD EXCAV, CRWLR, 3.125CY BKT	1.00	HR	137.70			1.00	137.70	137.70
MIL	XMIXX020 E	Small Tools	0.11	HR	1.57			0.11	0.17	0.17
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
	TOTAL					3.00	94.38	1.11	137.88	232.25
	CODEX	4 B-laborer + 1 1.5 Cy Hydr. Excavator, Cwlr			PROD =	100%			CREW HOURS =	48
MIL	B-LABORER F	Laborers, (Semi-Skilled)	1.00	HR	26.87	1.00	26.87			26.87
MIL	B-LABORER L	Laborers, (Semi-Skilled)	3.00	HR	26.37	3.00	79.11			79.11
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	38.24	1.00	38.24			38.24
MIL	H25CA016 E	HYD EXCAV, CRWLR, 1.50 CY BKT	1.00	HR	64.88			1.00	64.88	64.88
MIL	XMIXX020 E	Small Tools	0.11	HR	1.57			0.11	0.17	0.17
	TOTAL					5.00	144.22	1.11	65.05	209.28
	CODLA	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Wheel			PROD =	100%			CREW HOURS =	437
MIL	B-LABORER L	Laborers, (Semi-Skilled)	0.50	HR	26.37	0.50	13.19			13.19
MIL	B-EQOPRMEDF	Equip. Operators, Medium	1.00	HR	37.25	1.00	37.25			37.25
MIL	L40CA004 E	LDR,FE, WH, 2.50 CY, ARTIC, 936	1.00	HR	33.38			1.00	33.38	33.38
	TOTAL					1.50	50.44	1.00	33.38	83.82
	CODLB	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Cwlr			PROD =	100%			CREW HOURS =	264
MIL	B-LABORER L	Laborers, (Semi-Skilled)	0.50	HR	26.37	0.50	13.19			13.19
MIL	B-EQOPRMEDF	Equip. Operators, Medium	1.00	HR	37.25	1.00	37.25			37.25
MIL	L35CA004 E	LDR,FE, CRWLR, 1.50 CY	1.00	HR	33.51			1.00	33.51	33.51
	TOTAL					1.50	50.44	1.00	33.51	83.94
	CODTC	1 B-eqoprmed + 1 Dozer, Cat D-4H, 90 Hp			PROD =	100%			CREW HOURS =	9280
MIL	B-EQOPRMEDF	Equip. Operators, Medium	0.25	HR	37.25	0.25	9.31			9.31
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	36.75	1.00	36.75			36.75
MIL	T10CA004 E	BLADE, ANGLE, HYDR (FOR D4	1.00	HR	3.51			1.00	3.51	3.51
MIL	T15CA004 E	DOZER,CWLR, D-4H,PS (ADD BLADE	1.00	HR	23.52			1.00	23.52	23.52
	TOTAL					1.25	46.07	2.00	27.03	73.10
	CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp			PROD =	100%			CREW HOURS =	895
MIL	B-EQOPRMEDF	Equip. Operators, Medium	0.25	HR	37.25	0.25	9.31			9.31
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	36.75	1.00	36.75			36.75
MIL	T10CA010 E	BLADE, ANGLE, HYDR (FOR D6	1.00	HR	4.16			1.00	4.16	4.16
MIL	T15CA010 E	DOZER,CWLR, D-6H,PS (ADD BLADE	1.00	HR	47.64			1.00	47.64	47.64
	TOTAL					1.25	46.07	2.00	51.80	97.87

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	LABOR HOURS	LABOR COST	EQUIP HOURS	EQUIP COST	TOTAL COST
	CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp			PROD = 100%				CREW HOURS =	6274
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	36.75	1.00	36.75			36.75
MIL	B-EQOPRMEDF	Equip. Operators, Medium	0.25	HR	37.25	0.25	9.31			9.31
MIL	T10CA013	E BLADE, UNIVERSAL, HYDR (FOR D7	1.00	HR	6.28			1.00	6.28	6.28
MIL	T15CA013	E DOZER,CWLR, D-7H,PS (ADD BLADE	1.00	HR	69.65			1.00	69.65	69.65
	TOTAL					1.25	46.07	2.00	75.93	122.00
	CODTK	1 B-eqoprmed + 1 Dozer/Roller, Cat D-8L, 335 Hp			PROD = 100%				CREW HOURS =	679
MIL	B-EQOPRCRNF	Equip. Operators, Crane/Shovel	0.25	HR	38.74	0.25	9.68			9.68
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	38.24	1.00	38.24			38.24
MIL	R40SO001	E ROLLR,VIB,SD,TOW,SHPF,25.5T,72"	1.00	HR	22.70			1.00	22.70	22.70
MIL	T10CA017	E BLADE, UNIVERSAL, HYDR (FOR D8	1.00	HR	7.66			1.00	7.66	7.66
MIL	T15CA015	E DOZER,CWLR, D-8L,PS (ADD BLADE	1.00	HR	94.26			1.00	94.26	94.26
	TOTAL					1.25	47.92	3.00	124.61	172.53
	COEID	1 B-trkdvrhv + 1 12 Cy Dump Truck			PROD = 100%				CREW HOURS =	34800
MIL	B-TRKDVRHVL	Truck Drivers, Heavy	1.00	HR	30.30	1.00	30.30			30.30
MIL	T40XX010	E REAR DUMP BODY,12 CY,(36,000 GV	1.00	HR	2.72			1.00	2.72	2.72
MIL	T50KE003	E TRK,HWY, 46,000 GVW, 6X4, 3 AXL	1.00	HR	34.71			1.00	34.71	34.71
	TOTAL					1.00	30.30	2.00	37.43	67.73
	COELA	1 B-eqoprlt			PROD = 100%				CREW HOURS =	2000
MIL	B-EQOPRLT L	Equip. Operators, Light	1.00	HR	35.49	1.00	35.49			35.49
MIL	B-EQOPRLT F	Equip. Operators, Light	0.25	HR	35.99	0.25	9.00			9.00
	TOTAL					1.25	44.49	0.00	0.00	44.49
	COETH	1 B-trkdvrhv + 1 16.5 Cy Dump Truck			PROD = 100%				CREW HOURS =	12626
MIL	B-TRKDVRHVL	Truck Drivers, Heavy	1.00	HR	30.30	1.00	30.30			30.30
MIL	T55EU001	E TRK,OFF-HWY,R-DUMP, 14-19CY, 25	1.00	HR	42.58			1.00	42.58	42.58
	TOTAL					1.00	30.30	1.00	42.58	72.88
	COETK	1 B-trkdvrhv + 1 25 Cy Dump Truck			PROD = 100%				CREW HOURS =	4483
MIL	B-TRKDVRHVL	Truck Drivers, Heavy	1.00	HR	30.30	1.00	30.30			30.30
MIL	T55CA001	E TRK,OFF-HWY,R-DUMP, 22-30CY, 35	1.00	HR	78.43			1.00	78.43	78.43
	TOTAL					1.00	30.30	1.00	78.43	108.73
	COETL	3 B-laborer + 2 12 Cy Dump Trck/CrawlrLoadr			PROD = 100%				CREW HOURS =	57
MIL	B-LABORER L	Laborers, (Semi-Skilled)	2.00	HR	26.37	2.00	52.74			52.74
MIL	B-LABORER F	Laborers, (Semi-Skilled)	1.00	HR	26.87	1.00	26.87			26.87
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	36.75	1.00	36.75			36.75
MIL	B-TRKDVRHVL	Truck Drivers, Heavy	2.00	HR	30.30	2.00	60.61			60.61
MIL	L35CA007	E LDR,FE, CRWLR, 3.75 CY	1.00	HR	88.47			1.00	88.47	88.47
MIL	XMIXX020	E Small Tools	0.28	HR	1.57			0.28	0.44	0.44
MIL	T40XX010	E REAR DUMP BODY,12 CY,(36,000 GV	2.00	HR	2.72			2.00	5.44	5.44
MIL	T50KE003	E TRK,HWY, 46,000 GVW, 6X4, 3 AXL	2.00	HR	34.71			2.00	69.41	69.41
	TOTAL					6.00	176.97	5.28	163.76	340.74

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO. UOM	RATE	LABOR HOURS	LABOR COST	EQUIP HOURS	EQUIP COST	TOTAL COST
	* COFCF	2 B-eqoprmed + 1 12-G Grader & 1 11 Tire Roller		PROD = 100%				CREW HOURS =	24
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00 HR	26.37	1.00	26.37			26.37
MIL	B-EQOPRMEDF	Equip. Operators, Medium	0.50 HR	37.25	0.50	18.63			18.63
MIL	B-EQOPRMEDL	Equip. Operators, Medium	2.00 HR	36.75	2.00	73.51			73.51
MIL	G15CA003 E	GRADER,MOTOR, ARTIC, CAT 12-G	1.00 HR	34.82			1.00	34.82	34.82
MIL	XMIXX020 E	Small Tools	0.16 HR	1.57			0.16	0.25	0.25
MIL	R30CA001 E	ROLLR,STATIC,S/P,13T,84"W,11TIR	1.00 HR	16.95			1.00	16.95	16.95
	TOTAL				3.50	118.51	2.16	52.02	170.53
	COFCK	1 B-eqoprmed + Roller		PROD = 100%				CREW HOURS =	1249
MIL	* R45BO002 E	ROLLER,VIB,DD,S/P, 6.9T, 55"W	1.00 HR	28.39			1.00	28.39	28.39
MIL	B-EQOPRMEDL	Eq Oper, Medium	1.00 HR	36.75	1.00	36.75			36.75
MIL	B-LABORER L	Laborer (Semi-Skilled)	0.50 HR	26.37	0.50	13.19			13.19
	TOTAL				1.50	49.94	1.00	28.39	78.33
	* COFCP	2 B-eqoprmed + 1 Tire Roller+Water Wagon,6000Gal		PROD = 100%				CREW HOURS =	2652
MIL	B-LABORER L	Laborers, (Semi-Skilled)	0.50 HR	26.37	0.50	13.19			13.19
MIL	B-EQOPRMEDL	Equip. Operators, Medium	2.00 HR	36.75	2.00	73.51			73.51
MIL	B-EQOPRMEDF	Equip. Operators, Medium	0.25 HR	37.25	0.25	9.31			9.31
MIL	R30CA003 E	LNDFL COMP,SHPSFT,S/P 22T, 76"W	1.00 HR	51.58			1.00	51.58	51.58
MIL	T60KI002 E	TRK,WTR,OF-HY, 6000GAL,W/CAT621	1.00 HR	67.71			1.00	67.71	67.71
	TOTAL				2.75	96.01	2.00	119.30	215.30
	COFGA	1 B-eqoprmed + 1 Grader 12-G		PROD = 100%				CREW HOURS =	1509
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00 HR	26.37	1.00	26.37			26.37
MIL	B-EQOPRMEDF	Equip. Operators, Medium	1.00 HR	37.25	1.00	37.25			37.25
MIL	G15CA003 E	GRADER,MOTOR, ARTIC, CAT 12-G	1.00 HR	34.82			1.00	34.82	34.82
	TOTAL				2.00	63.62	1.00	34.82	98.45
	COFWG	1 B-eqoprlt + 1 Wtr-pmp, Submersible, 6 In.		PROD = 100%				CREW HOURS =	4640
MIL	B-LABORER L	Laborers, (Semi-Skilled)	0.50 HR	26.37	0.50	13.19			13.19
MIL	B-EQOPRLT F	Equip. Operators, Light	1.00 HR	35.99	1.00	35.99			35.99
MIL	P55GR004 E	PUMP,SUBM, 6"D,1950GPM/40'HD, E	1.00 HR	6.55			1.00	6.55	6.55
	TOTAL				1.50	49.18	1.00	6.55	55.72
	COFWI	1 B-trkdvrhvl+ 1 Wtr Trk, 3000 Gal/6" Pump		PROD = 100%				CREW HOURS =	200
MIL	B-EQOPRMEDF	Equip. Operators, Medium	0.25 HR	37.25	0.25	9.31			9.31
MIL	B-TRKDVRHVL	Truck Drivers, Heavy	1.00 HR	30.30	1.00	30.30			30.30
MIL	B-EQOPRLT L	Equip. Operators, Light	0.50 HR	35.49	0.50	17.74			17.74
MIL	P55GR004 E	PUMP,SUBM, 6"D,1950GPM/40'HD, E	0.50 HR	6.55			0.50	3.27	3.27
MIL	T40XX033 E	WATER TANK, 3000 GAL (ADD TRK	1.00 HR	3.28			1.00	3.28	3.28
MIL	T50KE003 E	TRK,HWY, 46,000 GVW, 6X4, 3 AXL	1.00 HR	34.71			1.00	34.71	34.71
	TOTAL				1.75	57.36	2.50	41.26	98.62

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	COFWK	1 B-trkdvrhvl+ 1 Wtr Wag, 6000 Gal/6" Pump			PROD =	100%			CREW HOURS =	0
MIL	B-EQOPRLT F	Equip. Operators, Light	0.25	HR	35.99	0.25	9.00			9.00
MIL	B-TRKDVRHVL	Truck Drivers, Heavy	1.00	HR	30.30	1.00	30.30			30.30
MIL	B-EQOPRLT L	Equip. Operators, Light	0.50	HR	35.49	0.50	17.74			17.74
MIL	P55GR004 E	PUMP,SUBM, 6"D,1950GPM/40'HD, E	1.00	HR	6.55			1.00	6.55	6.55
MIL	T60KI002 E	TRK,WTR,OF-HY, 6000GAL,W/CAT621	1.00	HR	67.71			1.00	67.71	67.71
	TOTAL					1.75	57.05	2.00	74.26	131.30
	COKBD	2 B-laborer + 1 Bitum.Dist.Truck/Sweepr			PROD =	100%			CREW HOURS =	2
MIL	A25RS007 E	ASPH DISTR, 3000 GAL, (ADD TR	1.00	HR	15.92			1.00	15.92	15.92
MIL	B-LABORER L	Laborers, (Semi-Skilled)	2.00	HR	26.37	2.00	52.74			52.74
MIL	B-TRKDVRLTL	Truck Drivers, Light	1.00	HR	29.98	1.00	29.98			29.98
MIL	B-TRKDVRHVL	Truck Drivers, Heavy	1.00	HR	30.30	1.00	30.30			30.30
MIL	B15MB004 E	STR SWEEPER, 7'W/SPRINKER, TOWE	1.00	HR	4.28			1.00	4.28	4.28
MIL	T50KE003 E	TRK,HWY, 46,000 GVW, 6X4, 3 AXL	1.00	HR	34.71			1.00	34.71	34.71
MIL	T50FO011 E	TRK,HWY, 24,500 GVW, 4X2, 2 AXL	1.00	HR	14.90			1.00	14.90	14.90
	TOTAL					4.00	113.02	4.00	69.80	182.82
	COMCA	5 B-laborer + 1 16" Chipper/1 3-3/4Cy,Cwlr Ldr			PROD =	100%			CREW HOURS =	669
MIL	B-LABORER L	Laborers, (Semi-Skilled)	4.00	HR	26.37	4.00	105.48			105.48
MIL	B-LABORER F	Laborers, (Semi-Skilled)	1.00	HR	26.87	1.00	26.87			26.87
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	36.75	1.00	36.75			36.75
MIL	B20CI006 E	B-CHIPPER, 16" DIA LOG, TRLR-MT	1.00	HR	6.67			1.00	6.67	6.67
MIL	L35CA007 E	LDR,FE, CRWLR, 3.75 CY	1.00	HR	88.47			1.00	88.47	88.47
MIL	XMIXX020 E	Small Tools	0.74	HR	1.57			0.74	1.16	1.16
	TOTAL					6.00	169.11	2.74	96.30	265.40
	EELEA	1 B-electrn			PROD =	100%			CREW HOURS =	1
MIL	B-ELECTRN L	Electricians	1.00	HR	38.71	1.00	38.71			38.71
MIL	B-ELECTRN F	Electricians	0.25	HR	39.21	0.25	9.80			9.80
	TOTAL					1.25	48.52	0.00	0.00	48.52
	EELEF	4 B-electrn + Small Tools			PROD =	100%			CREW HOURS =	0
MIL	B-ELECTRN F	Electricians	0.66	HR	39.21	0.66	25.88			25.88
MIL	B-ELECTRN A	Electricians	2.00	HR	32.81	2.00	65.62			65.62
MIL	B-ELECTRN L	Electricians	2.00	HR	38.71	2.00	77.43			77.43
MIL	XMIXX020 E	Small Tools	0.45	HR	1.57			0.45	0.71	0.71
	TOTAL					4.66	168.92	0.45	0.71	169.63
	HTESA	1 Indust Hygen Tech + Small Tools			PROD =	100%			CREW HOURS =	4640
MIL	XMIXX020 E	Small Tools	1.00	HR	1.57			1.00	1.57	1.57
RAD	FH-HYGTEH L	Industrial Hygiene Technician	1.00	HR	27.38	1.00	27.38			27.38
	TOTAL					1.00	27.38	1.00	1.57	28.95

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	MPLUA	1 B-plumber + Small Tools			PROD =	100%			CREW HOURS =	18
MIL	B-PLUMBER F	Plumbers	0.25	HR	42.84	0.25	10.71			10.71
MIL	B-PLUMBER L	Plumbers	1.00	HR	42.34	1.00	42.34			42.34
MIL	XMIXX020 E	Small Tools	0.34	HR	1.57			0.34	0.53	0.53
	TOTAL					1.25	53.04	0.34	0.53	53.58
	MPLUB	2 B-plumber + Small Tools			PROD =	100%			CREW HOURS =	1
MIL	B-PLUMBER A	Plumbers	1.00	HR	35.81	1.00	35.81			35.81
MIL	B-PLUMBER F	Plumbers	0.50	HR	42.84	0.50	21.42			21.42
MIL	B-PLUMBER L	Plumbers	1.00	HR	42.34	1.00	42.34			42.34
MIL	XMIXX020 E	Small Tools	0.67	HR	1.57			0.67	1.05	1.05
	TOTAL					2.50	99.56	0.67	1.05	100.61
	MPLUC	1 B-plumber + Small Tools			PROD =	100%			CREW HOURS =	0
MIL	B-PLUMBER L	Plumbers	1.00	HR	42.34	1.00	42.34			42.34
MIL	B-PLUMBER F	Plumbers	0.10	HR	42.84	0.10	4.28			4.28
MIL	XMIXX020 E	Small Tools	0.19	HR	1.57			0.19	0.30	0.30
	TOTAL					1.10	46.62	0.19	0.30	46.92
	MPLUD	1 B-plumber + Small Tools			PROD =	100%			CREW HOURS =	1
MIL	B-PLUMBER F	Plumbers	0.25	HR	42.84	0.25	10.71			10.71
MIL	B-PLUMBER L	Plumbers	1.00	HR	42.34	1.00	42.34			42.34
MIL	XMIXX020 E	Small Tools	0.34	HR	1.57			0.34	0.53	0.53
	TOTAL					1.25	53.04	0.34	0.53	53.58
	MPLUE	1 B-plumber/laborer + Small Tools			PROD =	100%			CREW HOURS =	280
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
MIL	B-PLUMBER L	Plumbers	1.00	HR	42.34	1.00	42.34			42.34
MIL	B-PLUMBER F	Plumbers	0.50	HR	42.84	0.50	21.42			21.42
MIL	XMIXX020 E	Small Tools	0.67	HR	1.57			0.67	1.05	1.05
	TOTAL					2.50	90.12	0.67	1.05	91.18
	MPLUQ	3 B-plumber + 1 20 Ton Crane, Hydraulic+Welder			PROD =	100%			CREW HOURS =	5
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
MIL	B-EQOPRMEDL	Equip. Operators, Medium	0.40	HR	36.75	0.40	14.70			14.70
MIL	B-PLUMBER A	Plumbers	1.00	HR	35.81	1.00	35.81			35.81
MIL	B-PLUMBER L	Plumbers	1.00	HR	42.34	1.00	42.34			42.34
MIL	B-PLUMBER F	Plumbers	1.00	HR	42.84	1.00	42.84			42.84
MIL	C75GV002 E	CRANE,HYD,S/P,RT,4WD,20T/70'BOO	0.40	HR	34.78			0.40	13.91	13.91
MIL	XMIXX020 E	Small Tools	1.27	HR	1.57			1.27	1.99	1.99
MIL	W35XX009 E	WELDER, 300 AMP, SKID,ELEC DRIV	1.00	HR	1.62			1.00	1.62	1.62
	TOTAL					4.40	162.05	2.67	17.53	179.58

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	MPLUS	2 B-plumber + 1 20 Ton Crane, Hydraulic R/T			PROD =	100%			CREW HOURS =	8
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
MIL	B-EQOPRMEDL	Equip. Operators, Medium	0.50	HR	36.75	0.50	18.38			18.38
MIL	B-PLUMBER F	Plumbers	1.00	HR	42.84	1.00	42.84			42.84
MIL	B-PLUMBER L	Plumbers	1.00	HR	42.34	1.00	42.34			42.34
MIL	C75GV002 E	CRANE,HYD,S/P,RT,4WD,20T/70'BOO	0.50	HR	34.78			0.50	17.39	17.39
MIL	XMIXX020 E	Small Tools	0.56	HR	1.57			0.56	0.88	0.88
	TOTAL					3.50	129.92	1.06	18.27	148.19
	MSHMA	1 B-shtmtlwk + Small Tools			PROD =	100%			CREW HOURS =	68
MIL	B-SHTMTLWKL	Sheet Metal Workers	1.00	HR	45.11	1.00	45.11			45.11
MIL	B-SHTMTLWKF	Sheet Metal Workers	0.25	HR	45.61	0.25	11.40			11.40
MIL	XMIXX020 E	Small Tools	0.34	HR	1.57			0.34	0.53	0.53
	TOTAL					1.25	56.51	0.34	0.53	57.04
	MSHMB	2 B-shtmtlwk + Small Tools			PROD =	100%			CREW HOURS =	1
MIL	B-SHTMTLWKA	Sheet Metal Workers	1.00	HR	37.90	1.00	37.90			37.90
MIL	B-SHTMTLWKL	Sheet Metal Workers	1.00	HR	45.11	1.00	45.11			45.11
MIL	B-SHTMTLWKF	Sheet Metal Workers	0.50	HR	45.61	0.50	22.80			22.80
MIL	XMIXX020 E	Small Tools	0.69	HR	1.57			0.69	1.08	1.08
	TOTAL					2.50	105.81	0.69	1.08	106.89
	MSHMC	2 B-shtmtlwk + Small Tools			PROD =	100%			CREW HOURS =	3
MIL	B-SHTMTLWKL	Sheet Metal Workers	2.00	HR	45.11	2.00	90.22			90.22
MIL	B-SHTMTLWKF	Sheet Metal Workers	0.25	HR	45.61	0.25	11.40			11.40
MIL	XMIXX020 E	Small Tools	0.64	HR	1.57			0.64	1.00	1.00
	TOTAL					2.25	101.62	0.64	1.00	102.62
	MSHMD	2 B-shtmtlwk + Small Tools			PROD =	100%			CREW HOURS =	8
MIL	B-SHTMTLWKA	Sheet Metal Workers	1.00	HR	37.90	1.00	37.90			37.90
MIL	B-SHTMTLWKL	Sheet Metal Workers	1.00	HR	45.11	1.00	45.11			45.11
MIL	B-SHTMTLWKF	Sheet Metal Workers	0.50	HR	45.61	0.50	22.80			22.80
MIL	XMIXX020 E	Small Tools	0.69	HR	1.57			0.69	1.08	1.08
	TOTAL					2.50	105.81	0.69	1.08	106.89
	MSHMF	2 B-shtmtlwk/laborer + Small Tools			PROD =	100%			CREW HOURS =	32
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
MIL	B-SHTMTLWKA	Sheet Metal Workers	1.00	HR	37.90	1.00	37.90			37.90
MIL	B-SHTMTLWKF	Sheet Metal Workers	0.50	HR	45.61	0.50	22.80			22.80
MIL	B-SHTMTLWKL	Sheet Metal Workers	1.00	HR	45.11	1.00	45.11			45.11
MIL	XMIXX020 E	Small Tools	1.03	HR	1.57			1.03	1.62	1.62
	TOTAL					3.50	132.18	1.03	1.62	133.80

SRC	ITEM ID	DESCRIPTION	NO. UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	MSHMG	3 B-shtmtlwk/laborer + Power Tools		PROD =	100%			CREW HOURS =	2
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00 HR	26.37	1.00	26.37			26.37
MIL	B-SHTMTLWKA	Sheet Metal Workers	1.00 HR	37.90	1.00	37.90			37.90
MIL	B-SHTMTLWKF	Sheet Metal Workers	1.00 HR	45.61	1.00	45.61			45.61
MIL	B-SHTMTLWKL	Sheet Metal Workers	1.00 HR	45.11	1.00	45.11			45.11
MIL	XMIXX010 E	Misc. Power Tools	0.13 HR	6.40			0.13	0.83	0.83
MIL	XMIXX020 E	Small Tools	0.78 HR	1.57			0.78	1.22	1.22
	TOTAL				4.00	154.98	0.91	2.06	157.04
	MSPFA	1 B-stm/pipe + Small Tools		PROD =	100%			CREW HOURS =	9
MIL	B-STM/PIPEL	Steam / Pipefitters	1.00 HR	43.10	1.00	43.10			43.10
MIL	B-STM/PIPEF	Steam / Pipefitters	0.25 HR	43.60	0.25	10.90			10.90
MIL	XMIXX020 E	Small Tools	0.36 HR	1.57			0.36	0.57	0.57
	TOTAL				1.25	54.00	0.36	0.57	54.57
	MSPFB	2 B-stm/pipe + Small Tools		PROD =	100%			CREW HOURS =	51
MIL	B-STM/PIPEA	Steam / Pipefitters	1.00 HR	36.46	1.00	36.46			36.46
MIL	B-STM/PIPEL	Steam / Pipefitters	1.00 HR	43.10	1.00	43.10			43.10
MIL	B-STM/PIPEF	Steam / Pipefitters	0.50 HR	43.60	0.50	21.80			21.80
MIL	XMIXX020 E	Small Tools	0.72 HR	1.57			0.72	1.13	1.13
	TOTAL				2.50	101.36	0.72	1.13	102.49
	MSPFC	2 B-stm/pipe + Small Tools		PROD =	100%			CREW HOURS =	3
MIL	B-STM/PIPEL	Steam / Pipefitters	2.00 HR	43.10	2.00	86.20			86.20
MIL	B-STM/PIPEF	Steam / Pipefitters	0.50 HR	43.60	0.50	21.80			21.80
MIL	XMIXX020 E	Small Tools	0.72 HR	1.57			0.72	1.13	1.13
	TOTAL				2.50	108.00	0.72	1.13	109.13
	MSPFI	2 B-stm/pipe + Small Tools		PROD =	100%			CREW HOURS =	0
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00 HR	26.37	1.00	26.37			26.37
MIL	B-STM/PIPEF	Steam / Pipefitters	0.50 HR	43.60	0.50	21.80			21.80
MIL	B-STM/PIPEL	Steam / Pipefitters	1.00 HR	43.10	1.00	43.10			43.10
MIL	B-STM/PIPEA	Steam / Pipefitters	1.00 HR	36.46	1.00	36.46			36.46
MIL	XMIXX020 E	Small Tools	1.06 HR	1.57			1.06	1.66	1.66
	TOTAL				3.50	127.73	1.06	1.66	129.40
	MSPFP	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T		PROD =	100%			CREW HOURS =	59
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00 HR	26.37	1.00	26.37			26.37
MIL	B-EQOPRMEDL	Equip. Operators, Medium	0.30 HR	36.75	0.30	11.03			11.03
MIL	B-STM/PIPEF	Steam / Pipefitters	1.00 HR	43.60	1.00	43.60			43.60
MIL	B-STM/PIPEL	Steam / Pipefitters	1.00 HR	43.10	1.00	43.10			43.10
MIL	B-STM/PIPEA	Steam / Pipefitters	1.00 HR	36.46	1.00	36.46			36.46
MIL	C75GV002 E	CRANE,HYD,S/P,RT,4WD,20T/70'BOO	0.30 HR	34.78			0.30	10.44	10.44
MIL	XMIXX020 E	Small Tools	1.32 HR	1.57			1.32	2.07	2.07
	TOTAL				4.30	160.56	1.62	12.51	173.07

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	MSPFQ	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T			PROD = 100%				CREW HOURS =	15
MIL	B-LABORER	L Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
MIL	B-EQOPRMEDL	Equip. Operators, Medium	0.30	HR	36.75	0.30	11.03			11.03
MIL	B-STM/PIPEF	Steam / Pipefitters	1.00	HR	43.60	1.00	43.60			43.60
MIL	B-STM/PIPEL	Steam / Pipefitters	1.00	HR	43.10	1.00	43.10			43.10
MIL	B-STM/PIPEA	Steam / Pipefitters	1.00	HR	36.46	1.00	36.46			36.46
MIL	C75GV002	E CRANE,HYD,S/P,RT,4WD,20T/70'BOO	0.30	HR	34.78			0.30	10.44	10.44
MIL	XMIXX020	E Small Tools	1.32	HR	1.57			1.32	2.07	2.07
	TOTAL					4.30	160.56	1.62	12.51	173.07
	MSPFS	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T			PROD = 100%				CREW HOURS =	80
MIL	B-LABORER	L Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
MIL	B-EQOPRMEDL	Equip. Operators, Medium	0.50	HR	36.75	0.50	18.38			18.38
MIL	B-STM/PIPEF	Steam / Pipefitters	1.00	HR	43.60	1.00	43.60			43.60
MIL	B-STM/PIPEL	Steam / Pipefitters	1.00	HR	43.10	1.00	43.10			43.10
MIL	B-STM/PIPEA	Steam / Pipefitters	1.00	HR	36.46	1.00	36.46			36.46
MIL	C75GV002	E CRANE,HYD,S/P,RT,4WD,20T/70'BOO	0.50	HR	34.78			0.50	17.39	17.39
MIL	XMIXX020	E Small Tools	1.37	HR	1.57			1.37	2.15	2.15
	TOTAL					4.50	167.91	1.87	19.54	187.45
	MSPIA	1 B-sprnklr + Small Tools			PROD = 100%				CREW HOURS =	10
MIL	B-SPRNKLR	L Sprinkler Installers	1.00	HR	43.10	1.00	43.10			43.10
MIL	B-SPRNKLR	F Sprinkler Installers	0.25	HR	43.60	0.25	10.90			10.90
MIL	XMIXX020	E Small Tools	0.36	HR	1.57			0.36	0.57	0.57
	TOTAL					1.25	54.00	0.36	0.57	54.57
	SIWRB	2 B-rodman + Small Tools			PROD = 100%				CREW HOURS =	25
MIL	B-RODMAN	L Rodmen, (Reinforcing)	2.00	HR	42.96	2.00	85.91			85.91
MIL	B-RODMAN	F Rodmen, (Reinforcing)	0.50	HR	43.46	0.50	21.73			21.73
MIL	XMIXX020	E Small Tools	0.39	HR	1.57			0.39	0.61	0.61
	TOTAL					2.50	107.64	0.39	0.61	108.26
	SIWRC	3 B-rodman + Small Tools			PROD = 100%				CREW HOURS =	3
MIL	B-RODMAN	F Rodmen, (Reinforcing)	1.00	HR	43.46	1.00	43.46			43.46
MIL	B-RODMAN	L Rodmen, (Reinforcing)	3.00	HR	42.96	3.00	128.87			128.87
MIL	XMIXX020	E Small Tools	0.68	HR	1.57			0.68	1.07	1.07
	TOTAL					4.00	172.33	0.68	1.07	173.40
	SIWSI	4 B-strsteel + 1 20 Ton Crane, Hydraulic R/T			PROD = 100%				CREW HOURS =	100
MIL	B-STRSTEELF	Structural Steel Workers	1.00	HR	43.46	1.00	43.46			43.46
MIL	B-STRSTEELA	Structural Steel Workers	2.00	HR	36.48	2.00	72.96			72.96
MIL	B-STRSTEELL	Structural Steel Workers	2.00	HR	42.96	2.00	85.91			85.91
MIL	B-WELDERS	L Welders, Structural Steel	1.00	HR	43.28	1.00	43.28			43.28
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	36.75	1.00	36.75			36.75
MIL	C75GV002	E CRANE,HYD,S/P,RT,4WD,20T/70'BOO	1.00	HR	34.78			1.00	34.78	34.78
MIL	XMIXX020	E Small Tools	1.95	HR	1.57			1.95	3.06	3.06

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
MIL	W35XX002	E WELDER, 200 AMP, W/1 AXLE TRLR	1.00	HR	7.24			1.00	7.24	7.24
	TOTAL					7.00	282.37	3.95	45.09	327.46
	SIWSM	6 B-strsteel + 1 60 Ton Crane, Hydr. Truck Mtd			PROD =	100%			CREW HOURS =	7
MIL	B-STRSTEELL	Structural Steel Workers	3.00	HR	42.96	3.00	128.87			128.87
MIL	B-STRSTEELA	Structural Steel Workers	2.00	HR	36.48	2.00	72.96			72.96
MIL	B-STRSTEELF	Structural Steel Workers	1.00	HR	43.46	1.00	43.46			43.46
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	38.24	1.00	38.24			38.24
MIL	B-EQOPROILL	Equip. Operators, Oilers	1.00	HR	29.77	1.00	29.77			29.77
MIL	C80GV007	E CRANE,HYD,TRK MTD, 60T /115'BOO	1.00	HR	72.66			1.00	72.66	72.66
MIL	XMIXX020	E Small Tools	1.86	HR	1.57			1.86	2.92	2.92
	TOTAL					8.00	313.30	2.86	75.58	388.88
	SIWSO	6 B-strsteel + 1 60 Ton Crane, Hydr. Truck Mtd			PROD =	100%			CREW HOURS =	96
MIL	B-STRSTEELF	Structural Steel Workers	1.00	HR	43.46	1.00	43.46			43.46
MIL	B-STRSTEELL	Structural Steel Workers	3.00	HR	42.96	3.00	128.87			128.87
MIL	B-STRSTEELA	Structural Steel Workers	2.00	HR	36.48	2.00	72.96			72.96
MIL	B-WELDERS L	Welders, Structural Steel	2.00	HR	43.28	2.00	86.57			86.57
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	38.24	1.00	38.24			38.24
MIL	B-EQOPRLT L	Equip. Operators, Light	1.00	HR	35.49	1.00	35.49			35.49
MIL	B-EQOPROILL	Equip. Operators, Oilers	1.00	HR	29.77	1.00	29.77			29.77
MIL	C80GV007	E CRANE,HYD,TRK MTD, 60T /115'BOO	1.00	HR	72.66			1.00	72.66	72.66
MIL	XMIXX020	E Small Tools	3.14	HR	1.57			3.14	4.93	4.93
MIL	W35XX002	E WELDER, 200 AMP, W/1 AXLE TRLR	2.00	HR	7.24			2.00	14.48	14.48
	TOTAL					11.00	435.35	6.14	92.08	527.43
	ULABA	1 B-laborer + Small Tools			PROD =	100%			CREW HOURS =	194
MIL	B-LABORER F	Laborers, (Semi-Skilled)	0.25	HR	26.87	0.25	6.72			6.72
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00	HR	26.37	1.00	26.37			26.37
MIL	XMIXX020	E Small Tools	0.13	HR	1.57			0.13	0.20	0.20
	TOTAL					1.25	33.09	0.13	0.20	33.29
	ULABB	2 B-laborer + Small Tools			PROD =	100%			CREW HOURS =	6
MIL	B-LABORER L	Laborers, (Semi-Skilled)	2.00	HR	26.37	2.00	52.74			52.74
MIL	B-LABORER F	Laborers, (Semi-Skilled)	0.50	HR	26.87	0.50	13.44			13.44
MIL	XMIXX020	E Small Tools	0.27	HR	1.57			0.27	0.42	0.42
	TOTAL					2.50	66.18	0.27	0.42	66.60
	ULABC	3 B-laborer + Small Tools			PROD =	100%			CREW HOURS =	30
MIL	B-LABORER L	Laborers, (Semi-Skilled)	3.00	HR	26.37	3.00	79.11			79.11
MIL	B-LABORER F	Laborers, (Semi-Skilled)	0.50	HR	26.87	0.50	13.44			13.44
MIL	XMIXX020	E Small Tools	0.40	HR	1.57			0.40	0.63	0.63
	TOTAL					3.50	92.55	0.40	0.63	93.18

SRC	ITEM ID	DESCRIPTION	NO. UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	ULABE	1 B-laborer + Misc. Power Tools		PROD = 100%			CREW HOURS =		585
MIL	B-LABORER	L Laborers, (Semi-Skilled)	1.00 HR	26.37	1.00	26.37			26.37
MIL	B-LABORER	F Laborers, (Semi-Skilled)	0.25 HR	26.87	0.25	6.72			6.72
MIL	XMIXX010	E Misc. Power Tools	0.22 HR	6.40			0.22	1.41	1.41
MIL	XMIXX020	E Small Tools	0.09 HR	1.57			0.09	0.14	0.14
	TOTAL				1.25	33.09	0.31	1.55	34.64
	ULABF	3 X-laborer + 1 20 Ton Crane, Hydraulic R/T		PROD = 100%			CREW HOURS =		8
MIL	B-LABORER	L Laborers, (Semi-Skilled)	3.00 HR	26.37	3.00	79.11			79.11
MIL	B-LABORER	F Laborers, (Semi-Skilled)	0.50 HR	26.87	0.50	13.44			13.44
MIL	XMIXX020	E Small Tools	1.00 HR	1.57			1.00	1.57	1.57
MIL	C75GV002	E CRANE,HYD,S/P,RT,4WD,20T/70'BOO	1.00 HR	34.78			1.00	34.78	34.78
	TOTAL				3.50	92.55	2.00	36.35	128.90
	ULABJ	3 B-laborer + 1 3/4 Ton Pickup Truck		PROD = 100%			CREW HOURS =		76
MIL	B-LABORER	L Laborers, (Semi-Skilled)	2.00 HR	26.37	2.00	52.74			52.74
MIL	B-LABORER	F Laborers, (Semi-Skilled)	1.00 HR	26.87	1.00	26.87			26.87
MIL	XMIXX020	E Small Tools	0.25 HR	1.57			0.25	0.39	0.39
MIL	T50F0003	E TRK,HWY, 8,600GVW,4X2, 3/4T-PKU	0.40 HR	7.66			0.40	3.07	3.07
	TOTAL				3.00	79.61	0.65	3.46	83.07
	ULABL	3 B-laborer + 1 3 Ton Flatbed Truck		PROD = 100%			CREW HOURS =		720
MIL	B-LABORER	L Laborers, (Semi-Skilled)	2.00 HR	26.37	2.00	52.74			52.74
MIL	B-LABORER	F Laborers, (Semi-Skilled)	1.00 HR	26.87	1.00	26.87			26.87
MIL	XMIXX020	E Small Tools	0.47 HR	1.57			0.47	0.74	0.74
MIL	T40XX016	E FLATBED, 8'x 16.0' (ADD TRK	1.00 HR	0.68			1.00	0.68	0.68
MIL	T50F0011	E TRK,HWY, 24,500 GVW, 4X2, 2 AXL	1.00 HR	14.90			1.00	14.90	14.90
	TOTAL				3.00	79.61	2.47	16.32	95.93
	ULABN	3 B-laborer + 1 Flatbed Truck W/Hyd. Crane		PROD = 100%			CREW HOURS =		12
MIL	B-LABORER	F Laborers, (Semi-Skilled)	1.00 HR	26.87	1.00	26.87			26.87
MIL	B-LABORER	L Laborers, (Semi-Skilled)	2.00 HR	26.37	2.00	52.74			52.74
MIL	B-EQOPRLT	L Equip. Operators, Light	1.00 HR	35.49	1.00	35.49			35.49
MIL	XMIXX020	E Small Tools	0.47 HR	1.57			0.47	0.74	0.74
MIL	T40XX016	E FLATBED, 8'x 16.0' (ADD TRK	1.00 HR	0.68			1.00	0.68	0.68
MIL	T40XX003	E HYDR CRANE 8.0T,W/ 85'BOOM	1.00 HR	12.48			1.00	12.48	12.48
MIL	T50KE003	E TRK,HWY, 46,000 GVW, 6X4, 3 AXL	1.00 HR	34.71			1.00	34.71	34.71
	TOTAL				4.00	115.10	3.47	48.61	163.71
	ULADB	2 B-laborer + 1 Rotary Drill, Water Well		PROD = 100%			CREW HOURS =		0
MIL	D35IN003	E DRILL,ROTARY, 16" WATER WELL,TR	1.00 HR	101.75			1.00	101.75	101.75
MIL	XMIXX020	E Small Tools	1.00 HR	1.57			1.00	1.57	1.57
MIL	B-LABORER	F Laborers, (Semi-Skilled)	1.00 HR	26.87	1.00	26.87			26.87
MIL	B-LABORER	L Laborers, (Semi-Skilled)	1.00 HR	26.37	1.00	26.37			26.37
MIL	B-EQOPRMED	L Equip. Operators, Medium	1.00 HR	36.75	1.00	36.75			36.75
	TOTAL				3.00	90.00	2.00	103.32	193.31

** CREW BACKUP **

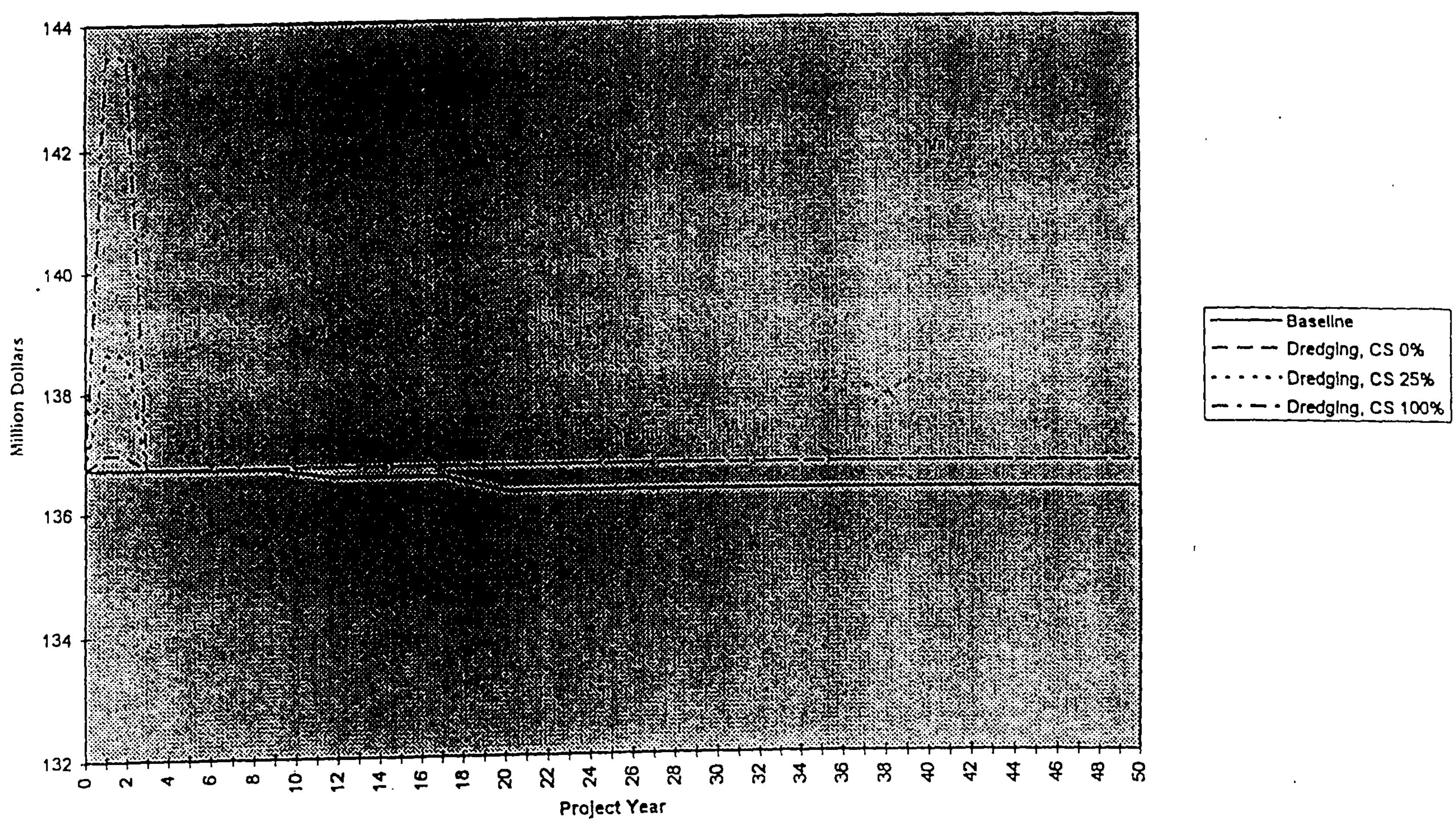
SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	LABOR HOURS	LABOR COST	EQUIP HOURS	EQUIP COST	TOTAL COST
	UOEHE	1 B-eqoprcrn + 1 40 Ton Crane, Hydraulic R/T			PROD =	100%			CREW HOURS =	0
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	38.24	1.00	38.24			38.24
MIL	B-EQOPROILL	Equip. Operators, Oilers	1.00	HR	29.77	1.00	29.77			29.77
MIL	C75GV012 E	CRANE,HYD,S/P,RT,4WD,40T/84'BOO	1.00	HR	64.05			1.00	64.05	64.05
MIL	XMIXX020 E	Small Tools	0.11	HR	1.57			0.11	0.17	0.17
	TOTAL					2.00	68.01	1.11	64.22	132.23
	UOEHJ	1 B-eqoprcrn + 1 100 Ton Crane, Cwlr			PROD =	100%			CREW HOURS =	4640
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	38.24	1.00	38.24			38.24
MIL	B-EQOPROILL	Equip. Operators, Oilers	1.00	HR	29.77	1.00	29.77			29.77
MIL	C85MA004 E	CR,ME,CWLR,LIFTING,100T/210'BOO	1.00	HR	88.52			1.00	88.52	88.52
MIL	XMIXX020 E	Small Tools	0.11	HR	1.57			0.11	0.17	0.17
MIL	B25ES030 E	BKT,CLAM, 4.00CY, HVYDTY/SQ NOS	1.00	HR	7.91			1.00	7.91	7.91
	TOTAL					2.00	68.01	2.11	96.61	164.61
	USKCF	6 B-Laborer + 1 3T Flat B Truck			PROD =	100%			CREW HOURS =	4077
MIL	B-LABORER L	Laborers, (Semi-Skilled)	6.00	HR	26.37	6.00	158.22			158.22
MIL	B-SKILLWKRL	Skilled Workers	1.00	HR	26.37	1.00	26.37			26.37
MIL	B-SKILLWKRF	Skilled Workers	1.00	HR	26.87	1.00	26.87			26.87
MIL	XMIXX020 E	Small Tools	1.00	HR	1.57			1.00	1.57	1.57
MIL	T50FO011 E	TRK,HWY, 24,500 GVW, 4X2, 2 AXL	1.00	HR	14.90			1.00	14.90	14.90
MIL	T40XX016 E	FLATBED, 8'x 16.0' (ADD TRK	1.00	HR	0.68			1.00	0.68	0.68
	TOTAL					8.00	211.47	3.00	17.15	228.62
	XASPA	7 X-laborer + 1 Asphalt Paving Machine			PROD =	100%			CREW HOURS =	121
MIL	A30BG003 E	ASPH FINISHER, 10'W/SCREED,PNEU	1.00	HR	59.74			1.00	59.74	59.74
MIL	B15MB002 E	STR SWEEPER, 7'W/SPRINKER	1.00	HR	1.60			1.00	1.60	1.60
MIL	XMIXX020 E	Small Tools	2.00	HR	1.57			2.00	3.14	3.14
MIL	R30CA001 E	ROLLR,STATIC,S/P,13T,84"W,11TIR	1.00	HR	16.95			1.00	16.95	16.95
MIL	R30IG008 E	ROLLER,STATIC,3WHL,S/P, 12T,84"	2.00	HR	14.40			2.00	28.80	28.80
MIL	T40XX016 E	FLATBED, 8'x 16.0' (ADD TRK	1.00	HR	0.68			1.00	0.68	0.68
MIL	T50FO011 E	TRK,HWY, 24,500 GVW, 4X2, 2 AXL	1.00	HR	14.90			1.00	14.90	14.90
MIL	T50FO011 E	TRK,HWY, 24,500 GVW, 4X2, 2 AXL	1.00	HR	14.90			1.00	14.90	14.90
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	7.00	HR	29.81	7.00	208.66			208.66
MIL	X-EQOPRMEDL	Outside Equip. Operators, Mediu	3.00	HR	36.75	3.00	110.26			110.26
MIL	X-EQOPRMEDF	Outside Equip. Operators, Mediu	1.00	HR	37.25	1.00	37.25			37.25
MIL	X-TRKDVRHVL	Outside Truck Drivers, Heavy	1.00	HR	29.40	1.00	29.40			29.40
	TOTAL					12.00	385.57	10.00	140.71	526.28
	XCBGA	2 X-carpnter + Small Tools			PROD =	100%			CREW HOURS =	51
MIL	XMIXX020 E	Small Tools	6.00	HR	1.57			6.00	9.42	9.42
MIL	X-CARPNTERL	Outside Carpenters	1.00	HR	37.73	1.00	37.73			37.73
MIL	X-CARPNTERF	Outside Carpenters	1.00	HR	38.23	1.00	38.23			38.23
MIL	X-CEMTFINRL	Outside Cement Finishers	1.00	HR	33.49	1.00	33.49			33.49
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	1.00	HR	29.81	1.00	29.81			29.81
	TOTAL					4.00	139.26	6.00	9.42	148.68

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	LABOR HOURS	LABOR COST	EQUIP HOURS	EQUIP COST	TOTAL COST
	XCMAA	1 X-cemtfinr + Small Tools			PROD =	100%			CREW HOURS =	308
MIL	X-CEMTFINRL	Outside Cement Finishers	1.00	HR	33.49	1.00	33.49			33.49
MIL	XMIXX020 E	SMALL TOOLS	1.00	HR	1.57			1.00	1.57	1.57
	TOTAL					1.00	33.49	1.00	1.57	35.06
	XLABB	2 X-laborer + Small Tools			PROD =	100%			CREW HOURS =	4640
MIL	XMIXX020 E	Small Tools	1.00	HR	1.57			1.00	1.57	1.57
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	2.00	HR	29.81	2.00	59.62			59.62
MIL	X-LABORER F	Outside Laborers, (Semi-Skilled	0.34	HR	30.31	0.34	10.30			10.30
	TOTAL					2.34	69.92	1.00	1.57	71.49
	XLABF	2 X-laborer + 1 Loader/Backhoe			PROD =	100%			CREW HOURS =	77
MIL	L50CA003 E	LDR,BH,WH, 1.38CY FE BKT, 30"DI	1.00	HR	19.32			1.00	19.32	19.32
MIL	XMIXX020 E	Small Tools	0.25	HR	1.57			0.25	0.39	0.39
MIL	X-LABORER F	Outside Laborers, (Semi-Skilled	1.00	HR	30.31	1.00	30.31			30.31
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	1.00	HR	29.81	1.00	29.81			29.81
MIL	X-EQOPRMEDL	Outside Equip. Operators, Mediu	1.00	HR	36.75	1.00	36.75			36.75
	TOTAL					3.00	96.87	1.25	19.71	116.58
	XPLUC	1 X-plumber + Small Tools			PROD =	100%			CREW HOURS =	20
MIL	XMIXX020 E	Small Tools	1.00	HR	1.57			1.00	1.57	1.57
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	2.00	HR	29.81	2.00	59.62			59.62
MIL	X-PLUMBER F	Outside Plumbers	0.17	HR	42.84	0.17	7.28			7.28
MIL	X-PLUMBER L	Outside Plumbers	1.00	HR	42.34	1.00	42.34			42.34
	TOTAL					3.17	109.23	1.00	1.57	110.80
	XPLUD	2 X-plumber + Misc. Power Tools			PROD =	100%			CREW HOURS =	2
MIL	XMIXX010 E	Misc. Power Tools	1.00	HR	6.40			1.00	6.40	6.40
MIL	XMIXX020 E	Small Tools	1.00	HR	1.57			1.00	1.57	1.57
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	1.00	HR	29.81	1.00	29.81			29.81
MIL	X-PLUMBER L	Outside Plumbers	1.00	HR	42.34	1.00	42.34			42.34
MIL	X-PLUMBER F	Outside Plumbers	0.17	HR	42.84	0.17	7.28			7.28
MIL	X-PLUMBER A	Outside Plumbers	1.00	HR	35.81	1.00	35.81			35.81
	TOTAL					3.17	115.23	2.00	7.97	123.20
	XSABA	3 X-eqoprmed + 1 Grader, 2 Rollers, 3 Trucks			PROD =	100%			CREW HOURS =	284
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	3.00	HR	29.81	3.00	89.42			89.42
MIL	X-EQOPRMEDL	Outside Equip. Operators, Mediu	2.00	HR	36.75	2.00	73.51			73.51
MIL	X-TRKDVRLTL	Outside Truck Drivers, Light	2.00	HR	29.33	2.00	58.67			58.67
MIL	G15CA003 E	GRADER,MOTOR, ARTIC, CAT 12-G	1.00	HR	34.82			1.00	34.82	34.82
MIL	T60KI002 E	TRK,WTR,OF-HY, 6000GAL,W/CAT621	1.00	HR	67.71			1.00	67.71	67.71
MIL	A10ET001 E	CHIPSPREADER,S/P, 10'W, MECH	1.00	HR	20.52			1.00	20.52	20.52
MIL	L35CA004 E	LDR,FE, CRWLR, 1.50 CY	1.00	HR	33.51			1.00	33.51	33.51
MIL	T15CA015 E	DOZER,CWLR, D-8L,PS (ADD BLADE	1.00	HR	94.26			1.00	94.26	94.26
MIL	T10CA016 E	BLADE, STRAIGHT, HYDR (FOR D8	1.00	HR	7.17			1.00	7.17	7.17
MIL	X-EQOPRMEDF	Outside Equip. Operators, Mediu	1.00	HR	37.25	1.00	37.25			37.25
	TOTAL					8.00	258.85	6.00	257.99	516.85

Fig. 10: Local Government Expenditures

All Local Governments, Ashtabula County



** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	ZAIRSAMPLE	AIR SAMPLING			PROD =	0.00%			CREW HOURS =	625
RAD	FH-AIRMOT	F Air Monitoring Technicians	1.00	HR	23.09	1.00	23.09			23.09
RAD	FH-AIRMOT	L Air Monitoring Technicians	1.00	HR	22.59	1.00	22.59			22.59
RAD	FH-CHEALT	L Certified Health Physicist	1.00	HR	54.75	1.00	54.75			54.75
UPB	XMIXX010	E MISC. POWER TOOLS	1.00	HR	6.40			1.00	6.40	6.40
UPB	XMIXX020	E SMALL TOOLS	1.00	HR	1.57			1.00	1.57	1.57
UPB	XMIXX010	E AIR PUMPS & SUPPLIES	6.00	HR	6.40			6.00	38.40	38.40
	TOTAL					3.00	100.43	8.00	46.37	146.80
	ZCHEMIST	WATER QUALITY CREW			PROD =	0.00%			CREW HOURS =	625
FOP	FC-FLABT	L Field Constr. QC./Lab Technicia	1.00	HR	13.29	1.00	13.29			13.29
FOP	FC-FLABT	L Field Constr. QC./Lab Technicia	1.00	HR	13.29	1.00	13.29			13.29
FOP	FC-FLDER	L Field Engineers	1.00	HR	25.17	1.00	25.17			25.17
UPB	XMIXX010	E MISC. POWER TOOLS	1.00	HR	6.40			1.00	6.40	6.40
UPB	XMIXX020	E SMALL TOOLS	1.00	HR	1.57			1.00	1.57	1.57
UPB	XMIXX020	E MISC EQUIPMENTSUPPLIES	10.00	HR	1.57			10.00	15.70	15.70
	TOTAL					3.00	51.74	12.00	23.67	75.41
	ZH2OSAMPLE	MARINE SURVEY CREW			PROD =	0.00%			CREW HOURS =	2800
FOP	FC-FLABT	L Field Constr. QC./Lab Technicia	1.00	HR	13.29	1.00	13.29			13.29
UPB	XMIXX010	E MISC.SAMPLING EQUIP	1.00	HR	6.40			1.00	6.40	6.40
UPB	XMIXX020	E SMALL TOOLS	1.00	HR	1.57			1.00	1.57	1.57
	TOTAL					1.00	13.29	2.00	7.97	21.26

ITEM ID	DESCRIPTION				
01. LANDS					
12. NAVIGATION					
AASBC	2 B-asbtswkr + Small Tools	PROD =	100%	CREW HOURS =	41
ACARA	1 B-carpnter + Small Tools	PROD =	100%	CREW HOURS =	104
ACARB	2 B-carpnter + Small Tools	PROD =	100%	CREW HOURS =	41
ACARC	1 B-carpnter + Misc Power Tools	PROD =	100%	CREW HOURS =	18
ACARI	2 B-carpntr/labr(semi-skld) + Sm.Tools	PROD =	100%	CREW HOURS =	8
ACARJ	3 B-carpntr/labr(semi-skld) + MiscPowrTools	PROD =	100%	CREW HOURS =	31
ACARU	6 B-carpnter + 1 40 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	31
ACMAA	1 B-cemtfinr + Small Tools	PROD =	100%	CREW HOURS =	59
ACMAC	1 B-cemtfinr + Misc Power Tools	PROD =	100%	CREW HOURS =	160
AGLAB	2 B-glazier + Small Tools	PROD =	100%	CREW HOURS =	41
ALABE	4 B-laborer + 2 Concrete Vibrators	PROD =	100%	CREW HOURS =	17
ALABM	3 B-laborer/0.5 rodmen + MiscPwrTools	PROD =	100%	CREW HOURS =	221
ALATA	1 B-lathers + Small Tools	PROD =	100%	CREW HOURS =	25
AMABA	1 B-brklayr + Small Tools	PROD =	100%	CREW HOURS =	1
APTRA	1 B-paintord + Small Tools	PROD =	100%	CREW HOURS =	41
ARFCA	1 B-roofer + Small Tools	PROD =	100%	CREW HOURS =	52
ATIFA	1 B-tilelyr + Small Tools	PROD =	100%	CREW HOURS =	63
CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD =	100%	CREW HOURS =	166
CLACC	3 B-laborer + 1 Hand Compaction Rammer	PROD =	100%	CREW HOURS =	264
CLADM	5 B-laborer + 1 Truck & Drill Rig, 335 Hp	PROD =	100%	CREW HOURS =	133
CODEA	1 B-eqoprcrn + 1 1 Cy Hydr. Excavator	PROD =	100%	CREW HOURS =	134
CODEJ	2 B-laborer + 1 Loader/Backhoe	PROD =	100%	CREW HOURS =	82
CODEK	5 B-laborer + 1 Loader/Backhoe	PROD =	100%	CREW HOURS =	2
CODEO	1 B-eqoprcrn + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	75
CODET	1 B-eqoprcrn + 1 2.0 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	14
CODEU	1 B-eqoprcrn + 1 3.0 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	4695
CODEX	4 B-laborer + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	48
CODLA	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Wheel	PROD =	100%	CREW HOURS =	437
CODLB	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Cwlr	PROD =	100%	CREW HOURS =	264
CODTC	1 B-eqoprmed + 1 Dozer, Cat D-4H, 90 Hp	PROD =	100%	CREW HOURS =	9280
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp	PROD =	100%	CREW HOURS =	895
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD =	100%	CREW HOURS =	6274
CODTK	1 B-eqoprmed + 1 Dozer/Roller, Cat D-8L, 335 Hp	PROD =	100%	CREW HOURS =	679
COEID	1 B-trkdvrhv + 1 12 Cy Dump Truck	PROD =	100%	CREW HOURS =	34800
COELA	1 B-eqoprlt	PROD =	100%	CREW HOURS =	2000
COETH	1 B-trkdvrhv + 1 16.5 Cy Dump Truck	PROD =	100%	CREW HOURS =	12626
COETK	1 B-trkdvrhv + 1 25 Cy Dump Truck	PROD =	100%	CREW HOURS =	4483
COETL	3 B-laborer + 2 12 Cy Dump Trck/CrawlrLoadr	PROD =	100%	CREW HOURS =	57
* COFCF	2 B-eqoprmed + 1 12-G Grader & 1 11 Tire Roller	PROD =	100%	CREW HOURS =	24
COFCK	1 B-eqoprmed + Roller	PROD =	100%	CREW HOURS =	1249
* COFCP	2 B-eqoprmed + 1 Tire Roller+Water Wagon,6000Gal	PROD =	100%	CREW HOURS =	2652
COFGA	1 B-eqoprmed + 1 Grader 12-G	PROD =	100%	CREW HOURS =	1509
COFWG	1 B-eqoprlt + 1 Wtr-pmp, Submersible, 6 In.	PROD =	100%	CREW HOURS =	4640
COFWI	1 B-trkdvrhvl+ 1 Wtr Trk, 3000 Gal/6" Pump	PROD =	100%	CREW HOURS =	200
COFWK	1 B-trkdvrhvl+ 1 Wtr Wag, 6000 Gal/6" Pump	PROD =	100%	CREW HOURS =	0
COKBD	2 B-laborer + 1 Bitum.Dist.Truck/Sweepr	PROD =	100%	CREW HOURS =	2
COMCA	5 B-laborer + 1 16" Chipper/1 3-3/4Cy,Cwlr Ldr	PROD =	100%	CREW HOURS =	669
EELEA	1 B-electrn	PROD =	100%	CREW HOURS =	1
EELEF	4 B-electrn + Small Tools	PROD =	100%	CREW HOURS =	0

ITEM ID	DESCRIPTION			
HTESA	1 Indust Hygen Tech + Small Tools	PROD =	100%	CREW HOURS = 4640
MPLUA	1 B-plumber + Small Tools	PROD =	100%	CREW HOURS = 18
MPLUB	2 B-plumber + Small Tools	PROD =	100%	CREW HOURS = 1
MPLUC	1 B-plumber + Small Tools	PROD =	100%	CREW HOURS = 0
MPLUD	1 B-plumber + Small Tools	PROD =	100%	CREW HOURS = 1
MPLUE	1 B-plumber/laborer + Small Tools	PROD =	100%	CREW HOURS = 280
MPLUQ	3 B-plumber + 1 20 Ton Crane, Hydraulic+Welder	PROD =	100%	CREW HOURS = 5
MPLUS	2 B-plumber + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS = 8
MSHMA	1 B-shtmtlwk + Small Tools	PROD =	100%	CREW HOURS = 68
MSHMB	2 B-shtmtlwk + Small Tools	PROD =	100%	CREW HOURS = 1
MSHMC	2 B-shtmtlwk + Small Tools	PROD =	100%	CREW HOURS = 3
MSHMD	2 B-shtmtlwk + Small Tools	PROD =	100%	CREW HOURS = 8
MSHMF	2 B-shtmtlwk/laborer + Small Tools	PROD =	100%	CREW HOURS = 32
MSHMG	3 B-shtmtlwk/laborer + Power Tools	PROD =	100%	CREW HOURS = 2
MSPFA	1 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS = 9
MSPFB	2 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS = 51
MSPFC	2 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS = 3
MSPFI	2 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS = 0
MSPFP	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS = 59
MSPFQ	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS = 15
MSPFS	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS = 80
MSPIA	1 B-sprnklr + Small Tools	PROD =	100%	CREW HOURS = 10
SIWRB	2 B-rodman + Small Tools	PROD =	100%	CREW HOURS = 25
SIWRC	3 B-rodman + Small Tools	PROD =	100%	CREW HOURS = 3
SIWSI	4 B-strsteel + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS = 100
SIWSM	6 B-strsteel + 1 60 Ton Crane, Hydr. Truck Mtd	PROD =	100%	CREW HOURS = 7
SIWSO	6 B-strsteel + 1 60 Ton Crane, Hydr. Truck Mtd	PROD =	100%	CREW HOURS = 96
ULABA	1 B-laborer + Small Tools	PROD =	100%	CREW HOURS = 194
ULABB	2 B-laborer + Small Tools	PROD =	100%	CREW HOURS = 6
ULABC	3 B-laborer + Small Tools	PROD =	100%	CREW HOURS = 30
ULABE	1 B-laborer + Misc. Power Tools	PROD =	100%	CREW HOURS = 585
ULABF	3 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS = 8
ULABJ	3 B-laborer + 1 3/4 Ton Pickup Truck	PROD =	100%	CREW HOURS = 76
ULABL	3 B-laborer + 1 3 Ton Flatbed Truck	PROD =	100%	CREW HOURS = 720
ULABN	3 B-laborer + 1 Flatbed Truck W/Hyd. Crane	PROD =	100%	CREW HOURS = 12
ULADB	2 B-laborer + 1 Rotary Drill, Water Well	PROD =	100%	CREW HOURS = 0
UOEHE	1 B-eqoprcrn + 1 40 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS = 0
UOEHJ	1 B-eqoprcrn + 1 100 Ton Crane, Cwlr	PROD =	100%	CREW HOURS = 4640
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD =	100%	CREW HOURS = 4077
XASPA	7 X-laborer + 1 Asphalt Paving Machine	PROD =	100%	CREW HOURS = 121
XCBGA	2 X-carpnter + Small Tools	PROD =	100%	CREW HOURS = 51
XCMAA	1 X-cemtfinr + Small Tools	PROD =	100%	CREW HOURS = 308
XLABB	2 X-laborer + Small Tools	PROD =	100%	CREW HOURS = 4640
XLABF	2 X-laborer + 1 Loader/Backhoe	PROD =	100%	CREW HOURS = 77
XPLUC	1 X-plumber + Small Tools	PROD =	100%	CREW HOURS = 20
XPLUD	2 X-plumber + Misc. Power Tools	PROD =	100%	CREW HOURS = 2
XSABA	3 X-eqoprmed + 1 Grader, 2 Rollers, 3 Trucks	PROD =	100%	CREW HOURS = 284
XSGRA	3 X-eqoprmed + 1 Shpf Roller,Grader,Water Truck	PROD =	100%	CREW HOURS = 415
XXPLA	3 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS = 582
XXPLB	4 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS = 8
XXQHK	1 X-eqoprhvy + 1 3.0 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS = 3480

ITEM ID	DESCRIPTION		
ZA	MARINE SURVEY CREW	PROD = 0.00%	CREW HOURS = 320
ZAIRSAMPLE	AIR SAMPLING	PROD = 0.00%	CREW HOURS = 625
ZCHEMIST	WATER QUALITY CREW	PROD = 0.00%	CREW HOURS = 625
ZH2OSAMPLE	MARINE SURVEY CREW	PROD = 0.00%	CREW HOURS = 2800

23. OTHER STUDIES
30. ENGINEERING & DESIGN
31. CONSTRUCTION MANAGEMENT

ITEM ID	DESCRIPTION		
0_ 5. Prime Contractor			
0_10. Post Closure General Contractor			
0_15. Allowance			
01_ 1. ACQUISTION			
01_ 2. ADMINSTRATION			
12_ 1. DREDGING			
ACARB	2 B-carpnter + Small Tools	PROD = 100%	CREW HOURS = 2
ACARI	2 B-carpntr/labr(semi-skld) + Sm.Tools	PROD = 100%	CREW HOURS = 8
ACARJ	3 B-carpntr/labr(semi-skld) + MiscPowrTools	PROD = 100%	CREW HOURS = 2
ACMAC	1 B-cemtfinr + Misc Power Tools	PROD = 100%	CREW HOURS = 19
ALABE	4 B-laborer + 2 Concrete Vibrators	PROD = 100%	CREW HOURS = 5
CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD = 100%	CREW HOURS = 165
CODEJ	2 B-laborer + 1 Loader/Backhoe	PROD = 100%	CREW HOURS = 56
CODEU	1 B-eqoprcrn + 1 3.0 Cy Hydr. Excavator, Cwlr	PROD = 100%	CREW HOURS = 4640
CODEX	4 B-laborer + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD = 100%	CREW HOURS = 48
CODLA	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Wheel	PROD = 100%	CREW HOURS = 10
CODTC	1 B-eqoprmed + 1 Dozer, Cat D-4H, 90 Hp	PROD = 100%	CREW HOURS = 9280
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp	PROD = 100%	CREW HOURS = 196
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD = 100%	CREW HOURS = 165
COEID	1 B-trkdvrhv + 1 12 Cy Dump Truck	PROD = 100%	CREW HOURS = 34800
COFWG	1 B-eqoprlt + 1 Wtr-pmp, Submersible, 6 In.	PROD = 100%	CREW HOURS = 4640
COFWK	1 B-trkdvrhvl+ 1 Wtr Wag, 6000 Gal/6" Pump	PROD = 100%	CREW HOURS = 0
COMCA	5 B-laborer + 1 16" Chipper/1 3-3/4Cy,Cwlr Ldr	PROD = 100%	CREW HOURS = 57
HTESA	1 Indust Hygen Tech + Small Tools	PROD = 100%	CREW HOURS = 4640
MSPFB	2 B-stm/pipe + Small Tools	PROD = 100%	CREW HOURS = 16
SIWRB	2 B-rodman + Small Tools	PROD = 100%	CREW HOURS = 7
SIWRC	3 B-rodman + Small Tools	PROD = 100%	CREW HOURS = 2
ULABC	3 B-laborer + Small Tools	PROD = 100%	CREW HOURS = 30
ULABE	1 B-laborer + Misc. Power Tools	PROD = 100%	CREW HOURS = 0
ULABJ	3 B-laborer + 1 3/4 Ton Pickup Truck	PROD = 100%	CREW HOURS = 26
ULABL	3 B-laborer + 1 3 Ton Flatbed Truck	PROD = 100%	CREW HOURS = 186
UOEHJ	1 B-eqoprcrn + 1 100 Ton Crane, Cwlr	PROD = 100%	CREW HOURS = 4640
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD = 100%	CREW HOURS = 604
XASPA	7 X-laborer + 1 Asphalt Paving Machine	PROD = 100%	CREW HOURS = 111
XLABB	2 X-laborer + Small Tools	PROD = 100%	CREW HOURS = 4640
XSABA	3 X-eqoprmed + 1 Grader, 2 Rollers, 3 Trucks	PROD = 100%	CREW HOURS = 1
XXPLB	4 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 8
ZA	MARINE SURVEY CREW	PROD = 0.00%	CREW HOURS = 320
ZAIRSAMPLE	AIR SAMPLING	PROD = 0.00%	CREW HOURS = 625
ZCHEMIST	WATER QUALITY CREW	PROD = 0.00%	CREW HOURS = 625
ZH2OSAMPLE	MARINE SURVEY CREW	PROD = 0.00%	CREW HOURS = 2800
12_ 2. DISPOSAL			
AASBC	2 B-asbtswkr + Small Tools	PROD = 100%	CREW HOURS = 41
ACARA	1 B-carpnter + Small Tools	PROD = 100%	CREW HOURS = 104
ACARB	2 B-carpnter + Small Tools	PROD = 100%	CREW HOURS = 39
ACARC	1 B-carpnter + Misc Power Tools	PROD = 100%	CREW HOURS = 18
ACARJ	3 B-carpntr/labr(semi-skld) + MiscPowrTools	PROD = 100%	CREW HOURS = 28
ACARU	6 B-carpnter + 1 40 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 31
ACMAA	1 B-cemtfinr + Small Tools	PROD = 100%	CREW HOURS = 59
ACMAC	1 B-cemtfinr + Misc Power Tools	PROD = 100%	CREW HOURS = 141

ITEM ID	DESCRIPTION				
AGLAB	2 B-glazier + Small Tools	PROD =	100%	CREW HOURS =	41
ALABE	4 B-laborer + 2 Concrete Vibrators	PROD =	100%	CREW HOURS =	12
ALABM	3 B-laborer/0.5 rodmen + MiscPwrTools	PROD =	100%	CREW HOURS =	221
ALATA	1 B-lathers + Small Tools	PROD =	100%	CREW HOURS =	25
AMABA	1 B-brklayr + Small Tools	PROD =	100%	CREW HOURS =	1
APTRA	1 B-paintord + Small Tools	PROD =	100%	CREW HOURS =	41
ARFCA	1 B-roofer + Small Tools	PROD =	100%	CREW HOURS =	52
ATIFA	1 B-tilelyr + Small Tools	PROD =	100%	CREW HOURS =	63
CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD =	100%	CREW HOURS =	1
CLACC	3 B-laborer + 1 Hand Compaction Rammer	PROD =	100%	CREW HOURS =	264
CLADM	5 B-laborer + 1 Truck & Drill Rig, 335 Hp	PROD =	100%	CREW HOURS =	133
CODEA	1 B-eqoprcrn + 1 1 Cy Hydr. Excavator	PROD =	100%	CREW HOURS =	134
CODEJ	2 B-laborer + 1 Loader/Backhoe	PROD =	100%	CREW HOURS =	27
CODEK	5 B-laborer + 1 Loader/Backhoe	PROD =	100%	CREW HOURS =	2
CODEO	1 B-eqoprcrn + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	75
CODET	1 B-eqoprcrn + 1 2.0 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	14
CODEU	1 B-eqoprcrn + 1 3.0 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	55
CODLA	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Wheel	PROD =	100%	CREW HOURS =	428
CODLB	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Cwlr	PROD =	100%	CREW HOURS =	264
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp	PROD =	100%	CREW HOURS =	699
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD =	100%	CREW HOURS =	6109
CODTK	1 B-eqoprmed + 1 Dozer/Roller, Cat D-8L, 335 Hp	PROD =	100%	CREW HOURS =	679
COELA	1 B-eqoprlt	PROD =	100%	CREW HOURS =	2000
COETH	1 B-trkdvrhv + 1 16.5 Cy Dump Truck	PROD =	100%	CREW HOURS =	12626
COETK	1 B-trkdvrhv + 1 25 Cy Dump Truck	PROD =	100%	CREW HOURS =	4483
COETL	3 B-laborer + 2 12 Cy Dump Trck/CrawlrLoadr	PROD =	100%	CREW HOURS =	57
* COFCF	2 B-eqoprmed + 1 12-G Grader & 1 11 Tire Roller	PROD =	100%	CREW HOURS =	24
COFCK	1 B-eqoprmed + Roller	PROD =	100%	CREW HOURS =	1249
* COFCP	2 B-eqoprmed + 1 Tire Roller+Water Wagon,6000Gal	PROD =	100%	CREW HOURS =	2652
COFGA	1 B-eqoprmed + 1 Grader 12-G	PROD =	100%	CREW HOURS =	1509
COFWI	1 B-trkdvrhvl+ 1 Wtr Trk, 3000 Gal/6" Pump	PROD =	100%	CREW HOURS =	200
COKBD	2 B-laborer + 1 Bitum.Dist.Truck/Sweepr	PROD =	100%	CREW HOURS =	2
COMCA	5 B-laborer + 1 16" Chipper/1 3-3/4Cy,Cwlr Ldr	PROD =	100%	CREW HOURS =	612
EELEA	1 B-electrn	PROD =	100%	CREW HOURS =	1
EELEF	4 B-electrn + Small Tools	PROD =	100%	CREW HOURS =	0
MPLUA	1 B-plumber + Small Tools	PROD =	100%	CREW HOURS =	18
MPLUB	2 B-plumber + Small Tools	PROD =	100%	CREW HOURS =	1
MPLUC	1 B-plumber + Small Tools	PROD =	100%	CREW HOURS =	0
MPLUD	1 B-plumber + Small Tools	PROD =	100%	CREW HOURS =	1
MPLUE	1 B-plumber/laborer + Small Tools	PROD =	100%	CREW HOURS =	280
MPLUQ	3 B-plumber + 1 20 Ton Crane, Hydraulic+Welder	PROD =	100%	CREW HOURS =	5
MPLUS	2 B-plumber + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	8
MSHMA	1 B-shtmtlwk + Small Tools	PROD =	100%	CREW HOURS =	68
MSHMB	2 B-shtmtlwk + Small Tools	PROD =	100%	CREW HOURS =	1
MSHMC	2 B-shtmtlwk + Small Tools	PROD =	100%	CREW HOURS =	3
MSHMD	2 B-shtmtlwk + Small Tools	PROD =	100%	CREW HOURS =	8
MSHMF	2 B-shtmtlwk/laborer + Small Tools	PROD =	100%	CREW HOURS =	32
MSHMG	3 B-shtmtlwk/laborer + Power Tools	PROD =	100%	CREW HOURS =	2
MSPFA	1 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS =	9
MSPFB	2 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS =	35
MSPFC	2 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS =	3

** CREW BACKUP - Feature **

ITEM ID	DESCRIPTION		
MSPFI	2 B-stm/pipe + Small Tools	PROD = 100%	CREW HOURS = 0
MSPFP	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 59
MSPFQ	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 15
MSPFS	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 80
MSPIA	1 B-sprnklr + Small Tools	PROD = 100%	CREW HOURS = 10
SIWRB	2 B-rodman + Small Tools	PROD = 100%	CREW HOURS = 18
SIWRC	3 B-rodman + Small Tools	PROD = 100%	CREW HOURS = 1
SIWSI	4 B-strsteel + 1 20 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 100
SIWSM	6 B-strsteel + 1 60 Ton Crane, Hydr. Truck Mtd	PROD = 100%	CREW HOURS = 7
SIWSO	6 B-strsteel + 1 60 Ton Crane, Hydr. Truck Mtd	PROD = 100%	CREW HOURS = 96
ULABA	1 B-laborer + Small Tools	PROD = 100%	CREW HOURS = 194
ULABB	2 B-laborer + Small Tools	PROD = 100%	CREW HOURS = 6
ULABE	1 B-laborer + Misc. Power Tools	PROD = 100%	CREW HOURS = 584
ULABF	3 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 8
ULABJ	3 B-laborer + 1 3/4 Ton Pickup Truck	PROD = 100%	CREW HOURS = 50
ULABL	3 B-laborer + 1 3 Ton Flatbed Truck	PROD = 100%	CREW HOURS = 533
ULABN	3 B-laborer + 1 Flatbed Truck W/Hyd. Crane	PROD = 100%	CREW HOURS = 12
ULADB	2 B-laborer + 1 Rotary Drill, Water Well	PROD = 100%	CREW HOURS = 0
UOEHE	1 B-eqoprcrn + 1 40 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 0
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD = 100%	CREW HOURS = 3473
XASPA	7 X-laborer + 1 Asphalt Paving Machine	PROD = 100%	CREW HOURS = 9
XCBGA	2 X-carpnter + Small Tools	PROD = 100%	CREW HOURS = 51
XCMAA	1 X-cemtfinr + Small Tools	PROD = 100%	CREW HOURS = 308
XLABF	2 X-laborer + 1 Loader/Backhoe	PROD = 100%	CREW HOURS = 77
XPLUC	1 X-plumber + Small Tools	PROD = 100%	CREW HOURS = 20
XPLUD	2 X-plumber + Misc. Power Tools	PROD = 100%	CREW HOURS = 2
XSABA	3 X-eqoprmed + 1 Grader, 2 Rollers, 3 Trucks	PROD = 100%	CREW HOURS = 283
XSGRA	3 X-eqoprmed + 1 Shpf Roller,Grader,Water Truck	PROD = 100%	CREW HOURS = 415
XXPLA	3 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 582
XXQHK	1 X-eqoprhvy + 1 3.0 Cy Hydr. Excavator, Cwlr	PROD = 100%	CREW HOURS = 3480

23_ 1. CMP
30_ 5. FS Phase - CMP/EIS
30_10. Pre-Const. Engineering & Design
30_15. Engineering During Construction
31_ 5. CONSTRUCTION MANAGEMENT

ITEM ID DESCRIPTION

0_ 5. 0. Overhead Items - AA
0_ 5. 5. General Subcontractor
0_ 5.10. Mech. Subcontractor
0_ 5.15. Elect. Subcontractor
0_ 5.20. sitework contractor
0_ 5.25. Landscape Subcontractor
0_ 5.30. Drywall Subcontractor
0_ 5.35. Paint & Sealent Subcontractor
0_ 5.40. Acoustical Subcontractor
0_ 5.45. Flooring Subcontractor
0_ 5.50. Plumbing Subcontractor
0_ 5.55. HVAC Subcontractor
0_ 5.60. Fire Protection Subcontractor
0_ 5.65. Controls Subcontractor
0_ 5.70. Structural Steel Subcontractor
0_ 5.75. Liner Subcontractor
0_ 5.80. Security Subcontractor
0_ 5.85. Metal Bldg. Subcontractor
0_10. 0. Overhead Items - PC
0_15. 0. Overhead Items - AL
01_ 1. 1. DREDGING(TRANSFER SITE)
01_ 1. 2. DISPOSAL SITE
01_ 2. 1. CORPS
01_ 2. 2. LOCAL
12_ 1. 1. MOB/DEMOB

ACARJ	3 B-carpntr/labr(semi-skld) + MiscPowrTools	PROD = 100%	CREW HOURS = 2
ACMAC	1 B-cemtfinr + Misc Power Tools	PROD = 100%	CREW HOURS = 19
ALABE	4 B-laborer + 2 Concrete Vibrators	PROD = 100%	CREW HOURS = 2
SIWRC	3 B-rodman + Small Tools	PROD = 100%	CREW HOURS = 2
ULABJ	3 B-laborer + 1 3/4 Ton Pickup Truck	PROD = 100%	CREW HOURS = 26
ULABL	3 B-laborer + 1 3 Ton Flatbed Truck	PROD = 100%	CREW HOURS = 186
XSABA	3 X-eqoprmed + 1 Grader, 2 Rollers, 3 Trucks	PROD = 100%	CREW HOURS = 1

12_ 1. 2. CONSTRUCT TRANSFER

ACARB	2 B-carpnter + Small Tools	PROD = 100%	CREW HOURS = 2
ACARI	2 B-carpntr/labr(semi-skld) + Sm.Tools	PROD = 100%	CREW HOURS = 8
ALABE	4 B-laborer + 2 Concrete Vibrators	PROD = 100%	CREW HOURS = 3
CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD = 100%	CREW HOURS = 165
CODEJ	2 B-laborer + 1 Loader/Backhoe	PROD = 100%	CREW HOURS = 56
CODEX	4 B-laborer + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD = 100%	CREW HOURS = 48
CODLA	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Wheel	PROD = 100%	CREW HOURS = 10
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp	PROD = 100%	CREW HOURS = 196
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD = 100%	CREW HOURS = 165
COFWK	1 B-trkdvrhvl+ 1 Wtr Wag, 6000 Gal/6" Pump	PROD = 100%	CREW HOURS = 0
COMCA	5 B-laborer + 1 16" Chipper/1 3-3/4Cy,Cwlr Ldr	PROD = 100%	CREW HOURS = 57
MSPFB	2 B-stm/pipe + Small Tools	PROD = 100%	CREW HOURS = 16
SIWRB	2 B-rodman + Small Tools	PROD = 100%	CREW HOURS = 7
ULABC	3 B-laborer + Small Tools	PROD = 100%	CREW HOURS = 30
ULABE	1 B-laborer + Misc. Power Tools	PROD = 100%	CREW HOURS = 0
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD = 100%	CREW HOURS = 604
XASPA	7 X-laborer + 1 Asphalt Paving Machine	PROD = 100%	CREW HOURS = 111

ITEM ID	DESCRIPTION		
XXPLB	4 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 8
12_ 1. 4. DREDGING			
12_ 1. 5. OPERATE TRANSFER FACILITY			
CODEU	1 B-eqoprcrn + 1 3.0 Cy Hydr. Excavator, Cwlr	PROD = 100%	CREW HOURS = 4640
CODTC	1 B-eqoprmed + 1 Dozer, Cat D-4H, 90 Hp	PROD = 100%	CREW HOURS = 9280
COFWG	1 B-eqoprlt + 1 Wtr-pmp, Submersible, 6 In.	PROD = 100%	CREW HOURS = 4640
HTESA	1 Indust Hygen Tech + Small Tools	PROD = 100%	CREW HOURS = 4640
UOEHJ	1 B-eqoprcrn + 1 100 Ton Crane, Cwlr	PROD = 100%	CREW HOURS = 4640
12_ 1. 6. TRANSPORT TO LANDFILL			
COEID	1 B-trkdvrhv + 1 12 Cy Dump Truck	PROD = 100%	CREW HOURS = 34800
XLABB	2 X-laborer + Small Tools	PROD = 100%	CREW HOURS = 4640
12_ 1. 7. SAMPLING & ANALYSIS			
ZA	MARINE SURVEY CREW	PROD = 0.00%	CREW HOURS = 320
ZAIRSAMPLE	AIR SAMPLING	PROD = 0.00%	CREW HOURS = 625
ZCHEMIST	WATER QUALITY CREW	PROD = 0.00%	CREW HOURS = 625
ZH2OSAMPLE	MARINE SURVEY CREW	PROD = 0.00%	CREW HOURS = 2800
12_ 2. 1. CONSTRUCT TSCA CELL			
12_ 2. 2. CONSTRUCT NTSCA CELL			
12_ 2. 3. WETLAND MIT. - DISPOSAL FACILITY			
12_ 2. 4. OPERATE CDF			
12_ 2. 5. SAMPLE & ANALYSIS(DISPOSAL FAC)			
12_ 2.10. CONSTRUCT LANDFILL			
AASBC	2 B-asbtswkr + Small Tools	PROD = 100%	CREW HOURS = 41
ACARA	1 B-carpnter + Small Tools	PROD = 100%	CREW HOURS = 104
ACARB	2 B-carpnter + Small Tools	PROD = 100%	CREW HOURS = 39
ACARC	1 B-carpnter + Misc Power Tools	PROD = 100%	CREW HOURS = 18
ACARJ	3 B-carpntr/labr(semi-skld) + MiscPowrTools	PROD = 100%	CREW HOURS = 28
ACARU	6 B-carpnter + 1 40 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 31
ACMAA	1 B-cemtfinr + Small Tools	PROD = 100%	CREW HOURS = 59
ACMAC	1 B-cemtfinr + Misc Power Tools	PROD = 100%	CREW HOURS = 141
AGLAB	2 B-glazier + Small Tools	PROD = 100%	CREW HOURS = 41
ALABE	4 B-laborer + 2 Concrete Vibrators	PROD = 100%	CREW HOURS = 12
ALABM	3 B-laborer/0.5 rodmen + MiscPwrTools	PROD = 100%	CREW HOURS = 221
ALATA	1 B-lathers + Small Tools	PROD = 100%	CREW HOURS = 25
AMABA	1 B-brklayr + Small Tools	PROD = 100%	CREW HOURS = 1
APTRA	1 B-paintord + Small Tools	PROD = 100%	CREW HOURS = 41
ARFCA	1 B-roofer + Small Tools	PROD = 100%	CREW HOURS = 52
ATIFA	1 B-tilelyr + Small Tools	PROD = 100%	CREW HOURS = 63
CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD = 100%	CREW HOURS = 1
CLACC	3 B-laborer + 1 Hand Compaction Rammer	PROD = 100%	CREW HOURS = 264
CLADM	5 B-laborer + 1 Truck & Drill Rig, 335 Hp	PROD = 100%	CREW HOURS = 133
CODEA	1 B-eqoprcrn + 1 1 Cy Hydr. Excavator	PROD = 100%	CREW HOURS = 134
CODEJ	2 B-laborer + 1 Loader/Backhoe	PROD = 100%	CREW HOURS = 27
CODEK	5 B-laborer + 1 Loader/Backhoe	PROD = 100%	CREW HOURS = 2
CODEO	1 B-eqoprcrn + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD = 100%	CREW HOURS = 75
CODET	1 B-eqoprcrn + 1 2.0 Cy Hydr. Excavator, Cwlr	PROD = 100%	CREW HOURS = 14
CODEU	1 B-eqoprcrn + 1 3.0 Cy Hydr. Excavator, Cwlr	PROD = 100%	CREW HOURS = 55

ITEM ID	DESCRIPTION				
CODLA	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Wheel	PROD =	100%	CREW HOURS =	428
CODLB	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Cwlr	PROD =	100%	CREW HOURS =	264
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp	PROD =	100%	CREW HOURS =	699
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD =	100%	CREW HOURS =	6109
CODTK	1 B-eqoprmed + 1 Dozer/Roller, Cat D-8L, 335 Hp	PROD =	100%	CREW HOURS =	679
COELA	1 B-eqoprlt	PROD =	100%	CREW HOURS =	2000
COETH	1 B-trkdvrhv + 1 16.5 Cy Dump Truck	PROD =	100%	CREW HOURS =	12626
COETK	1 B-trkdvrhv + 1 25 Cy Dump Truck	PROD =	100%	CREW HOURS =	4483
COETL	3 B-laborer + 2 12 Cy Dump Trck/CrawlrLoadr	PROD =	100%	CREW HOURS =	57
* COFCF	2 B-eqoprmed + 1 12-G Grader & 1 11 Tire Roller	PROD =	100%	CREW HOURS =	24
COFCK	1 B-eqoprmed + Roller	PROD =	100%	CREW HOURS =	1249
* COFCP	2 B-eqoprmed + 1 Tire Roller+Water Wagon,6000Gal	PROD =	100%	CREW HOURS =	2652
COFGA	1 B-eqoprmed + 1 Grader 12-G	PROD =	100%	CREW HOURS =	1509
COFWI	1 B-trkdvrhvl+ 1 Wtr Trk, 3000 Gal/6" Pump	PROD =	100%	CREW HOURS =	200
COKBD	2 B-laborer + 1 Bitum.Dist.Truck/Sweepr	PROD =	100%	CREW HOURS =	2
COMCA	5 B-laborer + 1 16" Chipper/1 3-3/4Cy,Cwlr Ldr	PROD =	100%	CREW HOURS =	612
EELEA	1 B-electrn	PROD =	100%	CREW HOURS =	1
EELEF	4 B-electrn + Small Tools	PROD =	100%	CREW HOURS =	0
MPLUA	1 B-plumber + Small Tools	PROD =	100%	CREW HOURS =	18
MPLUB	2 B-plumber + Small Tools	PROD =	100%	CREW HOURS =	1
MPLUC	1 B-plumber + Small Tools	PROD =	100%	CREW HOURS =	0
MPLUD	1 B-plumber + Small Tools	PROD =	100%	CREW HOURS =	1
MPLUE	1 B-plumber/laborer + Small Tools	PROD =	100%	CREW HOURS =	280
MPLUQ	3 B-plumber + 1 20 Ton Crane, Hydraulic+Welder	PROD =	100%	CREW HOURS =	5
MPLUS	2 B-plumber + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	8
MSHMA	1 B-shtmtlwk + Small Tools	PROD =	100%	CREW HOURS =	68
MSHMB	2 B-shtmtlwk + Small Tools	PROD =	100%	CREW HOURS =	1
MSHMC	2 B-shtmtlwk + Small Tools	PROD =	100%	CREW HOURS =	3
MSHMD	2 B-shtmtlwk + Small Tools	PROD =	100%	CREW HOURS =	8
MSHMF	2 B-shtmtlwk/laborer + Small Tools	PROD =	100%	CREW HOURS =	32
MSHMG	3 B-shtmtlwk/laborer + Power Tools	PROD =	100%	CREW HOURS =	2
MSPFA	1 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS =	9
MSPFB	2 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS =	35
MSPFC	2 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS =	3
MSPFI	2 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS =	0
MSPFP	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	59
MSPFQ	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	15
MSPFS	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	80
MSPIA	1 B-sprnklr + Small Tools	PROD =	100%	CREW HOURS =	10
SIWRB	2 B-rodman + Small Tools	PROD =	100%	CREW HOURS =	18
SIWRC	3 B-rodman + Small Tools	PROD =	100%	CREW HOURS =	1
SIWSI	4 B-strsteel + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	100
SIWSM	6 B-strsteel + 1 60 Ton Crane, Hydr. Truck Mtd	PROD =	100%	CREW HOURS =	7
SIWSO	6 B-strsteel + 1 60 Ton Crane, Hydr. Truck Mtd	PROD =	100%	CREW HOURS =	96
ULABA	1 B-laborer + Small Tools	PROD =	100%	CREW HOURS =	194
ULABB	2 B-laborer + Small Tools	PROD =	100%	CREW HOURS =	6
ULABE	1 B-laborer + Misc. Power Tools	PROD =	100%	CREW HOURS =	584
ULABF	3 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	8
ULABJ	3 B-laborer + 1 3/4 Ton Pickup Truck	PROD =	100%	CREW HOURS =	50
ULABL	3 B-laborer + 1 3 Ton Flatbed Truck	PROD =	100%	CREW HOURS =	533
ULABN	3 B-laborer + 1 Flatbed Truck W/Hyd. Crane	PROD =	100%	CREW HOURS =	12

ITEM ID	DESCRIPTION				
ULADB	2 B-laborer + 1 Rotary Drill, Water Well	PROD =	100%	CREW HOURS =	0
UOEHE	1 B-eqoprcrn + 1 40 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	0
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD =	100%	CREW HOURS =	3473
XASPA	7 X-laborer + 1 Asphalt Paving Machine	PROD =	100%	CREW HOURS =	9
XCBGA	2 X-carpnter + Small Tools	PROD =	100%	CREW HOURS =	51
XCMAA	1 X-cemtfinr + Small Tools	PROD =	100%	CREW HOURS =	308
XLABF	2 X-laborer + 1 Loader/Backhoe	PROD =	100%	CREW HOURS =	77
XPLUC	1 X-plumber + Small Tools	PROD =	100%	CREW HOURS =	20
XPLUD	2 X-plumber + Misc. Power Tools	PROD =	100%	CREW HOURS =	2
XSABA	3 X-eqoprmed + 1 Grader, 2 Rollers, 3 Trucks	PROD =	100%	CREW HOURS =	283
XSGRA	3 X-eqoprmed + 1 Shpf Roller,Grader,Water Truck	PROD =	100%	CREW HOURS =	415
XXPLA	3 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	582
XXQHK	1 X-eqoprhvy + 1 3.0 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	3480

30_15. 1. Project Engineer
30_15. 2. Project Manager
30_15. 3. Environmental Engineering
30_15. 4. Geotechnical Engineering
30_15. 5. Environmental Health Team
30_15. 6. Cost Engineering
30_15. 7. General Design
30_15. 8. Civil/Structural Design

ITEM ID DESCRIPTION

0_ 5. 5. 0. Overhead Items - SC
0_ 5.10. 0. Overhead Items - ME
0_ 5.15. 0. Overhead Items - EL
0_ 5.20. 0. Overhead Items - SW
0_ 5.25. 0. Overhead Items - LS
0_ 5.30. 0. Overhead Items - GW
0_ 5.35. 0. Overhead Items - PS
0_ 5.40. 0. Overhead Items - AT
0_ 5.45. 0. Overhead Items - RF
0_ 5.50. 0. Overhead Items - PL
0_ 5.55. 0. Overhead Items - HV
0_ 5.60. 0. Overhead Items - FP
0_ 5.65. 0. Overhead Items - MC
0_ 5.70. 0. Overhead Items - SS
0_ 5.75. 0. Overhead Items - LR
0_ 5.80. 0. Overhead Items - SG
0_ 5.85. 0. Overhead Items - MB
01_ 1. 2. 5. TSCA DISPOSAL SITE
01_ 1. 2.10. NTSCA DISPOSAL SITE
12_ 1. 1.01. Const. Equipment & Facilities
12_ 1. 1.04. Setup/Construct Temp. Facilities

ACARJ	3 B-carpntr/labr(semi-skld) + MiscPowrTools	PROD = 100%	CREW HOURS = 2
ACMAC	1 B-cemtfinr + Misc Power Tools	PROD = 100%	CREW HOURS = 19
ALABE	4 B-laborer + 2 Concrete Vibrators	PROD = 100%	CREW HOURS = 2
SIWRC	3 B-rodman + Small Tools	PROD = 100%	CREW HOURS = 2
ULABJ	3 B-laborer + 1 3/4 Ton Pickup Truck	PROD = 100%	CREW HOURS = 26
ULABL	3 B-laborer + 1 3 Ton Flatbed Truck	PROD = 100%	CREW HOURS = 186
XSABA	3 X-eqoprmed + 1 Grader, 2 Rollers, 3 Trucks	PROD = 100%	CREW HOURS = 1

12_ 1. 1.05. Construct Temporary Utilities
12_ 1. 2. 1. CLEAR & GRUB ** OVERTIME **

COMCA	5 B-laborer + 1 16" Chipper/1 3-3/4Cy,Cwlr Ldr	PROD = 100%	CREW HOURS = 57

12_ 1. 2. 2. CONSTRUCT SETTLING BASIN ** OVERTIME **

CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD = 100%	CREW HOURS = 54
CODEJ	2 B-laborer + 1 Loader/Backhoe	PROD = 100%	CREW HOURS = 15
CODLA	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Wheel	PROD = 100%	CREW HOURS = 4
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp	PROD = 100%	CREW HOURS = 125
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD = 100%	CREW HOURS = 54
COFWK	1 B-trkdvrhvl+ 1 Wtr Wag, 6000 Gal/6" Pump	PROD = 100%	CREW HOURS = 0
ULABE	1 B-laborer + Misc. Power Tools	PROD = 100%	CREW HOURS = 0
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD = 100%	CREW HOURS = 135

12_ 1. 2. 3. DREDGING MATERIAL STORAGE AREA ** OVERTIME **

CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD = 100%	CREW HOURS = 55
CODEJ	2 B-laborer + 1 Loader/Backhoe	PROD = 100%	CREW HOURS = 33
CODEX	4 B-laborer + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD = 100%	CREW HOURS = 17
CODLA	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Wheel	PROD = 100%	CREW HOURS = 5
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp	PROD = 100%	CREW HOURS = 33
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD = 100%	CREW HOURS = 55
COFWK	1 B-trkdvrhvl+ 1 Wtr Wag, 6000 Gal/6" Pump	PROD = 100%	CREW HOURS = 0

ITEM ID	DESCRIPTION				
ULABE	1 B-laborer + Misc. Power Tools	PROD =	100%	CREW HOURS =	0
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD =	100%	CREW HOURS =	147
XASPA	7 X-laborer + 1 Asphalt Paving Machine	PROD =	100%	CREW HOURS =	15
12_ 1. 2. 4. LOADING AREA ACCESS ROAD					
CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD =	100%	CREW HOURS =	26
CODEX	4 B-laborer + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	11
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp	PROD =	100%	CREW HOURS =	21
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD =	100%	CREW HOURS =	26
COFWK	1 B-trkdvrhvl+ 1 Wtr Wag, 6000 Gal/6" Pump	PROD =	100%	CREW HOURS =	0
ULABE	1 B-laborer + Misc. Power Tools	PROD =	100%	CREW HOURS =	0
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD =	100%	CREW HOURS =	178
XASPA	7 X-laborer + 1 Asphalt Paving Machine	PROD =	100%	CREW HOURS =	75
12_ 1. 2. 5. SETTLING BASIN ACCESS ROAD					
CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD =	100%	CREW HOURS =	14
CODEX	4 B-laborer + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	15
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp	PROD =	100%	CREW HOURS =	8
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD =	100%	CREW HOURS =	14
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD =	100%	CREW HOURS =	101
XASPA	7 X-laborer + 1 Asphalt Paving Machine	PROD =	100%	CREW HOURS =	19
XXPLB	4 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	8
12_ 1. 2. 6. DECONTAMINATION PAD	** OVERTIME **				
ACARB	2 B-carpnter + Small Tools	PROD =	100%	CREW HOURS =	2
ACARI	2 B-carpntr/labr(semi-skld) + Sm.Tools	PROD =	100%	CREW HOURS =	8
ALABE	4 B-laborer + 2 Concrete Vibrators	PROD =	100%	CREW HOURS =	3
CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD =	100%	CREW HOURS =	5
CODEJ	2 B-laborer + 1 Loader/Backhoe	PROD =	100%	CREW HOURS =	5
CODEX	4 B-laborer + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	1
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp	PROD =	100%	CREW HOURS =	3
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD =	100%	CREW HOURS =	5
SIWRB	2 B-rodman + Small Tools	PROD =	100%	CREW HOURS =	7
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD =	100%	CREW HOURS =	2
12_ 1. 2. 7. SUMP WELLS	** OVERTIME **				
CODEJ	2 B-laborer + 1 Loader/Backhoe	PROD =	100%	CREW HOURS =	3
MSPFB	2 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS =	16
12_ 1. 2. 8. FILTER CELL CONTAINMENT AREA & T	** OVERTIME **				
CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD =	100%	CREW HOURS =	7
CODEX	4 B-laborer + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	2
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp	PROD =	100%	CREW HOURS =	3
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD =	100%	CREW HOURS =	7
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD =	100%	CREW HOURS =	29
XASPA	7 X-laborer + 1 Asphalt Paving Machine	PROD =	100%	CREW HOURS =	2
12_ 1. 2. 9. CONTAINMENT CONTROL BASIN	** OVERTIME **				
CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD =	100%	CREW HOURS =	3
CODEX	4 B-laborer + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	3
CODLA	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Wheel	PROD =	100%	CREW HOURS =	1

ITEM ID	DESCRIPTION			
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp		PROD = 100%	CREW HOURS = 3
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp		PROD = 100%	CREW HOURS = 3
COFWK	1 B-trkdvrhvl+ 1 Wtr Wag, 6000 Gal/6" Pump		PROD = 100%	CREW HOURS = 0
ULABE	1 B-laborer + Misc. Power Tools		PROD = 100%	CREW HOURS = 0
USKCF	6 B-Laborer + 1 3T Flat B Truck		PROD = 100%	CREW HOURS = 12
12_ 1. 2.10. FENCING				
ULABC	3 B-laborer + Small Tools		PROD = 100%	CREW HOURS = 30
12_ 1. 4. 1. DREDGING (312B TSCA)				
12_ 1. 4. 2. DREDGING (312B NTSCA)				
12_ 1. 4. 3. DREDGING (O & M NTSCA)				
12_ 1. 4. 4. DREDGING (312A NTSCA)				
12_ 1. 5. 1. DREDGING (312B TSCA)		** OVERTIME **		
CODEU	1 B-eqoprcrn + 1 3.0 Cy Hydr. Excavator, Cwlr		PROD = 100%	CREW HOURS = 1000
CODTC	1 B-eqoprmed + 1 Dozer, Cat D-4H, 90 Hp		PROD = 100%	CREW HOURS = 2000
COFWG	1 B-eqoprlt + 1 Wtr-pmp, Submersible, 6 In.		PROD = 100%	CREW HOURS = 1000
HTESA	1 Indust Hygen Tech + Small Tools		PROD = 100%	CREW HOURS = 1000
UOEHJ	1 B-eqoprcrn + 1 100 Ton Crane, Cwlr		PROD = 100%	CREW HOURS = 1000
12_ 1. 5. 2. DREDGING (312B NTSCA)		** OVERTIME **		
CODEU	1 B-eqoprcrn + 1 3.0 Cy Hydr. Excavator, Cwlr		PROD = 100%	CREW HOURS = 2873
CODTC	1 B-eqoprmed + 1 Dozer, Cat D-4H, 90 Hp		PROD = 100%	CREW HOURS = 5747
COFWG	1 B-eqoprlt + 1 Wtr-pmp, Submersible, 6 In.		PROD = 100%	CREW HOURS = 2873
HTESA	1 Indust Hygen Tech + Small Tools		PROD = 100%	CREW HOURS = 2873
UOEHJ	1 B-eqoprcrn + 1 100 Ton Crane, Cwlr		PROD = 100%	CREW HOURS = 2873
12_ 1. 5. 3. DREDGING (O & M NTSCA)		** OVERTIME **		
CODEU	1 B-eqoprcrn + 1 3.0 Cy Hydr. Excavator, Cwlr		PROD = 100%	CREW HOURS = 415
CODTC	1 B-eqoprmed + 1 Dozer, Cat D-4H, 90 Hp		PROD = 100%	CREW HOURS = 829
COFWG	1 B-eqoprlt + 1 Wtr-pmp, Submersible, 6 In.		PROD = 100%	CREW HOURS = 415
HTESA	1 Indust Hygen Tech + Small Tools		PROD = 100%	CREW HOURS = 415
UOEHJ	1 B-eqoprcrn + 1 100 Ton Crane, Cwlr		PROD = 100%	CREW HOURS = 415
12_ 1. 5. 4. DREDGING (312A NTSCA)				
CODEU	1 B-eqoprcrn + 1 3.0 Cy Hydr. Excavator, Cwlr		PROD = 100%	CREW HOURS = 352
CODTC	1 B-eqoprmed + 1 Dozer, Cat D-4H, 90 Hp		PROD = 100%	CREW HOURS = 704
COFWG	1 B-eqoprlt + 1 Wtr-pmp, Submersible, 6 In.		PROD = 100%	CREW HOURS = 352
HTESA	1 Indust Hygen Tech + Small Tools		PROD = 100%	CREW HOURS = 352
UOEHJ	1 B-eqoprcrn + 1 100 Ton Crane, Cwlr		PROD = 100%	CREW HOURS = 352
12_ 1. 6. 1. DREDGING (312B TSCA)		** OVERTIME **		
COEID	1 B-trkdvrhv + 1 12 Cy Dump Truck		PROD = 100%	CREW HOURS = 7500
XLABB	2 X-laborer + Small Tools		PROD = 100%	CREW HOURS = 1000
12_ 1. 6. 2. DREDGING (312B NTSCA)		** OVERTIME **		
COEID	1 B-trkdvrhv + 1 12 Cy Dump Truck		PROD = 100%	CREW HOURS = 21550
XLABB	2 X-laborer + Small Tools		PROD = 100%	CREW HOURS = 2873
12_ 1. 6. 3. DREDGING (O & M NTSCA)		** OVERTIME **		
COEID	1 B-trkdvrhv + 1 12 Cy Dump Truck		PROD = 100%	CREW HOURS = 3110

ITEM ID	DESCRIPTION		
XLABB	2 X-laborer + Small Tools	PROD = 100%	CREW HOURS = 415
12_ 1. 6. 4. DREDGING (312A NTSCA)			
COEID	1 B-trkdvrhv + 1 12 Cy Dump Truck	PROD = 100%	CREW HOURS = 2640
XLABB	2 X-laborer + Small Tools	PROD = 100%	CREW HOURS = 352
12_ 1. 7. 1. DREDGING			
ZA	MARINE SURVEY CREW	PROD = 0.00%	CREW HOURS = 320
ZAIRSAMPLE	AIR SAMPLING	PROD = 0.00%	CREW HOURS = 625
ZCHEMIST	WATER QUALITY CREW	PROD = 0.00%	CREW HOURS = 625
ZH2OSAMPLE	MARINE SURVEY CREW	PROD = 0.00%	CREW HOURS = 2325
12_ 1. 7. 2. TRANSFER FACILITY			
ZH2OSAMPLE	MARINE SURVEY CREW	PROD = 0.00%	CREW HOURS = 475
12_ 2.10.01. Landfill Support Services/Facil.			
AASBC	2 B-asbtswkr + Small Tools	PROD = 100%	CREW HOURS = 41
ACARA	1 B-carpnter + Small Tools	PROD = 100%	CREW HOURS = 104
ACARB	2 B-carpnter + Small Tools	PROD = 100%	CREW HOURS = 39
ACARC	1 B-carpnter + Misc Power Tools	PROD = 100%	CREW HOURS = 18
ACARJ	3 B-carpntr/labr(semi-skld) + MiscPowrTools	PROD = 100%	CREW HOURS = 28
ACARU	6 B-carpnter + 1 40 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 31
ACMAA	1 B-cemtfinr + Small Tools	PROD = 100%	CREW HOURS = 59
ACMAC	1 B-cemtfinr + Misc Power Tools	PROD = 100%	CREW HOURS = 141
AGLAB	2 B-glazier + Small Tools	PROD = 100%	CREW HOURS = 41
ALABE	4 B-laborer + 2 Concrete Vibrators	PROD = 100%	CREW HOURS = 12
ALATA	1 B-lathers + Small Tools	PROD = 100%	CREW HOURS = 25
AMABA	1 B-brklayr + Small Tools	PROD = 100%	CREW HOURS = 1
APTRA	1 B-paintord + Small Tools	PROD = 100%	CREW HOURS = 41
ARFCA	1 B-roofer + Small Tools	PROD = 100%	CREW HOURS = 52
ATIFA	1 B-tilelyr + Small Tools	PROD = 100%	CREW HOURS = 63
CLACA	5 B-laborer + 2 Hand Compaction Rammer	PROD = 100%	CREW HOURS = 1
CLACC	3 B-laborer + 1 Hand Compaction Rammer	PROD = 100%	CREW HOURS = 9
CLADM	5 B-laborer + 1 Truck & Drill Rig, 335 Hp	PROD = 100%	CREW HOURS = 133
CODEA	1 B-eqoprcrn + 1 1 Cy Hydr. Excavator	PROD = 100%	CREW HOURS = 11
CODEJ	2 B-laborer + 1 Loader/Backhoe	PROD = 100%	CREW HOURS = 27
CODEK	5 B-laborer + 1 Loader/Backhoe	PROD = 100%	CREW HOURS = 2
CODLB	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Cwlr	PROD = 100%	CREW HOURS = 6
CODTK	1 B-eqoprmed + 1 Dozer/Roller, Cat D-8L, 335 Hp	PROD = 100%	CREW HOURS = 74
EELEA	1 B-electrn	PROD = 100%	CREW HOURS = 1
EELEF	4 B-electrn + Small Tools	PROD = 100%	CREW HOURS = 0
MPLUA	1 B-plumber + Small Tools	PROD = 100%	CREW HOURS = 18
MPLUB	2 B-plumber + Small Tools	PROD = 100%	CREW HOURS = 1
MPLUC	1 B-plumber + Small Tools	PROD = 100%	CREW HOURS = 0
MPLUD	1 B-plumber + Small Tools	PROD = 100%	CREW HOURS = 1
MPLUE	1 B-plumber/laborer + Small Tools	PROD = 100%	CREW HOURS = 280
MPLUS	2 B-plumber + 1 20 Ton Crane, Hydraulic R/T	PROD = 100%	CREW HOURS = 4
MSHMA	1 B-shtmtlwk + Small Tools	PROD = 100%	CREW HOURS = 68
MSHMB	2 B-shtmtlwk + Small Tools	PROD = 100%	CREW HOURS = 1
MSHMC	2 B-shtmtlwk + Small Tools	PROD = 100%	CREW HOURS = 3
MSHMD	2 B-shtmtlwk + Small Tools	PROD = 100%	CREW HOURS = 8

ITEM ID	DESCRIPTION				
MSHMF	2 B-shtmtlwk/laborer + Small Tools	PROD =	100%	CREW HOURS =	32
MSHMG	3 B-shtmtlwk/laborer + Power Tools	PROD =	100%	CREW HOURS =	2
MSPFA	1 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS =	9
MSPFB	2 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS =	35
MSPFC	2 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS =	3
MSPFI	2 B-stm/pipe + Small Tools	PROD =	100%	CREW HOURS =	0
MSPFP	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	59
MSPFQ	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	15
MSPFS	3 B-stm/pipe + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	80
MSPIA	1 B-sprnklr + Small Tools	PROD =	100%	CREW HOURS =	10
SIWRB	2 B-rodman + Small Tools	PROD =	100%	CREW HOURS =	18
SIWRC	3 B-rodman + Small Tools	PROD =	100%	CREW HOURS =	1
SIWSI	4 B-strsteel + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	100
SIWSM	6 B-strsteel + 1 60 Ton Crane, Hydr. Truck Mtd	PROD =	100%	CREW HOURS =	7
SIWSO	6 B-strsteel + 1 60 Ton Crane, Hydr. Truck Mtd	PROD =	100%	CREW HOURS =	96
ULABA	1 B-laborer + Small Tools	PROD =	100%	CREW HOURS =	194
ULABB	2 B-laborer + Small Tools	PROD =	100%	CREW HOURS =	6
ULABE	1 B-laborer + Misc. Power Tools	PROD =	100%	CREW HOURS =	2
ULABF	3 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	8
ULABL	3 B-laborer + 1 3 Ton Flatbed Truck	PROD =	100%	CREW HOURS =	533
ULABN	3 B-laborer + 1 Flatbed Truck W/Hyd. Crane	PROD =	100%	CREW HOURS =	12
ULADB	2 B-laborer + 1 Rotary Drill, Water Well	PROD =	100%	CREW HOURS =	0
UOEHE	1 B-eqoprcrn + 1 40 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	0
XCMAA	1 X-cemtfinr + Small Tools	PROD =	100%	CREW HOURS =	308
XPLUC	1 X-plumber + Small Tools	PROD =	100%	CREW HOURS =	5
XPLUD	2 X-plumber + Misc. Power Tools	PROD =	100%	CREW HOURS =	2
XSABA	3 X-eqoprmed + 1 Grader, 2 Rollers, 3 Trucks	PROD =	100%	CREW HOURS =	3
XSGRA	3 X-eqoprmed + 1 Shpf Roller,Grader,Water Truck	PROD =	100%	CREW HOURS =	2
12_ 2.10.02. Landfill Construction					
CLACC	3 B-laborer + 1 Hand Compaction Rammer	PROD =	100%	CREW HOURS =	10
CODEA	1 B-eqoprcrn + 1 1 Cy Hydr. Excavator	PROD =	100%	CREW HOURS =	8
CODLA	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Wheel	PROD =	100%	CREW HOURS =	319
CODTE	1 B-eqoprmed + 1 Dozer, Cat D-6H, 165 Hp	PROD =	100%	CREW HOURS =	699
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD =	100%	CREW HOURS =	1086
CODTK	1 B-eqoprmed + 1 Dozer/Roller, Cat D-8L, 335 Hp	PROD =	100%	CREW HOURS =	339
COETH	1 B-trkdvrhv + 1 16.5 Cy Dump Truck	PROD =	100%	CREW HOURS =	12626
COETK	1 B-trkdvrhv + 1 25 Cy Dump Truck	PROD =	100%	CREW HOURS =	3150
COFCK	1 B-eqoprmed + Roller	PROD =	100%	CREW HOURS =	492
* COFCP	2 B-eqoprmed + 1 Tire Roller+Water Wagon,6000Gal	PROD =	100%	CREW HOURS =	437
COFGA	1 B-eqoprmed + 1 Grader 12-G	PROD =	100%	CREW HOURS =	700
ULABE	1 B-laborer + Misc. Power Tools	PROD =	100%	CREW HOURS =	295
ULABJ	3 B-laborer + 1 3/4 Ton Pickup Truck	PROD =	100%	CREW HOURS =	29
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD =	100%	CREW HOURS =	3186
XSABA	3 X-eqoprmed + 1 Grader, 2 Rollers, 3 Trucks	PROD =	100%	CREW HOURS =	21
XXPLA	3 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	96
XXQHK	1 X-eqoprhvy + 1 3.0 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	2829
12_ 2.10.03. Site Improvements					
ALABM	3 B-laborer/0.5 rodmen + MiscPwrTools	PROD =	100%	CREW HOURS =	221
CLACC	3 B-laborer + 1 Hand Compaction Rammer	PROD =	100%	CREW HOURS =	246

ITEM ID	DESCRIPTION				
CODEA	1 B-eqoprcrn + 1 1 Cy Hydr. Excavator	PROD =	100%	CREW HOURS =	116
CODEO	1 B-eqoprcrn + 1 1.5 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	75
CODET	1 B-eqoprcrn + 1 2.0 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	14
CODEU	1 B-eqoprcrn + 1 3.0 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	55
CODLA	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Wheel	PROD =	100%	CREW HOURS =	109
CODLB	1 B-eqoprmed + 1 1.5 Cy Front End Ldr, Cwlr	PROD =	100%	CREW HOURS =	258
CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD =	100%	CREW HOURS =	383
CODTK	1 B-eqoprmed + 1 Dozer/Roller, Cat D-8L, 335 Hp	PROD =	100%	CREW HOURS =	267
COETK	1 B-trkdvrhv + 1 25 Cy Dump Truck	PROD =	100%	CREW HOURS =	1333
COETL	3 B-laborer + 2 12 Cy Dump Trck/CrawlrLoadr	PROD =	100%	CREW HOURS =	57
* COFCF	2 B-eqoprmed + 1 12-G Grader & 1 11 Tire Roller	PROD =	100%	CREW HOURS =	24
COFCK	1 B-eqoprmed + Roller	PROD =	100%	CREW HOURS =	133
* COFCP	2 B-eqoprmed + 1 Tire Roller+Water Wagon,6000Gal	PROD =	100%	CREW HOURS =	73
COFGA	1 B-eqoprmed + 1 Grader 12-G	PROD =	100%	CREW HOURS =	185
COFWI	1 B-trkdvrhvl+ 1 Wtr Trk, 3000 Gal/6" Pump	PROD =	100%	CREW HOURS =	200
COKBD	2 B-laborer + 1 Bitum.Dist.Truck/Sweepr	PROD =	100%	CREW HOURS =	2
COMCA	5 B-laborer + 1 16" Chipper/1 3-3/4Cy,Cwlr Ldr	PROD =	100%	CREW HOURS =	612
MPLUQ	3 B-plumber + 1 20 Ton Crane, Hydraulic+Welder	PROD =	100%	CREW HOURS =	5
MPLUS	2 B-plumber + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	5
ULABE	1 B-laborer + Misc. Power Tools	PROD =	100%	CREW HOURS =	288
ULABJ	3 B-laborer + 1 3/4 Ton Pickup Truck	PROD =	100%	CREW HOURS =	21
USKCF	6 B-Laborer + 1 3T Flat B Truck	PROD =	100%	CREW HOURS =	287
XASPA	7 X-laborer + 1 Asphalt Paving Machine	PROD =	100%	CREW HOURS =	9
XCBGA	2 X-carpnter + Small Tools	PROD =	100%	CREW HOURS =	51
XLABF	2 X-laborer + 1 Loader/Backhoe	PROD =	100%	CREW HOURS =	77
XPLUC	1 X-plumber + Small Tools	PROD =	100%	CREW HOURS =	15
XSABA	3 X-eqoprmed + 1 Grader, 2 Rollers, 3 Trucks	PROD =	100%	CREW HOURS =	258
XSGRA	3 X-eqoprmed + 1 Shpf Roller,Grader,Water Truck	PROD =	100%	CREW HOURS =	372
XXPLA	3 X-laborer + 1 20 Ton Crane, Hydraulic R/T	PROD =	100%	CREW HOURS =	486
XXQHK	1 X-eqoprhvy + 1 3.0 Cy Hydr. Excavator, Cwlr	PROD =	100%	CREW HOURS =	651

12_ 2.10.05. General Conditions

12_ 2.10.08. Operations

CODTG	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp	PROD =	100%	CREW HOURS =	4640
COFCK	1 B-eqoprmed + Roller	PROD =	100%	CREW HOURS =	624
* COFCP	2 B-eqoprmed + 1 Tire Roller+Water Wagon,6000Gal	PROD =	100%	CREW HOURS =	2142
COFGA	1 B-eqoprmed + 1 Grader 12-G	PROD =	100%	CREW HOURS =	624

12_ 2.10.10. Post-Closure Operation/Maint.

COELA	1 B-eqoprlt	PROD =	100%	CREW HOURS =	2000
XSGRA	3 X-eqoprmed + 1 Shpf Roller,Grader,Water Truck	PROD =	100%	CREW HOURS =	41

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
MIL	B-ASBTSWKR	Asbestos Workers	22.66	0.0%	33.2%	7.46	0.00	37.63	HR	12/30/99	37.79	104
MIL	B-BRKLAYR	Bricklayers	23.35	0.0%	32.5%	5.90	0.00	36.83	HR	12/30/99	33.57	1
MIL	B-CARPNTER	Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	33.22	992
MIL	B-CEMTFINR	Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	30.23	376
MIL	B-ELECTRN	Electricians	24.03	0.0%	22.9%	9.19	0.00	38.71	HR	12/30/99	36.58	1
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	10589
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	7348
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	31077
MIL	B-EQOPROIL	Equip. Operators, Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	27.66	9438
MIL	B-GLAZIER	Glaziers	23.32	0.0%	35.1%	6.96	0.00	38.47	HR	12/30/99	31.58	103
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	46698
MIL	B-LATHERS	Lathers	24.08	0.0%	33.1%	6.60	0.00	38.66	HR	12/30/99	31.54	31
MIL	B-PAINTORD	Painters, Ordinary	22.63	0.0%	35.1%	7.43	0.00	38.01	HR	12/30/99	29.28	51
MIL	B-PLUMBER	Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	37.55	477
MIL	B-RODMAN	Rodmen, (Reinforcing)	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	39.15	187
MIL	B-ROOFER	Roofers, Composition	22.63	0.0%	45.5%	8.30	0.00	41.22	HR	12/30/99	32.31	66
MIL	B-SHTMTLWK	Sheet Metal Workers	25.58	0.0%	41.0%	9.05	0.00	45.11	HR	12/30/99	37.58	201
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	8153
MIL	B-SPRNKLR	Sprinkler Installers	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	37.53	13
MIL	B-STM/PIPE	Steam/Pipefitters	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	38.03	610
MIL	B-STRSTEEL	Structural Steel Workers	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	42.08	1114
MIL	B-TILELYR	Tile Layers, (Floor)	23.10	0.0%	29.9%	5.90	0.00	35.91	HR	12/30/99	30.42	78
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	52225
MIL	B-TRKDVRLT	Truck Drivers, Light	18.05	0.0%	30.3%	6.46	0.00	29.98	HR	12/30/99	24.87	2
MIL	B-WELDERS	Welders, Structural Steel	25.10	0.0%	30.3%	10.58	0.00	43.28	HR	12/30/99	42.08	291
FOP	FC-FLABT	Field Constr. QC./Lab Technician	9.47	0.0%	30.9%	0.89	0.00	13.29	HR	01/01/99	13.29	4050
FOP	FC-FLDER	Field Engineers	20.00	0.0%	21.4%	0.89	0.00	25.17	HR	01/01/99	25.17	625
FOP	FC-SURYC	Surveyors, Chief	13.55	0.0%	25.5%	0.89	0.00	17.90	HR	01/01/99	17.90	320
RAD	FH-AIRMOT	Air Monitoring Technicians	16.50	0.0%	18.0%	3.12	0.00	22.59	HR	01/01/99	22.59	1250
RAD	FH-CHEALT	Certified Health Physicist	40.00	0.0%	18.0%	7.55	0.00	54.75	HR	01/01/99	54.75	625
RAD	FH-HYGTEH	Industrial Hygiene Technician	20.00	0.0%	18.0%	3.78	0.00	27.38	HR	01/01/99	27.38	4640
MIL	X-CARPNTER	Outside Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	30.77	101
MIL	X-CEMTFINR	Outside Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	28.04	358
MIL	X-ELECTRN	Outside Electricians	24.03	0.0%	22.9%	9.19	0.00	38.71	HR	12/30/99	33.15	120
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	31.61	3976
MIL	X-EQOPRLT	Outside Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	27.95	78
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	3628
MIL	X-EQOPROIL	Outside Equip. Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	24.58	3928
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	19732
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	943
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	1135
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	17.74	0.0%	30.3%	6.22	0.00	29.33	HR	12/30/99	23.24	983

** LABOR BACKUP - Contract **

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
01. LANDS												
12. NAVIGATION												
MIL	B-ASBTSWKR	Asbestos Workers	22.66	0.0%	33.2%	7.46	0.00	37.63	HR	12/30/99	37.79	104
MIL	B-BRKLAYR	Bricklayers	23.35	0.0%	32.5%	5.90	0.00	36.83	HR	12/30/99	33.57	1
MIL	B-CARPNTER	Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	33.22	992
MIL	B-CEMTFINR	Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	30.23	376
MIL	B-ELECTRN	Electricians	24.03	0.0%	22.9%	9.19	0.00	38.71	HR	12/30/99	36.58	1
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	10589
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	7348
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	31077
MIL	B-EQOPROIL	Equip. Operators, Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	27.66	9438
MIL	B-GLAZIER	Glaziers	23.32	0.0%	35.1%	6.96	0.00	38.47	HR	12/30/99	31.58	103
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	46698
MIL	B-LATHERS	Lathers	24.08	0.0%	33.1%	6.60	0.00	38.66	HR	12/30/99	31.54	31
MIL	B-PAINTORD	Painters, Ordinary	22.63	0.0%	35.1%	7.43	0.00	38.01	HR	12/30/99	29.28	51
MIL	B-PLUMBER	Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	37.55	477
MIL	B-RODMAN	Rodmen, (Reinforcing)	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	39.15	187
MIL	B-ROOFER	Roofers, Composition	22.63	0.0%	45.5%	8.30	0.00	41.22	HR	12/30/99	32.31	66
MIL	B-SHTMTLWK	Sheet Metal Workers	25.58	0.0%	41.0%	9.05	0.00	45.11	HR	12/30/99	37.58	201
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	8153
MIL	B-SPRNKLR	Sprinkler Installers	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	37.53	13
MIL	B-STM/PIPE	Steam/Pipefitters	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	38.03	610
MIL	B-STRSTEEL	Structural Steel Workers	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	42.08	1114
MIL	B-TILELYR	Tile Layers, (Floor)	23.10	0.0%	29.9%	5.90	0.00	35.91	HR	12/30/99	30.42	78
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	52225
MIL	B-TRKDVRLT	Truck Drivers, Light	18.05	0.0%	30.3%	6.46	0.00	29.98	HR	12/30/99	24.87	2
MIL	B-WELDERS	Welders, Structural Steel	25.10	0.0%	30.3%	10.58	0.00	43.28	HR	12/30/99	42.08	291
FOP	FC-FLABT	Field Constr. QC./Lab Technician	9.47	0.0%	30.9%	0.89	0.00	13.29	HR	01/01/99	13.29	4050
FOP	FC-FLDER	Field Engineers	20.00	0.0%	21.4%	0.89	0.00	25.17	HR	01/01/99	25.17	625
FOP	FC-SURYC	Surveyors, Chief	13.55	0.0%	25.5%	0.89	0.00	17.90	HR	01/01/99	17.90	320
RAD	FH-AIRMOT	Air Monitoring Technicians	16.50	0.0%	18.0%	3.12	0.00	22.59	HR	01/01/99	22.59	1250
RAD	FH-CHEALT	Certified Health Physicist	40.00	0.0%	18.0%	7.55	0.00	54.75	HR	01/01/99	54.75	625
RAD	FH-HYGTEH	Industrial Hygiene Technician	20.00	0.0%	18.0%	3.78	0.00	27.38	HR	01/01/99	27.38	4640
MIL	X-CARPNTER	Outside Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	30.77	101
MIL	X-CEMTFINR	Outside Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	28.04	358
MIL	X-ELECTRN	Outside Electricians	24.03	0.0%	22.9%	9.19	0.00	38.71	HR	12/30/99	33.15	120
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	31.61	3976
MIL	X-EQOPRLT	Outside Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	27.95	78
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	3628
MIL	X-EQOPROIL	Outside Equip. Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	24.58	3928
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	19732
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	943
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	1135
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	17.74	0.0%	30.3%	6.22	0.00	29.33	HR	12/30/99	23.24	983
23. OTHER STUDIES												
30. ENGINEERING & DESIGN												
31. CONSTRUCTION MANAGEMENT												

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
0_ 5. Prime Contractor												
0_10. Post Closure General Contractor												
0_15. Allowance												
01_ 1. ACQUISTION												
01_ 2. ADMINSTRATION												
12_ 1. DREDGING												
MIL	B-CARPNTER	Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	33.22	29
MIL	B-CEMTFINR	Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	30.23	26
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	9328
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	4640
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	12174
MIL	B-EQOPROIL	Equip. Operators, Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	27.66	9280
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	12885
MIL	B-RODMAN	Rodmen, (Reinforcing)	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	39.15	26
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	1207
MIL	B-STM/PIPE	Steam/Pipefitters	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	38.03	40
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	34800
FOP	FC-FLABT	Field Constr. QC./Lab Technician	9.47	0.0%	30.9%	0.89	0.00	13.29	HR	01/01/99	13.29	4050
FOP	FC-FLDER	Field Engineers	20.00	0.0%	21.4%	0.89	0.00	25.17	HR	01/01/99	25.17	625
FOP	FC-SURYC	Surveyors, Chief	13.55	0.0%	25.5%	0.89	0.00	17.90	HR	01/01/99	17.90	320
RAD	FH-AIRMOT	Air Monitoring Technicians	16.50	0.0%	18.0%	3.12	0.00	22.59	HR	01/01/99	22.59	1250
RAD	FH-CHEALT	Certified Health Physicist	40.00	0.0%	18.0%	7.55	0.00	54.75	HR	01/01/99	54.75	625
RAD	FH-HYGTEH	Industrial Hygiene Technician	20.00	0.0%	18.0%	3.78	0.00	27.38	HR	01/01/99	27.38	4640
MIL	X-ELECTRN	Outside Electricians	24.03	0.0%	22.9%	9.19	0.00	38.71	HR	12/30/99	33.15	120
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	31.61	48
MIL	X-EQOPRLT	Outside Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	27.95	78
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	838
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	12070
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	44
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	229
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	17.74	0.0%	30.3%	6.22	0.00	29.33	HR	12/30/99	23.24	2
12_ 2. DISPOSAL												
MIL	B-ASBTSWKR	Asbestos Workers	22.66	0.0%	33.2%	7.46	0.00	37.63	HR	12/30/99	37.79	104
MIL	B-BRKLAYR	Bricklayers	23.35	0.0%	32.5%	5.90	0.00	36.83	HR	12/30/99	33.57	1
MIL	B-CARPNTER	Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	33.22	963
MIL	B-CEMTFINR	Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	30.23	351
MIL	B-ELECTRN	Electricians	24.03	0.0%	22.9%	9.19	0.00	38.71	HR	12/30/99	36.58	1
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	1261
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	2708
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	18903
MIL	B-EQOPROIL	Equip. Operators, Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	27.66	158
MIL	B-GLAZIER	Glaziers	23.32	0.0%	35.1%	6.96	0.00	38.47	HR	12/30/99	31.58	103
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	33813
MIL	B-LATHERS	Lathers	24.08	0.0%	33.1%	6.60	0.00	38.66	HR	12/30/99	31.54	31
MIL	B-PAINTORD	Painters, Ordinary	22.63	0.0%	35.1%	7.43	0.00	38.01	HR	12/30/99	29.28	51
MIL	B-PLUMBER	Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	37.55	477
MIL	B-RODMAN	Rodmen, (Reinforcing)	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	39.15	161
MIL	B-ROOFER	Roofers, Composition	22.63	0.0%	45.5%	8.30	0.00	41.22	HR	12/30/99	32.31	66
MIL	B-SHTMTLWK	Sheet Metal Workers	25.58	0.0%	41.0%	9.05	0.00	45.11	HR	12/30/99	37.58	201
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	6946

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
MIL	B-SPRNKLR	Sprinkler Installers	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	37.53	13
MIL	B-STM/PIPE	Steam/Pipefitters	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	38.03	570
MIL	B-STRSTEEL	Structural Steel Workers	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	42.08	1114
MIL	B-TILELYR	Tile Layers, (Floor)	23.10	0.0%	29.9%	5.90	0.00	35.91	HR	12/30/99	30.42	78
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	17425
MIL	B-TRKDVRLT	Truck Drivers, Light	18.05	0.0%	30.3%	6.46	0.00	29.98	HR	12/30/99	24.87	2
MIL	B-WELDERS	Welders, Structural Steel	25.10	0.0%	30.3%	10.58	0.00	43.28	HR	12/30/99	42.08	291
MIL	X-CARPNTER	Outside Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	30.77	101
MIL	X-CEMTFINR	Outside Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	28.04	358
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	31.61	3928
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	2789
MIL	X-EQOPROIL	Outside Equip. Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	24.58	3928
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	7662
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	899
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	905
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	17.74	0.0%	30.3%	6.22	0.00	29.33	HR	12/30/99	23.24	981

23_ 1. CMP
30_ 5. FS Phase - CMP/EIS
30_10. Pre-Const. Engineering & Design
30_15. Engineering During Construction
31_ 5. CONSTRUCTION MANAGEMENT

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
0_ 5. 0. Overhead Items - AA												
0_ 5. 5. General Subcontractor												
0_ 5.10. Mech. Subcontractor												
0_ 5.15. Elect. Subcontractor												
0_ 5.20. sitework contractor												
0_ 5.25. Landscape Subcontractor												
0_ 5.30. Drywall Subcontractor												
0_ 5.35. Paint & Sealent Subcontractor												
0_ 5.40. Acoustical Subcontractor												
0_ 5.45. Flooring Subcontractor												
0_ 5.50. Plumbing Subcontractor												
0_ 5.55. HVAC Subcontractor												
0_ 5.60. Fire Protection Subcontractor												
0_ 5.65. Controls Subcontractor												
0_ 5.70. Structural Steel Subcontractor												
0_ 5.75. Liner Subcontractor												
0_ 5.80. Security Subcontractor												
0_ 5.85. Metal Bldg. Subcontractor												
0_10. 0. Overhead Items - PC												
0_15. 0. Overhead Items - AL												
01_ 1. 1. DREDGING(TRANSFER SITE)												
01_ 1. 2. DISPOSAL SITE												
01_ 2. 1. CORPS												
01_ 2. 2. LOCAL												
12_ 1. 1. MOB/DEMOB												
MIL	B-CARPNTER	Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	33.22	7
MIL	B-CEMTFINR	Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	30.23	22
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	743
MIL	B-RODMAN	Rodmen, (Reinforcing)	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	39.15	8
MIL	X-ELECTRN	Outside Electricians	24.03	0.0%	22.9%	9.19	0.00	38.71	HR	12/30/99	33.15	120
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	31.61	48
MIL	X-EQOPRLT	Outside Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	27.95	78
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	385
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	400
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	24
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	118
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	17.74	0.0%	30.3%	6.22	0.00	29.33	HR	12/30/99	23.24	2
12_ 1. 2. CONSTRUCT TRANSFER												
MIL	B-CARPNTER	Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	33.22	22
MIL	B-CEMTFINR	Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	30.23	3
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	48
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	0
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	574
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	5181
MIL	B-RODMAN	Rodmen, (Reinforcing)	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	39.15	17
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	1207
MIL	B-STM/PIPE	Steam/Pipefitters	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	38.03	40
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	0
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	454
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	812

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	20
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	111
12_ 1. 4. DREDGING												
12_ 1. 5. OPERATE TRANSFER FACILITY												
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	9280
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	4640
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	11600
MIL	B-EQOPROIL	Equip. Operators, Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	27.66	9280
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	6960
RAD	FH-HYGTEH	Industrial Hygiene Technician	20.00	0.0%	18.0%	3.78	0.00	27.38	HR	01/01/99	27.38	4640
12_ 1. 6. TRANSPORT TO LANDFILL												
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	34800
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	10858
12_ 1. 7. SAMPLING & ANALYSIS												
FOP	FC-FLABT	Field Constr. QC./Lab Technician	9.47	0.0%	30.9%	0.89	0.00	13.29	HR	01/01/99	13.29	4050
FOP	FC-FLDER	Field Engineers	20.00	0.0%	21.4%	0.89	0.00	25.17	HR	01/01/99	25.17	625
FOP	FC-SURYC	Surveyors, Chief	13.55	0.0%	25.5%	0.89	0.00	17.90	HR	01/01/99	17.90	320
RAD	FH-AIRMOT	Air Monitoring Technicians	16.50	0.0%	18.0%	3.12	0.00	22.59	HR	01/01/99	22.59	1250
RAD	FH-CHEALT	Certified Health Physicist	40.00	0.0%	18.0%	7.55	0.00	54.75	HR	01/01/99	54.75	625
12_ 2. 1. CONSTRUCT TSCA CELL												
12_ 2. 2. CONSTRUCT NTSCA CELL												
12_ 2. 3. WETLAND MIT. - DISPOSAL FACILITY												
12_ 2. 4. OPERATE CDF												
12_ 2. 5. SAMPLE & ANALYSIS(DISPOSAL FAC)												
12_ 2.10. CONSTRUCT LANDFILL												
MIL	B-ASBTSWKR	Asbestos Workers	22.66	0.0%	33.2%	7.46	0.00	37.63	HR	12/30/99	37.79	104
MIL	B-BRKLAYR	Bricklayers	23.35	0.0%	32.5%	5.90	0.00	36.83	HR	12/30/99	33.57	1
MIL	B-CARPNTER	Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	33.22	963
MIL	B-CEMTFINR	Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	30.23	351
MIL	B-ELECTRN	Electricians	24.03	0.0%	22.9%	9.19	0.00	38.71	HR	12/30/99	36.58	1
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	1261
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	2708
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	18903
MIL	B-EQOPROIL	Equip. Operators, Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	27.66	158
MIL	B-GLAZIER	Glaziers	23.32	0.0%	35.1%	6.96	0.00	38.47	HR	12/30/99	31.58	103
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	33813
MIL	B-LATHERS	Lathers	24.08	0.0%	33.1%	6.60	0.00	38.66	HR	12/30/99	31.54	31
MIL	B-PAINTORD	Painters, Ordinary	22.63	0.0%	35.1%	7.43	0.00	38.01	HR	12/30/99	29.28	51
MIL	B-PLUMBER	Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	37.55	477
MIL	B-RODMAN	Rodmen, (Reinforcing)	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	39.15	161
MIL	B-ROOFER	Roofers, Composition	22.63	0.0%	45.5%	8.30	0.00	41.22	HR	12/30/99	32.31	66
MIL	B-SHTMTLWK	Sheet Metal Workers	25.58	0.0%	41.0%	9.05	0.00	45.11	HR	12/30/99	37.58	201
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	6946
MIL	B-SPRNKLR	Sprinkler Installers	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	37.53	13
MIL	B-STM/PIPE	Steam/Pipefitters	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	38.03	570
MIL	B-STRSTEEL	Structural Steel Workers	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	42.08	1114
MIL	B-TILELYR	Tile Layers, (Floor)	23.10	0.0%	29.9%	5.90	0.00	35.91	HR	12/30/99	30.42	78

** LABOR BACKUP - Sub Feat **

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	17425
MIL	B-TRKDVRLT	Truck Drivers, Light	18.05	0.0%	30.3%	6.46	0.00	29.98	HR	12/30/99	24.87	2
MIL	B-WELDERS	Welders, Structural Steel	25.10	0.0%	30.3%	10.58	0.00	43.28	HR	12/30/99	42.08	291
MIL	X-CARPNTER	Outside Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	30.77	101
MIL	X-CEMTFINR	Outside Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	28.04	358
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	31.61	3928
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	2789
MIL	X-EQOPROIL	Outside Equip. Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	24.58	3928
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	7662
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	899
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	905
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	17.74	0.0%	30.3%	6.22	0.00	29.33	HR	12/30/99	23.24	981

30_15. 1. Project Engineer
30_15. 2. Project Manager
30_15. 3. Environmental Engineering
30_15. 4. Geotechnical Engineering
30_15. 5. Environmental Health Team
30_15. 6. Cost Engineering
30_15. 7. General Design
30_15. 8. Civil/Structural Design

** LABOR BACKUP - Element **

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
0_ 5. 5. 0. Overhead Items - SC												
0_ 5.10. 0. Overhead Items - ME												
0_ 5.15. 0. Overhead Items - EL												
0_ 5.20. 0. Overhead Items - SW												
0_ 5.25. 0. Overhead Items - LS												
0_ 5.30. 0. Overhead Items - GW												
0_ 5.35. 0. Overhead Items - PS												
0_ 5.40. 0. Overhead Items - AT												
0_ 5.45. 0. Overhead Items - RF												
0_ 5.50. 0. Overhead Items - PL												
0_ 5.55. 0. Overhead Items - HV												
0_ 5.60. 0. Overhead Items - FP												
0_ 5.65. 0. Overhead Items - MC												
0_ 5.70. 0. Overhead Items - SS												
0_ 5.75. 0. Overhead Items - LR												
0_ 5.80. 0. Overhead Items - SG												
0_ 5.85. 0. Overhead Items - MB												
01_ 1. 2. 5. TSCA DISPOSAL SITE												
01_ 1. 2.10. NTSCA DISPOSAL SITE												
12_ 1. 1.01. Const. Equipment & Facilities												
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	96
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	31.61	48
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	48
12_ 1. 1.04. Setup/Construct Temp. Facilities												
MIL	B-CARPNTER	Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	33.22	7
MIL	B-CEMTFINR	Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	30.23	22
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	647
MIL	B-RODMAN	Rodmen, (Reinforcing)	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	39.15	8
MIL	X-EQOPRLT	Outside Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	27.95	70
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	213
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	143
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	70
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	17.74	0.0%	30.3%	6.22	0.00	29.33	HR	12/30/99	23.24	2
12_ 1. 1.05. Construct Temporary Utilities												
MIL	X-ELECTRN	Outside Electricians	24.03	0.0%	22.9%	9.19	0.00	38.71	HR	12/30/99	33.15	120
MIL	X-EQOPRLT	Outside Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	27.95	8
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	171
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	257
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	24
12_ 1. 2. 1. CLEAR & GRUB				** OVERTIME **								
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	57
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	286
12_ 1. 2. 2. CONSTRUCT SETTLING BASIN				** OVERTIME **								
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	0
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	243
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	1116
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	269

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	0
12_ 1. 2. 3. DREDGING MATERIAL STORAGE AREA				** OVERTIME **								
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	17
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	0
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	148
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	1303
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	294
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	0
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	61
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	106
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	15
12_ 1. 2. 4. LOADING AREA ACCESS ROAD												
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	11
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	0
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	59
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	1240
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	356
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	0
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	301
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	526
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	75
12_ 1. 2. 5. SETTLING BASIN ACCESS ROAD												
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	15
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	27
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	732
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	202
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	84
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	165
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	20
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	19
12_ 1. 2. 6. DECONTAMINATION PAD				** OVERTIME **								
MIL	B-CARPNTER	Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	33.22	22
MIL	B-CEMTFINR	Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	30.23	3
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	1
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	15
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	80
MIL	B-RODMAN	Rodmen, (Reinforcing)	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	39.15	17
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	4
12_ 1. 2. 7. SUMP WELLS				** OVERTIME **								
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	3
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	6
MIL	B-STM/PIPE	Steam/Pipefitters	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	38.03	40
12_ 1. 2. 8. FILTER CELL CONTAINMENT AREA & T				** OVERTIME **								
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	2
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	12

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	215
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	58
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	8
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	14
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	2
12_ 1. 2. 9. CONTAINMENT CONTROL BASIN				** OVERTIME **								
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	3
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	0
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	9
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	99
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	24
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	0
12_ 1. 2.10. FENCING												
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	105
12_ 1. 4. 1. DREDGING (312B TSCA)												
12_ 1. 4. 2. DREDGING (312B NTSCA)												
12_ 1. 4. 3. DREDGING (O & M NTSCA)												
12_ 1. 4. 4. DREDGING (312A NTSCA)												
12_ 1. 5. 1. DREDGING (312B TSCA)				** OVERTIME **								
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	2000
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	1000
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	2500
MIL	B-EQOPROIL	Equip. Operators, Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	27.66	2000
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	1500
RAD	FH-HYGTEH	Industrial Hygiene Technician	20.00	0.0%	18.0%	3.78	0.00	27.38	HR	01/01/99	27.38	1000
12_ 1. 5. 2. DREDGING (312B NTSCA)				** OVERTIME **								
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	5747
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	2873
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	7183
MIL	B-EQOPROIL	Equip. Operators, Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	27.66	5747
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	4310
RAD	FH-HYGTEH	Industrial Hygiene Technician	20.00	0.0%	18.0%	3.78	0.00	27.38	HR	01/01/99	27.38	2873
12_ 1. 5. 3. DREDGING (O & M NTSCA)				** OVERTIME **								
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	829
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	415
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	1037
MIL	B-EQOPROIL	Equip. Operators, Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	27.66	829
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	622
RAD	FH-HYGTEH	Industrial Hygiene Technician	20.00	0.0%	18.0%	3.78	0.00	27.38	HR	01/01/99	27.38	415
12_ 1. 5. 4. DREDGING (312A NTSCA)												
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	704
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	352
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	880
MIL	B-EQOPROIL	Equip. Operators, Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	27.66	704
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	528

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
RAD	FH-HYGTEH	Industrial Hygiene Technician	20.00	0.0%	18.0%	3.78	0.00	27.38	HR	01/01/99	27.38	352
12_ 1. 6. 1. DREDGING (312B TSCA)				** OVERTIME **								
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	7500
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	2340
12_ 1. 6. 2. DREDGING (312B NTSCA)				** OVERTIME **								
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	21550
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	6724
12_ 1. 6. 3. DREDGING (O & M NTSCA)				** OVERTIME **								
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	3110
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	970
12_ 1. 6. 4. DREDGING (312A NTSCA)												
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	2640
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	824
12_ 1. 7. 1. DREDGING												
FOP	FC-FLABT	Field Constr. QC./Lab Technician	9.47	0.0%	30.9%	0.89	0.00	13.29	HR	01/01/99	13.29	3575
FOP	FC-FLDER	Field Engineers	20.00	0.0%	21.4%	0.89	0.00	25.17	HR	01/01/99	25.17	625
FOP	FC-SURYC	Surveyors, Chief	13.55	0.0%	25.5%	0.89	0.00	17.90	HR	01/01/99	17.90	320
RAD	FH-AIRMOT	Air Monitoring Technicians	16.50	0.0%	18.0%	3.12	0.00	22.59	HR	01/01/99	22.59	1250
RAD	FH-CHEALT	Certified Health Physicist	40.00	0.0%	18.0%	7.55	0.00	54.75	HR	01/01/99	54.75	625
12_ 1. 7. 2. TRANSFER FACILITY												
FOP	FC-FLABT	Field Constr. QC./Lab Technician	9.47	0.0%	30.9%	0.89	0.00	13.29	HR	01/01/99	13.29	475
12_ 2.10.01. Landfill Support Services/Facil.												
MIL	B-ASBTSWKR	Asbestos Workers	22.66	0.0%	33.2%	7.46	0.00	37.63	HR	12/30/99	37.79	104
MIL	B-BRKLAYR	Bricklayers	23.35	0.0%	32.5%	5.90	0.00	36.83	HR	12/30/99	33.57	1
MIL	B-CARPNTER	Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	33.22	521
MIL	B-CEMTFINR	Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	30.23	240
MIL	B-ELECTRN	Electricians	24.03	0.0%	22.9%	9.19	0.00	38.71	HR	12/30/99	36.58	1
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	237
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	108
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	199
MIL	B-EQOPROIL	Equip. Operators, Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	27.66	103
MIL	B-GLAZIER	Glaziers	23.32	0.0%	35.1%	6.96	0.00	38.47	HR	12/30/99	31.58	103
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	3329
MIL	B-LATHERS	Lathers	24.08	0.0%	33.1%	6.60	0.00	38.66	HR	12/30/99	31.54	31
MIL	B-PAINTORD	Painters, Ordinary	22.63	0.0%	35.1%	7.43	0.00	38.01	HR	12/30/99	29.28	51
MIL	B-PLUMBER	Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	37.55	453
MIL	B-RODMAN	Rodmen, (Reinforcing)	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	39.15	51
MIL	B-ROOFER	Roofers, Composition	22.63	0.0%	45.5%	8.30	0.00	41.22	HR	12/30/99	32.31	66
MIL	B-SHTMTLWK	Sheet Metal Workers	25.58	0.0%	41.0%	9.05	0.00	45.11	HR	12/30/99	37.58	201
MIL	B-SPRNKLR	Sprinkler Installers	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	37.53	13
MIL	B-STM/PIPE	Steam/Pipefitters	26.62	0.0%	24.8%	9.88	0.00	43.10	HR	12/30/99	38.03	570
MIL	B-STRSTEEL	Structural Steel Workers	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	42.08	1114
MIL	B-TILELYR	Tile Layers, (Floor)	23.10	0.0%	29.9%	5.90	0.00	35.91	HR	12/30/99	30.42	78
MIL	B-WELDERS	Welders, Structural Steel	25.10	0.0%	30.3%	10.58	0.00	43.28	HR	12/30/99	42.08	291

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
MIL	X-CEMTFINR	Outside Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	28.04	308
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	17
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	26
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	9
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	17.74	0.0%	30.3%	6.22	0.00	29.33	HR	12/30/99	23.24	9
12_ 2.10.02. Landfill Construction												
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	431
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	4726
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	20933
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	6373
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	15776
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	31.61	2829
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	160
MIL	X-EQOPROIL	Outside Equip. Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	24.58	2829
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	3181
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	144
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	17.74	0.0%	30.3%	6.22	0.00	29.33	HR	12/30/99	23.24	43
12_ 2.10.03. Site Improvements												
MIL	B-CARPNTER	Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	33.22	441
MIL	B-CEMTFINR	Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	30.23	110
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	34.98	593
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	100
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	2113
MIL	B-EQOPROIL	Equip. Operators, Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	27.66	55
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	7544
MIL	B-PLUMBER	Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	37.55	24
MIL	B-RODMAN	Rodmen, (Reinforcing)	24.85	0.0%	30.3%	10.58	0.00	42.96	HR	12/30/99	39.15	110
MIL	B-SKILLWKR	Skilled Workers	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	29.39	573
MIL	B-TRKDVRHV	Truck Drivers, Heavy	18.30	0.0%	30.3%	6.46	0.00	30.30	HR	12/30/99	26.04	1648
MIL	B-TRKDVRLT	Truck Drivers, Light	18.05	0.0%	30.3%	6.46	0.00	29.98	HR	12/30/99	24.87	2
MIL	X-CARPNTER	Outside Carpenters	23.38	0.0%	30.1%	7.31	0.00	37.73	HR	12/30/99	30.77	101
MIL	X-CEMTFINR	Outside Cement Finishers	21.10	0.0%	30.3%	6.00	0.00	33.49	HR	12/30/99	28.04	51
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	31.61	651
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	2489
MIL	X-EQOPROIL	Outside Equip. Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	24.58	651
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	3925
MIL	X-PLUMBER	Outside Plumbers	26.15	0.0%	24.8%	9.70	0.00	42.34	HR	12/30/99	33.71	746
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	9
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	17.74	0.0%	30.3%	6.22	0.00	29.33	HR	12/30/99	23.24	888
12_ 2.10.05. General Conditions												
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	24.13	0.0%	30.3%	6.80	0.00	38.24	HR	12/30/99	31.61	448
MIL	X-EQOPROIL	Outside Equip. Oilers	17.63	0.0%	30.3%	6.80	0.00	29.77	HR	12/30/99	24.58	448
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	448
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	17.79	0.0%	30.3%	6.22	0.00	29.40	HR	12/30/99	24.55	896
12_ 2.10.08. Operations												
MIL	B-EQOPRMED	Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	32.72	11866
MIL	B-LABORER	Laborers, (Semi-Skilled)	17.17	0.0%	30.3%	4.00	0.00	26.37	HR	12/30/99	25.28	2007

** LABOR BACKUP - Element **

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
12_ 2.10.10. Post-Closure Operation/Maint.												
MIL	B-EQOPRLT	Equip. Operators, Light	22.02	0.0%	30.3%	6.80	0.00	35.49	HR	12/30/99	30.98	2500
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	22.99	0.0%	30.3%	6.80	0.00	36.75	HR	12/30/99	30.38	124
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	19.77	0.0%	30.3%	4.05	0.00	29.81	HR	12/30/99	24.17	83
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	17.74	0.0%	30.3%	6.22	0.00	29.33	HR	12/30/99	23.24	41

** EQUIPMENT BACKUP **

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL ** HOURS
UPB	A10ET001	CHIPSPREADER,S/P, 10'W, MECH	5.67	1.41	5.96	1.47	0.26	0.04	5.70	20.52 HR	284
UPB	A25RS007	ASPH DISTR, 3000 GAL	3.98	0.79	4.99	1.65			4.51	15.92 HR	2
UPB	A30BG003	ASPH FINISHER, 10'W/SCREED,PNEUM	18.65	4.67	7.81	2.25	1.16	0.18	25.01	59.74 HR	121
UPB	B15MB002	STR SWEEPER, 7'W/SPRINKER	0.64	0.13		0.14			0.69	1.60 HR	121
UPB	B15MB004	STR SWEEPER, 7'W/SPRINKER, TOWED	0.86	0.18	1.80	0.44	0.05	0.01	0.94	4.28 HR	2
MIL	B25ES012	BKT,CLAM, 4.75CY,GEN PURP/SQNOSE	3.61	0.80					3.35	7.76 HR	32
MIL	B25ES030	BKT,CLAM, 4.00CY, HVYDTY/SQ NOSE	3.68	0.82					3.41	7.91 HR	4640
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39 HR	611
UPB	C65WC002	CONC VIBRATOR, 2.50D, EL,HI-FREQ	0.31	0.03	0.07	0.17			1.01	1.59 HR	34
MIL	C75GV002	CRANE,HYD,S/P,RT,4WD,20T/70'BOOM	10.81	3.37	6.17	1.91	1.14	0.18	11.20	34.78 HR	782
MIL	C75GV011	CRANE,HYD,S/P,RT,4WD,30T/80'BOOM	14.82	4.79	7.35	2.27	3.43	0.53	15.44	48.63 HR	8
UPB	C75GV012	CRANE,HYD,S/P,RT,4WD,40T/84'BOOM	20.65	6.45	10.41	3.22	1.66	0.26	21.40	64.05 HR	31
MIL	C75GV014	CRANE,HYD,S/P,RT,4WD,60T/110'BM	27.10	8.48	11.47	3.54	3.28	0.51	28.09	82.47 HR	8
UPB	C80GV007	CRANE,HYD,TRK MTD, 60T /115'BOOM	24.59	8.52	12.65	3.39	1.11	0.17	22.23	72.66 HR	102
MIL	C80GV008	CRANE,HYD,TRK MTD, 75T /114'BOOM	23.84	9.33	12.65	3.39	2.19	0.34	24.68	76.41 HR	8
MIL	C80GV010	CRANE,HYD,TRK MTD, 90T /114'BOOM	27.14	10.60	12.80	3.43	2.34	0.36	28.08	84.75 HR	8
MIL	C85AM003	CRANE,DRAG/CLAM, 4.5CY / 95'BOOM	45.59	15.57	11.33	2.57			55.82	130.87 HR	32
UPB	C85MA004	CR,ME,CWLR,LIFTING,100T/210'BOOM	31.36	11.96	8.84	2.00			34.36	88.52 HR	4640
UPB	D35IN003	DRILL,ROTARY, 16" WATER WELL,TRK	22.05	7.40	29.93	11.71	1.13	0.18	29.35	101.75 HR	86
UPB	D35RO002	DRILL,R-BLASTH, 6.75"-9.88",TRK	28.81	9.72	24.06	9.42	2.29	0.35	38.40	113.05 HR	133
UPB	G10HO004	GENERATOR, 5.5 KW, 120/240V,PORT	0.23	0.04	1.10	0.27			0.17	1.82 HR	48
MIL	G15CA001	GRADER,MOTOR, ARTIC, CAT 120-G	8.55	2.78	5.78	2.02	0.52	0.08	8.98	28.71 HR	16
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82 HR	2249
MIL	G15CA004	GRADER,MOTOR, ARTIC, CAT 140-G	11.06	3.59	6.93	2.43	0.64	0.10	11.62	36.36 HR	70
MIL	H25CA004	HYD EXCAV,CRWLR, 1.00CY BKT,LONG	15.83	3.47	5.78	2.26			16.98	44.32 HR	134
UPB	H25CA007	HYD EXCAV, CRWLR, 2.00 CY BKT	31.61	7.71	11.55	4.52			36.33	91.72 HR	22
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70 HR	8199
MIL	H25CA012	HYD EXCAV, CRWLR, 1.00 CY BKT	14.50	3.18	5.45	2.13			15.55	40.81 HR	8
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88 HR	123
MIL	H25CA018	HYD EXCAV, CRWLR, 1.75 CY BKT	26.09	5.72	9.24	3.62			27.98	72.65 HR	8
MIL	H25HI001	HYD EXCAV, CRWLR, 0.28 CY BKT	10.00	2.19	3.33	1.30			10.72	27.54 HR	8
MIL	H25HI010	HYD EXCAV, CRWLR, 1.60 CY BKT,LC	19.34	4.72	7.44	2.91			22.23	56.64 HR	8
MIL	H25HI019	HYD EXCAV, CRWLR, 3.78 CY BKT	43.72	11.45	19.13	4.33			65.03	143.66 HR	8
MIL	H25KO003	HYD EXCAV, CRWLR, 1.05 CY BKT	11.27	2.75	5.82	2.28			12.95	35.06 HR	8
MIL	L10BU005	LANDCLR,ROTRY CUTTR, 5'W-SIDE MT	0.59	0.12		1.10			0.76	2.56 HR	16
UPB	L35CA004	LDR,FE, CRWLR, 1.50 CY	8.68	2.12	4.37	1.71			16.64	33.51 HR	564
UPB	L35CA007	LDR,FE, CRWLR, 3.75 CY	22.94	5.59	11.47	4.49			43.98	88.47 HR	742
UPB	L40CA004	LDR,FE, WH, 2.75 CY, ARTIC, 936E	9.09	2.59	6.80	2.94	2.15	0.33	9.48	33.38 HR	437
MIL	L40CA005	LDR,FE, WH, 3.25 CY, ARTIC, 950E	12.30	3.49	8.06	3.49	2.84	0.44	12.83	43.45 HR	32
MIL	L40CS008	LDR,FE, WH, 3.00 CY, 4WD ARTIC	10.14	2.85	8.57	3.71	1.96	0.30	10.55	38.09 HR	16
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32 HR	177
MIL	L50JC006	LDR,BH,WH, 1.50CY FE BKT, 36"DIP	5.60	1.57	4.84	1.59	0.67	0.10	6.65	21.01 HR	8
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55 HR	4810
MIL	R30BO001	ROLLR,STATIC,S/P,13T,68"W, 9TIRE	4.50	0.94	3.68	0.91	0.43	0.07	4.15	14.67 HR	8
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95 HR	560
MIL	R30CA002	ROLLR,STATIC,S/P,24T,68"W, 9TIRE	5.75	1.22	3.88	0.96	0.81	0.12	5.31	18.05 HR	8
MIL	R30CA003	LNDFL COMP,SHPSFT,S/P 22T, 76"W	16.78	4.09	10.58	2.62			17.51	51.58 HR	2668
MIL	R45BO002	ROLLER,VIB,DD,S/P, 6.9T, 55"W	8.30	1.66	4.90	1.62			11.92	28.39 HR	1281
MIL	R50DY002	ROLLER,VIB,SD,S/P,13.0T,66"W,PAD	9.45	1.91	6.86	2.26	0.20	0.03	12.36	33.08 HR	70
UPB	T10CA004	BLADE, ANGLE, HYDR, D-4	1.43	0.35		0.08			1.64	3.51 HR	9280
UPB	T10CA009	BLADE, STRAIGHT, HYDR, D-6	1.54	0.38		0.08			1.76	3.76 HR	16

** EQUIPMENT BACKUP **

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL ** HOURS
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16 HR	895
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28 HR	6274
UPB	T10CA016	BLADE, STRAIGHT, HYDR, D-8	2.95	0.72		0.12			3.38	7.17 HR	284
UPB	T10CA017	BLADE, UNIVERSAL, HYDR, D-8	3.15	0.77		0.13			3.61	7.66 HR	711
UPB	T15CA004	DOZER,CWLR, D-4H,PS	5.29	1.42	5.19	1.92			9.70	23.52 HR	9280
MIL	T15CA008	DOZER,CWLR, D-6D,PS	9.01	2.42	7.64	2.83			16.52	38.42 HR	16
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64 HR	927
MIL	T15CA012	DOZER,CWLR, D-7G,PS	15.93	4.27	10.92	4.05			29.23	64.41 HR	16
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65 HR	6274
MIL	T15CA015	DOZER,CWLR, D-8L,PS	26.41	6.44	18.29	5.28			37.85	94.26 HR	963
UPB	T15CA016	DOZER,CWLR, D-8N,PS	21.53	5.25	15.56	4.49			30.86	77.69 HR	32
MIL	T25JD003	TRACTOR,WH,FARM, 65-75HP, 2WD	2.19	0.43	3.63	1.05	0.37	0.06	1.99	9.72 HR	16
MIL	T30DW002	TRENCHR,CHN, 35"DP,8"W,4WD,W/BL	1.60	0.32	2.00	0.58	0.06	0.01	1.97	6.52 HR	40
UPB	T40XX003	HYDR CRANE 8.0T,W/ 85'BOOM	5.36	1.07		0.25			5.80	12.48 HR	29
UPB	T40XX010	REAR DUMP BODY, 12.0CY	1.23	0.24		0.09			1.16	2.72 HR	34914
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68 HR	4929
UPB	T40XX033	WATER TANK, 3000 GAL	1.63	0.33					1.32	3.28 HR	685
UPB	T45XX019	TRLR,LOWBOY, 75T, 3 AXLE	3.47	1.18		0.50	1.32	0.20	2.80	9.48 HR	12
UPB	T45XX023	TRLR,LOWBOY,120T, 4 AXLE	5.32	1.87		0.60	2.51	0.39	4.34	15.03 HR	896
UPB	T50FO003	TRK,HWY, 8,600GVW,4X2, 3/4T-PKUP	1.68	0.34	2.79	0.80	0.19	0.03	1.83	7.66 HR	30
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90 HR	5039
MIL	T50FO019	TRK,HWY, 43,000 GVW, 6X4, 3 AXLE	7.77	1.67	10.85	3.13	1.93	0.30	7.42	33.06 HR	368
MIL	T50GM016	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	4.23	0.92	8.97	2.59	1.31	0.20	4.06	22.28 HR	70
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71 HR	35575
UPB	T50KE004	TRK,HWY, 50,000 GVW, 6X4, 3 AXLE	10.00	2.02	10.85	3.13	0.44	0.07	9.43	35.93 HR	416
UPB	T55CA001	TRK,OFF-HWY,R-DUMP, 22-30CY, 35T	25.84	7.11	13.86	4.85	6.26	0.97	19.53	78.43 HR	4483
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71 HR	2936
UPB	W35XX002	WELDER, 200 AMP, W/1 AXLE TRLR	0.49	0.12	4.82	1.19	0.03	0.01	0.57	7.24 HR	291
UPB	W35XX009	WELDER, 300 AMP, SKID,ELEC DRIVE	0.37	0.06	0.66	0.27			0.26	1.62 HR	5
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40 HR	8071
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	30694

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL ** HOURS
01. LANDS											
12. NAVIGATION											
UPB	A10ET001	CHIPSPREADER,S/P, 10'W, MECH	5.67	1.41	5.96	1.47	0.26	0.04	5.70	20.52 HR	284
UPB	A25RS007	ASPH DISTR, 3000 GAL	3.98	0.79	4.99	1.65			4.51	15.92 HR	2
UPB	A30BG003	ASPH FINISHER, 10'W/SCREED,PNEUM	18.65	4.67	7.81	2.25	1.16	0.18	25.01	59.74 HR	121
UPB	B15MB002	STR SWEEPER, 7'W/SPRINKER	0.64	0.13		0.14			0.69	1.60 HR	121
UPB	B15MB004	STR SWEEPER, 7'W/SPRINKER, TOWED	0.86	0.18	1.80	0.44	0.05	0.01	0.94	4.28 HR	2
MIL	B25ES012	BKT,CLAM, 4.75CY,GEN PURP/SQNOSE	3.61	0.80					3.35	7.76 HR	32
MIL	B25ES030	BKT,CLAM, 4.00CY, HVYDTY/SQ NOSE	3.68	0.82					3.41	7.91 HR	4640
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39 HR	611
UPB	C65WC002	CONC VIBRATOR, 2.50D, EL,HI-FREQ	0.31	0.03	0.07	0.17			1.01	1.59 HR	34
MIL	C75GV002	CRANE,HYD,S/P,RT,4WD,20T/70'BOOM	10.81	3.37	6.17	1.91	1.14	0.18	11.20	34.78 HR	782
MIL	C75GV011	CRANE,HYD,S/P,RT,4WD,30T/80'BOOM	14.82	4.79	7.35	2.27	3.43	0.53	15.44	48.63 HR	8
UPB	C75GV012	CRANE,HYD,S/P,RT,4WD,40T/84'BOOM	20.65	6.45	10.41	3.22	1.66	0.26	21.40	64.05 HR	31
MIL	C75GV014	CRANE,HYD,S/P,RT,4WD,60T/110'BM	27.10	8.48	11.47	3.54	3.28	0.51	28.09	82.47 HR	8
UPB	C80GV007	CRANE,HYD,TRK MTD, 60T /115'BOOM	24.59	8.52	12.65	3.39	1.11	0.17	22.23	72.66 HR	102
MIL	C80GV008	CRANE,HYD,TRK MTD, 75T /114'BOOM	23.84	9.33	12.65	3.39	2.19	0.34	24.68	76.41 HR	8
MIL	C80GV010	CRANE,HYD,TRK MTD, 90T /114'BOOM	27.14	10.60	12.80	3.43	2.34	0.36	28.08	84.75 HR	8
MIL	C85AM003	CRANE,DRAG/CLAM, 4.5CY / 95'BOOM	45.59	15.57	11.33	2.57			55.82	130.87 HR	32
UPB	C85MA004	CR,ME,CWLR,LIFTING,100T/210'BOOM	31.36	11.96	8.84	2.00			34.36	88.52 HR	4640
UPB	D35IN003	DRILL,ROTARY, 16" WATER WELL,TRK	22.05	7.40	29.93	11.71	1.13	0.18	29.35	101.75 HR	86
UPB	D35RO002	DRILL,R-BLASTH, 6.75"-9.88",TRK	28.81	9.72	24.06	9.42	2.29	0.35	38.40	113.05 HR	133
UPB	G10HO004	GENERATOR, 5.5 KW, 120/240V,PORT	0.23	0.04	1.10	0.27			0.17	1.82 HR	48
MIL	G15CA001	GRADER,MOTOR, ARTIC, CAT 120-G	8.55	2.78	5.78	2.02	0.52	0.08	8.98	28.71 HR	16
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82 HR	2249
MIL	G15CA004	GRADER,MOTOR, ARTIC, CAT 140-G	11.06	3.59	6.93	2.43	0.64	0.10	11.62	36.36 HR	70
MIL	H25CA004	HYD EXCAV,CRWLR, 1.00CY BKT,LONG	15.83	3.47	5.78	2.26			16.98	44.32 HR	134
UPB	H25CA007	HYD EXCAV, CRWLR, 2.00 CY BKT	31.61	7.71	11.55	4.52			36.33	91.72 HR	22
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70 HR	8199
MIL	H25CA012	HYD EXCAV, CRWLR, 1.00 CY BKT	14.50	3.18	5.45	2.13			15.55	40.81 HR	8
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88 HR	123
MIL	H25CA018	HYD EXCAV, CRWLR, 1.75 CY BKT	26.09	5.72	9.24	3.62			27.98	72.65 HR	8
MIL	H25HI001	HYD EXCAV, CRWLR, 0.28 CY BKT	10.00	2.19	3.33	1.30			10.72	27.54 HR	8
MIL	H25HI010	HYD EXCAV, CRWLR, 1.60 CY BKT,LC	19.34	4.72	7.44	2.91			22.23	56.64 HR	8
MIL	H25HI019	HYD EXCAV, CRWLR, 3.78 CY BKT	43.72	11.45	19.13	4.33			65.03	143.66 HR	8
MIL	H25KO003	HYD EXCAV, CRWLR, 1.05 CY BKT	11.27	2.75	5.82	2.28			12.95	35.06 HR	8
MIL	L10BU005	LANDCLR,ROTRY CUTTR, 5'W-SIDE MT	0.59	0.12		1.10			0.76	2.56 HR	16
UPB	L35CA004	LDR,FE, CRWLR, 1.50 CY	8.68	2.12	4.37	1.71			16.64	33.51 HR	564
UPB	L35CA007	LDR,FE, CRWLR, 3.75 CY	22.94	5.59	11.47	4.49			43.98	88.47 HR	742
UPB	L40CA004	LDR,FE, WH, 2.75 CY, ARTIC, 936E	9.09	2.59	6.80	2.94	2.15	0.33	9.48	33.38 HR	437
MIL	L40CA005	LDR,FE, WH, 3.25 CY, ARTIC, 950E	12.30	3.49	8.06	3.49	2.84	0.44	12.83	43.45 HR	32
MIL	L40CS008	LDR,FE, WH, 3.00 CY, 4WD ARTIC	10.14	2.85	8.57	3.71	1.96	0.30	10.55	38.09 HR	16
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32 HR	177
MIL	L50JC006	LDR,BH,WH, 1.50CY FE BKT, 36"DIP	5.60	1.57	4.84	1.59	0.67	0.10	6.65	21.01 HR	8
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55 HR	4810
MIL	R30BO001	ROLLR,STATIC,S/P,13T,68"W, 9TIRE	4.50	0.94	3.68	0.91	0.43	0.07	4.15	14.67 HR	8
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95 HR	560
MIL	R30CA002	ROLLR,STATIC,S/P,24T,68"W, 9TIRE	5.75	1.22	3.88	0.96	0.81	0.12	5.31	18.05 HR	8
MIL	R30CA003	LNDFL COMP,SHPSFT,S/P 22T, 76"W	16.78	4.09	10.58	2.62			17.51	51.58 HR	2668
MIL	R45BO002	ROLLER,VIB,DD,S/P, 6.9T, 55"W	8.30	1.66	4.90	1.62			11.92	28.39 HR	1281
MIL	R50DY002	ROLLER,VIB,SD,S/P,13.0T,66"W,PAD	9.45	1.91	6.86	2.26	0.20	0.03	12.36	33.08 HR	70

** EQUIPMENT BACKUP - Contract **

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL ** HOURS
UPB	T10CA004	BLADE, ANGLE, HYDR, D-4	1.43	0.35		0.08			1.64	3.51 HR	9280
UPB	T10CA009	BLADE, STRAIGHT, HYDR, D-6	1.54	0.38		0.08			1.76	3.76 HR	16
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16 HR	895
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28 HR	6274
UPB	T10CA016	BLADE, STRAIGHT, HYDR, D-8	2.95	0.72		0.12			3.38	7.17 HR	284
UPB	T10CA017	BLADE, UNIVERSAL, HYDR, D-8	3.15	0.77		0.13			3.61	7.66 HR	711
UPB	T15CA004	DOZER,CWLR, D-4H,PS	5.29	1.42	5.19	1.92			9.70	23.52 HR	9280
MIL	T15CA008	DOZER,CWLR, D-6D,PS	9.01	2.42	7.64	2.83			16.52	38.42 HR	16
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64 HR	927
MIL	T15CA012	DOZER,CWLR, D-7G,PS	15.93	4.27	10.92	4.05			29.23	64.41 HR	16
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65 HR	6274
MIL	T15CA015	DOZER,CWLR, D-8L,PS	26.41	6.44	18.29	5.28			37.85	94.26 HR	963
UPB	T15CA016	DOZER,CWLR, D-8N,PS	21.53	5.25	15.56	4.49			30.86	77.69 HR	32
MIL	T25JD003	TRACTOR,WH,FARM, 65-75HP, 2WD	2.19	0.43	3.63	1.05	0.37	0.06	1.99	9.72 HR	16
MIL	T30DW002	TRENCHR,CHN, 35"DP,8"W,4WD,W/BL	1.60	0.32	2.00	0.58	0.06	0.01	1.97	6.52 HR	40
UPB	T40XX003	HYDR CRANE 8.0T,W/ 85'BOOM	5.36	1.07		0.25			5.80	12.48 HR	29
UPB	T40XX010	REAR DUMP BODY, 12.0CY	1.23	0.24		0.09			1.16	2.72 HR	34914
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68 HR	4929
UPB	T40XX033	WATER TANK, 3000 GAL	1.63	0.33					1.32	3.28 HR	685
UPB	T45XX019	TRLR,LOWBOY, 75T, 3 AXLE	3.47	1.18		0.50	1.32	0.20	2.80	9.48 HR	12
UPB	T45XX023	TRLR,LOWBOY,120T, 4 AXLE	5.32	1.87		0.60	2.51	0.39	4.34	15.03 HR	896
UPB	T50FO003	TRK,HWY, 8,600GVW,4X2, 3/4T-PKUP	1.68	0.34	2.79	0.80	0.19	0.03	1.83	7.66 HR	30
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90 HR	5039
MIL	T50FO019	TRK,HWY, 43,000 GVW, 6X4, 3 AXLE	7.77	1.67	10.85	3.13	1.93	0.30	7.42	33.06 HR	368
MIL	T50GM016	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	4.23	0.92	8.97	2.59	1.31	0.20	4.06	22.28 HR	70
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71 HR	35575
UPB	T50KE004	TRK,HWY, 50,000 GVW, 6X4, 3 AXLE	10.00	2.02	10.85	3.13	0.44	0.07	9.43	35.93 HR	416
UPB	T55CA001	TRK,OFF-HWY,R-DUMP, 22-30CY, 35T	25.84	7.11	13.86	4.85	6.26	0.97	19.53	78.43 HR	4483
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71 HR	2936
UPB	W35XX002	WELDER, 200 AMP, W/1 AXLE TRLR	0.49	0.12	4.82	1.19	0.03	0.01	0.57	7.24 HR	291
UPB	W35XX009	WELDER, 300 AMP, SKID,ELEC DRIVE	0.37	0.06	0.66	0.27			0.26	1.62 HR	5
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40 HR	8071
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	30694

23. OTHER STUDIES
30. ENGINEERING & DESIGN
31. CONSTRUCTION MANAGEMENT

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE		** TOTAL ** HOURS
0_ 5. Prime Contractor												
0_10. Post Closure General Contractor												
0_15. Allowance												
01_ 1. ACQUISTION												
01_ 2. ADMINSTRATION												
12_ 1. DREDGING												
UPB	A10ET001	CHIPSPREADER,S/P, 10'W, MECH	5.67	1.41	5.96	1.47	0.26	0.04	5.70	20.52	HR	1
UPB	A30BG003	ASPH FINISHER, 10'W/SCREED,PNEUM	18.65	4.67	7.81	2.25	1.16	0.18	25.01	59.74	HR	111
UPB	B15MB002	STR SWEEPER, 7'W/SPRINKER	0.64	0.13		0.14			0.69	1.60	HR	111
MIL	B25ES012	BKT,CLAM, 4.75CY,GEN PURP/SQNOSE	3.61	0.80					3.35	7.76	HR	32
MIL	B25ES030	BKT,CLAM, 4.00CY, HVYDTY/SQ NOSE	3.68	0.82					3.41	7.91	HR	4640
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39	HR	330
UPB	C65WC002	CONC VIBRATOR, 2.50D, EL,HI-FREQ	0.31	0.03	0.07	0.17			1.01	1.59	HR	9
MIL	C75GV002	CRANE,HYD,S/P,RT,4WD,20T/70'BOOM	10.81	3.37	6.17	1.91	1.14	0.18	11.20	34.78	HR	8
MIL	C85AM003	CRANE,DRAG/CLAM, 4.5CY / 95'BOOM	45.59	15.57	11.33	2.57			55.82	130.87	HR	32
UPB	C85MA004	CR,ME,CWLR,LIFTING,100T/210'BOOM	31.36	11.96	8.84	2.00			34.36	88.52	HR	4640
UPB	D35IN003	DRILL,ROTARY, 16" WATER WELL,TRK	22.05	7.40	29.93	11.71	1.13	0.18	29.35	101.75	HR	86
UPB	G10HO004	GENERATOR, 5.5 KW, 120/240V,PORT	0.23	0.04	1.10	0.27			0.17	1.82	HR	5
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82	HR	1
MIL	G15CA004	GRADER,MOTOR, ARTIC, CAT 140-G	11.06	3.59	6.93	2.43	0.64	0.10	11.62	36.36	HR	70
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70	HR	4640
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88	HR	48
UPB	L35CA004	LDR,FE, CRWLR, 1.50 CY	8.68	2.12	4.37	1.71			16.64	33.51	HR	1
UPB	L35CA007	LDR,FE, CRWLR, 3.75 CY	22.94	5.59	11.47	4.49			43.98	88.47	HR	57
UPB	L40CA004	LDR,FE, WH, 2.75 CY, ARTIC, 936E	9.09	2.59	6.80	2.94	2.15	0.33	9.48	33.38	HR	10
MIL	L40CS008	LDR,FE, WH, 3.00 CY, 4WD ARTIC	10.14	2.85	8.57	3.71	1.96	0.30	10.55	38.09	HR	16
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32	HR	56
MIL	L50JC006	LDR,BH,WH, 1.50CY FE BKT, 36"DIP	5.60	1.57	4.84	1.59	0.67	0.10	6.65	21.01	HR	8
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	4710
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95	HR	111
MIL	R50DY002	ROLLER,VIB,SD,S/P,13.0T,66"W,PAD	9.45	1.91	6.86	2.26	0.20	0.03	12.36	33.08	HR	70
UPB	T10CA004	BLADE, ANGLE, HYDR, D-4	1.43	0.35		0.08			1.64	3.51	HR	9280
UPB	T10CA009	BLADE, STRAIGHT, HYDR, D-6	1.54	0.38		0.08			1.76	3.76	HR	16
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16	HR	196
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28	HR	165
UPB	T10CA016	BLADE, STRAIGHT, HYDR, D-8	2.95	0.72		0.12			3.38	7.17	HR	1
UPB	T15CA004	DOZER,CWLR, D-4H,PS	5.29	1.42	5.19	1.92			9.70	23.52	HR	9280
MIL	T15CA008	DOZER,CWLR, D-6D,PS	9.01	2.42	7.64	2.83			16.52	38.42	HR	16
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64	HR	196
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65	HR	165
MIL	T15CA015	DOZER,CWLR, D-8L,PS	26.41	6.44	18.29	5.28			37.85	94.26	HR	1
MIL	T30DW002	TRENCHR,CHN, 35"DP,8"W,4WD,W/BL	1.60	0.32	2.00	0.58	0.06	0.01	1.97	6.52	HR	40
UPB	T40XX010	REAR DUMP BODY, 12.0CY	1.23	0.24		0.09			1.16	2.72	HR	34800
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	901
UPB	T40XX033	WATER TANK, 3000 GAL	1.63	0.33					1.32	3.28	HR	70
UPB	T45XX019	TRLR,LOWBOY, 75T, 3 AXLE	3.47	1.18		0.50	1.32	0.20	2.80	9.48	HR	12
UPB	T50FO003	TRK,HWY, 8,600GVW,4X2, 3/4T-PKUP	1.68	0.34	2.79	0.80	0.19	0.03	1.83	7.66	HR	10
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	1013
MIL	T50GM016	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	4.23	0.92	8.97	2.59	1.31	0.20	4.06	22.28	HR	70
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71	HR	34832
UPB	T50KE004	TRK,HWY, 50,000 GVW, 6X4, 3 AXLE	10.00	2.02	10.85	3.13	0.44	0.07	9.43	35.93	HR	48

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL ** HOURS
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71 HR	1
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40 HR	7805
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	22295
12_ 2. DISPOSAL											
UPB	A10ET001	CHIPSPREADER,S/P, 10'W, MECH	5.67	1.41	5.96	1.47	0.26	0.04	5.70	20.52 HR	283
UPB	A25RS007	ASPH DISTR, 3000 GAL	3.98	0.79	4.99	1.65			4.51	15.92 HR	2
UPB	A30BG003	ASPH FINISHER, 10'W/SCREED,PNEUM	18.65	4.67	7.81	2.25	1.16	0.18	25.01	59.74 HR	9
UPB	B15MB002	STR SWEEPER, 7'W/SPRINKER	0.64	0.13		0.14			0.69	1.60 HR	9
UPB	B15MB004	STR SWEEPER, 7'W/SPRINKER, TOWED	0.86	0.18	1.80	0.44	0.05	0.01	0.94	4.28 HR	2
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39 HR	282
UPB	C65WC002	CONC VIBRATOR, 2.50D, EL,HI-FREQ	0.31	0.03	0.07	0.17			1.01	1.59 HR	24
MIL	C75GV002	CRANE,HYD,S/P,RT,4WD,20T/70'BOOM	10.81	3.37	6.17	1.91	1.14	0.18	11.20	34.78 HR	774
MIL	C75GV011	CRANE,HYD,S/P,RT,4WD,30T/80'BOOM	14.82	4.79	7.35	2.27	3.43	0.53	15.44	48.63 HR	8
UPB	C75GV012	CRANE,HYD,S/P,RT,4WD,40T/84'BOOM	20.65	6.45	10.41	3.22	1.66	0.26	21.40	64.05 HR	31
MIL	C75GV014	CRANE,HYD,S/P,RT,4WD,60T/110'BM	27.10	8.48	11.47	3.54	3.28	0.51	28.09	82.47 HR	8
UPB	C80GV007	CRANE,HYD,TRK MTD, 60T /115'BOOM	24.59	8.52	12.65	3.39	1.11	0.17	22.23	72.66 HR	102
MIL	C80GV008	CRANE,HYD,TRK MTD, 75T /114'BOOM	23.84	9.33	12.65	3.39	2.19	0.34	24.68	76.41 HR	8
MIL	C80GV010	CRANE,HYD,TRK MTD, 90T /114'BOOM	27.14	10.60	12.80	3.43	2.34	0.36	28.08	84.75 HR	8
UPB	D35IN003	DRILL,ROTARY, 16" WATER WELL,TRK	22.05	7.40	29.93	11.71	1.13	0.18	29.35	101.75 HR	0
UPB	D35RO002	DRILL,R-BLASTH, 6.75"-9.88",TRK	28.81	9.72	24.06	9.42	2.29	0.35	38.40	113.05 HR	133
UPB	G10HO004	GENERATOR, 5.5 KW, 120/240V,PORT	0.23	0.04	1.10	0.27			0.17	1.82 HR	43
MIL	G15CA001	GRADER,MOTOR, ARTIC, CAT 120-G	8.55	2.78	5.78	2.02	0.52	0.08	8.98	28.71 HR	16
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82 HR	2248
MIL	H25CA004	HYD EXCAV,CRWLR, 1.00CY BKT,LONG	15.83	3.47	5.78	2.26			16.98	44.32 HR	134
UPB	H25CA007	HYD EXCAV, CRWLR, 2.00 CY BKT	31.61	7.71	11.55	4.52			36.33	91.72 HR	22
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70 HR	3559
MIL	H25CA012	HYD EXCAV, CRWLR, 1.00 CY BKT	14.50	3.18	5.45	2.13			15.55	40.81 HR	8
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88 HR	75
MIL	H25CA018	HYD EXCAV, CRWLR, 1.75 CY BKT	26.09	5.72	9.24	3.62			27.98	72.65 HR	8
MIL	H25HI001	HYD EXCAV, CRWLR, 0.28 CY BKT	10.00	2.19	3.33	1.30			10.72	27.54 HR	8
MIL	H25HI010	HYD EXCAV, CRWLR, 1.60 CY BKT,LC	19.34	4.72	7.44	2.91			22.23	56.64 HR	8
MIL	H25HI019	HYD EXCAV, CRWLR, 3.78 CY BKT	43.72	11.45	19.13	4.33			65.03	143.66 HR	8
MIL	H25KO003	HYD EXCAV, CRWLR, 1.05 CY BKT	11.27	2.75	5.82	2.28			12.95	35.06 HR	8
MIL	L10BU005	LANDCLR,ROTRY CUTTR, 5'W-SIDE MT	0.59	0.12		1.10			0.76	2.56 HR	16
UPB	L35CA004	LDR,FE, CRWLR, 1.50 CY	8.68	2.12	4.37	1.71			16.64	33.51 HR	563
UPB	L35CA007	LDR,FE, CRWLR, 3.75 CY	22.94	5.59	11.47	4.49			43.98	88.47 HR	685
UPB	L40CA004	LDR,FE, WH, 2.75 CY, ARTIC, 936E	9.09	2.59	6.80	2.94	2.15	0.33	9.48	33.38 HR	428
MIL	L40CA005	LDR,FE, WH, 3.25 CY, ARTIC, 950E	12.30	3.49	8.06	3.49	2.84	0.44	12.83	43.45 HR	32
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32 HR	121
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55 HR	100
MIL	R30BO001	ROLLR,STATIC,S/P,13T,68"W, 9TIRE	4.50	0.94	3.68	0.91	0.43	0.07	4.15	14.67 HR	8
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95 HR	449
MIL	R30CA002	ROLLR,STATIC,S/P,24T,68"W, 9TIRE	5.75	1.22	3.88	0.96	0.81	0.12	5.31	18.05 HR	8
MIL	R30CA003	LNDFL COMP,SHPSFT,S/P 22T, 76"W	16.78	4.09	10.58	2.62			17.51	51.58 HR	2668
MIL	R45BO002	ROLLER,VIB,DD,S/P, 6.9T, 55"W	8.30	1.66	4.90	1.62			11.92	28.39 HR	1281
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16 HR	699
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28 HR	6109
UPB	T10CA016	BLADE, STRAIGHT, HYDR, D-8	2.95	0.72		0.12			3.38	7.17 HR	283
UPB	T10CA017	BLADE, UNIVERSAL, HYDR, D-8	3.15	0.77		0.13			3.61	7.66 HR	711
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64 HR	731

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL ** HOURS
MIL	T15CA012	DOZER,CWLR, D-7G,PS	15.93	4.27	10.92	4.05			29.23	64.41 HR	16
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65 HR	6109
MIL	T15CA015	DOZER,CWLR, D-8L,PS	26.41	6.44	18.29	5.28			37.85	94.26 HR	962
UPB	T15CA016	DOZER,CWLR, D-8N,PS	21.53	5.25	15.56	4.49			30.86	77.69 HR	32
MIL	T25JD003	TRACTOR,WH,FARM, 65-75HP, 2WD	2.19	0.43	3.63	1.05	0.37	0.06	1.99	9.72 HR	16
UPB	T40XX003	HYDR CRANE 8.0T,W/ 85'BOOM	5.36	1.07		0.25			5.80	12.48 HR	29
UPB	T40XX010	REAR DUMP BODY, 12.0CY	1.23	0.24		0.09			1.16	2.72 HR	114
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68 HR	4028
UPB	T40XX033	WATER TANK, 3000 GAL	1.63	0.33					1.32	3.28 HR	615
UPB	T45XX023	TRLR,LOWBOY,120T, 4 AXLE	5.32	1.87		0.60	2.51	0.39	4.34	15.03 HR	896
UPB	T50FO003	TRK,HWY, 8,600GVW,4X2, 3/4T-PKUP	1.68	0.34	2.79	0.80	0.19	0.03	1.83	7.66 HR	20
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90 HR	4027
MIL	T50FO019	TRK,HWY, 43,000 GVW, 6X4, 3 AXLE	7.77	1.67	10.85	3.13	1.93	0.30	7.42	33.06 HR	368
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71 HR	743
UPB	T50KE004	TRK,HWY, 50,000 GVW, 6X4, 3 AXLE	10.00	2.02	10.85	3.13	0.44	0.07	9.43	35.93 HR	368
UPB	T55CA001	TRK,OFF-HWY,R-DUMP, 22-30CY, 35T	25.84	7.11	13.86	4.85	6.26	0.97	19.53	78.43 HR	4483
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71 HR	2935
UPB	W35XX002	WELDER, 200 AMP, W/1 AXLE TRLR	0.49	0.12	4.82	1.19	0.03	0.01	0.57	7.24 HR	291
UPB	W35XX009	WELDER, 300 AMP, SKID,ELEC DRIVE	0.37	0.06	0.66	0.27			0.26	1.62 HR	5
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40 HR	266
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	8398

23_ 1. CMP
30_ 5. FS Phase - CMP/EIS
30_10. Pre-Const. Engineering & Design
30_15. Engineering During Construction
31_ 5. CONSTRUCTION MANAGEMENT

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE		** TOTAL ** HOURS
0_ 5. 0. Overhead Items - AA												
0_ 5. 5. General Subcontractor												
0_ 5.10. Mech. Subcontractor												
0_ 5.15. Elect. Subcontractor												
0_ 5.20. sitework contractor												
0_ 5.25. Landscape Subcontractor												
0_ 5.30. Drywall Subcontractor												
0_ 5.35. Paint & Sealent Subcontractor												
0_ 5.40. Acoustical Subcontractor												
0_ 5.45. Flooring Subcontractor												
0_ 5.50. Plumbing Subcontractor												
0_ 5.55. HVAC Subcontractor												
0_ 5.60. Fire Protection Subcontractor												
0_ 5.65. Controls Subcontractor												
0_ 5.70. Structural Steel Subcontractor												
0_ 5.75. Liner Subcontractor												
0_ 5.80. Security Subcontractor												
0_ 5.85. Metal Bldg. Subcontractor												
0_10. 0. Overhead Items - PC												
0_15. 0. Overhead Items - AL												
01_ 1. 1. DREDGING(TRANSFER SITE)												
01_ 1. 2. DISPOSAL SITE												
01_ 2. 1. CORPS												
01_ 2. 2. LOCAL												
12_ 1. 1. MOB/DEMOB												
UPB	A10ET001	CHIPSPREADER,S/P, 10'W, MECH	5.67	1.41	5.96	1.47	0.26	0.04	5.70	20.52	HR	1
MIL	B25ES012	BKT,CLAM, 4.75CY,GEN PURP/SQNOSE	3.61	0.80					3.35	7.76	HR	32
UPB	C65WC002	CONC VIBRATOR, 2.50D, EL,HI-FREQ	0.31	0.03	0.07	0.17			1.01	1.59	HR	3
MIL	C85AM003	CRANE,DRAG/CLAM, 4.5CY / 95'BOOM	45.59	15.57	11.33	2.57			55.82	130.87	HR	32
UPB	D35IN003	DRILL,ROTARY, 16" WATER WELL,TRK	22.05	7.40	29.93	11.71	1.13	0.18	29.35	101.75	HR	86
UPB	G10HO004	GENERATOR, 5.5 KW, 120/240V,PORT	0.23	0.04	1.10	0.27			0.17	1.82	HR	2
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82	HR	1
MIL	G15CA004	GRADER,MOTOR, ARTIC, CAT 140-G	11.06	3.59	6.93	2.43	0.64	0.10	11.62	36.36	HR	70
UPB	L35CA004	LDR,FE, CRWLR, 1.50 CY	8.68	2.12	4.37	1.71			16.64	33.51	HR	1
MIL	L40CS008	LDR,FE, WH, 3.00 CY, 4WD ARTIC	10.14	2.85	8.57	3.71	1.96	0.30	10.55	38.09	HR	16
MIL	L50JC006	LDR,BH,WH, 1.50CY FE BKT, 36"DIP	5.60	1.57	4.84	1.59	0.67	0.10	6.65	21.01	HR	8
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	70
MIL	R50DY002	ROLLER,VIB,SD,S/P,13.0T,66"W,PAD	9.45	1.91	6.86	2.26	0.20	0.03	12.36	33.08	HR	70
UPB	T10CA009	BLADE, STRAIGHT, HYDR, D-6	1.54	0.38		0.08			1.76	3.76	HR	16
UPB	T10CA016	BLADE, STRAIGHT, HYDR, D-8	2.95	0.72		0.12			3.38	7.17	HR	1
MIL	T15CA008	DOZER,CWLR, D-6D,PS	9.01	2.42	7.64	2.83			16.52	38.42	HR	16
MIL	T15CA015	DOZER,CWLR, D-8L,PS	26.41	6.44	18.29	5.28			37.85	94.26	HR	1
MIL	T30DW002	TRENCHR,CHN, 35"DP,8"W,4WD,W/BL	1.60	0.32	2.00	0.58	0.06	0.01	1.97	6.52	HR	40
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	186
UPB	T40XX033	WATER TANK, 3000 GAL	1.63	0.33					1.32	3.28	HR	70
UPB	T45XX019	TRLR,LOWBOY, 75T, 3 AXLE	3.47	1.18		0.50	1.32	0.20	2.80	9.48	HR	12
UPB	T50FO003	TRK,HWY, 8,600GVW,4X2, 3/4T-PKUP	1.68	0.34	2.79	0.80	0.19	0.03	1.83	7.66	HR	10
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	186
MIL	T50GM016	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	4.23	0.92	8.97	2.59	1.31	0.20	4.06	22.28	HR	70
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71	HR	32
UPB	T50KE004	TRK,HWY, 50,000 GVW, 6X4, 3 AXLE	10.00	2.02	10.85	3.13	0.44	0.07	9.43	35.93	HR	48

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE		** TOTAL ** HOURS
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71	HR	1
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40	HR	5
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	413
12_ 1. 2. CONSTRUCT TRANSFER												
UPB	A30BG003	ASPH FINISHER, 10'W/SCREED,PNEUM	18.65	4.67	7.81	2.25	1.16	0.18	25.01	59.74	HR	111
UPB	B15MB002	STR SWEEPER, 7'W/SPRINKER	0.64	0.13		0.14			0.69	1.60	HR	111
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39	HR	330
UPB	C65WC002	CONC VIBRATOR, 2.50D, EL,HI-FREQ	0.31	0.03	0.07	0.17			1.01	1.59	HR	6
MIL	C75GV002	CRANE,HYD,S/P,RT,4WD,20T/70'BOOM	10.81	3.37	6.17	1.91	1.14	0.18	11.20	34.78	HR	8
UPB	G10HO004	GENERATOR, 5.5 KW, 120/240V,PORT	0.23	0.04	1.10	0.27			0.17	1.82	HR	3
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88	HR	48
UPB	L35CA007	LDR,FE, CRWLR, 3.75 CY	22.94	5.59	11.47	4.49			43.98	88.47	HR	57
UPB	L40CA004	LDR,FE, WH, 2.75 CY, ARTIC, 936E	9.09	2.59	6.80	2.94	2.15	0.33	9.48	33.38	HR	10
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32	HR	56
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	0
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95	HR	111
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16	HR	196
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28	HR	165
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64	HR	196
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65	HR	165
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	715
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	826
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71	HR	0
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40	HR	0
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	962
12_ 1. 4. DREDGING												
12_ 1. 5. OPERATE TRANSFER FACILITY												
MIL	B25ES030	BKT,CLAM, 4.00CY, HVYDTY/SQ NOSE	3.68	0.82					3.41	7.91	HR	4640
UPB	C85MA004	CR,ME,CWLR,LIFTING,100T/210'BOOM	31.36	11.96	8.84	2.00			34.36	88.52	HR	4640
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70	HR	4640
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	4640
UPB	T10CA004	BLADE, ANGLE, HYDR, D-4	1.43	0.35		0.08			1.64	3.51	HR	9280
UPB	T15CA004	DOZER,CWLR, D-4H,PS	5.29	1.42	5.19	1.92			9.70	23.52	HR	9280
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	5661
12_ 1. 6. TRANSPORT TO LANDFILL												
UPB	T40XX010	REAR DUMP BODY, 12.0CY	1.23	0.24		0.09			1.16	2.72	HR	34800
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71	HR	34800
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	4640
12_ 1. 7. SAMPLING & ANALYSIS												
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40	HR	7800
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	10620
12_ 2. 1. CONSTRUCT TSCA CELL												
12_ 2. 2. CONSTRUCT NTSCA CELL												
12_ 2. 3. WETLAND MIT. - DISPOSAL FACILITY												
12_ 2. 4. OPERATE CDF												
12_ 2. 5. SAMPLE & ANALYSIS(DISPOSAL FAC)												

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE		** TOTAL ** HOURS
12_	2.10. CONSTRUCT LANDFILL											
UPB	A10ET001	CHIPSPREADER,S/P, 10'W, MECH	5.67	1.41	5.96	1.47	0.26	0.04	5.70	20.52	HR	283
UPB	A25RS007	ASPH DISTR, 3000 GAL	3.98	0.79	4.99	1.65			4.51	15.92	HR	2
UPB	A30BG003	ASPH FINISHER, 10'W/SCREED,PNEUM	18.65	4.67	7.81	2.25	1.16	0.18	25.01	59.74	HR	9
UPB	B15MB002	STR SWEEPER, 7'W/SPRINKER	0.64	0.13		0.14			0.69	1.60	HR	9
UPB	B15MB004	STR SWEEPER, 7'W/SPRINKER, TOWED	0.86	0.18	1.80	0.44	0.05	0.01	0.94	4.28	HR	2
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39	HR	282
UPB	C65WC002	CONC VIBRATOR, 2.50D, EL,HI-FREQ	0.31	0.03	0.07	0.17			1.01	1.59	HR	24
MIL	C75GV002	CRANE,HYD,S/P,RT,4WD,20T/70'BOOM	10.81	3.37	6.17	1.91	1.14	0.18	11.20	34.78	HR	774
MIL	C75GV011	CRANE,HYD,S/P,RT,4WD,30T/80'BOOM	14.82	4.79	7.35	2.27	3.43	0.53	15.44	48.63	HR	8
UPB	C75GV012	CRANE,HYD,S/P,RT,4WD,40T/84'BOOM	20.65	6.45	10.41	3.22	1.66	0.26	21.40	64.05	HR	31
MIL	C75GV014	CRANE,HYD,S/P,RT,4WD,60T/110'BM	27.10	8.48	11.47	3.54	3.28	0.51	28.09	82.47	HR	8
UPB	C80GV007	CRANE,HYD,TRK MTD, 60T /115'BOOM	24.59	8.52	12.65	3.39	1.11	0.17	22.23	72.66	HR	102
MIL	C80GV008	CRANE,HYD,TRK MTD, 75T /114'BOOM	23.84	9.33	12.65	3.39	2.19	0.34	24.68	76.41	HR	8
MIL	C80GV010	CRANE,HYD,TRK MTD, 90T /114'BOOM	27.14	10.60	12.80	3.43	2.34	0.36	28.08	84.75	HR	8
UPB	D35IN003	DRILL,ROTARY, 16" WATER WELL,TRK	22.05	7.40	29.93	11.71	1.13	0.18	29.35	101.75	HR	0
UPB	D35RO002	DRILL,R-BLASTH, 6.75"-9.88",TRK	28.81	9.72	24.06	9.42	2.29	0.35	38.40	113.05	HR	133
UPB	G10HO004	GENERATOR, 5.5 KW, 120/240V,PORT	0.23	0.04	1.10	0.27			0.17	1.82	HR	43
MIL	G15CA001	GRADER,MOTOR, ARTIC, CAT 120-G	8.55	2.78	5.78	2.02	0.52	0.08	8.98	28.71	HR	16
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82	HR	2248
MIL	H25CA004	HYD EXCAV,CRWLR, 1.00CY BKT,LONG	15.83	3.47	5.78	2.26			16.98	44.32	HR	134
UPB	H25CA007	HYD EXCAV, CRWLR, 2.00 CY BKT	31.61	7.71	11.55	4.52			36.33	91.72	HR	22
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70	HR	3559
MIL	H25CA012	HYD EXCAV, CRWLR, 1.00 CY BKT	14.50	3.18	5.45	2.13			15.55	40.81	HR	8
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88	HR	75
MIL	H25CA018	HYD EXCAV, CRWLR, 1.75 CY BKT	26.09	5.72	9.24	3.62			27.98	72.65	HR	8
MIL	H25HI001	HYD EXCAV, CRWLR, 0.28 CY BKT	10.00	2.19	3.33	1.30			10.72	27.54	HR	8
MIL	H25HI010	HYD EXCAV, CRWLR, 1.60 CY BKT,LC	19.34	4.72	7.44	2.91			22.23	56.64	HR	8
MIL	H25HI019	HYD EXCAV, CRWLR, 3.78 CY BKT	43.72	11.45	19.13	4.33			65.03	143.66	HR	8
MIL	H25KO003	HYD EXCAV, CRWLR, 1.05 CY BKT	11.27	2.75	5.82	2.28			12.95	35.06	HR	8
MIL	L10BU005	LANDCLR,ROTRY CUTTR, 5'W-SIDE MT	0.59	0.12		1.10			0.76	2.56	HR	16
UPB	L35CA004	LDR,FE, CRWLR, 1.50 CY	8.68	2.12	4.37	1.71			16.64	33.51	HR	563
UPB	L35CA007	LDR,FE, CRWLR, 3.75 CY	22.94	5.59	11.47	4.49			43.98	88.47	HR	685
UPB	L40CA004	LDR,FE, WH, 2.75 CY, ARTIC, 936E	9.09	2.59	6.80	2.94	2.15	0.33	9.48	33.38	HR	428
MIL	L40CA005	LDR,FE, WH, 3.25 CY, ARTIC, 950E	12.30	3.49	8.06	3.49	2.84	0.44	12.83	43.45	HR	32
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32	HR	121
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	100
MIL	R30BO001	ROLLR,STATIC,S/P,13T,68"W, 9TIRE	4.50	0.94	3.68	0.91	0.43	0.07	4.15	14.67	HR	8
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95	HR	449
MIL	R30CA002	ROLLR,STATIC,S/P,24T,68"W, 9TIRE	5.75	1.22	3.88	0.96	0.81	0.12	5.31	18.05	HR	8
MIL	R30CA003	LNDFL COMP,SHPSFT,S/P 22T, 76"W	16.78	4.09	10.58	2.62			17.51	51.58	HR	2668
MIL	R45BO002	ROLLER,VIB,DD,S/P, 6.9T, 55"W	8.30	1.66	4.90	1.62			11.92	28.39	HR	1281
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16	HR	699
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28	HR	6109
UPB	T10CA016	BLADE, STRAIGHT, HYDR, D-8	2.95	0.72		0.12			3.38	7.17	HR	283
UPB	T10CA017	BLADE, UNIVERSAL, HYDR, D-8	3.15	0.77		0.13			3.61	7.66	HR	711
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64	HR	731
MIL	T15CA012	DOZER,CWLR, D-7G,PS	15.93	4.27	10.92	4.05			29.23	64.41	HR	16
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65	HR	6109
MIL	T15CA015	DOZER,CWLR, D-8L,PS	26.41	6.44	18.29	5.28			37.85	94.26	HR	962
UPB	T15CA016	DOZER,CWLR, D-8N,PS	21.53	5.25	15.56	4.49			30.86	77.69	HR	32

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE		** TOTAL ** HOURS
MIL	T25JD003	TRACTOR,WH,FARM, 65-75HP, 2WD	2.19	0.43	3.63	1.05	0.37	0.06	1.99	9.72	HR	16
UPB	T40XX003	HYDR CRANE 8.0T,W/ 85'BOOM	5.36	1.07		0.25			5.80	12.48	HR	29
UPB	T40XX010	REAR DUMP BODY, 12.0CY	1.23	0.24		0.09			1.16	2.72	HR	114
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	4028
UPB	T40XX033	WATER TANK, 3000 GAL	1.63	0.33					1.32	3.28	HR	615
UPB	T45XX023	TRLR,LOWBOY,120T, 4 AXLE	5.32	1.87		0.60	2.51	0.39	4.34	15.03	HR	896
UPB	T50FO003	TRK,HWY, 8,600GVW,4X2, 3/4T-PKUP	1.68	0.34	2.79	0.80	0.19	0.03	1.83	7.66	HR	20
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	4027
MIL	T50FO019	TRK,HWY, 43,000 GVW, 6X4, 3 AXLE	7.77	1.67	10.85	3.13	1.93	0.30	7.42	33.06	HR	368
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71	HR	743
UPB	T50KE004	TRK,HWY, 50,000 GVW, 6X4, 3 AXLE	10.00	2.02	10.85	3.13	0.44	0.07	9.43	35.93	HR	368
UPB	T55CA001	TRK,OFF-HWY,R-DUMP, 22-30CY, 35T	25.84	7.11	13.86	4.85	6.26	0.97	19.53	78.43	HR	4483
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71	HR	2935
UPB	W35XX002	WELDER, 200 AMP, W/1 AXLE TRLR	0.49	0.12	4.82	1.19	0.03	0.01	0.57	7.24	HR	291
UPB	W35XX009	WELDER, 300 AMP, SKID,ELEC DRIVE	0.37	0.06	0.66	0.27			0.26	1.62	HR	5
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40	HR	266
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	8398

30_15. 1. Project Engineer
30_15. 2. Project Manager
30_15. 3. Environmental Engineering
30_15. 4. Geotechnical Engineering
30_15. 5. Environmental Health Team
30_15. 6. Cost Engineering
30_15. 7. General Design
30_15. 8. Civil/Structural Design

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE		** TOTAL ** HOURS
0_ 5. 5. 0. Overhead Items - SC												
0_ 5.10. 0. Overhead Items - ME												
0_ 5.15. 0. Overhead Items - EL												
0_ 5.20. 0. Overhead Items - SW												
0_ 5.25. 0. Overhead Items - LS												
0_ 5.30. 0. Overhead Items - GW												
0_ 5.35. 0. Overhead Items - PS												
0_ 5.40. 0. Overhead Items - AT												
0_ 5.45. 0. Overhead Items - RF												
0_ 5.50. 0. Overhead Items - PL												
0_ 5.55. 0. Overhead Items - HV												
0_ 5.60. 0. Overhead Items - FP												
0_ 5.65. 0. Overhead Items - MC												
0_ 5.70. 0. Overhead Items - SS												
0_ 5.75. 0. Overhead Items - LR												
0_ 5.80. 0. Overhead Items - SG												
0_ 5.85. 0. Overhead Items - MB												
01_ 1. 2. 5. TSCA DISPOSAL SITE												
01_ 1. 2.10. NTSCA DISPOSAL SITE												
12_ 1. 1.01. Const. Equipment & Facilities												
MIL	B25ES012	BKT,CLAM, 4.75CY,GEN PURP/SQNOSE	3.61	0.80					3.35	7.76	HR	32
MIL	C85AM003	CRANE,DRAG/CLAM, 4.5CY / 95'BOOM	45.59	15.57	11.33	2.57			55.82	130.87	HR	32
MIL	L40CS008	LDR,FE, WH, 3.00 CY, 4WD ARTIC	10.14	2.85	8.57	3.71	1.96	0.30	10.55	38.09	HR	16
UPB	T10CA009	BLADE, STRAIGHT, HYDR, D-6	1.54	0.38		0.08			1.76	3.76	HR	16
MIL	T15CA008	DOZER,CWLR, D-6D,PS	9.01	2.42	7.64	2.83			16.52	38.42	HR	16
UPB	T45XX019	TRLR,LOWBOY, 75T, 3 AXLE	3.47	1.18		0.50	1.32	0.20	2.80	9.48	HR	12
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71	HR	32
UPB	T50KE004	TRK,HWY, 50,000 GVW, 6X4, 3 AXLE	10.00	2.02	10.85	3.13	0.44	0.07	9.43	35.93	HR	48
12_ 1. 1.04. Setup/Construct Temp. Facilities												
UPB	A10ET001	CHIPSPREADER,S/P, 10'W, MECH	5.67	1.41	5.96	1.47	0.26	0.04	5.70	20.52	HR	1
UPB	C65WC002	CONC VIBRATOR, 2.50D, EL,HI-FREQ	0.31	0.03	0.07	0.17			1.01	1.59	HR	3
UPB	G10HO004	GENERATOR, 5.5 KW, 120/240V,PORT	0.23	0.04	1.10	0.27			0.17	1.82	HR	2
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82	HR	1
MIL	G15CA004	GRADER,MOTOR, ARTIC, CAT 140-G	11.06	3.59	6.93	2.43	0.64	0.10	11.62	36.36	HR	70
UPB	L35CA004	LDR,FE, CRWLR, 1.50 CY	8.68	2.12	4.37	1.71			16.64	33.51	HR	1
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	70
MIL	R50DY002	ROLLER,VIB,SD,S/P,13.0T,66"W,PAD	9.45	1.91	6.86	2.26	0.20	0.03	12.36	33.08	HR	70
UPB	T10CA016	BLADE, STRAIGHT, HYDR, D-8	2.95	0.72		0.12			3.38	7.17	HR	1
MIL	T15CA015	DOZER,CWLR, D-8L,PS	26.41	6.44	18.29	5.28			37.85	94.26	HR	1
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	186
UPB	T40XX033	WATER TANK, 3000 GAL	1.63	0.33					1.32	3.28	HR	70
UPB	T50FO003	TRK,HWY, 8,600GVW,4X2, 3/4T-PKUP	1.68	0.34	2.79	0.80	0.19	0.03	1.83	7.66	HR	10
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	186
MIL	T50GM016	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	4.23	0.92	8.97	2.59	1.31	0.20	4.06	22.28	HR	70
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71	HR	1
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40	HR	5
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	241
12_ 1. 1.05. Construct Temporary Utilities												
UPB	D35IN003	DRILL,ROTARY, 16" WATER WELL,TRK	22.05	7.40	29.93	11.71	1.13	0.18	29.35	101.75	HR	86

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE		** TOTAL ** HOURS
MIL	L50JC006	LDR,BH,WH, 1.50CY FE BKT, 36"DIP	5.60	1.57	4.84	1.59	0.67	0.10	6.65	21.01	HR	8
MIL	T30DW002	TRENCHR,CHN, 35"DP,8"W,4WD,W/BL	1.60	0.32	2.00	0.58	0.06	0.01	1.97	6.52	HR	40
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	171
12_ 1. 2. 1. CLEAR & GRUB				** OVERTIME **								
UPB	L35CA007	LDR,FE, CRWLR, 3.75 CY	22.94	5.59	11.47	4.49			43.98	88.47	HR	57
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	42
12_ 1. 2. 2. CONSTRUCT SETTLING BASIN				** OVERTIME **								
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39	HR	109
UPB	L40CA004	LDR,FE, WH, 2.75 CY, ARTIC, 936E	9.09	2.59	6.80	2.94	2.15	0.33	9.48	33.38	HR	4
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32	HR	15
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	0
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16	HR	125
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28	HR	54
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64	HR	125
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65	HR	54
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	135
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	135
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71	HR	0
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40	HR	0
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	147
12_ 1. 2. 3. DREDGING MATERIAL STORAGE AREA				** OVERTIME **								
UPB	A30BG003	ASPH FINISHER, 10'W/SCREED,PNEUM	18.65	4.67	7.81	2.25	1.16	0.18	25.01	59.74	HR	15
UPB	B15MB002	STR SWEEPER, 7'W/SPRINKER	0.64	0.13		0.14			0.69	1.60	HR	15
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39	HR	111
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88	HR	17
UPB	L40CA004	LDR,FE, WH, 2.75 CY, ARTIC, 936E	9.09	2.59	6.80	2.94	2.15	0.33	9.48	33.38	HR	5
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32	HR	33
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	0
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95	HR	15
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16	HR	33
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28	HR	55
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64	HR	33
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65	HR	55
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	162
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	178
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71	HR	0
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40	HR	0
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	194
12_ 1. 2. 4. LOADING AREA ACCESS ROAD												
UPB	A30BG003	ASPH FINISHER, 10'W/SCREED,PNEUM	18.65	4.67	7.81	2.25	1.16	0.18	25.01	59.74	HR	75
UPB	B15MB002	STR SWEEPER, 7'W/SPRINKER	0.64	0.13		0.14			0.69	1.60	HR	75
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39	HR	52
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88	HR	11
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	0
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95	HR	75
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16	HR	21
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28	HR	26

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE		** TOTAL ** HOURS
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64	HR	21
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65	HR	26
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	253
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	328
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71	HR	0
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40	HR	0
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	334
12_ 1. 2. 5. SETTLING BASIN ACCESS ROAD												
UPB	A30BG003	ASPH FINISHER, 10'W/SCREED,PNEUM	18.65	4.67	7.81	2.25	1.16	0.18	25.01	59.74	HR	19
UPB	B15MB002	STR SWEEPER, 7'W/SPRINKER	0.64	0.13		0.14			0.69	1.60	HR	19
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39	HR	27
MIL	C75GV002	CRANE,HYD,S/P,RT,4WD,20T/70'BOOM	10.81	3.37	6.17	1.91	1.14	0.18	11.20	34.78	HR	8
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88	HR	15
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95	HR	19
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16	HR	8
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28	HR	14
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64	HR	8
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65	HR	14
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	120
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	139
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	159
12_ 1. 2. 6. DECONTAMINATION PAD				** OVERTIME **								
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39	HR	11
UPB	C65WC002	CONC VIBRATOR, 2.50D, EL,HI-FREQ	0.31	0.03	0.07	0.17			1.01	1.59	HR	6
UPB	G10HO004	GENERATOR, 5.5 KW, 120/240V,PORT	0.23	0.04	1.10	0.27			0.17	1.82	HR	3
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88	HR	1
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32	HR	5
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16	HR	3
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28	HR	5
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64	HR	3
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65	HR	5
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	2
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	2
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	14
12_ 1. 2. 7. SUMP WELLS				** OVERTIME **								
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32	HR	3
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	12
12_ 1. 2. 8. FILTER CELL CONTAINMENT AREA & T				** OVERTIME **								
UPB	A30BG003	ASPH FINISHER, 10'W/SCREED,PNEUM	18.65	4.67	7.81	2.25	1.16	0.18	25.01	59.74	HR	2
UPB	B15MB002	STR SWEEPER, 7'W/SPRINKER	0.64	0.13		0.14			0.69	1.60	HR	2
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39	HR	13
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88	HR	2
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95	HR	2
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16	HR	3
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28	HR	7
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64	HR	3
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65	HR	7

** EQUIPMENT BACKUP - Element **

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE		** TOTAL ** HOURS
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	31
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	33
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	35
12_ 1. 2. 9. CONTAINMENT CONTROL BASIN				** OVERTIME **								
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39	HR	7
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88	HR	3
UPB	L40CA004	LDR,FE, WH, 2.75 CY, ARTIC, 936E	9.09	2.59	6.80	2.94	2.15	0.33	9.48	33.38	HR	1
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	0
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16	HR	3
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28	HR	3
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64	HR	3
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65	HR	3
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	12
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	12
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71	HR	0
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40	HR	0
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	13
12_ 1. 2.10. FENCING												
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	12
12_ 1. 4. 1. DREDGING (312B TSCA)												
12_ 1. 4. 2. DREDGING (312B NTSCA)												
12_ 1. 4. 3. DREDGING (O & M NTSCA)												
12_ 1. 4. 4. DREDGING (312A NTSCA)												
12_ 1. 5. 1. DREDGING (312B TSCA)				** OVERTIME **								
MIL	B25ES030	BKT,CLAM, 4.00CY, HVYDTY/SQ NOSE	3.68	0.82					3.41	7.91	HR	1000
UPB	C85MA004	CR,ME,CWLR,LIFTING,100T/210'BOOM	31.36	11.96	8.84	2.00			34.36	88.52	HR	1000
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70	HR	1000
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	1000
UPB	T10CA004	BLADE, ANGLE, HYDR, D-4	1.43	0.35		0.08			1.64	3.51	HR	2000
UPB	T15CA004	DOZER,CWLR, D-4H,PS	5.29	1.42	5.19	1.92			9.70	23.52	HR	2000
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	1220
12_ 1. 5. 2. DREDGING (312B NTSCA)				** OVERTIME **								
MIL	B25ES030	BKT,CLAM, 4.00CY, HVYDTY/SQ NOSE	3.68	0.82					3.41	7.91	HR	2873
UPB	C85MA004	CR,ME,CWLR,LIFTING,100T/210'BOOM	31.36	11.96	8.84	2.00			34.36	88.52	HR	2873
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70	HR	2873
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	2873
UPB	T10CA004	BLADE, ANGLE, HYDR, D-4	1.43	0.35		0.08			1.64	3.51	HR	5747
UPB	T15CA004	DOZER,CWLR, D-4H,PS	5.29	1.42	5.19	1.92			9.70	23.52	HR	5747
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	3505
12_ 1. 5. 3. DREDGING (O & M NTSCA)				** OVERTIME **								
MIL	B25ES030	BKT,CLAM, 4.00CY, HVYDTY/SQ NOSE	3.68	0.82					3.41	7.91	HR	415
UPB	C85MA004	CR,ME,CWLR,LIFTING,100T/210'BOOM	31.36	11.96	8.84	2.00			34.36	88.52	HR	415
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70	HR	415
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55	HR	415
UPB	T10CA004	BLADE, ANGLE, HYDR, D-4	1.43	0.35		0.08			1.64	3.51	HR	829
UPB	T15CA004	DOZER,CWLR, D-4H,PS	5.29	1.42	5.19	1.92			9.70	23.52	HR	829

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL ** HOURS
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	506
12_ 1. 5. 4. DREDGING (312A NTSCA)											
MIL	B25ES030	BKT,CLAM, 4.00CY, HVYDTY/SQ NOSE	3.68	0.82					3.41	7.91 HR	352
UPB	C85MA004	CR,ME,CWLR,LIFTING,100T/210'BOOM	31.36	11.96	8.84	2.00			34.36	88.52 HR	352
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70 HR	352
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55 HR	352
UPB	T10CA004	BLADE, ANGLE, HYDR, D-4	1.43	0.35		0.08			1.64	3.51 HR	704
UPB	T15CA004	DOZER,CWLR, D-4H,PS	5.29	1.42	5.19	1.92			9.70	23.52 HR	704
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	429
12_ 1. 6. 1. DREDGING (312B TSCA)				** OVERTIME **							
UPB	T40XX010	REAR DUMP BODY, 12.0CY	1.23	0.24		0.09			1.16	2.72 HR	7500
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71 HR	7500
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	1000
12_ 1. 6. 2. DREDGING (312B NTSCA)				** OVERTIME **							
UPB	T40XX010	REAR DUMP BODY, 12.0CY	1.23	0.24		0.09			1.16	2.72 HR	21550
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71 HR	21550
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	2873
12_ 1. 6. 3. DREDGING (O & M NTSCA)				** OVERTIME **							
UPB	T40XX010	REAR DUMP BODY, 12.0CY	1.23	0.24		0.09			1.16	2.72 HR	3110
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71 HR	3110
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	415
12_ 1. 6. 4. DREDGING (312A NTSCA)											
UPB	T40XX010	REAR DUMP BODY, 12.0CY	1.23	0.24		0.09			1.16	2.72 HR	2640
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71 HR	2640
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	352
12_ 1. 7. 1. DREDGING											
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40 HR	7325
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	10145
12_ 1. 7. 2. TRANSFER FACILITY											
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40 HR	475
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	475
12_ 2.10.01. Landfill Support Services/Facil.											
UPB	A10ET001	CHIPSPREADER,S/P, 10'W, MECH	5.67	1.41	5.96	1.47	0.26	0.04	5.70	20.52 HR	3
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39 HR	11
UPB	C65WC002	CONC VIBRATOR, 2.50D, EL,HI-FREQ	0.31	0.03	0.07	0.17			1.01	1.59 HR	24
MIL	C75GV002	CRANE,HYD,S/P,RT,4WD,20T/70'BOOM	10.81	3.37	6.17	1.91	1.14	0.18	11.20	34.78 HR	172
UPB	C75GV012	CRANE,HYD,S/P,RT,4WD,40T/84'BOOM	20.65	6.45	10.41	3.22	1.66	0.26	21.40	64.05 HR	31
UPB	C80GV007	CRANE,HYD,TRK MTD, 60T /115'BOOM	24.59	8.52	12.65	3.39	1.11	0.17	22.23	72.66 HR	102
UPB	D35IN003	DRILL,ROTARY, 16" WATER WELL,TRK	22.05	7.40	29.93	11.71	1.13	0.18	29.35	101.75 HR	0
UPB	D35RO002	DRILL,R-BLASTH, 6.75"-9.88",TRK	28.81	9.72	24.06	9.42	2.29	0.35	38.40	113.05 HR	133
UPB	G10HO004	GENERATOR, 5.5 KW, 120/240V,PORT	0.23	0.04	1.10	0.27			0.17	1.82 HR	43
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82 HR	6
MIL	H25CA004	HYD EXCAV,CRWLR, 1.00CY BKT,LONG	15.83	3.47	5.78	2.26			16.98	44.32 HR	11

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE		** TOTAL ** HOURS
UPB	L35CA004	LDR,FE, CRWLR, 1.50 CY	8.68	2.12	4.37	1.71			16.64	33.51	HR	9
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32	HR	28
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95	HR	2
UPB	T10CA016	BLADE, STRAIGHT, HYDR, D-8	2.95	0.72		0.12			3.38	7.17	HR	3
UPB	T10CA017	BLADE, UNIVERSAL, HYDR, D-8	3.15	0.77		0.13			3.61	7.66	HR	74
MIL	T15CA015	DOZER,CWLR, D-8L,PS	26.41	6.44	18.29	5.28			37.85	94.26	HR	77
UPB	T40XX003	HYDR CRANE 8.0T,W/ 85'BOOM	5.36	1.07		0.25			5.80	12.48	HR	12
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	546
UPB	T40XX033	WATER TANK, 3000 GAL	1.63	0.33					1.32	3.28	HR	2
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	533
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71	HR	15
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71	HR	3
UPB	W35XX002	WELDER, 200 AMP, W/1 AXLE TRLR	0.49	0.12	4.82	1.19	0.03	0.01	0.57	7.24	HR	291
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40	HR	72
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	1888
12_ 2.10.02. Landfill Construction												
UPB	A10ET001	CHIPSPREADER,S/P, 10'W, MECH	5.67	1.41	5.96	1.47	0.26	0.04	5.70	20.52	HR	21
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39	HR	10
MIL	C75GV002	CRANE,HYD,S/P,RT,4WD,20T/70'BOOM	10.81	3.37	6.17	1.91	1.14	0.18	11.20	34.78	HR	96
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82	HR	721
MIL	H25CA004	HYD EXCAV,CRWLR, 1.00CY BKT,LONG	15.83	3.47	5.78	2.26			16.98	44.32	HR	8
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70	HR	2829
UPB	L35CA004	LDR,FE, CRWLR, 1.50 CY	8.68	2.12	4.37	1.71			16.64	33.51	HR	21
UPB	L40CA004	LDR,FE, WH, 2.75 CY, ARTIC, 936E	9.09	2.59	6.80	2.94	2.15	0.33	9.48	33.38	HR	319
MIL	R30CA003	LNDFL COMP,SHPSFT,S/P 22T, 76"W	16.78	4.09	10.58	2.62			17.51	51.58	HR	437
MIL	R45BO002	ROLLER,VIB,DD,S/P, 6.9T, 55"W	8.30	1.66	4.90	1.62			11.92	28.39	HR	492
UPB	T10CA010	BLADE, ANGLE, HYDR, D-6	1.71	0.42		0.08			1.96	4.16	HR	699
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28	HR	1086
UPB	T10CA016	BLADE, STRAIGHT, HYDR, D-8	2.95	0.72		0.12			3.38	7.17	HR	21
UPB	T10CA017	BLADE, UNIVERSAL, HYDR, D-8	3.15	0.77		0.13			3.61	7.66	HR	339
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64	HR	699
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65	HR	1086
MIL	T15CA015	DOZER,CWLR, D-8L,PS	26.41	6.44	18.29	5.28			37.85	94.26	HR	360
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68	HR	3186
UPB	T50FO003	TRK,HWY, 8,600GVW,4X2, 3/4T-PKUP	1.68	0.34	2.79	0.80	0.19	0.03	1.83	7.66	HR	11
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90	HR	3186
UPB	T55CA001	TRK,OFF-HWY,R-DUMP, 22-30CY, 35T	25.84	7.11	13.86	4.85	6.26	0.97	19.53	78.43	HR	3150
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71	HR	458
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40	HR	65
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	3630
12_ 2.10.03. Site Improvements												
UPB	A10ET001	CHIPSPREADER,S/P, 10'W, MECH	5.67	1.41	5.96	1.47	0.26	0.04	5.70	20.52	HR	258
UPB	A25RS007	ASPH DISTR, 3000 GAL	3.98	0.79	4.99	1.65			4.51	15.92	HR	2
UPB	A30BG003	ASPH FINISHER, 10'W/SCREED,PNEUM	18.65	4.67	7.81	2.25	1.16	0.18	25.01	59.74	HR	9
UPB	B15MB002	STR SWEEPER, 7'W/SPRINKER	0.64	0.13		0.14			0.69	1.60	HR	9
UPB	B15MB004	STR SWEEPER, 7'W/SPRINKER, TOWED	0.86	0.18	1.80	0.44	0.05	0.01	0.94	4.28	HR	2
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39	HR	246
MIL	C75GV002	CRANE,HYD,S/P,RT,4WD,20T/70'BOOM	10.81	3.37	6.17	1.91	1.14	0.18	11.20	34.78	HR	490
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82	HR	839

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL ** HOURS
MIL	H25CA004	HYD EXCAV,CRWLR, 1.00CY BKT,LONG	15.83	3.47	5.78	2.26			16.98	44.32 HR	116
UPB	H25CA007	HYD EXCAV, CRWLR, 2.00 CY BKT	31.61	7.71	11.55	4.52			36.33	91.72 HR	14
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70 HR	706
UPB	H25CA016	HYD EXCAV, CRWLR, 1.50 CY BKT	22.50	4.94	9.56	3.74			24.14	64.88 HR	75
UPB	L35CA004	LDR,FE, CRWLR, 1.50 CY	8.68	2.12	4.37	1.71			16.64	33.51 HR	516
UPB	L35CA007	LDR,FE, CRWLR, 3.75 CY	22.94	5.59	11.47	4.49			43.98	88.47 HR	669
UPB	L40CA004	LDR,FE, WH, 2.75 CY, ARTIC, 936E	9.09	2.59	6.80	2.94	2.15	0.33	9.48	33.38 HR	109
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32 HR	77
UPB	P55GR004	PUMP,SUBM, 6"D,1950GPM/40'HD, EL	1.03	0.28	2.97	1.38			0.89	6.55 HR	100
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95 HR	405
MIL	R30CA003	LNDFL COMP,SHPSFT,S/P 22T, 76"W	16.78	4.09	10.58	2.62			17.51	51.58 HR	73
MIL	R45BO002	ROLLER,VIB,DD,S/P, 6.9T, 55"W	8.30	1.66	4.90	1.62			11.92	28.39 HR	133
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28 HR	383
UPB	T10CA016	BLADE, STRAIGHT, HYDR, D-8	2.95	0.72		0.12			3.38	7.17 HR	258
UPB	T10CA017	BLADE, UNIVERSAL, HYDR, D-8	3.15	0.77		0.13			3.61	7.66 HR	267
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65 HR	383
MIL	T15CA015	DOZER,CWLR, D-8L,PS	26.41	6.44	18.29	5.28			37.85	94.26 HR	525
UPB	T40XX010	REAR DUMP BODY, 12.0CY	1.23	0.24		0.09			1.16	2.72 HR	114
MIL	T40XX016	FLATBED, 8'x 16.0'	0.34	0.07					0.27	0.68 HR	296
UPB	T40XX033	WATER TANK, 3000 GAL	1.63	0.33					1.32	3.28 HR	572
UPB	T50FO003	TRK,HWY, 8,600GVW,4X2, 3/4T-PKUP	1.68	0.34	2.79	0.80	0.19	0.03	1.83	7.66 HR	9
UPB	T50FO011	TRK,HWY, 24,700 GVW, 4X2, 2 AXLE	2.87	0.70	5.66	1.52	1.03	0.16	2.96	14.90 HR	307
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71 HR	687
UPB	T55CA001	TRK,OFF-HWY,R-DUMP, 22-30CY, 35T	25.84	7.11	13.86	4.85	6.26	0.97	19.53	78.43 HR	1333
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71 HR	332
UPB	W35XX009	WELDER, 300 AMP, SKID,ELEC DRIVE	0.37	0.06	0.66	0.27			0.26	1.62 HR	5
UPB	XMIXX010	MISC. POWER TOOLS	2.17	0.76	0.60	0.27			2.60	6.40 HR	130
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57 HR	2797

12_ 2.10.05. General Conditions

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL ** HOURS
MIL	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.62	0.08	0.55	0.14			1.00	2.39 HR	16
MIL	C75GV002	CRANE,HYD,S/P,RT,4WD,20T/70'BOOM	10.81	3.37	6.17	1.91	1.14	0.18	11.20	34.78 HR	16
MIL	C75GV011	CRANE,HYD,S/P,RT,4WD,30T/80'BOOM	14.82	4.79	7.35	2.27	3.43	0.53	15.44	48.63 HR	8
MIL	C75GV014	CRANE,HYD,S/P,RT,4WD,60T/110'BM	27.10	8.48	11.47	3.54	3.28	0.51	28.09	82.47 HR	8
MIL	C80GV008	CRANE,HYD,TRK MTD, 75T /114'BOOM	23.84	9.33	12.65	3.39	2.19	0.34	24.68	76.41 HR	8
MIL	C80GV010	CRANE,HYD,TRK MTD, 90T /114'BOOM	27.14	10.60	12.80	3.43	2.34	0.36	28.08	84.75 HR	8
MIL	G15CA001	GRADER,MOTOR, ARTIC, CAT 120-G	8.55	2.78	5.78	2.02	0.52	0.08	8.98	28.71 HR	16
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82 HR	16
UPB	H25CA007	HYD EXCAV, CRWLR, 2.00 CY BKT	31.61	7.71	11.55	4.52			36.33	91.72 HR	8
UPB	H25CA008	HYD EXCAV, CRWLR, 3.125CY BKT	42.67	11.18	16.63	3.77			63.46	137.70 HR	24
MIL	H25CA012	HYD EXCAV, CRWLR, 1.00 CY BKT	14.50	3.18	5.45	2.13			15.55	40.81 HR	8
MIL	H25CA018	HYD EXCAV, CRWLR, 1.75 CY BKT	26.09	5.72	9.24	3.62			27.98	72.65 HR	8
MIL	H25HI001	HYD EXCAV, CRWLR, 0.28 CY BKT	10.00	2.19	3.33	1.30			10.72	27.54 HR	8
MIL	H25HI010	HYD EXCAV, CRWLR, 1.60 CY BKT,LC	19.34	4.72	7.44	2.91			22.23	56.64 HR	8
MIL	H25HI019	HYD EXCAV, CRWLR, 3.78 CY BKT	43.72	11.45	19.13	4.33			65.03	143.66 HR	8
MIL	H25KO003	HYD EXCAV, CRWLR, 1.05 CY BKT	11.27	2.75	5.82	2.28			12.95	35.06 HR	8
MIL	L10BU005	LANDCLR,ROTRY CUTTR, 5'W-SIDE MT	0.59	0.12		1.10			0.76	2.56 HR	16
UPB	L35CA004	LDR,FE, CRWLR, 1.50 CY	8.68	2.12	4.37	1.71			16.64	33.51 HR	16
UPB	L35CA007	LDR,FE, CRWLR, 3.75 CY	22.94	5.59	11.47	4.49			43.98	88.47 HR	16
MIL	L40CA005	LDR,FE, WH, 3.25 CY, ARTIC, 950E	12.30	3.49	8.06	3.49	2.84	0.44	12.83	43.45 HR	32
UPB	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	5.53	1.53	3.88	1.28	0.48	0.07	6.55	19.32 HR	16

** EQUIPMENT BACKUP - Element **

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE		** TOTAL ** HOURS
MIL	R30BO001	ROLLR,STATIC,S/P,13T,68"W, 9TIRE	4.50	0.94	3.68	0.91	0.43	0.07	4.15	14.67	HR	8
MIL	R30CA002	ROLLR,STATIC,S/P,24T,68"W, 9TIRE	5.75	1.22	3.88	0.96	0.81	0.12	5.31	18.05	HR	8
MIL	R30CA003	LNDFL COMP,SHPSFT,S/P 22T, 76"W	16.78	4.09	10.58	2.62			17.51	51.58	HR	16
MIL	R45BO002	ROLLER,VIB,DD,S/P, 6.9T, 55"W	8.30	1.66	4.90	1.62			11.92	28.39	HR	32
UPB	T10CA017	BLADE, UNIVERSAL, HYDR, D-8	3.15	0.77		0.13			3.61	7.66	HR	32
UPB	T15CA010	DOZER,CWLR, D-6H,PS	11.38	3.05	9.01	3.34			20.87	47.64	HR	32
MIL	T15CA012	DOZER,CWLR, D-7G,PS	15.93	4.27	10.92	4.05			29.23	64.41	HR	16
UPB	T15CA016	DOZER,CWLR, D-8N,PS	21.53	5.25	15.56	4.49			30.86	77.69	HR	32
MIL	T25JD003	TRACTOR,WH,FARM, 65-75HP, 2WD	2.19	0.43	3.63	1.05	0.37	0.06	1.99	9.72	HR	16
UPB	T40XX003	HYDR CRANE 8.0T,W/ 85'BOOM	5.36	1.07		0.25			5.80	12.48	HR	17
UPB	T45XX023	TRLR,LOWBOY,120T, 4 AXLE	5.32	1.87		0.60	2.51	0.39	4.34	15.03	HR	896
MIL	T50FO019	TRK,HWY, 43,000 GVW, 6X4, 3 AXLE	7.77	1.67	10.85	3.13	1.93	0.30	7.42	33.06	HR	368
UPB	T50KE004	TRK,HWY, 50,000 GVW, 6X4, 3 AXLE	10.00	2.02	10.85	3.13	0.44	0.07	9.43	35.93	HR	368
12_ 2.10.08. Operations												
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82	HR	624
MIL	R30CA003	LNDFL COMP,SHPSFT,S/P 22T, 76"W	16.78	4.09	10.58	2.62			17.51	51.58	HR	2142
MIL	R45BO002	ROLLER,VIB,DD,S/P, 6.9T, 55"W	8.30	1.66	4.90	1.62			11.92	28.39	HR	624
UPB	T10CA013	BLADE, UNIVERSAL, HYDR, D-7	2.60	0.63		0.08			2.98	6.28	HR	4640
UPB	T15CA013	DOZER,CWLR, D-7H,PS	17.26	4.63	11.74	4.35			31.66	69.65	HR	4640
UPB	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.15	5.61	16.63	5.48	4.07	0.63	17.13	67.71	HR	2142
12_ 2.10.10. Post-Closure Operation/Maint.												
UPB	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-G	10.86	3.51	6.24	2.18	0.55	0.09	11.39	34.82	HR	41
UPB	R30CA001	ROLLR,STATIC,S/P,13T,84"W,11TIRE	5.11	1.11	3.88	0.96	0.98	0.15	4.75	16.95	HR	41
UPB	T40XX033	WATER TANK, 3000 GAL	1.63	0.33					1.32	3.28	HR	41
MIL	T50KE003	TRK,HWY, 46,000 GVW, 6X4, 3 AXLE	9.42	1.91	10.85	3.13	0.44	0.07	8.89	34.71	HR	41
UPB	XMIXX020	SMALL TOOLS	0.50	0.22	0.16	0.07			0.63	1.57	HR	83

ASHTABULA LONG TERM MANAGEMENT STUDY
ASHTABULA OHIO
DRAFT LETTER REPORT

APPENDIX S
ECONOMIC EVALUATION

Note:
1. All average annual benefits and average annual costs in this appendix reflect a 6.375 percent annual interest rate, a 50 year project life and October 2000 prices.

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo New York 14207

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Sub Appendix S4. Plans Evaluated

SECTION 1

INTRODUCTION

A. PROBLEM IDENTIFICATION

Ashtabula Harbor is on the south shore of Lake Erie, at the mouth of the Ashtabula River. The Ashtabula River drainage basin covers approximately 137 square miles. The harbor is 59 miles northeast of Cleveland, Ohio, and about 37 miles south west of Erie, Pennsylvania (see Figure S1.) The City of Ashtabula Ohio is situated on the east and west banks of the Ashtabula River, near its mouth. A portion of the city is located in Ashtabula township and a portion in Saybrook township. Major tributaries include Fields Brook, Hubbard Run, and Ashtabula Creek.

There is concentrated industrial development around Fields Brook, a tributary to the river, and east of the river mouth. From the 1940's through the late 70's, unregulated discharges and mismanagement of hazardous waste seriously contaminated Ashtabula River sediments and degraded biological communities. Regular dredging in the river is being prevented due to the contaminated sediments, impeding both commercial and recreational navigation.

The Ashtabula River Remedial Action Plan (RAP) Advisory Council was established in 1988 with volunteer members representing local, Federal, and State government agencies, industry, business, special interest groups, Ohio Sea Grant and unaffiliated citizens. The Ohio Environmental Protection Agency (OEPA) served as the secretariat for the group and produced the Stage 1 Report and Newsletters.

In 1994, representatives of USEPA and the local congressional office proposed an alternative to the impending designation of the river as an extension of the Fields Brook Superfund site. The alternative was creation of a partnership of public and private interests similar to the Indiana River Partnership, which would made a schedule, set milestones, and demonstrate continuous progress toward remediation of the Ashtabula River. The partnership would be a more comprehensive, structured attempt to get the river dredged with over 50 official partners, including the United States Environmental Protection Agency (USEPA), the United States Army Corps of Engineers (USACE), and the Ohio Environmental Protection Agency (OEPA), as well as many local affiliates.

The RAP Council voted to support creation of the Ashtabula River Partnership (Partnership). On 7 July 1994, the Ashtabula River Partnership's charter was signed. The Partnership's stated purpose is "to look beyond traditional approaches to determine a comprehensive solution for the impairment of beneficial uses posed by the contaminated sediments not suitable for open-lake disposal." One of the outputs of the Partnership would be the development of a Comprehensive Management Plan. This report is a summary of that plan.

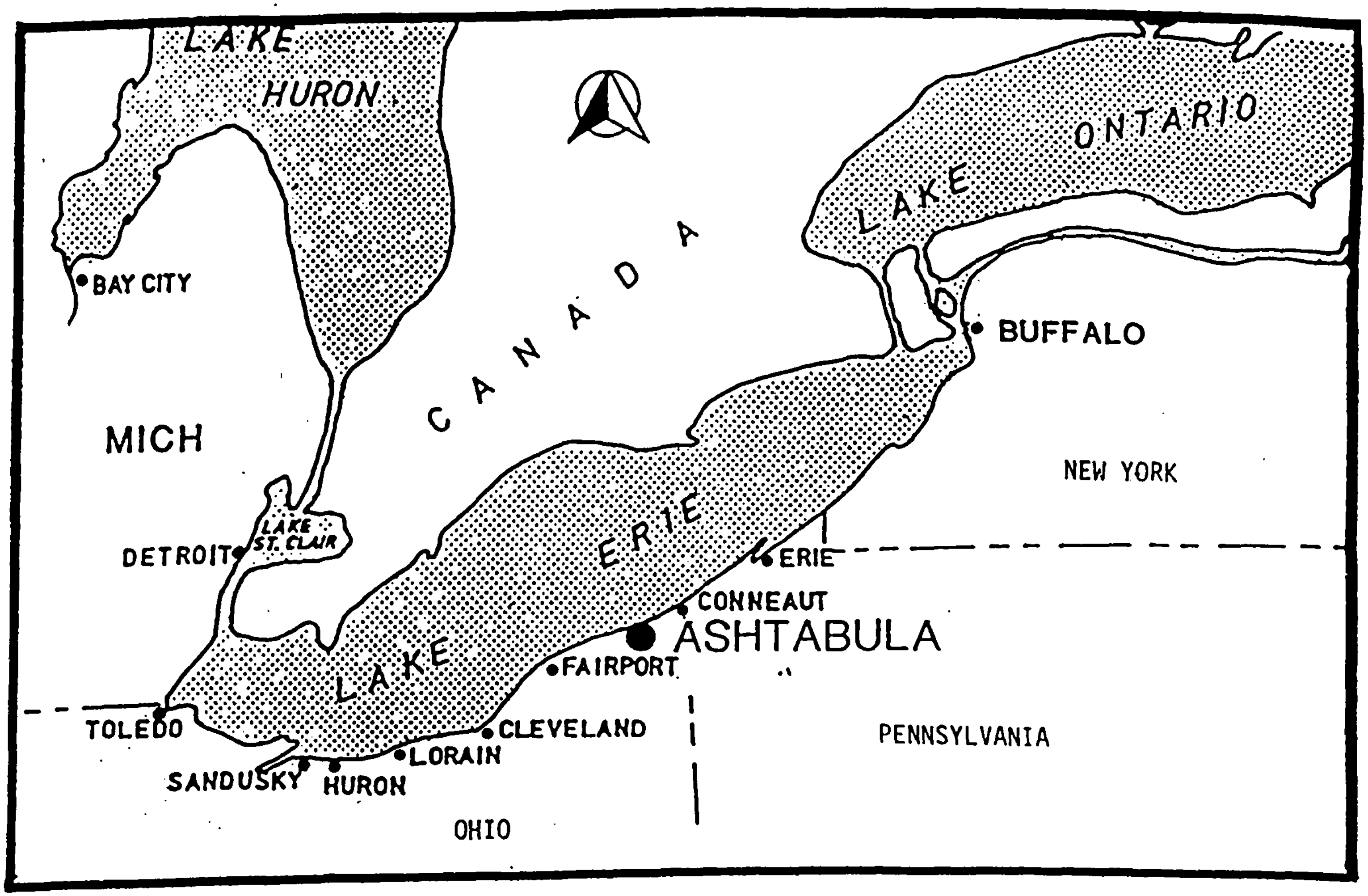

FIGURE 1

LOCATION MAP

SCALE OF MILES
0 25 50

Figure S1. General Location Of Ashtabula Harbor

B. REPORT PURPOSE.

The Comprehensive Management Plan (CMP) is a major step in achieving the Partnership goal of remediation of the Ashtabula River. The purpose of the Comprehensive Management Plan (CMP) is to manage the contaminated sediments in the lower (navigable) Ashtabula River and Harbor. It was developed by the Partnership. The U.S. Army Corps of Engineers (USACE), Buffalo District Office, working as a partner and at the direction of the Partnership, is the project manager for the preparation of the CMP.

The Corps Of Engineers dredges approximately 150,000 cubic yards of sediment from the shipping channels, located downstream of the 5th Street Bridge, once every 2 years and disposes of it in the open lake. Prior to each dredging, USACE samples and characterizes the sediment. With each recent dredging campaign, an increasingly large area has been found to be unsuitable for open-lake disposal due to the slow migration of contaminants downstream from the 5th Street Bridge.

The Partnership was founded, at least in part, on the concept that it is better to build a single disposal facility for the removal and containment of polluted sediments located in the river, and thus prevent ongoing contamination of the harbor, than to fill multiple CDFs, one after another, with harbor sediment polluted by the dilution of these contaminated harbor sediments--with each resulting CDF requiring long-term maintenance. One of the Partnership's goals is a complete one-time cleanup of the river and the polluted sections of the harbor, to an extent that will prevent the future pollution of the harbor so that future dredgings can be open-lake disposed.

This appendix provides a compressed description of the plan devised to perform this one time cleanup. It also discusses the authorities used to perform the cleanup, the costs of the cleanup by authority, and the various benefits associated with the corresponding authorities used to perform this cleanup.

In addition, there are four sub- appendices. Sub-Appendix S1 is a detailed presentation of how Commercial Navigation benefits were derived. Sub-Appendix S2 presents the derivation of local economic impacts developed by Ohio State University. Sub-Appendix S3 provides an evaluation of some recreational benefits associated with remediation of the Ashtabula River located upstream of the 5th Street Bridge. Sub-Appendix S4 presents a summary of preliminary plans that were evaluated and their respective costs, as well as costs for the Recommended Plan.

SECTION 2

"RECOMMENDED ENVIRONMENTAL DREDGING PLAN"

A. PROJECT DESCRIPTION

The Army Corps of Engineers currently maintains navigation channels (see Figure S2) at Ashtabula Harbor, Ohio. The existing federal project is 100 percent complete. A major rehabilitation project for the east and west breakwaters was completed in Fiscal Year 1982. The major project components follows:

1. An outer harbor, an area of about 185 acres, protected by east and west breakwaters.

2. An entrance channel from deep water in lake Erie, 29 feet in soft material and 30 feet in hard material.

3. A navigation channel generally 1,100 feet wide through the outer harbor, parallel to and 100 feet from the west breakwater, extending from the entrance channel to just opposite the inner breakwater, 28 feet in soft material and 29 feet in hard material.

4. A navigation channel extending from inside the inner breakwater to Pinney Dock and Transport Company's Minnesota slip and also to a point 2,000 feet upstream from the mouth of the Ashtabula River. This area is 27 feet in soft material and 28 feet in hard material.

5. Deepening and enlarging of a turning basin in the easterly portion of the outer harbor to depths of 22 feet in soft material and 23 feet in hard material.

6. In the outer harbor, a 700 foot access channel leading south-eastward from the harbor channel and terminating in a basin having a width of 1,200 feet and a length of 1,500 feet, all dredged to a depth of 28 feet in earth and 29 feet in rock.

7. A channel in the Ashtabula River upstream of the terminus of the lower 27 foot deep channel, to a depth of 18 feet to the upper car ferry slip; continuing with a channel 16 feet deep.

From 1980 to 1994, Ashtabula Harbor channels located below the Fifth Street Bridge have been dredged eight times. Dredging took place in 1980, 1981, 1983, 1987, 1989, 1990, 1993 and 1994. Approximately 121,806 cubic yards of material has been removed every time dredging has taken place in the lower river area. All of these cubic yards, except 23,800 cubic yards dredged in 1993, have been open lake disposed of. The navigation channels located upstream of the Fifth Street Bridge have not been dredged for at least the last 30 years. This is due to the potentially contaminated dredge material located in this area.

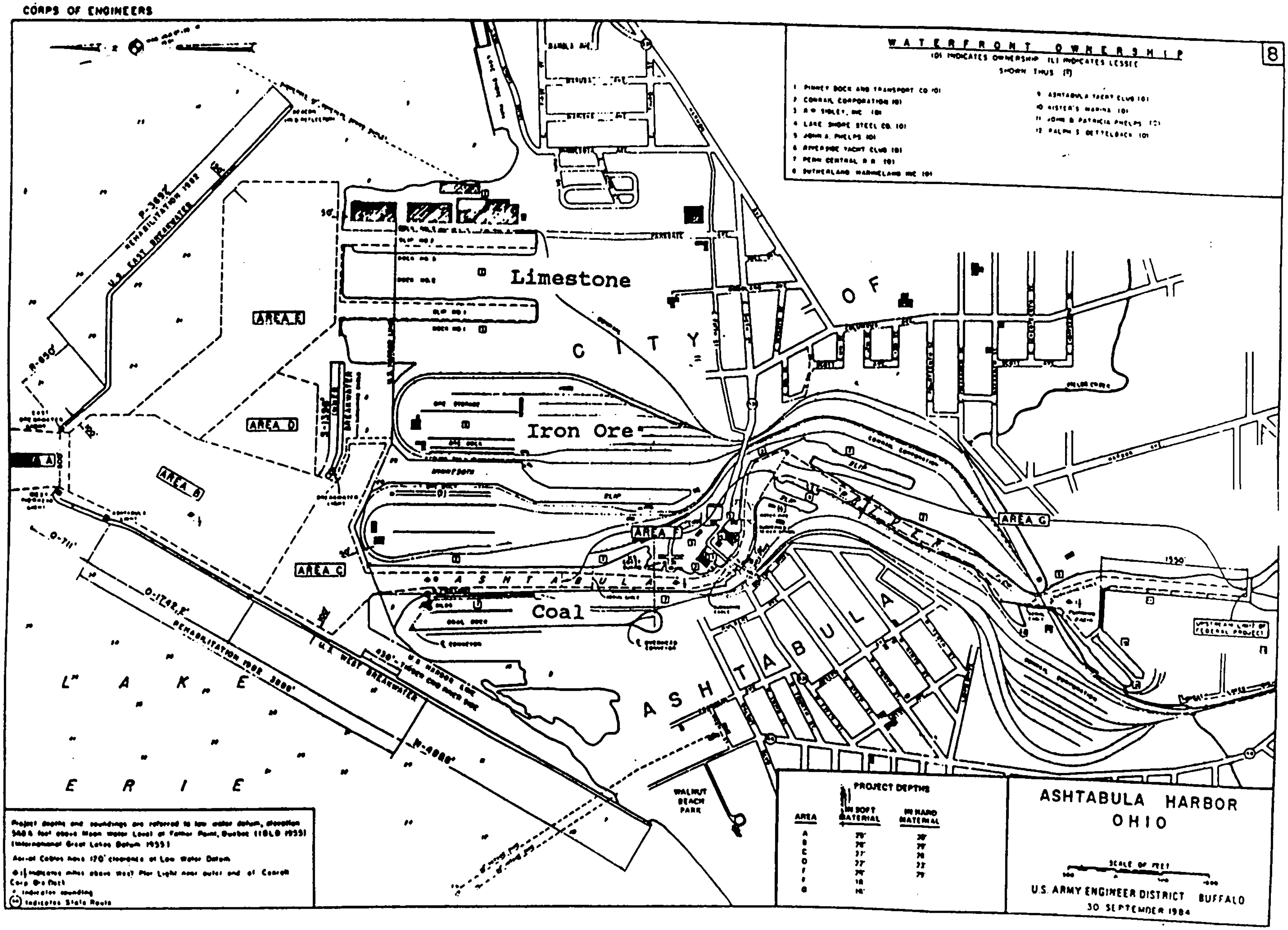

Figure S2. Map Of The Federal Project At Ashtabula Harbor

B. "RECOMMENDED ENVIRONMENTAL DREDGING PLAN" DESCRIPTION.

A wide range of alternatives were considered to address the cleanup of polluted bottom sediments. Alternatives ranged from no action, to an in-river shear cap to alternatives that included dredging, transfer/de-watering/transfer, treatment technologies, transportation to a disposal site and eventual disposal of TSCA and non TSCA dredged material at the disposal site.

Alternative components were assessed/evaluated for environmental and social acceptability, for engineering and economic feasibility, and/or for best meeting the project planning objectives. An array of alternative plan components pertaining to dredging methods, transfer facilities, treatment measures and disposal sites were progressively assessed and evaluated by various work groups within the Ashtabula River Partnership. This process led to the development of a "Recommended Environmental Dredging Plan". See the Main Report for further information on the planning process.

The Partnerships "Recommended Environmental Dredging Plan" proposes the dredging, remediation and disposal of almost 696,000 cubic yards of sediments. The recommended plan is the Deep Dredging Scenario-Dewatering Facility At Interim CDF-Option 3.

The "Recommended Environmental Dredging Plan" calls for the disposal of 696,000 cubic yards of sediment. Approximately 150,000 cubic yards of sediment proposed for removal are significantly PCB contaminated and would be handled and disposed of in accordance with Toxic Substance Control Act (TSCA) regulations. The remaining 546,000 tons of sediment is non-TSCA.

The "Recommended Environmental Dredging Plan" calls for the dredging of the contaminated bottom sediments, movement of the sediments to a staging area, developing and utilizing a transfer/dewatering facility at the staging area located somewhere along the river, trucking the dewatered dredge material from the staging area to an upland landfill disposal facility (State Road site) and disposing of the material, as appropriate in TSCA and Non-TSCA disposal facilities. The facilities would also address leachate collection, treatment and monitoring procedures, and closure and post closure monitoring measures.

In addition to polluted sediment removal and disposal, the Partnership developed a recommendation for aquatic ecosystem restoration. Restoration would involve the development of aquatic fishery shelves which would restore several acres of aquatic/fishery shallows areas and associated shoreline. These measures would be implemented as a separate, but related project. Consequently the costs associated with these aquatic ecosystem measures were not included in the costs of the "Recommended Environmental Dredging Plan". Therefore, whenever "Recommended Environmental Dredging Plan" costs are discussed, they do not include ecosystem restoration measure costs.

C. "RECOMMENDED ENVIRONMENTAL DREDGING PLAN" COSTS-

The cost estimate for the "Recommended Environmental Dredging Plan" was prepared using the Micro Computer-Aided Cost Estimating System (MCACES) software, which was developed by Building Systems Design Inc., of Atlanta, GA. The MCACES software system includes a project database and supporting databases including the unit price book, crews, labor rates, and equipment ownership schedule costs. All the databases work in conjunction with each other to produce a detailed cost estimate.

The cost estimate is based upon all the construction features associated with the current Fiscal Year 2000 level of design for the "Recommended Environmental Dredging Plan", which includes changes to the disposal site and water treatment technologies at the dewatering facility. The cost estimate for the "Recommended Environmental Dredging Plan" is in accordance with the policy, guidance and procedures described in the Department of the Army's Engineering Regulation (ER) 1110-2-1302. All costs reflect October 2000 price levels, a 6.375% annual Federal Discount Rate and a 50 year project evaluation period.

The cost estimate provided by Cost Estimating was $47,615,000. This included costs for construction of the project as well as monitoring and maintenance costs that would be incurred over the 50-year life of the project. The monitoring and maintenance costs included Disposal Site Post Construction Monitoring ($1,301,300) and Annual Maintenance Expenditures at the disposal site ($1,307,900). These types of costs are normally presented as average annual costs. Consequently, these expenditures were subtracted from the $47,615,000 to arrive at a construction cost of $45,005,800. These Post Construction Disposal Site Monitoring Costs ($1,301,300) and Post Construction Disposal Site Maintenance Costs ($1,307,900) were converted to average annual dollars and are reflected in Disposal Site Average Annual Costs.

The components of the construction cost estimate ($45,005,800) for this "Recommended Environmental Dredging Plan" is provided in Table S1. Average annual costs were computed for the "Recommended Environmental Dredging Plan". Table S1 provides a summary of First Costs, Investment Costs and Average Annual Costs associated with the "Recommended Environmental Dredging Plan". First Costs are basically Construction Costs, Study Costs, Engineering and Design Costs, Construction Management Costs and Real Estate Costs associated with building the "Recommended Environmental Dredging Plan". All costs reflect October 2000 price levels.

Construction Costs associated with polluted sediment remediation came to $37,202,100 . This $37,202,100 included: dredging costs ($11,460,200), construction of a dewatering facility and operation thereof ($4,985,600), TSCA related landfill construction costs ($2,834,700 , non TSCA related landfill construction costs ($10,319,800), sampling and analysis costs for the construction period ($816,600), sampling and analysis at the disposal facility after construction ($173,100) and construction contingencies ($6,702,100).

Study Costs and Engineering And Design costs during construction were $4,876,200. Construction Management costs were $2,555,100 . Real Estate costs associated with Section 312 and O&M were $372,400. Total First Costs came to $45,005,800.

Interest During Construction assumed a 4 year construction period, starting in May of 2002 and ending in September 2005. It was assumed minimal construction took place in January, February or March. Construction cost time streams were developed for 20 cost categories on a monthly expenditure basis. Interest During Construction was computed using a 6.375 % annual interest rate and monthly compounding. Interest During Construction came to $5,531,600.

Interest During Construction ($5,531,600) was added to Project First Costs ($ 45,005,800) to arrive at project Investment costs. Project Investment costs came to $50,537,400.

There were a number of Disposal Site expenditures that would be made after the project was constructed. Disposal Site expenditures included post construction monitoring (sampling and laboratory analysis) of the completed disposal facility and operations and maintenance expenditures associated with the TSCA and non-TSCA portion of the CDF. Each of these costs

Table S1-Derivation Of Average Annual Costs-"Recommended Environmental Dredging Plan"-October 2000 Prices

Total Project Construction Costs And First Costs	
Construction Costs	
Dredging Costs	$11,460,200
Dewatering Costs	$ 4,985,600
Landfill Costs-TSCA	$ 2,834,700
Landfill Costs- Non TSCA	$10,319,800
Sampling And Analysis	
During Dredging & At The Transfer Facility	$ 816,600
At The Disposal facility- After Construction	$ 173,100
Construction Contingencies	$ 6,702,100

Total Construction Costs	$37,202,100
Study Costs And Engineering And Design During Construction	$ 4,876,200
Construction Management	$ 2,555,100
Real Estate- Section 312, O&M	$ 372,400

First Costs [1]	$45,005,800
Investment Costs	
Project First Costs To Be Average Annualized	$45,005,800
Interest During Construction [2]	$ 5,531,600

Investment Costs To Be Average Annualized	$50,537,400
Average Annual Costs	
Interest And Amortization (.06678897)	$ 3,375,400
Disposal Site	
Post Construction Monitoring [3]	$ 26,000
Annual Maintenance [4]	$ 26,200

Average Annual Costs [5]	$ 3,427,600
Present Worth Factor for 6.375%	14.97253
Present Worth Of Average Annual Costs	$51,319,853
Rounded PW of Average Annual Costs	$51,319,900

(1) Project First Costs provided by Cost Estimating came to $47,615,000. Included in these costs were expenditures over the 50 year life of the project for: Disposal Site Post Construction Monitoring ($1,301,300) and Annual Maintenance Expenditures at The Disposal Site ($1,307,900). These types of costs are normally presented as average annual costs. Consequently, these expenditures were subtracted from the $47,615,000 to arrive at a construction cost of $45,005,800. These Post Construction Disposal Site Monitoring Costs ($1,301,300) and Post Construction Disposal Site Maintenance Costs ($1,307,900) were converted to average annual dollars and are reflected in Disposal Site Average Annual Costs.

(2) Construction Costs used to develop Interest During Construction ($44,633,400) were computed by subtracting from Total First Costs ($45,005,800), the projects Real Estate costs ($372,400). IDC was based on 16 different construction cost components, a four-year construction period and monthly compounding using a 6.375 percent annual interest rate.

(3) Average Annual Disposal Site Post Construction Monitoring.- Disposal Site Post Construction Monitoring costs for a 50 year evaluation period were $1,301,300. These costs did not represent any discounting. This was the total amount that would be spent over the 50-year evaluation period in October 2000 prices. These costs were converted to an average annual dollar value. This average annual value came to $26,000. This average annual value reflects a 6.375 percent annual interest rate, a 50-year project life and October 2000 price levels.

(4) Average Annual Disposal Site Maintenance- Disposal Site Maintenance costs for the 50 year evaluation period were $1,307,900. These costs did not represent any discounting. This was the total amount that would be spent over the 50-year evaluation period in October 2000 prices. These costs were converted to an average annual dollar value. This average annual value came to $26,200. This average annual value reflects a 6.375 percent annual interest rate, a 50-year project life and October 2000 price levels.

(5) Average Annual Costs reflect a 6.375 annual interest rate, a 50-year project life and October 2000 price levels.

would be incurred every year over a 50-year period. Since these costs would be incurred every year, these are average annual costs. These average annual costs reflect a 6.375 percent annual interest rate, October 2000 price levels and a 50-year evaluation period. These yearly expenditures will now be discussed.

After the project is completed, post construction monitoring will take place at the disposal facility on a yearly basis. Test wells at the final disposal site would be inspected and monitored annually for the next 50 years. Annual Post Construction Monitoring Costs were placed at $26,000. Post Construction monitoring includes groundwater sampling, groundwater laboratory analysis, groundwater statistical analysis and reporting, NPDES (National Pollution Discharge Elimination System) sampling, NPDES monthly analysis, NPDES semi-annual analysis, NPDES annual organic analysis, NPDES reporting and miscellaneous monitoring.

Another annual cost at the disposal site was associated with annual maintenance of the CDF after construction. After the project is completed, the final disposal site would incur some annual maintenance costs for the next 50 years. Annual Maintenance Costs were placed at $26,200. These annual costs included such items as: repair of the capping system, revegetation, sedimentation basin cleanout, mowing, fence repair, monitoring well repairs, quarterly inspections and reports, implementation of a leachate management system, leachate transportation and disposal from the TSCA and Non-TSCA cells of the disposal site, maintenance of facility roads, and other miscellaneous items.

Total average annual project costs for the "Recommended Environmental Dredging Plan" came to $3,427,600. These average annual costs had two components: average annual costs associated with sediment remediation and annual post construction Disposal Site Costs.

The conversion of sediment remediation and post construction Disposal Site costs to average annual costs, used a 6.375% annual interest rate and a 50 year project evaluation period. All costs reflect October 2000 price levels.

D. "RECOMMENDED ENVIRONMENTAL DREDGING PLAN" COSTS BY AUTHORITY.

Although the Partnership Plan is an overall plan to clean up the river, project costs can be separated into costs by authority. There are basically four authorities used to implement the "Recommended Environmental Dredging Plan". Section 1 of the Rivers And Harbors Act of 1937 was used to remove all contaminated sediments located inside the Federal channel downstream of the 5th Street Bridge. Section 101 of Water Resources Development Act (WRDA) of 1986 was used to dispose of all contaminated sediments located inside the Federal channel downstream of the 5th Street Bridge. Section 312 (a) of WRDA 1990 was used for the removal and disposal of all contaminated sediments located outside of the Federal channel downstream of the 5th Street Bridge. Section 312 (b) of WRDA 1990 was used to remove and dispose of all contaminated sediments located upstream of the 5th Street Bridge, inside and outside the federal channel.

1. "Recommended Environmental Dredging Plan" First Costs By Authority Total "Recommended Environmental Dredging Plan" First Costs come to $45,005,800. Project First Costs associated with removing and disposing of sediments located within the Federal channel downstream of the 5th Street Bridge (Section 1 of the Rivers And Harbors Act of 1937 and Section 101 of WRDA 1986)) were $4,021,200. Project First costs associated with removing and disposal of sediments located outside of the Federal channel downstream of the 5th Street Bridge (Section 312 (a) authority), were $3,414,400 . Project First costs associated with removing and disposal of sediments located upstream of the 5th Street Bridge (Section 312 (b) authority), were $37,570,200. (See Table S2).

2."Recommended Environmental Dredging Plan" Average Annual Costs By Authority. Table S3 presents Average Annual Costs by Authority for the "Recommended Environmental Dredging Plan". Total Average Annual costs for the "Recommended Environmental Dredging Plan" are $3,427,600.

Project First Costs associated with removal and disposal of polluted sediments located upstream of the 5th Street Bridge came to $37,570,200. These are essentially costs associated with Section 312 (b). Average Annual costs associated with Section 312 (b) are $2,861,300.

Project First Costs associated with removal and disposal of polluted sediments located downstream of the 5th Street Bridge are $7,435,600. These project first costs can be divided into two components: costs associated with removing sediments located within the Federal channel and costs associated with removing sediments located adjacent to the Federal channel.

Project First Costs associated with removing sediments located within the Federal channel are $4,021,200. These costs are associated with Section 1 of the Rivers and Harbors Act of 1937 (sediment removal) and section 101 of WRDA 1986(sediment disposal). Average Annual costs associated with removing sediments located within the Federal channel are $306,200.

Project First Costs associated with removing sediments located adjacent to the Federal channel are $3,414.400 .These costs are associated with Section 312 (a). Average Annual costs associated with Section 312 (a) are $260,100.

Table S2. Ashtabula River Partnership "Recommended Environmental Dredging Plan" First Costs By Area/Authority

Action/Area	Authority	Cubic Yards Removed: TSCA	Non TSCA	Total Cubic Yards	Project First Costs
Sediment Below The 5th Street Bridge (Remove & Dispose)					
Inside The Federal Channel (remove) Inside Federal Channel (dispose)	Section 1 Of R&HA 1937 and Section 101 of WRDA 1986	62,200	0	62,200	$ 4,021,200
Outside The Federal channel (Remove & dispose)	Section 312 (a)	52,800	0	52,800	$ 3,414,400
Subtotals For Below The 5th Street Bridge		115,000	0	115,000	$ 7,435,600
Sediment Above The 5th Street Bridge(Remove & Dispose)	Section 312 (b)	431,000	150,000	581,000	$37,570,200
		546,000	150,000	696,000	$45,005,800

Table S3- Ashtabula River Partnership "Recommended Environmental Dredging Plan" Average Annual Project Costs- By Area By Authority

	Sediment Removal And Disposal Downstream Of The 5th Street Bridge			Sediment Removal & Disposal Upstream Of The 5th Street Bridge	Total Project Costs
Authority	Section 1 of R&HA 1937 & Section101 WRDA 1986	Section 312 A	Total Downstream	Section 312 (b)	All Authorities
Location	Within The Federal Channel	Adjacent To The Federal Channel	Total Downstream Of 5th St Brdge	Within & Adjacent To Fed Channel	All Locations
Investment Costs					
Project First Costs	$4,021,200	$3,414,400	$7,435,600	$37,570,200	$45,005,800
Interest During Construction [1]	$ 494,200	$ 419,700	$ 913,900	$ 4,617,700	$ 5,531,600
Investment Costs To Be Average Annualized	$4,515,400	$3,834,100	$8,349,500	$42,187,900	$50,537,400
Average Annual Costs					
Interest And Amortization (.066789)	$ 301,600	$ 256,100	$ 557,700	$ 2,817,700	$ 3,375,400
Disposal Site					
Post Construction Monitoring [2]	$ 2,300	$ 2,000	$ 4,300	$ 21,700	$ 26,000
Annual Maintenance [3]	$ 2,300	$ 2,000	$ 4,300	$ 21,900	$ 26,200
Average Annual Costs [4]	$ 306,200	$ 260,100	$ 566,300	$ 2,861,300	$ 3,427,600

(1) Interest During Construction Costs are based on total first costs ($45,005,800) less Real Estate costs ($372,400). IDC was based on a four year construction period, a 6.375% annual interest rate and monthly compounding. IDC was allocated among the various authorities based on each authorities percentage of Project First costs.
(2) Disposal Site Post Construction Monitoring – Based on an annual expenditure of $26,000 over a 50-year period. This was proportioned among R&HA of 1937, Section 312 (a) and Section 312 (b) based on each authorities percent of total Project First Costs.
(3) Disposal Site Annual Maintenance – Based on an annual expenditure of $26,200 over a 50 year period. Proportioning same as Disposal Site Post Construction Monitoring.
(4) Average Annual Costs reflect a 6.375 percent annual interest rate, a 50-year project life and October 2000 price levels.

SECTION 3

PROJECT AUTHORITIES

The 312 (b) assessment found the "Recommended Environmental Dredging Plan" to be justified under the 312 (b) authority. The 312 (b) assessment assumed that cleanup upstream and downstream of the 5th Street Bridge would be performed under this Authority. However, as discussed in Section 2 of the Main Report, the Partnership proposed that the "Recommended Environmental Dredging Plan" be implemented using a range of authorities. All removal and final disposition of polluted sediments (TSCA and Non-TSCA) located upstream of the 5th Street Bridge would be performed under Section 312 (b). Three different authorities were proposed to accomplish the removal and final disposition of polluted sediments (Non-TSCA only) located downstream of the 5th Street Bridge, in the commercial navigation portion of the project. Dredging of sediment within the Federal channels downstream of the 5th Street Bridge would be accomplished under Section 1 of the Rivers And Harbors Act of 1937. The use of Section 101, of WRDA 1986 would address the disposal operation costs and disposal facility costs for these sediments. The use of Section 312 (a) of WRDA 1990, as amended by Section 205 of WRDA 1996, would be used to accomplish dredging and disposal of contaminated sediments located outside of and adjacent to the federal channel, downstream of the 5th Street Bridge.

Each of these authorities use different benefit categories to show government interest. The benefit categories and project first costs associated with each of these authorities will now be discussed.

A. AUTHORITIES USED TO REMEDIATE CONTAMINATED SEDIMENTS LOCATED UPSTREAM OF THE 5TH STREET BRIDGE.

The Partnership recommends a number of authorities to accomplish the cleanup. For the area upstream of the 5th Street Bridge, the Partnership recommends the use of Section 312 (b) of WRDA 90, as amended by Section 205 Of WRDA 96, Environmental Restoration and Water Quality, to accomplish the cleanup. Section 312 (b) addresses removal of contaminated sediments to accomplish environmental enhancement and water quality improvements.

"Recommended Environmental Dredging Plan" Project First Costs associated with Section 312 (b) ($37,570,200) will be compared and justified based on Environmental Enhancement and Water Quality Outputs generated by the project, as required by Section 312 (b). A description of the environmental enhancements and water quality improvements used to justify the costs associated with the Section 312 (b) work are presented in the EIS, Appendix EA-J (Section 312 (b) Ecological Restoration Analysis) . The justification of this portion of the project is not addressed further in this Economic Appendix.

B. AUTHORITIES USED TO REMEDIATE CONTAMINATED SEDIMENTS LOCATED DOWNSTREAM OF THE 5TH STREET BRIDGE.

The Partnership proposes the usage of three authorities to accomplish any sediment remediation located downstream of the 5th Street Bridge, in the commercial navigation portion of the project. The project area downstream of the 5th Street Bridge must be cleaned up as part of this project if the Partnership's goal of open lake disposal of all future dredging is to be achieved. Federal participation in cleanup of the lower river requires an economic justification.

Table S-3 presented "Recommended Environmental Dredging Plan" Project First Costs broken down by Authority/Study area. "Recommended Environmental Dredging Plan" Project First Costs for sediment cleanup located downstream of the 5th Street Bridge came to $7,435,600. Average Annual Costs for this downstream area came to $566,300.

Two of the authorities dealt with the remediation of contaminated sediments located within the Federal channel. Dredging of sediment within the Federal channels downstream of the 5th Street Bridge would be accomplished under Section 1 Of the Rivers And Harbors Act of 1937. This authority governs the Corps regular Operations And Maintenance authorities/programs in this section of the river, in order to insure continued usage of the channels for commercial navigation purposes. The use of Section 101, of WRDA 1986 will address the disposal operations and disposal facility for these sediments. Benefits associated with the use of these two authorities would be commercial navigation transportation cost increases avoided. "Recommended Environmental Dredging Plan" Project First Costs associated with removal and disposal of contaminated sediments located within the Federal channel ($4,021,200) will be compared and justified based on commercial navigation transportation cost increases avoided.

The use of Section 312 (a) of WRDA 1990, as amended by Section 205 of WRDA 1996, would be used to accomplish dredging and disposal of contaminated sediments located outside/adjacent to the federal channel, downstream of the 5th Street Bridge. Section 312(a) may be considered if costs of restoration are economically justified based on savings in future operation and maintenance costs. "Recommended Environmental Dredging Plan" Project First Costs associated with Section 312 (a) came to $3,414,400 and will be compared and justified based on savings in future operation and maintenance costs.

SECTION 4

BENEFITS ASSOCIATED WITH REMEDIATION OF THE ASHTABULA RIVER.

A. INTRODUCTION

Again, the Partnership proposed that the "Recommended Environmental Dredging Plan" be implemented using a range of authorities. All removal and final disposition of polluted sediments (TSCA and Non-TSCA) located upstream of the 5th Street Bridge would be performed under Section 312 (b). Three different authorities were proposed to accomplish the removal and final disposition of polluted sediments (Non-TSCA only) located downstream of the 5th Street Bridge, in the commercial navigation portion of the project.

Total Project First Costs for the "Recommended Environmental Dredging Plan" come to $45,005,800 (See Table S-3). "Recommended Environmental Dredging Plan" Project First Costs associated with removal and final disposition of polluted sediments located upstream of the 5th Street Bridge (Section 312 (b) which includes TSCA and Non TSCA sediments) came to $37,570,200. Project First Costs associated with removal and final disposition of polluted sediments (Non-TSCA only) located downstream of the 5th Street Bridge were $7,435,600.

Total "Recommended Environmental Dredging Plan" Average Annual Costs come to $3,427,600. (See Table S-3). Average Annual Costs associated with sediment remediation located upstream of the 5th Street Bridge (Section 312 (b)) came to $2,861,300. Average Annual Costs associated with sediment remediation located downstream of the 5th Street Bridge came to $566,300. The costs associated with the "Recommended Environmental Dredging Plan" reflect October 2000 price levels, a 6.375% annual Federal Discount Rate and a 50 year project evaluation period.

B. BENEFITS ASSOCIATED WITH REMEDIATION OF CONTAMINATED SEDIMENTS LOCATED UPSTREAM OF THE 5TH STREET BRIDGE.

The Partnership recommends the use of Section 312 (b) to accomplish the cleanup of contaminated sediments located upstream of the 5th Street Bridge. Section 312 (b) addresses removal of contaminated sediments to accomplish environmental enhancement and water quality improvements.

Section 312 (b) costs will be compared and justified based on Environmental Enhancement and Water Quality Outputs generated by the project, as required by Section 312 (b). The EIS Report (Sub-Appendix EA-J-Section 312 (b) Ecological Restoration Analysis) provides a description of the environmental enhancements and water quality improvements used to justify the costs associated with the Section 312 (b) work. The justification of this portion of the project is not addressed further in this Economic Appendix.

C. BENEFITS ASSOCIATED WITH REMEDIATION OF CONTAMINATED SEDIMENTS LOCATED DOWNSTREAM OF THE 5TH STREET BRIDGE.

1. Introduction. The project area downstream of the 5th Street Bridge must be cleaned up as part of this project to allow open lake disposal of all future dredging and requires an economic justification. Project First Costs for remediation of contaminated sediments located downstream of the 5th Street Bridge comes to $7,435,600. Average annual costs for this downstream sediment cleanup came to $566,300.

The first step would be to demonstrate that there are enough benefits to justify the First Cost investment of $7,435,600 (average annual costs of $566,300) to cleanup the polluted sediments located downstream of the 5th Street Bridge. The main benefit category associated with cleanup of polluted sediments located downstream of the 5th Street Bridge are commercial navigation transportation cost savings. Benefits become the difference in average annual commercial navigation transportation costs between the "Without Project" condition and the "With Project" condition.

2. Benefits Associated With Remediation Of Contaminated Sediments Located Downstream Of The 5th Street Bridge. In general benefits associated with remediation of contaminated sediments located downstream of the 5th Street Bridge are essentially the difference in average annual commercial navigation transportation costs between the "Without Project" condition and the "With Project" condition. The "Without Project" and "With Project" are evaluated over a specific time period: 50 years.

In order to calculate Commercial navigation transportation costs under "Without Project" and "With Project" conditions, these two conditions must be defined. A description of the "Without Project" and "With Project" condition and their impact on commercial navigation transportation costs follows.

a. Description Of The "Without Project" And "With Project" Condition. For Economic Evaluation purposes, The "Without Project" condition describes the pattern of activities that would exist over the 50 year evaluation period in the Ashtabula Harbor approach and Ashtabula River channels in the absence of a one-time cleanup effort of contaminated bottom sediments. Under "Without Project" conditions, contaminated bottom sediments would continue to migrate downstream. Since there is no disposal facility available for these sediments, they cannot be dredged. Maintenance Dredging of the entire commercial navigation channels downstream of the 5th Street Bridge will cease within 6 years and would not be dredged during the 50 year project evaluation period (2006-2055). In addition no dredging would be performed upstream of the 5th Street Bridge. Dredging costs associated with commercial navigation for Federal channels located downstream of the 5th Street Bridge become zero. Without any maintenance dredging, the commercial navigation channels downstream of the 5th Street Bridge shoal up over a 50-year period to 17 foot channel depths.

Bulk commodity users currently being serviced via Ashtabula harbor would wish to continue to use the harbor over the 50-year evaluation period if economically feasible to do so. As Ashtabula

Harbor's navigation channels become shallower, bulk commodity users that currently source their bulk commodities through Ashtabula Harbor would see their delivered bulk commodity costs rise. Shippers would have increasingly less water column as the harbor silts up. This reduced water column would reduce the number of tons of commodities that could be carried on any one trip. Shippers would have to make more trips per season to deliver the same annual tonnages. More trips per season would increase the delivered price of the bulk commodity. This situation is already occurring at the R.W. Sidley cement and stone facility below the 5th Street Bridge. Ships need to light load in order to get close enough to unload their stone to the dock, resulting in higher costs.

Bulk Commodity users would likely continue to use the Port of Ashtabula, in the short term. However, this increase in the water portion of the transport bill would eventually drive up the delivered cost of a commodity via Ashtabula Harbor. Once the delivered price associated with using Ashtabula Harbor, and its decreasing channel depths, exceeded the total transportation costs associated with use of an alternative port; bulk commodity users would shift to alternative harbors. From this time on, total transportation costs would equal the transportation costs associated with using the alternative port.

Similarly, the "With Project" condition reflects the pattern of activities that would occur at Ashtabula Harbor over the 50-year evaluation period, relative to a one-time cleanup of contaminated bottom sediments. In addition, once this one time cleanup has taken place, all future dredged sediment taken from downstream of the Fifth Street Bridge could be disposed of in the open lake . The Corps of Engineers would continue to maintain the commercial navigation channels located downstream of the Fifth Street Bridge at currently maintained depths. Consequently, all commercial vessel users would have channel depths of 27 to 28 feet LWD in the Outer Harbor and channel depths of 27 feet and 18 feet LWD in the lower portion of the Ashtabula River. All current bulk commodity harbor users would continue to use Ashtabula harbor over the 50-year evaluation period.

b. Other Economic Data The economic impact on the port's major bulk commodity users was evaluated by calculating total transportation costs under "Without Project" and "With Project" conditions for iron ore, coal and limestone. Total transportation costs included a water component and a rail/truck component. A waterborne commerce computer model developed by the Army Corps of Engineers, Buffalo District, was used to develop water transportation costs. Rail and truck costs were developed from data provided by the Tennessee Valley Authority. The TVA maintains a computer database that can be used to generate rail costs and truck costs.

The Ashtabula 1994 commercial navigation season was assumed to be representative of traffic levels that would prefer to use Ashtabula Harbor during each year of the 50-year evaluation period under "With" and "Without Project" conditions. The Harbor's 1994 iron ore, coal and limestone sourcing patterns, origin destination pairs, tons moved, rail lines used, vessels used to move the bulk commodities, and the location of bulk commodity suppliers and end users were assumed to remain the same under "With Project" and "Without Project" conditions. There were seven origin/destination routes involved in sourcing iron ore, twenty-five origin/destination routes associated with coal movements, and four origin/destination routes associated with limestone movements.

c. "Without Project" Condition Average Annual Total Commercial Navigation Transportation Costs. Ashtabula Harbor is a major trans-shipment point for bulk commodities. The major bulk commodities using Ashtabula Harbor are iron ore, coal and limestone. Iron ore is received at Ashtabula Harbor from Lake Superior ports. The iron ore is loaded onto railroad cars at Ashtabula and transported to inland steel mills in Ohio, Pennsylvania and West Virginia. Coal is railed from Ohio, Pennsylvania and West Virginia to Ashtabula Harbor, loaded onto Great Lakes vessels and shipped to electric generating stations and other consumers in the United States and Canada. Limestone is shipped to Ashtabula from a number of ports on Michigan's north shore. The majority of this limestone is trucked to local area users. Some of this limestone is used in Ashtabula to make cement for local area use.

Under "Without Project" conditions it is assumed that contaminated bottom sediments have migrated to areas downstream of the Fifth Street Bridge by the year 2006 (Project Year 1.) Movement of contaminated sediment to this area would require that all sediment dredged from this area be placed in a confined dike disposal area. Since no dike disposal area currently exists in Ashtabula, all commercial navigation channel dredging would cease. The termination of dredging would result in the continual shoaling of the Federal navigation channels. This would decrease the channel's water column and the usable vessel draft of commercial vessels using Ashtabula Harbor. The decrease in commercial vessel draft would result in a reduction in the number of tons of bulk commodities being carried per trip to/from the harbor. More trips would have to be made to deliver the same amount of bulk materials to the various end users.

As Ashtabula Harbor's navigation channels become shallower, bulk commodity users that currently source their bulk commodities through Ashtabula Harbor would see their delivered costs rise. These users would likely continue to use the Port of Ashtabula, in the short term. However, their primary interest is the final delivered price of the bulk commodities. This delivered price may include a water component, a rail component, a truck component, or some combination thereof, associated with using Ashtabula Harbor as the trans-shipment port. As long as the delivered price via Ashtabula is less than a delivered price associated with using another port or transport mode (e.g., all train), the end user would continue to source commodities through Ashtabula. Eventually, reduced channel water depths would cause an increase in the water portion of the bulk commodities total transport bill associated with using Ashtabula Harbor. This increase in the water portion of the transport bill would eventually drive up the delivered cost of a commodity via Ashtabula Harbor until it equaled the delivered price of the same commodity via an alternative harbor or mode of transportation. Once the delivered price associated with using Ashtabula Harbor with its decreased channel depths exceeded the total transportation costs associated with use of an alternative port, bulk commodity users would shift to alternative harbors. From this time on, total transportation costs would equal the transportation costs associated with using the alternative port.

Total transportation costs (water plus rail/truck) were calculated for each year of the 50-year evaluation period, under "Without Project" conditions, for each of the origin destination pairs identified for iron ore, coal and limestone. Total transportation costs associated with using Ashtabula Harbor for moving iron ore, coal and limestone were allowed to increase over time until they equaled total transportation costs associated with using an alternative port. The alternative port for iron ore was Cleveland Harbor, Ohio. The alternative port for coal and limestone was Conneaut Harbor, Ohio. Once the switch was made to an alternative port, total transportation costs for the years remaining in the evaluation period were transportation costs associated with using the alternative port. These alternative port total transportation costs did not increase over the remaining evaluation period years. The transportation-cost time streams were converted to average annual dollars using a 6.375% annual interest rate and a 50-year project life. Table S4 provides a summary of these average annual costs, by commodity, by origin destination route and by transportation mode. Total average annual transportation costs, under "Without Project" conditions, totaled $144,800,400. These "Without Project" condition transportation costs reflect October 200 price levels.

d. "With Project" Condition Average Annual Total Commercial Navigation Transportation Costs. "With Project" condition total transportation costs (water plus rail/truck) were also calculated for iron ore, coal and limestone and their respective origin/destination routes. The "With Project" condition assumed that currently maintained harbor depths (27 to 28 feet LWD in the Outer Harbor and channel depths of 27 feet and 18 feet LWD on the lower portion of the Ashtabula River) would be available during each year of the 50-year evaluation period. Under these conditions, all bulk commodities would continue to use Ashtabula Harbor throughout the 50-year evaluation period. Total yearly transportation costs for any given origin/destination route, would be the same for any year during the 50 year evaluation period.

These transportation-cost time streams were converted to average annual dollars using a 6.375% annual interest rate and a 50-year project life. Table S5 provides a summary of these average annual costs, by commodity, by origin destination route, and transportation mode. Total average annual commercial navigation transportation costs, under "With Project" conditions, totaled $143,491,900. These "With Project" condition transportation costs reflect October 2000 price levels.

e. Average Annual Commercial Navigation Transportation Benefits. The difference between average annual commercial navigation transportation costs under the "Without Project" and the "With Project" condition is average annual transportation costs that would not be incurred if a one-time cleanup of polluted channel bottom sediment was performed. These average annual transportation costs avoided reflect the economic benefit of a one-time cleanup of contaminated channel bottom sediments to commercial transportation users. These benefits came to $1,308,500. These average annual benefits reflect a 6.375 percent annual interest rate, a 50-year project life and October 2000 price levels. Table S6 provides a summary of average annual commercial navigation transportation benefits by commodity and by origin/destination pair. A more complete discussion of the derivation of commercial navigation benefits is provided in Supplement 1.

Table S4.- Total Average Annual "Without Project" Condition Commercial Navigation Transportation Costs.

ORIGIN DESTINATION PAIR	Oct-00 WOP AVERAGE ANNUAL WATER COSTS	Oct-00 WOP AVERAGE ANNUAL RAIL/TRUCK COSTS	Oct-00 TOTAL WOP AVERAGE ANNUAL TRNSPRTATN COSTS
IRON ORE-Alternate Port= Cleveland, Ohio			
DULUTH, MINNESOTA	$ 1,733,800	$ 821,100	$ 2,554,900
ESCANABA, MICHIGAN	$ 1,101,800	$ 855,200	$ 1,957,000
PRESQUE ISLE, MICHIGAN	$13,581,400	$ 8,504,000	$ 22,085,400
ST. LAWRENCE RIVER	$ 4,057,900	$ 1,675,800	$ 5,733,700
SILVER BAY, MINNESOTA	$ 1,281,500	$ 986,900	$ 2,268,400
SUPERIOR WISCONSIN	$ 8,949,700	$ 6,063,100	$ 15,012,800
TWO HARBORS MINNESOTA	$ 297,800	$ 117,700	$ 415,500
	$31,003,900	$19,023,800	$ 50,027,700
COAL-Alternate Port= Conneaut			
ADVANCE, MICHIGAN	$ 875,300	$ 953,400	$ 1,828,700
BATH, ONTARIO	$ 257,900	$ 656,400	$ 914,300
CHARLEVOIX, MICHIGAN	$ 1,309,500	$ 2,154,600	$ 3,464,100
CLARKSON, ONTARIO	$ 470,800	$ 1,410,600	$ 1,881,400
COURTWRIGHT, ONTARIO	$ 1,271,600	$ 5,129,000	$ 6,400,600
DETROIT, MICHIGAN	$ 126,000	$ 428,600	$ 554,600
DUNKIRK, NEW YORK	$ 53,200	$ 248,800	$ 302,000
GLADSTONE, MICHIGAN	$ 194,000	$ 214,500	$ 408,500
GRAND HAVEN, MICHIGAN	$ 164,400	$ 138,200	$ 302,600
GREENBAY, WISCONSIN	$ 3,647,800	$ 3,354,800	$ 7,002,600
MANISTEE HARBOR, MICHIGAN	$ 832,100	$ 939,500	$ 1,771,600
MARINETTE, WISCONSIN	$ 161,600	$ 172,300	$ 333,900
MARYSVILLE, MICHIGAN	$ 59,100	$ 169,200	$ 228,300
MILWAUKEE, WISCONSIN	$ 5,840,100	$ 5,900,100	$ 11,740,200
NANTICOKE, ONTARIO	$ 1,629,100	$11,245,400	$ 12,874,500
NIAGARA RIVER, NEW YORK	$ 312,400	$ 1,213,200	$ 1,525,600
ONTONAGON HARBOR, MICHIGAN	$ 456,000	$ 386,500	$ 842,500
PICTON, ONTARIO	$ 716,200	$ 1,846,400	$ 2,562,600
PORT STANLEY, ONTARIO	$ 108,700	$ 794,700	$ 903,400
PORT WASHINGTON, WISCONSIN	$ 3,533,100	$ 3,999,700	$ 7,532,800
PRESQUE ISLE, MICHIGAN	$ 2,914,800	$ 5,950,800	$ 8,865,600
ST. CLAIR, MICHIGAN	$ 992,900	$ 3,657,600	$ 4,650,500
ST. LAWRENCE RIVER & ABOVE	$ 2,728,800	$ 4,080,600	$ 6,809,400
SUPERIOR WISCONSIN	$ 507,200	$ 405,900	$ 913,100
THUNDERBAY, ONTARIO	$ 1,603,900	$ 2,360,000	$ 3,963,900
	$30,766,500	$57,810,800	$ 88,577,300
LIMESTONE-Alternate Port=Conneaut			
CALCITE, MICHIGAN	$ 1,103,500	$ 580,700	$ 1,684,200
MARBLEHEAD, OHIO	$ 320,500	$ 314,600	$ 635,100
PORT INLAND, MICHIGAN	$ 2,046,700	$ 1,024,000	$ 3,070,700
STONEPORT, MICHIGAN	$ 603,900	$ 201,500	$ 805,400
	$ 4,074,600	$ 2,120,800	$ 6,195,400
Total WOP Avg Annual Transportation Costs	$65,845,000	$78,955,400	$144,800,400

Table S5.- Total Average Annual "With Project" Condition Commercial Navigation Transportation Costs

ORIGIN DESTINATION PAIR	Oct-00 WP AVERAGE ANNUAL WATER COSTS	Oct-00 WP AVERAGE ANNUAL RAIL COSTS	Oct-00 WP TOTAL AVERAGE ANNUAL TRNSPRTATN COSTS
IRON ORE			
DULUTH, MINNESOTA	$ 1,733,800	$ 821,100	$ 2,554,900
ESCANABA, MICHIGAN	$ 1,101,800	$ 855,200	$ 1,957,000
PRESQUE ISLE, MICHIGAN	$13,581,400	$ 8,504,000	$ 22,085,400
ST. LAWRENCE RIVER	$ 3,914,500	$ 1,604,100	$ 5,518,600
SILVER BAY, MINNESOTA	$ 1,323,300	$ 939,000	$ 2,262,300
SUPERIOR WISCONSIN	$ 9,256,300	$ 5,729,900	$ 14,986,200
TWO HARBORS MINNESOTA	$ 297,800	$ 117,700	$ 415,500
	$31,208,900	$18,571,000	$ 49,779,900
COAL			
ADVANCE, MICHIGAN	$ 870,500	$ 948,100	$ 1,818,600
BATH, ONTARIO	$ 259,300	$ 646,300	$ 905,600
CHARLEVOIX, MICHIGAN	$ 1,298,900	$ 2,141,600	$ 3,440,500
CLARKSON, ONTARIO	$ 472,400	$ 1,395,200	$ 1,867,600
COURTWRIGHT, ONTARIO	$ 1,224,500	$ 5,083,800	$ 6,308,300
DETROIT, MICHIGAN	$ 124,000	$ 427,200	$ 551,200
DUNKIRK, NEW YORK	$ 53,500	$ 248,300	$ 301,800
GLADSTONE, MICHIGAN	$ 192,900	$ 213,200	$ 406,100
GRAND HAVEN, MICHIGAN	$ 164,000	$ 137,800	$ 301,800
GREENBAY, WISCONSIN	$ 3,632,000	$ 3,334,500	$ 6,966,500
MANISTEE HARBOR, MICHIGAN	$ 828,200	$ 934,200	$ 1,762,400
MARINETTE, WISCONSIN	$ 160,900	$ 171,300	$ 332,200
MARYSVILLE, MICHIGAN	$ 57,800	$ 167,800	$ 225,600
MILWAUKEE, WISCONSIN	$ 5,794,600	$ 5,864,400	$ 11,659,000
NANTICOKE, ONTARIO	$ 1,611,200	$11,159,900	$ 12,771,100
NIAGARA RIVER, NEW YORK	$ 314,800	$ 1,206,400	$ 1,521,200
ONTONAGON HARBOR, MICHIGAN	$ 450,400	$ 384,700	$ 835,100
PICTON, ONTARIO	$ 719,900	$ 1,818,000	$ 2,537,900
PORT STANLEY, ONTARIO	$ 105,000	$ 792,900	$ 897,900
PORT WASHINGTON, WISCONSIN	$ 3,513,900	$ 3,973,600	$ 7,487,500
PRESQUE ISLE, MICHIGAN	$ 2,862,900	$ 5,876,200	$ 8,739,100
ST. CLAIR, MICHIGAN	$ 974,700	$ 3,640,200	$ 4,614,900
ST. LAWRENCE RIVER & ABOVE	$ 2,752,100	$ 3,993,300	$ 6,745,400
SUPERIOR WISCONSIN	$ 505,300	$ 403,100	$ 908,400
THUNDERBAY, ONTARIO	$ 1,584,400	$ 2,323,800	$ 3,908,200
	$30,528,100	$57,285,800	$ 87,813,900
LIMESTONE			
CALCITE, MICHIGAN	$ 1,071,800	$ 511,700	$ 1,583,500
MARBLEHEAD, OHIO	$ 306,300	$ 297,800	$ 604,100
PORT INLAND, MICHIGAN	$ 1,995,600	$ 909,500	$ 2,905,100
STONEPORT, MICHIGAN	$ 603,900	$ 201,500	$ 805,400
	$ 3,977,600	$ 1,920,500	$ 5,898,100
Total WP Transportation Costs	$65,714,600	$77,777,300	$143,491,900

Table S6.- Total Average Annual Commercial Navigation Benefits

ORIGIN DESTINATION PAIR	Oct-00 Average Annual WOP Transportation Costs	Oct-00 Average Annual WP Transportation Costs	Oct-00 Total Average Annual Transportation Benefits
IRON ORE			
DULUTH, MINNESOTA	$ 2,554,900	$ 2,554,900	$ 0
ESCANABA, MICHIGAN	$ 1,957,000	$ 1,957,000	$ 0
PRESQUE ISLE, MICHIGAN	$ 22,085,400	$ 22,085,400	$ 0
ST. LAWRENCE RIVER	$ 5,733,700	$ 5,518,600	$ 215,100
SILVER BAY, MINNESOTA	$ 2,268,400	$ 2,262,300	$ 6,100
SUPERIOR WISCONSIN	$ 15,012,800	$ 14,986,200	$ 26,600
TWO HARBORS MINNESOTA	$ 415,500	$ 415,500	$ 0
	$ 50,027,700	$ 49,779,900	$ 247,800
COAL			
ADVANCE, MICHIGAN	$ 1,828,700	$ 1,818,600	$ 10,100
BATH, ONTARIO	$ 914,300	$ 905,600	$ 8,700
CHARLEVOIX, MICHIGAN	$ 3,464,100	$ 3,440,500	$ 23,600
CLARKSON, ONTARIO	$ 1,881,400	$ 1,867,600	$ 13,800
COURTWRIGHT, ONTARIO	$ 6,400,600	$ 6,308,300	$ 92,300
DETROIT, MICHIGAN	$ 554,600	$ 551,200	$ 3,400
DUNKIRK, NEW YORK	$ 302,000	$ 301,800	$ 200
GLADSTONE, MICHIGAN	$ 408,500	$ 4 06,100	$ 2,400
GRAND HAVEN, MICHIGAN	$ 302,600	$ 301,800	$ 800
GREENBAY, WISCONSIN	$ 7,002,600	$ 6,966,500	$ 36,100
MANISTEE HARBOR, MICHIGAN	$ 1,771,600	$ 1,762,400	$ 9,200
MARINETTE, WISCONSIN	$ 333,900	$ 332,200	$ 1,700
MARYSVILLE, MICHIGAN	$ 228,300	$ 225,600	$ 2,700
MILWAUKEE, WISCONSIN	$ 11,740,200	$ 11,659,000	$ 81,200
NANTICOKE, ONTARIO	$ 12,874,500	$ 12,771,100	$ 103,400
NIAGARA RIVER, NEW YORK	$ 1,525,600	$ 1,521,200	$ 4,400
ONTONAGON HARBOR, MICHIGAN	$ 842,500	$ 835,100	$ 7,400
PICTON, ONTARIO	$ 2,562,600	$ 2,537,900	$ 24,700
PORT STANLEY, ONTARIO	$ 903,400	$ 897,900	$ 5,500
PORT WASHINGTON, WISCONSIN	$ 7,532,800	$ 7,487,500	$ 45,300
PRESQUE ISLE, MICHIGAN	$ 8,865,600	$ 8,739,100	$ 126,500
ST. CLAIR, MICHIGAN	$ 4,650,500	$ 4,614,900	$ 35,600
ST. LAWRENCE RIVER & ABOVE	$ 6,809,400	$ 6,745,400	$ 64,000
SUPERIOR WISCONSIN	$ 913,100	$ 908,400	$ 4,700
THUNDERBAY, ONTARIO	$ 3,963,900	$ 3,908,200	$ 55,700
	$ 88,577,300	$ 87,813,900	$ 763,400
LIMESTONE			
CALCITE, MICHIGAN	$ 1,684,200	$ 1,583,500	$ 100,700
MARBLEHEAD, OHIO	$ 635,100	$ 604,100	$ 31,000
PORT INLAND, MICHIGAN	$ 3,070,700	$ 2,905,100	$ 165,600
STONEPORT, MICHIGAN	$ 805,400	$ 805,400	$ 0
	$ 6,195,400	$ 5,898,100	$ 297,300
Total Transportation Benefits	$144,800,400	$143,491,900	$1,308,500

3. Benefits Associated With Section 312 (a). Since the federal interest in the cleanup of contaminated bottom sediments located downstream of the 5th Street Bridge has been demonstrated, the justification of the usage of Section 312 (a) can now be addressed. Section 312 (a) benefits are based upon the savings in future operation and maintenance costs. Therefore, operation and maintenance costs need to be calculated over the evaluation period under two assumptions: 312 (a) contaminated sediments remain in the river ("Normal Maintenance-Contaminated Sediments Present) versus contaminated sediments have been removed due to implementation of Section 312 (a) ("Normal Maintenance- Contaminated Sediments Removed").

a. Description Of Two Alternative "Future Maintenance" Conditions. Section 312 (a) is the authority used to remove contaminated sediments located downstream of the 5th Street Bridge and adjacent to the Federal channel (52,800 cubic yards). Benefits associated with Section 312 (a) are Operation and Maintenance Costs Avoided. Two alternative "Future Maintenance" scenarios have been developed in order to determine the increase in Operation and Maintenance Costs Avoided. The two "Future Maintenance" conditions assumes the Harbor will continue to be maintained over the 50-year evaluation period.

The label "Normal Maintenance-Contaminated Sediments Present" (NMCSP) assumes that Section 312 (a) contaminated sediments (52,800 cubic yards) have not been removed from the area located downstream of the 5th Street Bridge. However, in order to isolate the impacts on Operation and Maintenance costs from leaving just Section 312 (a) contaminated sediments in the River downstream of the 5th Street Bridge, it is assumed all other contaminated bottom sediments located downstream of the 5th Street Bridge (62,200) and upstream of the 5th Street Bridge (581,000) have been removed. This allows Operation And Maintenance Costs generated to reflect the cost associated with leaving the 312 (a) contaminated sediments (52,800 cubic yards) in the river.

Under "Normal Maintenance-Contaminated Sediments Present" , the contaminated sediment located downstream of the 5th Street Bridge and adjacent to the federal Channel (52,800 cubic yards) will remain in the river over the 50 year project evaluation period. These contaminated sediments will continue to migrate downstream into the federal navigation channels. This contaminated sediment will mix with cleaner sediment material that needs to be removed for commercial navigation purposes. This mixing will cause the dredged sediments to be classified as polluted, and be required to be placed in a confined disposal facility.

No confined disposal facility is currently available at Ashtabula Harbor. Consequently, this contaminated dredged sediment will have to be disposed of into either: a current area landfill with capacity, a new landfill or a new confined disposal facility. The additional costs incurred from dredging contaminated sediments and having to place them into a confined disposal area, will increase Operation and Maintenance costs. These increased costs will continue to be incurred as long as sediments needed to be removed for commercial navigation purposes are classified as needing confinement.

In order to calculate NMCSP Operation And Maintenance Costs, information needs to be provided on a range of variables that will affect these Operation and Maintenance costs. Such variables include: the number of cubic yards that need to be removed per dredging cycle by location throughout the harbor (river versus outer harbor), the dredging interval (yearly, every other year) the quality of the sediment of these cubic yards (number of cubic yards capable of being open lake disposed, number of cubic yards that need to be confined), cost per cubic yard for removal/transportation/discharge of non-contaminated bottom sediments at an open lake disposal site, cost per cubic yard for removal, transportation and discharge of contaminated bottom sediments to a contained disposal facility, cost for construction of the disposal facility, cost for maintenance of the disposal facility, etc.

Under "Normal Maintenance-Contaminated Sediments Removed" (NMCSR), Section 312 (a) contaminated sediments (58,200 cubic yards) have been removed from the area located downstream of the 5th Street Bridge. In addition, it is assumed all other contaminated bottom sediments located downstream of the 5th Street Bridge and upstream of the 5th Street Bridge have been removed. This allows all sediments dredged from the River to be open lake disposed. Consequently Operation And Maintenance costs under NMCSR are the maintenance costs associated with open lake disposal. Again such information as the number of cubic yards needed to be removed per dredging cycle, the length of the dredging cycle, and a cost per cubic yard for open lake disposal needs to be developed.

Section 312 (a) benefits are the difference between NMCSP and NMCSR average annual Operation and Maintenance costs. NMCSP Operation And Maintenance costs assume 312 (a) contaminated sediments have been left in the river downstream of the 5th Street Bridge. Consequently NMCSP Operation and Maintenance Costs increase since the contaminated 312 (a) sediments migrate downstream and mix with clean bottom sediments. These mixed bottom sediments have to be placed in a confined disposal facility, as opposed to being open lake disposed. NMCSR assumes the Partnerships cleanup plan for the entire Ashtabula River (upstream and downstream of the 5th street Bridge) has been completed. Consequently all sediments needed to be removed for commercial navigation, over the 50-year life of the project, can be open lake disposed.

b. "Normal Maintenance-Contaminated Sediments Present" (NMCSP) Operation And Maintenance Costs. Normal Maintenance-Contaminated Sediments Present" assumes that all contaminated sediment upstream of the 5th Street Bridge was removed as through the Partnership Plan. It also assumes that in project year 1, all contaminated sediments located in the Federal channel downstream of the 5th Street Bridge will be removed (62,200 cubic Yards.) This removes all the sources of contaminated sediments entering the Federal Channel except from the area adjacent to the Federal channel downstream of the 5th Street Bridge. This source of pollution is the Section 312 (a) cubic yards: 52,800.

The number of cubic yards needed to be removed from the commercial navigation channels was investigated under the 1990 "Letter Report And Draft Environmental Impact Statement Ashtabula Harbor Ohio, Ashtabula Confined Disposal Facility Project. Quantities dredged on an every other year basis for the whole harbor ranged from 172,000 to 233,500. Data on historical dredging volumes from the Chief Of Engineers Annual reports for a 22 year period (1973 to 1994) indicates about 272,000 cubic yards are removed every other year for total harbor maintenance. In recent years, fewer cubic yards have been removed from the Harbor due to the contaminated nature of sediments located downstream of the 5th Street Bridge. Physical Support Branch has estimated the number of cubic yards that recently have been removed on an every other year basis to be 130,000 cubic yards, 50,000 of which are located in the river.

Given the uncertainties of future cubic yards removed in the future, it is assumed 100,000 cubic yards will be removed on an every other year basis. It is assumed 50,000 cubic yards will come from the river, and 50,000 cubic yards from the outer harbor.

Since the 312 (a) contaminated sediment is not removed, it will continue contaminating the federal project dredging. Thus a portion of the dredged material will have to be disposed of in a CDF. Total cubic yards of 312(a) sediment is 52,800 cubic yards. The level of PCB toxicity of these cubic yards is not exactly known but ranges from undetectable levels to 20 ppm.

Assume the average level of contamination is 10. Given that open lake disposal calls for 1 ppm or less, it is estimated that this area of contaminated sediment could cause 528,000 cubic yards of dredged material to be classified as unsuitable for open lake disposal and need to be placed in a confined disposal facility. The following assumptions on mixing were made. Out of the 50,000 cubic yards that would be removed from the River on an every other year basis, 20,000 cubic yards would need to be contained. This is due to contaminated sediments, located outside the Federal channel and downstream of the 5th Street Bridge, eventually migrating into the Federal channel and causing the sediments located there to be classified as needing to be placed in a CDF. The remaining 30,000 cubic yards in the river would be open lake disposed, as well as the 50,000 cubic yards removed from the outer harbor. This mixing would continue over a 20 year time frame. After 20 years, all river and outer harbor sediments could be open lake disposed. Total cubic yards that needed to be contained came to 262,200. A time stream of cubic yards removed by year and their method of disposal, for NMCSP, is presented in Table S 7.

A number of different disposal facilities could be used to hold the contaminated sediment: use current landfills, build a new CDF at Ashtabula, build a new upland disposal site. This analysis assumes that the disposal facility will be a new CDF at Ashtabula. Information on potential dike locations and costs were obtained from the December 1992 "Letter Report Confined Disposal Facility Ashtabula Harbor Ashtabula Ohio". The location of the dike would be approximately 3 miles east of the harbor which is located/contacted to the lake shoreline (Site 1 Plan). This was the site recommended in the 1992 Letter Report prepared by Buffalo District. Construction first costs for this facility were updated from October 1991 prices to October 2000 prices using the ENR Construction Cost index. Construction first costs included Contractors Earnings and Contingencies, Engineering and Design, Construction Management and LERRDs. Also included in the evaluation were costs associated with building a breakwall and mooring facilities for the scows that carry the polluted material to the CDF, as well as pumpout equipment needed to remove the sediment from the scows and place it in the CDF. These costs in October 2000 prices came to $23,541,200 . This plan was sized to hold approximately 1,300,000 cubic yards.

Table S 7. "Nor al Maintenance-Conta inated Sedi ents Present" - Method Of Sediment Disposal By Year.

Location	River	River	Outer Harbor	All Locations
Method Of Disposal	CDF Non TSCA	Open Lake Disposed	Open Lake Disposed	Total Cubic Yards
Project Year				
1	20,000	30,000	50,000	100,000
Station 120+ to Bridge	62,200			62,200
3	20,000	30,000	50,000	100,000
5	20,000	30,000	50,000	100,000
7	20,000	30,000	50,000	100,000
9	20,000	30,000	50,000	100,000
11	20,000	30,000	50,000	100,000
13	20,000	30,000	50,000	100,000
15	20,000	30,000	50,000	100,000
17	20,000	30,000	50,000	100,000
19	20,000	30,000	50,000	100,000
21		50,000	50,000	100,000
23		50,000	50,000	100,000
25		50,000	50,000	100,000
27		50,000	50,000	100,000
29		50,000	50,000	100,000
31		50,000	50,000	100,000
33		50,000	50,000	100,000
35		50,000	50,000	100,000
37		50,000	50,000	100,000
39		50,000	50,000	100,000
41		50,000	50,000	100,000
43		50,000	50,000	100,000
45		50,000	50,000	100,000
47		50,000	50,000	100,000
49		50,000	50,000	100,000
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	262,200	1,050,000	1,250,000	2,562,200

However, "Normal Maintenance-Contaminated Sediments Present" (NMCSP) calls for 262,200 cubic yards to be confined. Construction costs were adjusted to reflect the lower number of cubic yards needed to be contained. Construction costs associated with holding 262,200 cubic yards came to $10,260,900. To these costs were added the present worth of annual dike maintenance costs ($438,700), the present worth of annual sand bypass costs ($490,600), the present worth of dredging costs associated with removing, transporting and placement into the dike of contaminated sediment ($1,806,500 based on a dredging/transport/disposal cost of $10.43 per cubic yard) and the present worth of dredging costs associated with removing, transporting and open lake disposal of clean sediment ($3,659,600 based on a dredging/transport/disposal cost of $5.57 per cubic yard). All discounting took place over a 50-year evaluation period and used a 6.375 percent annual interest rate. The present worth costs for NMCSP came to $16,656,300. These present worth costs were converted to average annual dollars using a 50-year project life and a 6.375 percent annual interest rate (See Table S8). Average annual NMCSP Operation And Maintenance Costs came to $1,112,500.

Table S 8. Average Annual Operation And Maintenance Costs Under "Normal Maintenance-Contaminated Sediments Present".

Dike Construction Costs	$10,260,900
Present Worth Of Dike Maintenance Costs	$ 438,700
Present Worth Of Annual Sand Bypass Costs	$ 490,600
Present Worth Of Polluted Sediment Disposal Dredging Costs	$ 1,806,500
Present Worth Of Open Lake Sediment Disposal Dredging Costs	$ 3,659,600

Total Present Worth Costs	$16,656,300
Partial Payment Factor (6.375% and 50 year project life)	.06678897

Average Annual NMCSP Operation And Maintenance Costs	$ 1,112,500

c. "Normal Maintenance- Contaminated Sediments Removed" (NMCSR) Operation And Maintenance Costs. NMCSR assumes the current partnership project is implemented. This means Section 312 (a) contaminated sediments have been removed from the area located downstream of the 5th Street Bridge. In addition, all other contaminated sediments identified by the Recommended Plan for removal and disposal, located upstream and downstream of the 5th Street Bridge, have also been removed. This will result in a cleanup of polluted and toxic harbor sediments currently located upstream and downstream of the 5th Street Bridge. The cleanup of contaminated sediments will insure that any future sediment moving downstream and into the commercial navigation channel is clean and acceptable for open lake disposal. This cleanup will allow all future dredging for commercial navigation purposes to be open lake disposed. The Federal channels located downstream of the 5th Street Bridge will be maintained at their current channel depths.

Assumptions on the number of cubic yards dredged per cycle (100,000) and the frequency of dredging (once every two years) was assumed to be the same as discussed previously. The difference between NMCSP and NMCSR is that NMCSR allows all sediment dredged over the 50-year evaluation is open lake disposed. Given a dredging cost per cubic yard of $5.57 for removing, transporting and open lake disposal of clean sediment, 100,000 cubic yards being removed once every two years, the present worth of open lake disposal costs came to $4,298,700. All discounting took place over a 50-year evaluation period and used a 6.375 percent annual interest rate. The derivation of NMCSR present worth costs are presented in Table S9. These present worth costs were converted to average annual dollars using a 50-year project life and a 6.375 percent annual interest rate. Average annual "Normal Maintenance- Contaminated Sediments Removed" Operation And Maintenance Costs came to $287,100 .

d. Section 312 (a) Benefits. Benefits associated with Section 312 (a) are the difference between NMCSP and NMCSR average annual Operation and Maintenance costs. NMCSP Operation And Maintenance costs assume 312 (a) contaminated sediments have been left in the river downstream of the 5th Street Bridge. NMCSR assumes the Partnerships cleanup plan for the entire Ashtabula River (upstream and downstream of the 5th Street Bridge) has been completed. It assumes all contaminated sediments located outside the Federal Channel and downstream of the 5th Street Bridge, have been removed under the authority of Section 312 (a). Consequently all sediments needed to be removed for commercial navigation, over the 50-year life of the project, can be open lake disposed.

NMCSP average annual Operation And Maintenance Costs were $1,112,500 . NMCSR average annual Operation And Maintenance Costs were $287,100 . Section 312 (a) benefits are the difference between NMCSP and NMCSR average annual Operation and Maintenance Costs: $825,400 (Table S10).

Table S10. Section 312 (a) Benefits

MCSP Average Annual Operation And Maintenance Costs	$1,112,500
MCSR Average Annual Operation And Maintenance Costs	$ 287,100

Section 312 (a) Average Annual Benefits	$ 825,400

Table S 9. Average Annual Operation And Maintenance Costs Under "Normal Maintenance- Contaminated Sediments Removed".

Year	Cy Open Lake disposed	Cost/CuYrd For Open Lake Disposal	Open Lake Drdg Costs	Present Worth Factor	Present Worth Value
1	100,000	$5.57	$557,000	0.940070505	$523,619
3	100,000	$5.57	$557,000	0.830770909	$462,739
5	100,000	$5.57	$557,000	0.734179298	$408,938
7	100,000	$5.57	$557,000	0.648818147	$361,392
9	100,000	$5.57	$557,000	0.573381719	$319,374
11	100,000	$5.57	$557,000	0.506716091	$282,241
13	100,000	$5.57	$557,000	0.447801506	$249,425
15	100,000	$5.57	$557,000	0.395736769	$220,425
17	100,000	$5.57	$557,000	0.349725466	$194,797
19	100,000	$5.57	$557,000	0.30906378	$172,149
21	100,000	$5.57	$557,000	0.273129723	$152,133
23	100,000	$5.57	$557,000	0.241373628	$134,445
25	100,000	$5.57	$557,000	0.213309733	$118,814
27	100,000	$5.57	$557,000	0.188508756	$104,999
29	100,000	$5.57	$557,000	0.166591324	$92,791
31	100,000	$5.57	$557,000	0.147222177	$82,003
33	100,000	$5.57	$557,000	0.13010503	$72,469
35	100,000	$5.57	$557,000	0.114978051	$64,043
37	100,000	$5.57	$557,000	0.101609847	$56,597
39	100,000	$5.57	$557,000	0.089795929	$50,016
41	100,000	$5.57	$557,000	0.079355586	$44,201
43	100,000	$5.57	$557,000	0.070129115	$39,062
45	100,000	$5.57	$557,000	0.061975382	$34,520
47	100,000	$5.57	$557,000	0.054769662	$30,507
49	100,000	$5.57	$557,000	0.048401734	$26,960

					$4,298,659
				Rounded	$4,298,700
			Partial Payment Factor		0.066788968

					$287,106
			Rounded		$287,100

SECTION 5
BENEFITS AND COSTS

A. OVERALL BENEFITS AND COSTS ASSOCIATED WITH THE REMEDIATION OF CONTAMINATED SEDIMENTS LOCATED DOWNSTREAM OF THE 5TH STREET BRIDGE.

Average annual benefits associated with remediation of all contaminated sediments located downstream of the 5th Street Bridge (contaminated sediments located within and outside the federal channel) were $1,308,500 (See Section 4, Table S6). Average annual costs associated with remediation of all contaminated sediments located downstream of the 5th Street Bridge, both within and outside the federal channel, were $566,300. (See Section 2, Table S 3). Net benefits associated with remediation of all contaminated sediments located downstream of the 5th Street Bridge are $742,200. The benefit to cost ratio for remediation of all contaminated sediments located downstream of the 5th Street Bridge, is 2.31. These figures are summarized in Table S 11.

Table S11. Benefits / Costs Associated With Remediation Of Contaminated Sediments Located Downstream Of The 5th Street Bridge.

Average Annual Benefits[1]	$ 1,308,500
Average Annual Costs[1]	$ 566,300
Net Benefits	$ 742,200
Benefit To Cost Ratio	2.31

1. All average annual benefits and costs reflect a 6.375% annual interest rate, October 2000 prices and a 50 year project life.

Since the remediation of all contaminated sediments located below the 5th Street Bridge has a positive benefit to cost ratio, the benefits and costs associated with the various authorities to cleanup the river downstream of the 5th Street Bridge can be developed. Consequently, these average annual costs and average annual benefits associated with the Authorities used to cleanup the River below the 5th Street Bridge, are presented in B and C below.

B. BENEFITS AND COSTS ASSOCIATED WITH THE REMEDIATION OF CONTAMINATED SEDIMENTS LOCATED DOWNSTREAM OF THE 5TH STREET BRIDGE AND WITHIN THE FEDERAL CHANNEL.

Two authorities dealt with the remediation of contaminated sediments located <u>within</u> the Federal channel downstream of the 5th Street Bridge. <u>Dredging</u> of sediment within the Federal channels downstream of the 5th Street Bridge would be accomplished under Section 1 Of the Rivers And Harbors Act of 1937. The use of Section 101, of WRDA 1986 would be used to address the <u>disposal operation costs and disposal facility costs</u> associated with contaminated sediment located within the Federal channel downstream of the 5th Street Bridge.

Benefits associated with the use of these two authorities would be commercial navigation transportation cost increases avoided. Average annual transportation cost increases avoided benefits came to $1,308,500. Average annual costs associated with remediation of contaminated sediments located downstream of the 5th Street Bridge and inside the Federal channel were $306,200. (See Section 2, Table S 3). Net benefits associated with remediation of contaminated sediments located downstream of the 5th Street Bridge and within the Federal channel are $1,002,300. The benefit to cost ratio for remediation of contaminated sediments located downstream of the 5th Street Bridge and within the Federal channel is 4.27. These figures are summarized in Table S 12.

Table S12. Benefits / Costs Associated With Remediation Of Contaminated Sediments Located Downstream Of The 5th Street Bridge And Within The Federal Channel.

Average Annual Benefits[1]	$ 1,308,500
Average Annual Costs[1]	$ 306,200
Net Benefits	$ 1,002,300
Benefit To Cost Ratio	4.27

1. All average annual benefits and costs reflect a 6.375% annual interest rate, October 2000 prices and a 50 year project life.

C. BENEFITS AND COSTS ASSOCIATED WITH THE REMEDIATION OF CONTAMINATED SEDIMENTS LOCATED DOWNSTREAM OF THE 5TH STREET BRIDGE AND OUTSIDE/ADJACENT TO THE FEDERAL CHANNEL

Section 312 (a) is the authority used to remove all contaminated sediments located adjacent to the Federal channel and downstream of the 5th Street Bridge. Benefits associated with Section 312 (a) are Operation And Maintenance costs avoided. This benefit analysis was presented in Section 4. Average Annual Operation and Maintenance Costs Avoided benefits came to $825,400 (See Section 4, Table S10). Average annual costs associated with Section 312 (a) were $260,100. (See Section 2, Table S 3). Net benefits associated with Section 312 (a) are $565,300. The benefit to cost ratio for Section 312 (a) is 3.17. These figures are summarized in Table S 13.

Table S13. Benefits / Costs Associated With Section 312 (a).

Average Annual Benefits[1]	$825,400
Average Annual Costs[1]	$260,100
Net Benefits	$565,300
Benefit To Cost Ratio	3.17

1. All average annual benefits and costs reflect a 6.375% annual interest rate, October 2000 prices and a 50 year project life.

ASHTABULA HARBOR LONG TERM MANAGEMENT STUDY
ASHTABULA, OHIO
DRAFT LETTER REPORT

SUB APPENDIX S1

COMMERCIAL NAVIGATION BENEFITS

Note:

1. All Commercial Navigation Benefits used to evaluate plans during the plan formulation phase of the study reflected a 7.625 percent annual interest rate, a 50 year project life and September 1996 prices. Commercial Navigation Benefits under these assumptions were $1,186,200. This documentation of this evaluation concludes on page 62 of this sub-appendix.

2. The ARP's Recommended Plan has evolved over time from September 1996 to October 2000. The ARP developed a "Recommended Environmental Dredging Plan". An MCASES cost estimate, reflecting October 2000 prices, was developed for this plan. In order to have comparable Commercial Navigation Benefits, the Commercial Navigation Benefits were reevaluated and calculated using a 6.375 percent annual interest rate, a 50 year project life and October 2000 prices. Commercial Navigation Benefits under these assumptions were $1,308,500. This re-evaluation starts on page 63 of this sub-appendix.

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo New York 14207

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SECTION 1

INTRODUCTION

A. REPORT PURPOSE

The purpose of this Economic Sub Appendix is to determine the level of Commercial Navigation benefits generated by a one time cleanup of Ashtabula's polluted channel sediments. Currently, channel material dredged from the channel area north of River Station 120+00 and north of the Fifth Street Bridge, has been taken to a disposal site located in the open lake. However, the sediment located from River Station 120+00 south to the head of navigation has varying levels of pollution. If this material is dredged, it would have to be placed in a secured confined disposal facility. Currently, no confined disposal facilities exist at Ashtabula Harbor. Due to the polluted nature of this sediment, this area of the Federal channel has not been dredged for the last 30 years. A storm event in this area could disturb the polluted channel bottom sediments which could lead to its migration downstream of the Fifth Street Bridge. This will result in the accumulation of contaminated bottom materials in the lower river navigation channels. Dredging, that historically occurred in this area for commercial navigation purposes, may have to be discontinued because of excessive dredged material disposal costs. This migration of polluted channel bottom sediments will have negative impacts on the commercial and recreational harbor users, increase the costs of disposal of dredged material and have negative impacts on the local economy.

This Economic Sub Appendix discusses what these increased commercial navigation costs are composed of, and documents their dollar value. A fifty-year evaluation period was used: 2006 to 2055. The annual interest rate used in converting cost time streams to present worth values and average annual dollar values was 7.625 percent.

B. HARBOR LOCATION AND TRIBUTARY AREA.

Ashtabula Harbor is on the south shore of Lake Erie, at the mouth of the Ashtabula River. The Ashtabula River drainage basin covers approximately 137 square miles. The harbor is 59 miles northeast of Cleveland, Ohio and about 37 miles south west of Erie, Pennsylvania (see Figure S1.1) The City of Ashtabula Ohio is situated on the east and west banks of the Ashtabula River, near its mouth. A portion of the city is located in Ashtabula township and a portion in Saybrook township.

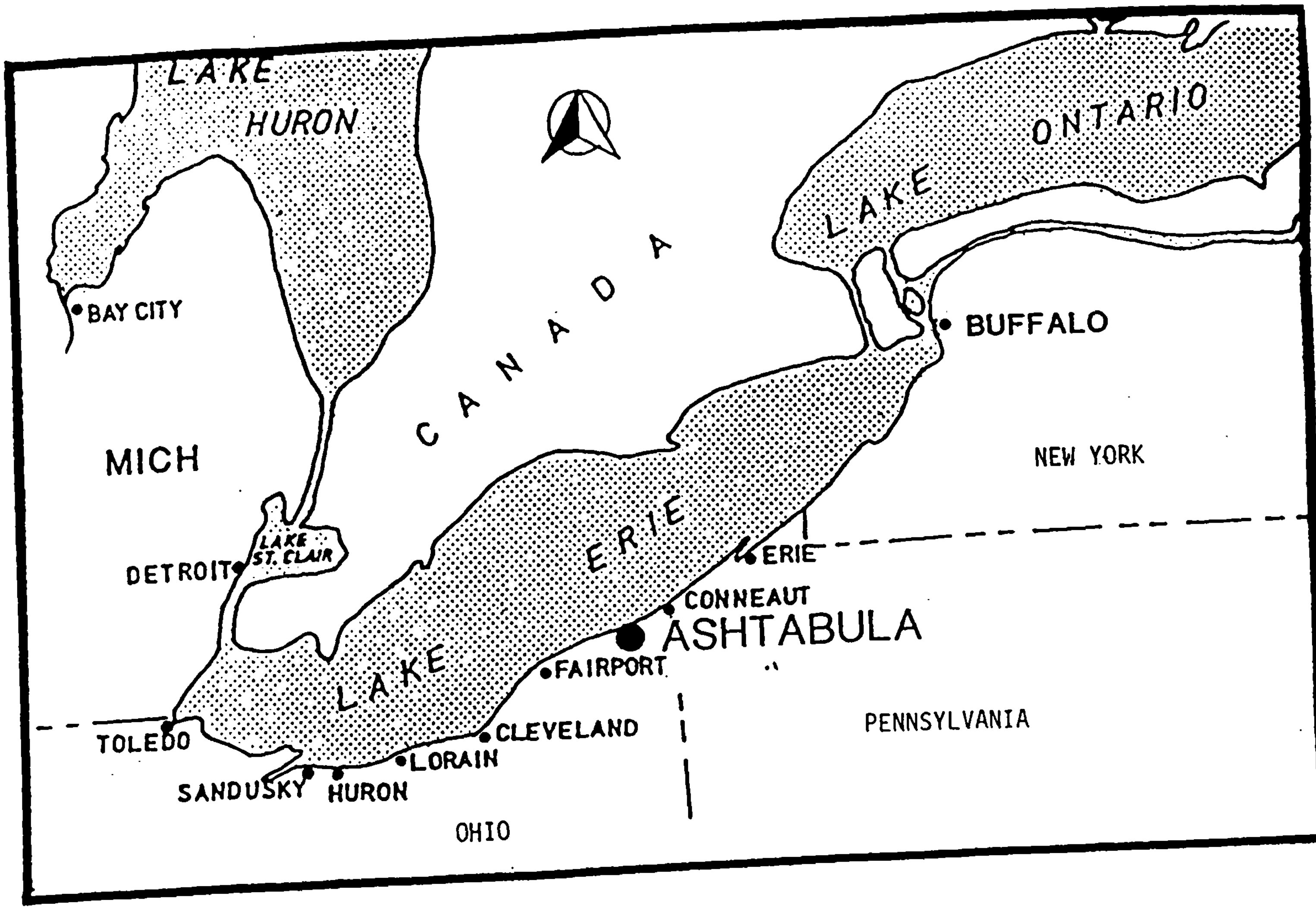


FIGURE 1

LOCATION MAP

SCALE OF MILES

0 25 50

FIGURE S1.1- GENERAL LOCATION OF ASHTABULA HARBOR

C. PROJECT DIMENSIONS.

The Army Corps of Engineers currently maintains navigation channels (see Figure S1.2) at Ashtabula Harbor, Ohio. The existing federal project is 100 percent complete. A major rehabilitation project for the east and west breakwaters was completed in Fiscal Year 1982. The major project components follows:

1. An outer harbor, an area of about 185 acres, protected by east and west breakwaters.

2. An entrance channel from deep water in Lake Erie, 29 feet in soft material and 30 feet in hard material.

3. A navigation channel generally 1,100 feet wide through the outer harbor, parallel to and 100 feet from the west breakwater, extending from the entrance channel to just opposite the inner breakwater, 28 feet in soft material and 29 feet in hard material.

4. A navigation channel extending from inside the inner breakwater to Pinney Dock and Transport Company's Minnesota slip and also to a point 2,000 feet upstream from the mouth of the Ashtabula River. This area is 27 feet in soft material and 28 feet in hard material.

5. Deepening and enlarging of a turning basin in the easterly portion of the outer harbor to depths of 22 feet in soft material and 23 feet in hard material.

6. In the outer harbor, a 700 foot access channel leading south-eastward from the harbor channel and terminating in a basin having a width of 1,200 feet and a length of 1,500 feet, all dredged to a depth of 28 feet in earth and 29 feet in rock.

7. A channel in the Ashtabula River upstream of the terminus of the lower 27 foot deep channel, to a depth of 18 feet to the upper car ferry slip; continuing with a channel 16 feet deep.

From 1980 to 1994, Ashtabula Harbor channels located downstream of the Fifth Street Bridge have been dredged eight times. Dredging took place in 1980, 1981, 1983, 1987, 1989, 1990, 1993 and 1994. Approximately 121,806 cubic yards of material has been removed every time dredging has taken place in this area. All of these cubic yards, except 23,800 cubic yards dredged in 1993, have been open lake disposed of. The navigation channels located upstream of the Fifth Street Bridge have not been dredged for at least the last 30 years. This is due to the potentially contaminated dredge material located in this area.

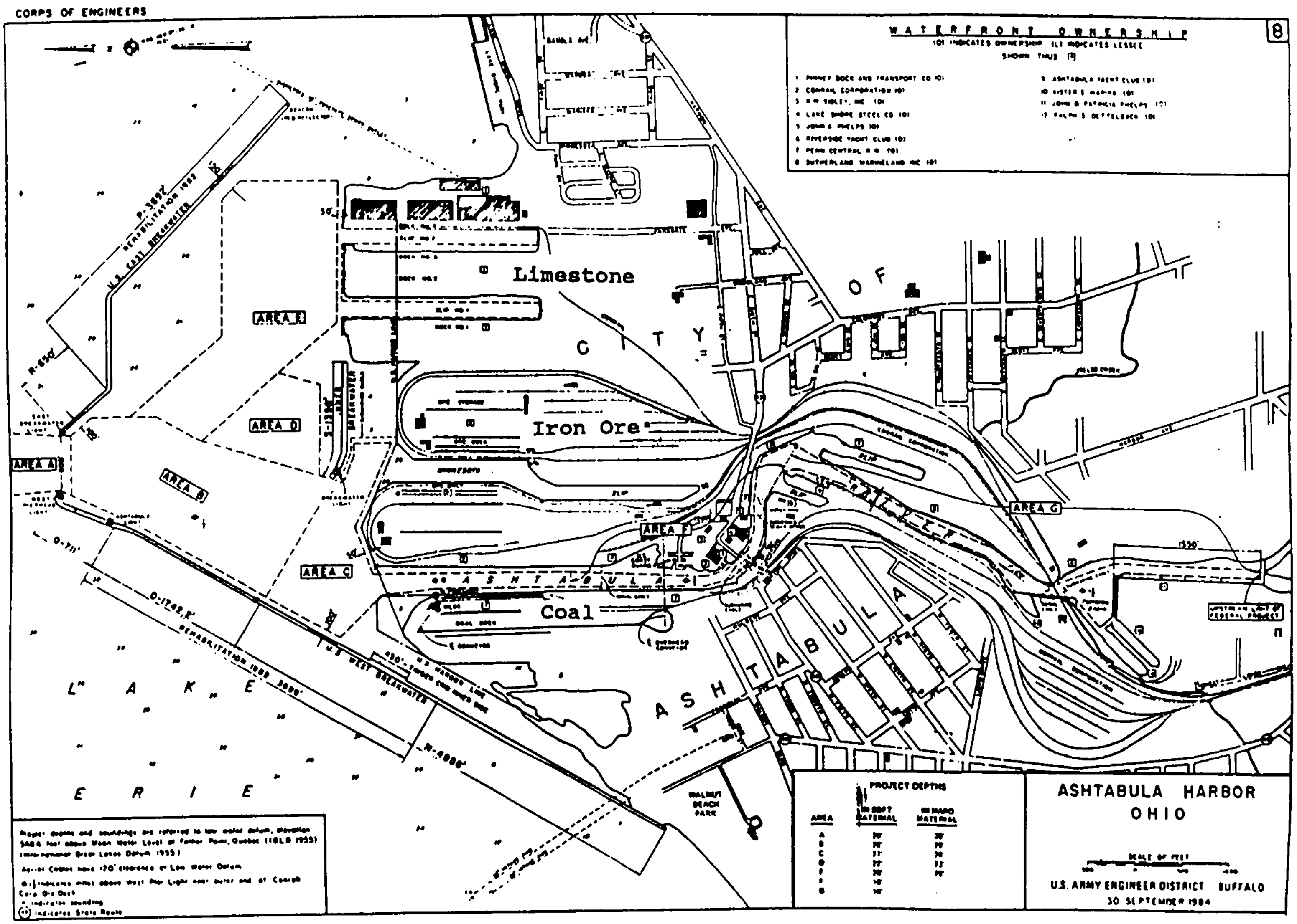


FIGURE S1.2- MAP OF THE FEDERAL PROJECT AT ASHTABULA HARBOR

D. BENEFIT CATEGORIES EVALUATED

This Sub Appendix documents the derivation of commercial navigation transportation costs avoided benefits. In addition to these Commercial Navigation benefits, cleanup of the Ashtabula River would have impacts on the local economy as well as benefit recreational boaters. The analyses associated with Local Economic Impacts and impacts on recreational boaters are presented in Sub Appendices S2 and S3 respectively. Other recreational impacts were evaluated by the Partnership and are located in the EIS evaluation (EIS-Main Report, EIS-Sub Appendix EA-J, EIS-Sub Appendix EA-J-Economic Sub Appendix).

1. Commercial Navigation Vessel Transportation Costs Avoided Benefits. Ashtabula Harbor is a major transshipment point for bulk commodities. The major bulk commodities using Ashtabula Harbor are iron ore, coal and limestone. Iron ore is received at Ashtabula Harbor from Lake Superior ports. The iron ore is loaded onto railroad cars at Ashtabula and transported to inland steel mills in Ohio, Pennsylvania and West Virginia. Coal is railed from Ohio, Pennsylvania and West Virginia to Ashtabula Harbor, loaded onto Great Lakes vessels and shipped to electrical generating stations and other consumers in the United States and Canada. Finally, limestone is shipped to Ashtabula from a number of ports on Michigan's north shore. The majority of this limestone is trucked to local area users. Some of this limestone is used in Ashtabula to make cement for local area use.

The economic impact on the ports major bulk commodity users was evaluated assuming that contaminated bottom sediments migrated to areas downstream of the Fifth Street Bridge. Movement of contaminated sediment to this area would require that all sediment dredged from this area be placed in a confined dike disposal area. Since no dike disposal area currently exists, all commercial navigation channel dredging would cease. The termination of dredging would result in the continual shoaling of the federal navigation channels. This will decrease the channels water column and the usable vessel draft of commercial vessels using Ashtabula Harbor. The decrease in commercial vessel draft would result in a reduction in the number of tons of bulk commodities being carried per trip to/from the harbor. More trips would have to be made to deliver the same amount of bulk materials to the various end users. As shoaling continued, transportation costs for bulk commodities would increase over time. As transportation costs increased at Ashtabula Harbor, the bulk commodities would eventually be sourced through an alternate Lake Erie port or potentially via another mode of transport. This increase in transportation costs, as compared to current transportation costs, would not be incurred if a one-time cleanup of the polluted bottom sediments were undertaken.

SECTION 2

CURRENT HARBOR CONDITIONS-USERS, TONNAGES, ORIGIN/DESTINATION ROUTES, SHOALING RATES, LOCATION OF POLLUTED BOTTOM SEDIMENTS.

A. MAJOR HARBOR USERS.

The federal channels in Ashtabula Harbor, Ohio, comprise the focal point for bulk transportation activities in this city (Figure S1.2). Although local industry accounts for a small portion of the commerce through the port, the primary movement of commerce entails the transshipment of dry bulk commodities to or from interior points. Three bulk commodities comprised over 95 percent of the commercial traffic leaving/entering the harbor in 1994: iron ore, coal and limestone.

The east basin of the outer harbor area contains docks that handle the iron ore and coal traffic. Limestone receipts take place in the east basin as well as on the east bank of the Ashtabula River.

Iron ore is received at the Conrail Corporation dock located in the east basin (see Figure S1.2, location 2). There is no shore based unloading equipment. Consequently the dock operator is dependent upon the shipboard unloading equipment on the vessel.

Coal is shipped from the Lower Lakes Dock Company coal loading dock (see Figure S1.2, location 7) located on the west bank of the Ashtabula River, at the Rivers mouth. Coal vessels are loaded while in the west side of the Ashtabula River.

There are two active limestone docks within the harbor. The largest volumes are unloaded in the east basin (See Figure S1.2, location 1, slip # 1) where larger ships can take advantage of the 27 foot available depths. The second dock is located along the east bank of the River channel below the Fifth Street Bridge (See Figure S1.2, location 3).

B. HARBOR TONNAGES.

Table S1.1 presents historical tonnages of iron ore, coal and limestone received/ shipped at Ashtabula Harbor. Average yearly iron ore traffic receipts between 1990 and 1994 was 4,795,500. Receipts were predominately from U. S. ports during this time period (86 percent of iron ore receipts originated from U.S ports). A review of more recent tonnage data indicate that the domestic share of this iron ore trade has become even larger (91 percent in 1993 and 91 percent in 1994).

Average yearly coal shipments between 1990 and 1994 was 4,774,100 short tons. Coal shipped to Canadian ports for domestic utility consumption and for transshipment to 100,000 DWT ocean going vessels bound for Europe, accounts for about 76 percent of harbor coal movements during

TABLE S1.1 - HISTORICAL TONNAGES AT ASHTABULA HARBOR 1985 TO 1994

YEAR	IRON ORE	COAL	LIMESTONE	SAND & GRAVEL	POTASSIC FERTILIZER	SALT	CLAY	OTHER	TOTAL TONS
1985	1,876,000	4,449,000	447,900	71,400	60,700	60,700	16,100	57,200	7,039,000
1986	2,775,000	3,685,000	346,000	42,600	140,900	19,500	6,900	148,100	7,164,000
1987	2,084,000	6,077,000	266,700	105,600	89,800	28,500	16,800	219,600	8,888,000
1988	3,070,000	5,991,000	550,600	175,700	64,300	23,700	11,000	448,700	10,335,000
1989	4,670,000	4,763,000	438,500	-	65,700	28,400	96,100	326,000	10,387,700
1990	5,589,000	5,328,000	480,000	-	95,000	1,000	155,000	204,000	11,852,000
1991	5,008,000	4,784,000	476,000	39,000	40,000	91,000	25,000	175,000	10,638,000
1992	4,326,000	5,340,000	516,000	-	-	95,000	32,000	263,000	10,572,000
1993	4,685,000	3,445,000	409,000	5,000	5,000	24,000	3,000	403,000	8,979,000
1994	4,369,600	4,823,500	667,300	5,000	27,000	41,000	-	435,100	10,368,500
10 YR AVG	3,845,260	4,868,550	459,800	44,430	58,840	41,280	36,190	267,970	9,622,320
5 YR AVG	4,795,520	4,744,100	509,660	9,800	33,400	50,400	43,000	296,020	10,481,900

this time period. More recent tonnage data (1993 and 1994) indicate that Canadian movements account for a lesser percentage of the harbors' coal traffic (60 percent in 1993 and 67 percent in 1994.). All limestone receipts are from domestic ports and have averaged 509,660 short tons during this five year period.

Average yearly tonnage for these three commodities is 10,049,280 from 1990 to 1994. These three commodities comprise over 95 percent of all tonnage passing through the Harbor during this five year period. Tonnage levels exhibited during the 1994 navigation season were felt to be representative of future commodity movements through the harbor during the evaluation period. The origin /destination routes of these commodities, and the vessels that service these routes are inputs needed to perform the transportation cost analysis.

C. ORIGIN/DESTINATION ROUTES-1994 NAVIGATION SEASON

Table S1.2 shows the origin/destination ports associated with iron ore, coal and limestone movements for 1994. A map showing a variety of Great Lakes ports is presented in Figure S1.3. This map can be used to find the location of the major origin/destination ports associated with bulk commodity movements through Ashtabula Harbor.

Iron ore is received at Ashtabula from upper Great Lakes Ports. The iron ore is mined in Minnesota, Wisconsin and the upper peninsula of Michigan. The iron ore is then railed to upper Great Lakes ports, transshipped by water to Ashtabula via self unloading vessels and then loaded onto rail cars for final delivery to steel mills located in the Youngstown, Ohio and Wierton, West Virginia areas. Upper Great Lakes ports located on Lake Superior include Duluth, Minnesota; Superior,Wisconsin; Presque Isle,Michigan; Silver Bay, Minnesota and Two Harbors, Minnesota. Escanaba Harbor, Michigan is another iron ore origin port and is located on Lake Michigan.

TABLE S1.2- SUMMARY OF 1994 DOCK TO DOCK DATA FOR IRON ORE, COAL AND LIMESTONE -ASHTABULA HARBOR, OHIO

ORIGIN PORT	VESSEL SIZE	TONS MOVED	DISTANCE TO ASHTABULA
IRON ORE-RECEIPTS			
DULUTH, MN.	5	25,365	876
	6	30,147	
	7	78,550	
	10	59,128	

SUBTOTAL, DULUTH, MN.		193,190	
ESCANABA, MI.	5	49,104	589
	6	41,780	
	7	66,871	
	8	43,467	

SUBTOTAL, ESCANABA, MI.		201,222	
PRESQUE ISLE HARBOR, MI.	5	252,797	641
	6	324,182	
	7	812,999	
	8	55,441	
	10	555,483	

SUB TOTAL, PRESQUE ISLE HARBOR, MI.		2,000,902	
ST. LAWRENCE RIVER AND ABOVE	7	377,445	908
SILVER BAY, MN.	8	26,682	834
	10	194,246	

SUB TOTAL- SILVER BAY, MN.		220,928	
SUPERIOR, WIS.	7	138,019	875
	8	564,628	
	10	645,528	

SUB TOTAL- SUPERIOR WIS.		1,348,175	
TWO HARBORS, MN.	8	27,690	853
TOTAL IRON ORE RECEIPTS		**4,369,552**	

TABLE S 1.2- CONTINUED

DESTINATION PORT	VESSEL SIZE	TONS MOVED	DISTANCE FROM ASHTABULA
COAL SHIPMENTS			
ADVANCE, MI.	5	79,830	530
BATH, ONT.	7	54,416	284
CHARLEVOIX, MI.	5	155,726	516
	7	24,602	

		180,328	
CLARKSON, ONTARIO	7	117,483	177
COURTRIGHT, ONT.	7	428,056	208
DETROIT, MI.	8	35,972	150
DUNKIRK HARBOR, NY.	5	20,905	84
GLADSTONE, MI.	8	17,951	596
GRAND HAVEN HARBOR, MI.	6	11,597	698
GREENBAY, WI.	5	280,760	658
MANISTEE HARBOR, MI.	5	52,449	610
	6	26,210	

		78,659	
MARINETTE,WI.	6	14,425	615
MARYSVILLE, MI.	7	14,133	206
MILWAUKEE, WI.	5	111,214	719
	6	15,051	
	7	339,213	
	8	28,308	

SUBTOTAL, MILWAUKEE, WI.		493,786	
NANTICOKE, ONT.	7	939,672	86

TABLE S 1.2- CONTINUED

DESTINATION PORT	VESSEL SIZE	TONS MOVED	DISTANCE FROM ASHTABULA
COAL SHIPMENTS			
NIAGARA RIVER, N.Y.	5	101,579	124
ONTONAGON HARBOR, MI.	8	32,393	756
PICTON, ONT.	7	153,073	277
PORT STANLEY, ONT.	7	66,761	56
PORT WASHINGTON, WI.	5	144,867	697
	7	158,891	
	8	30,816	
SUBTOTAL, PORT WASHINGTON, WI.		334,574	
PRESQUE ISLE, MI.	6	88,654	641
	7	84,987	
	8	201,129	
	10	120,008	
SUBTOTAL, PRESQUE ISLE, MI.		494,778	
ST.CLAIR, MI.	5	71,177	201
	6	80,720	
	7	27,856	
	8	126,752	
SUBTOTAL, ST. CLAIR, MI.		306,505	
ST. LAWRENCE RIVER AND ABOVE	7	336,235	617
SUPERIOR, WIS.	7	18,110	875
	8	15,826	
SUBTOTAL, SUPERIOR, WIS.		33,936	
THUNDER BAY, ONT.	7	195,657	754
TOTAL COAL SHIPMENTS		**4,823,464**	

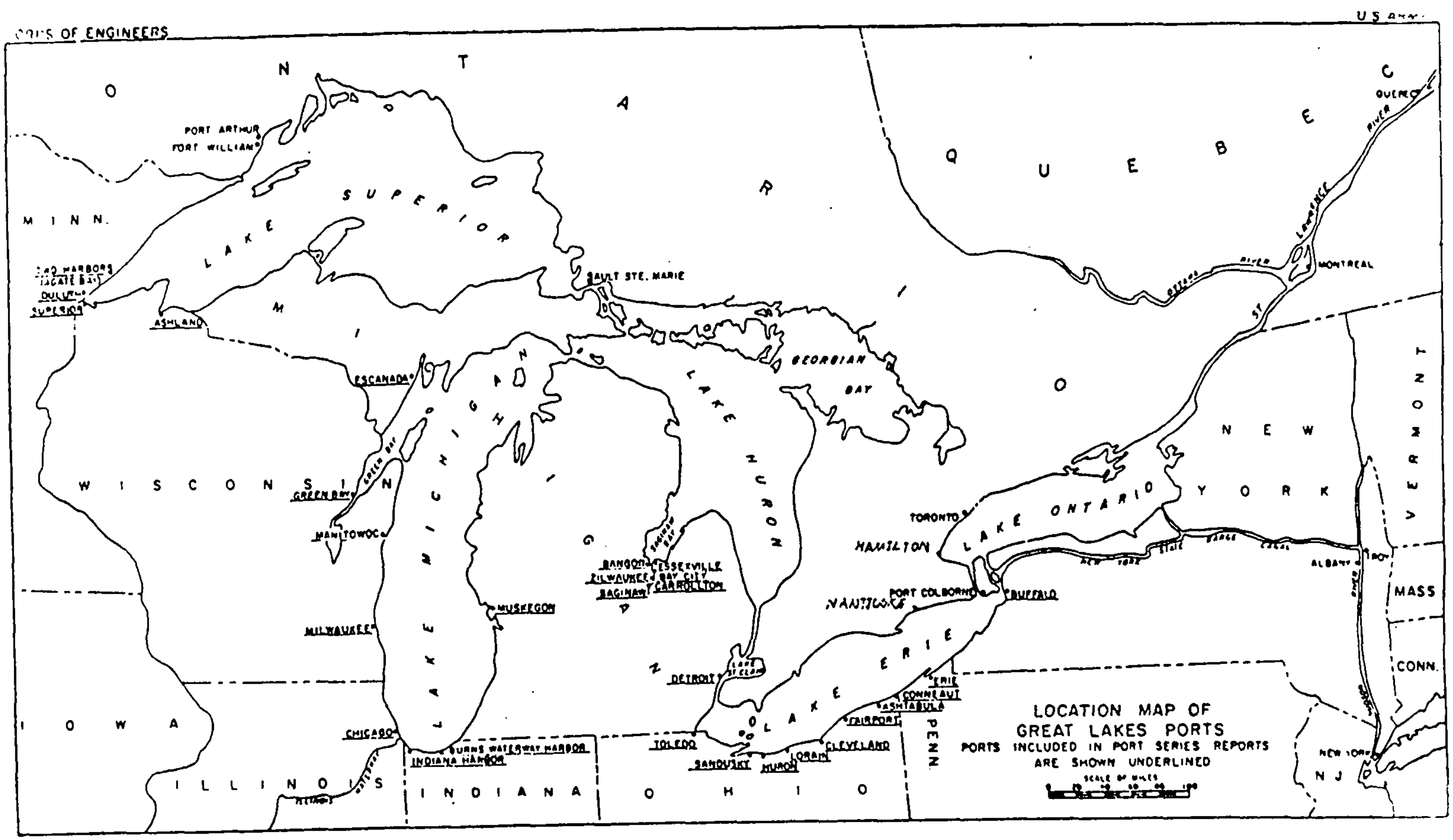
TABLE S1.2- CONTINUED

	ORIGIN PORT	VESSEL SIZE	TONS MOVED	DISTANCE TO ASHTABULA
LIMESTONE-RECEIPTS				
	CALCITE, MI.	5	177,817	418
	MARBLEHEAD, OH.	5	18,988	104
		6	60,162	
		8	24,341	

SUB TOTAL-MARBLEHEAD, OH.			103,491	719
	PORT INLAND, MI.	5	286,836	519
		6	29,150	

SUB TOTAL-PORT INLAND			315,986	
	STONEPORT, MI.	5	70,004	395
TOTAL LIMESTONE RECEIPTS			**667,298**	

FIGURE S1.3-MAJOR GREAT LAKE PORTS



Coal is railed from mines in Ohio, western Pennsylvania and West Virginia to Ashtabula, Ohio, for transshipment to Canadian or United States steam utility plants located adjacent to the upper Great Lakes, steel plants in the Hamilton/Toronto area, and for overseas shipment. Major Canadian destination ports include Nanticoke, Ontario (Lake Erie); Port Credit, Ontario (Lake Ontario); Courtwright, Ontario (Detroit River); and Thunder Bay, Ontario (Lake Superior). Major U.S. coal destination ports include Presque Isle Michigan (Lake Superior); Milwaukee, Wisconsin (Lake Michigan); Port Washington, Wisconsin (Lake Michigan);St. Clair, Michigan (Detroit River) and Greenbay Wisconsin (Lake Michigan).

Limestone is typically brought in from ports on Lake Huron such as Calcite, Marblehead and Stoneport. Port Inland is also a source of limestone and is located on Lake Michigan. Lake Huron ports accounted for approximately 90 percent of the limestone tonnages during the 1994 commercial navigation season. Stoneport, on Lake Michigan, accounted for the other 10 percent of limestone receipts during the 1994 season.

D. SHOALING RATES.

Commercial navigation transportation costs will increase if existing channel depths decrease as a result of deferred maintenance of existing authorized federal channels. A sedimentation study was performed to determine shoaling rates for the Outer Harbor as well as the lower River. Project depths at various locations throughout the Outer Harbor were delineated (Figure S1.4). Navigation routes taken by vessels to move bulk materials were outlined (See Figure S1.5). Finally, the Outer Harbor was divided into thirteen distinct areas, and shoaling rates determined for each of these areas (See Figure S1.6). Based upon the sedimentation study, and the vessel navigation routes, yearly shoaling rates were applied to the various navigation routes and thus commodities. This data is summarized in Table S1.3.

TABLE S1.3- YEARLY SHOALING RATE BY COMMODITY AND STARTING CHANNEL DEPTH

Commodity	Yearly Shoaling Rate (feet)	Starting Channel Depth (Ft)	Starting Channel Bottom Elevation (LWD)
Iron Ore			
Outer Harbor	0.50	27.0	541.6
Outer Harbor	0.50	28.0	540.6
Coal			
River	0.33	27.0	541.6
Outer Harbor	0.50	28.0	540.6
Limestone			
Outer Harbor	0.50	28.0	540.6
River	0.33	18.0	550.6

FIGURE S1.4- ASHTABULA HARBOR PROJECT DEPTHS

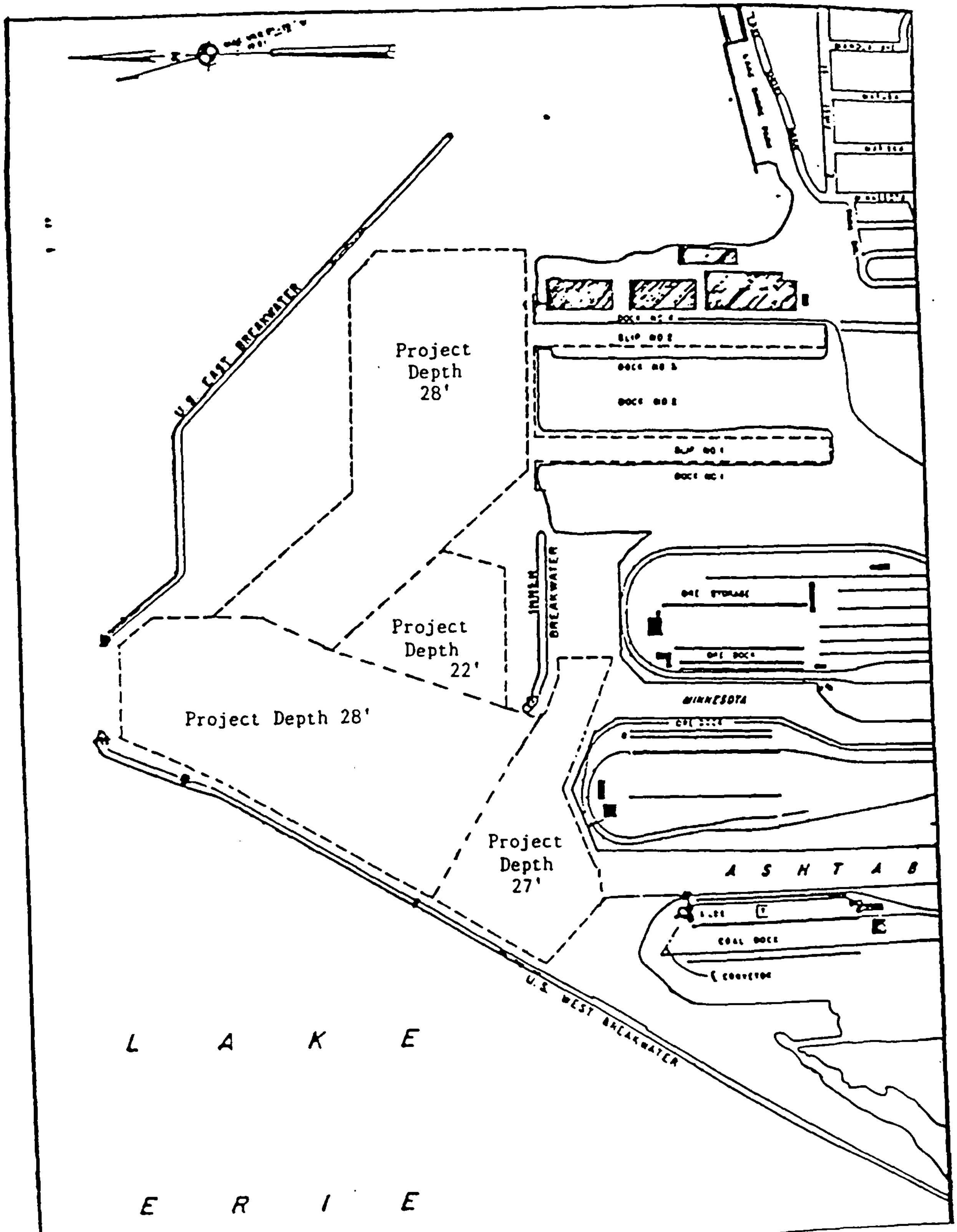


FIGURE S1.5- ASHTABULA HARBOR SELF UNLOADER NAVIGATION ROUTES

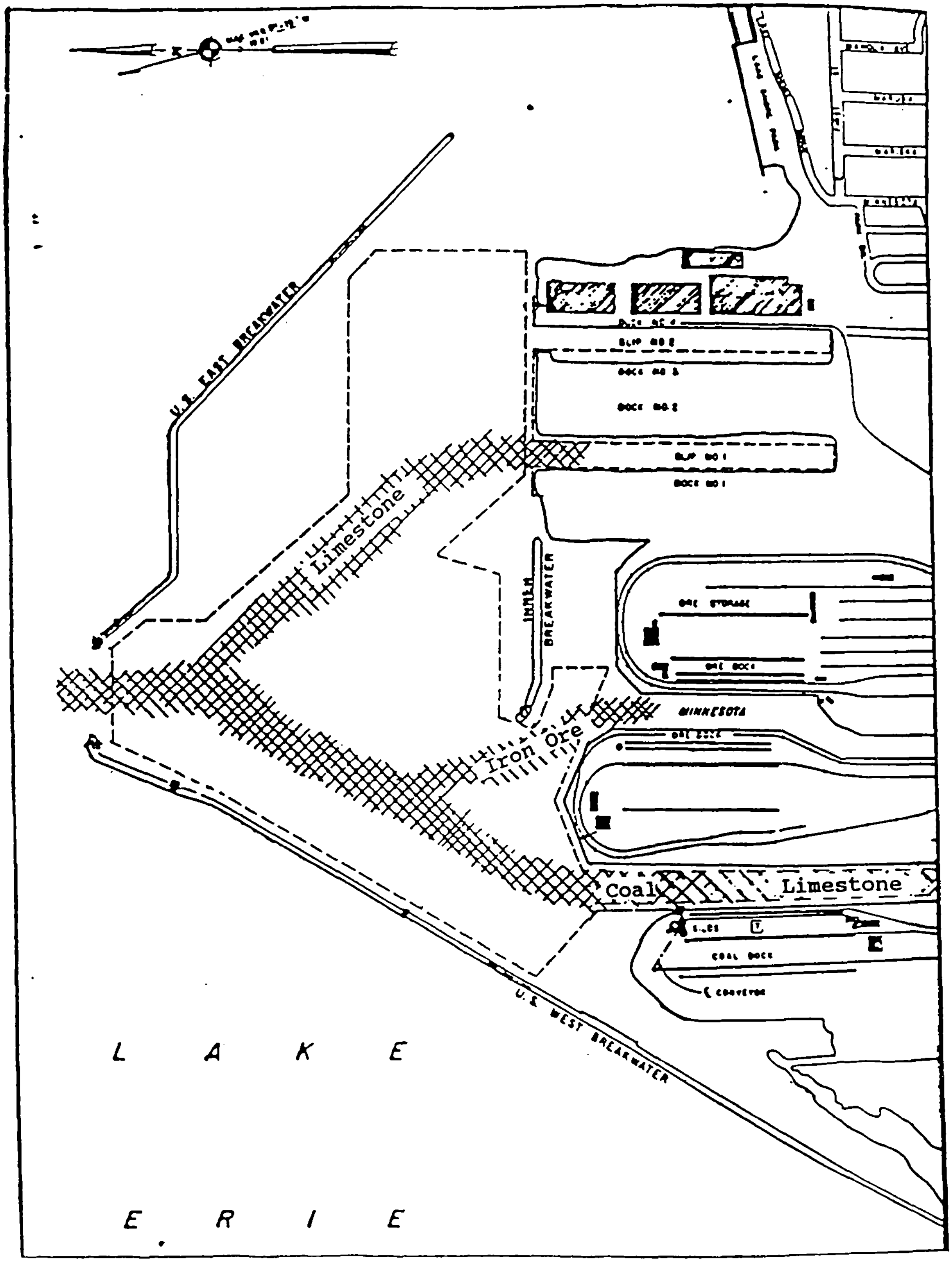
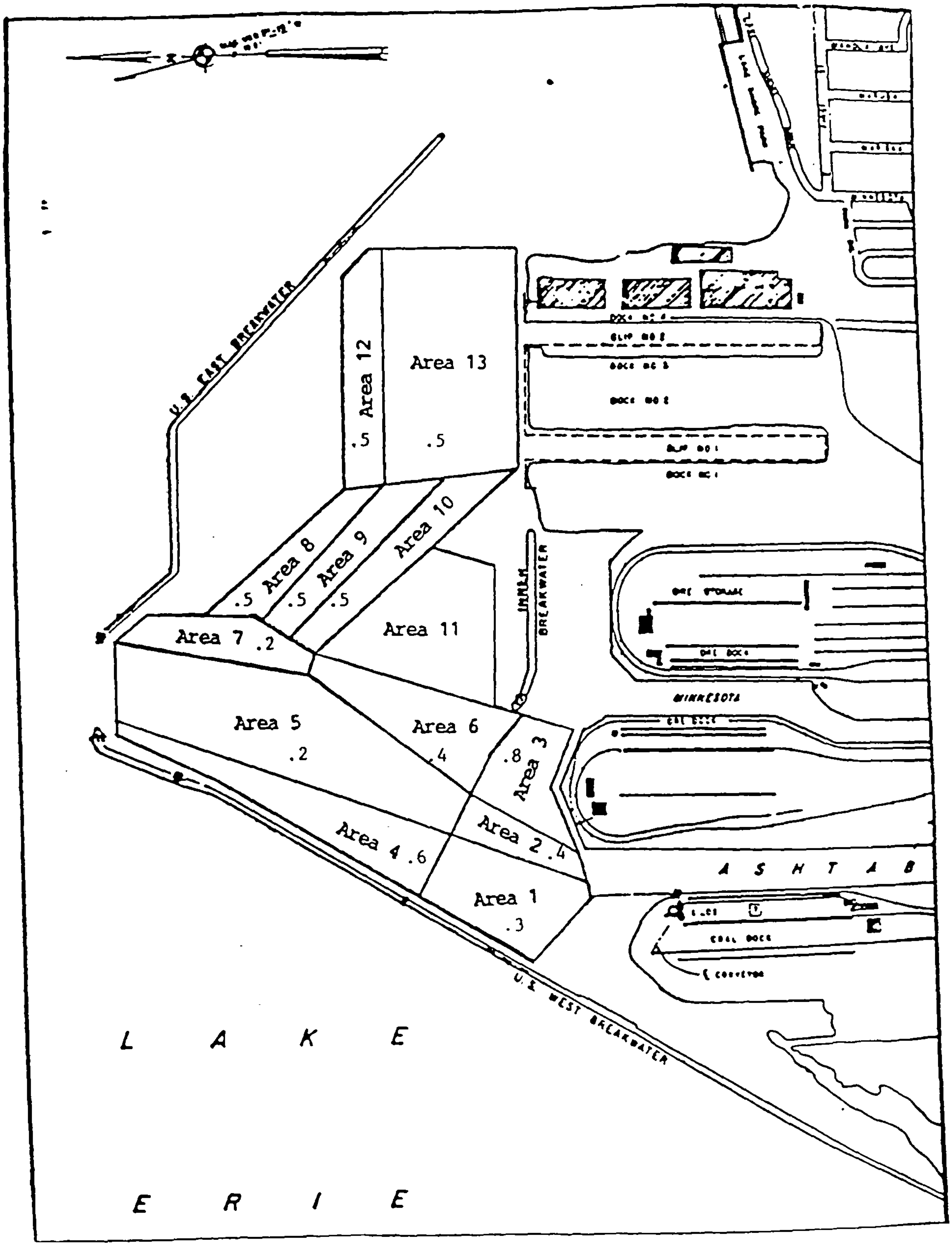


FIGURE S1.6- ASHTABULA HARBOR YEARLY SHOALING RATES BY AREA



E. LOCATION AND AMOUNT OF POLLUTED CHANNEL BOTTOM SEDIMENT.

Given the history of polluted bottom sediments in the Ashtabula River, especially those located above the Fifth Street Bridge, a one time cleanup project would need to include data on the location and quantity of these polluted bottom sediments, as well as the level of pollution.

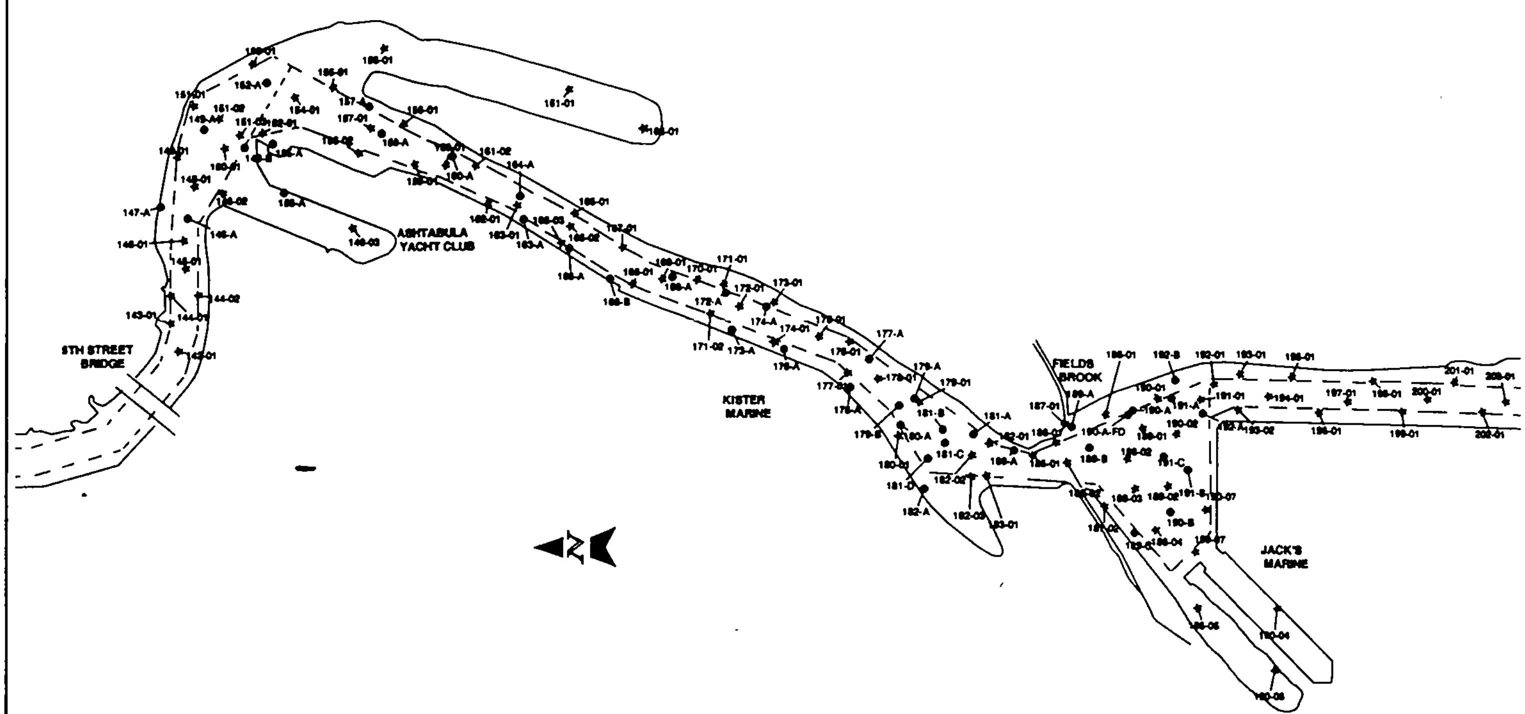
The quality of the bottom sediments, from the Fifth Street Bridge south to the head of navigation, was determined by developing a Sediment Sampling Program. This program was developed in 1994. The first task was to determine where the polluted bottom sediments were located. A total of 528 bottom sediment samples were taken from 34 different sampling locations throughout this area in 1990 and 1995. These sediment samples were then analyzed, by depth, to determine the composition of the sediments themselves. This data was then augmented with the analysis performed on 27 previous channel bottom samples taken in 1984 and 1987. These two sets of data allowed the location of the polluted sediments to be identified.

The samples were taken at various depths and had four attributes: a northing location, an easting location, a depth and a contaminant concentration. The contaminant concentration analysis focused on PCB levels. This data was input into a Groundwater Modeling System (GMS) which converted the sampled data to three dimensional data. The GMS then took the three dimensional data and was able to calculate volume estimates based on concentration levels.

Quantity estimates were developed for five PCB levels: 1 part per million (ppm) or more, 10 ppm or more, 30 ppm or more, 40 ppm or more and 50 ppm or more. The cubic yards associated with each of these levels are as follows: 1 ppm- 715,000 cubic yards, 10 ppm- 366,000 cubic yards, 30 ppm- 102,000 cubic yards, 40 ppm- 53,000 cubic yards and 50 ppm 28,000 cubic yards. Figure S1.7 provides the sampling locations of the Sediment Sampling Program. For a further discussion of the findings of the Sediment Sampling Program, see Appendix C, River Sampling Results.

Given the location and extent of polluted bottom sediments, these sediments will eventually migrate downstream of the Fifth Street Bridge. Once this happens,, maintenance of the commercial navigation channels located downstream of the Fifth Street Bridge would cease. Any future dredged material would have to be placed into a CDF. Since all the CDFs at Ashtabula are full, a new CDF would have to be built. This would have major impacts on the cost of maintaining Ashtabula Harbor.

FIGURE S1.7 - SEDIMENT SAMPLING LOCATIONS



● 1995 Sampling Locations

★ 1990 Woodward-Clyde Sampling Locations

US Army Corps
of Engineers
Buffalo District

SECTION 3

BENEFIT EVALUATION

A. INTRODUCTION

1. Commercial Navigation Transportation Costs. In general, the Corps Of Engineers develops two future scenarios called the "Without Project" condition and the "With Project" condition. These two conditions span a specific period of time, or evaluation period, say 50 years. The "Without Project" condition describes the pattern of activities that would exist over the evaluation period in the Ashtabula River and Ashtabula Harbor approach channels in the absence of a onetime cleanup effort of contaminated bottom sediments. Average annual commercial navigation transportation costs were determined under "Without Project" conditions.

Similarly, the "With Project" condition reflects the pattern of activities that would occur at Ashtabula, over the evaluation period, if the Corps participated in a onetime cleanup of contaminated bottom sediments. Average annual commercial navigation transportation costs were determined under "With Project" conditions.

Average Annual Benefits become the difference in average annual commercial navigation transportation costs between the "Without Project" Condition and the "With Project" condition. The derivation of these average annual commercial navigation benefits follows.

B. COMMERCIAL NAVIGATION TRANSPORTATION COSTS AVOIDED BENEFITS.

The Port of Ashtabula receives and ships millions of tons of cargo each year. Commodities are shipped to, as well as received from, the Port of Ashtabula from other Great Lakes ports and overseas. The port is heavily reliant on the Lake Erie and Ashtabula River navigation channels maintained by the Federal Government, specifically the Corps of Engineers. Most of the commodity tonnage at Ashtabula Harbor is transshipped through the port. For example, coal is received in Ashtabula by rail from inland mining regions located in Ohio, Pennsylvania and West Virginia. The coal is then transferred to lake boats, and transported to ultimate destinations by water. If the Corps' federal navigation channel maintenance practices change dramatically at Ashtabula, perhaps even cease, what would be the economic impact on the bulk commodity transportation industry? Assuming that maintenance of navigation channels is not carried out by another state or local governmental agency, how would the transportation industry react and what would be the impact on total transportation costs for commodity tonnages currently moving through Ashtabula Harbor?

1. Definition Of The "With Project" and "Without Project" Condition. The "With Project" condition assumes a onetime cleanup of polluted channel bottom material has taken place. Since this one time cleanup has taken place, all future dredge material taken from downstream of the Fifth Street Bridge will be able to be open lake disposed of. The Corps of Engineers will continue to maintain the commercial navigation channels located downstream of the Fifth Street Bridge at currently maintained depths. Consequently, all commercial vessel users will have

channel depths of 27 to 28 feet LWD in the Outer Harbor and channel depths of 27 feet and 18 feet LWD on the lower portion of the Ashtabula River.

Under "Without Project" conditions, it is assumed a onetime cleanup of polluted channel bottom sediments has not taken place. Consequently, over time, these bottom sediments will migrate downstream. Eventually, these bottom sediments will enter the commercial navigation channels located downstream of the Fifth Street Bridge. At this time, The Corps dredging of these channels will cease due to the lack of a CDF that will hold these contaminated bottom materials. Once dredging ceases, the navigation channels will silt up over time and return to natural conditions and bottom elevations.

Bulk commodity users that currently source their bulk commodities through Ashtabula Harbor, would likely continue to use the Port of Ashtabula, in the short term. These bulk commodity users are interested in the final delivered price of the bulk commodities that they use. This delivered price may include a water component, a rail component, a truck component, or some combination thereof; associated with using Ashtabula Harbor as the transshipment port. As long as this delivered price via Ashtabula is less than a delivered price associated with using another port or transport mode (ie all train), the end user will continue to source commodities through Ashtabula. Eventually, the channel water depths available at Ashtabula will begin to silt up. Reduced channel water depths will cause an increase in the water portion of the bulk commodities total transport bill associated with using Ashtabula Harbor. This increase in the water portion of the transport bill will eventually drive up the delivered cost of a commodity via Ashtabula Harbor until it equals the delivered price of the same commodity via an alternate harbor or mode of transport. Note, the delivered price via an alternate port may have water costs, rail costs or truck costs that are higher than those associated with using Ashtabula Harbor at its currently maintained depths. Use of alternate harbors could increase the vessel distance and or rail distance or truck distance commodities travel when moving from their origins to their destinations.

Average annual total transportation costs, both vessel and rail/truck components, need to be computed under "Without" and "With Project" conditions. The difference between average annual transportation costs under the "Without Project" and the "With Project" condition are average annual transportation costs that would not be incurred if a onetime cleanup of polluted channel bottom sediment was performed. These average annual transportation costs avoided reflect the economic benefit of a onetime cleanup of polluted channel bottom sediments.

2. General Description Of The Benefit Evaluation Process. Again, it is assumed the end user of the commodity pays the full transportation cost. If the commodities' transportation costs include a water component or a rail component or a truck component, the end user pays all of these costs. The end user is interested in a delivered price to his plant. The end user has no preferences about which port is used nor the mode of transport.

Ashtabulas' 1994 commercial navigation season was taken as being representative of traffic levels that would take place during each year of the 50 year project evaluation under "With" and "Without Project" conditions. The harbors' 1994 iron ore, coal and limestone sourcing patterns, origin/destination pairs, tons moved, rail-lines used, vessels used to move the commodities, and location of bulk commodity suppliers and end users were assumed to remain the same under "With" and "Without Project" conditions.

Total transportation costs associated with the "With Project" condition and "Without Project" condition were generated for each year of the 50 year evaluation period for all 1994 origin/destination routes involved in moving iron ore, coal and limestone. These time streams of transportation costs were converted to average annual dollar values using a 7.625 percent annual interest rate and a 50 year project life for May 1996 price levels. These average annual dollar values were then used to calculate average annual benefits.

Average annual transportation benefits equals average annual total transportation costs under "Without Project" conditions minus average annual total transportation costs under "With Project" conditions. These benefits were derived by commodity, by origin/destination pair. There were 7 origin/destination routes involved in sourcing iron ore, 25 origin/destination routes associated with coal movements, and 4 origin/destination routes associated with limestone movements. Transportation cost components for iron ore, coal and limestone, under "With Project" and "Without Project" conditions will now be discussed.

a. Transportation Cost Components Under "With Project" Conditions. Under "With Project" conditions, currently maintained Ashtabula Harbor channel depths will continue to be provided over the 50 year evaluation period. Outer Harbor limestone docks would have 28 foot channel depths, measured from Low Water Datum (LWD). Outer Harbor iron ore docks would have either 27 or 28 foot channel depths, depending on dock location. Lower River coal docks would have a 27 foot channel depth, measured from LWD. Docks located on the River above the current coal docks would have an 18 foot channel depth measured from LWD.

"With Project" condition transportation costs were calculated for iron ore, coal and limestone movements through Ashtabula Harbor. The 1994 commercial navigation season was taken as being representative of traffic levels that would take place at Ashtabula Harbor over the 50 year evaluation period. The harbors 1994 iron ore, coal and limestone sourcing patterns, origin/destination pairs, tons moved, rail-lines used and vessels used to move the commodities, were used in developing the "With Project" condition transportation costs.

Iron ore receipts basically involve a water component and a rail component under "With Project" conditions. The iron ore is delivered to upper Great Lakes ports, transshipped by water to Ashtabula and then loaded onto rail cars for final delivery to steel mills located in the Youngstown, Ohio and Wierton, West Virginia areas. Total annual iron ore transportation costs can be developed given yearly tons of iron ore received by origin/destination pair, water costs per ton given a 28/27 foot channel depth measured from LWD, and rail costs per ton from Ashtabula to final iron ore user locations. Since these total annual iron ore transportation costs do not change over the evaluation period under "With Project" conditions, these are average annual iron ore transportation costs.

Coal shipments also involve a rail and water component under "With Project" conditions. Coal is sourced from mines in Ohio, Pennsylvania and West Virginia via unit train to Ashtabula Harbor. The coal is then loaded onto vessels for delivery to end users (steam generation plants) located throughout the Great Lakes. Again, total annual coal transportation costs can be developed given yearly tons of coal shipped by origin/destination pair, water costs per ton given a 27 foot channel depth measured from LWD, and rail costs per ton from the coal fields to Ashtabula. Since these total annual coal transportation costs do not change over the evaluation period under "With Project" conditions, these are average annual coal transportation costs.

Limestone receipts were assumed to have a water component cost and a truck cost component under "With Project" conditions. Limestone generally comes from ports located on Lake Michigan, via water, to Ashtabula. The limestone is then moved to local end users via truck. Total annual limestone transportation costs can be developed given yearly tons of limestone received by origin/destination pair, water costs per ton given a 27 foot channel depth in the Outer Harbor and an 18 foot channel depth in the lower River, measured from LWD, and truck costs per ton. Since these total annual limestone transportation costs do not change over the evaluation period under "With Project" conditions, these are average annual limestone transportation costs.

b. Transportation Cost Components Under "Without Project" Conditions. Under "Without Project" conditions, end users will still need the same number of tons of iron ore, coal and limestone. The 1994 water origin/destination routes will remain the same under "Without Project" conditions. Also, the location of iron ore coal and limestone end users, as well as the location of iron ore, coal and limestone suppliers, will remain the same under "Without Project" conditions. The currently maintained Ashtabula harbor channel depths will experience shoaling, since channel maintenance will be discontinued once the polluted bottom sediments migrate below the Fifth Street Bridge. Channels will be allowed to shoal up to their equilibrium level. This reduced channel depth will result in an increase in the water cost of the yearly total transportation bill. Consequently, yearly total transportation costs (water and rail/truck) will grow over time under the "Without Project" condition.

The end user now has two choices: continue to use Ashtabula Harbor with its increasing yearly total transportation costs, or consider using alternate transportation modes and or harbors to source his raw material inputs. If the end user elects to stay at Ashtabula, the yearly total transportation costs under "Without Project" conditions will be composed of the rail/truck costs associated with moving bulk commodities to/from Ashtabula, and the ever increasing water costs associated with using Ashtabula Harbor. If the end user decides to shift mode or use an alternate port, "Without Project" condition yearly total transportation costs will consist of rail/truck costs associated with moving bulk commodities to/from the alternate port and the water costs associated with using the alternate port.

Now the end user must compare the growing yearly total transportation bill associated with using Ashtabula Harbor as the transshipment point versus the yearly total transportation cost associated with using an alternate port as the transshipment point. Alternate port yearly total transportation costs will have unique water and rail/truck costs associated with its use. If yearly total transportation costs associated with using the alternate port are less than the yearly total transportation costs associated with continuing to stay at Ashtabula Harbor, the end user should switch his sourcing pattern. Once the switch is made, yearly total transportation costs under "Without Project" conditions no longer grows. Yearly total transportation costs from this time forward becomes yearly total transportation costs associated with using the alternate port.

Transportation cost time streams need to be developed for each year of the evaluation period, under "Without Project" conditions, for iron ore, coal and limestone. These time streams of total transportation costs can then be converted to average annual dollar values using a 7.625 percent annual interest rate, a 50 year evaluation period and May 1996 price levels.

These "Without Project" condition transportation cost time streams are computed by commodity by origin/destination trade route. Depending upon the origin/destination pair, the transportation cost time streams may consist of total transportation costs (water and rail/truck) associated with continued use of Ashtabula Harbor over the 50 year evaluation period. Alternatively, these "Without Project" condition transportation cost time streams may be a combination of: yearly total transportation costs associated with using Ashtabula Harbor for some period of time and then yearly total transportation costs associated with using say an alternate port (Cleveland or Conneaut) for the rest of the evaluation period. In either case, these costs are always less than an all rail route to the final end user.

3. Derivation Of "With Project" Condition Transportation Costs. "With Project" condition transportation costs are fairly straightforward. Calculate the transportation costs for iron ore, coal and limestone associated with the water portion of the commodity movement, the rail portion of the commodity movement, and the truck portion of the commodity movement, given "With Project" conditions. Since these costs will be the same for each year of the 50 year evaluation period, these costs are average annual costs. Add together these two transportation costs: the water leg and the rail/truck leg. These annual costs become the "With Project" condition average annual transportation costs. The actual derivation of "With Project" condition water transportation costs and "With Project" condition rail/truck transportation costs follows.

a. "With Project" Condition Transportation Costs-Water Leg. A number of pieces of data need to be generated in order to calculate "With Project" condition water costs. One needs to know the commodities affected, their origin/destination routes, the tons moved by route, the vessels used by route, vessel operating characteristics, vessel operating costs, origin/destination harbor loading/unloading rates, and lake/channel levels throughout the origin/destination route.

(1). Origin/Destination Of Commodities Evaluated. Waterborne Commerce Statistics Dock To Dock data for 1994 was used to develop the origin/destination routes for iron ore, coal and limestone. There were 7 origin/destination pairs associated with the receipt of iron ore at Ashtabula in 1994. There were 25 origin/destination pairs associated with the shipment of coal and 4 origin/destination pairs associated with the receipt of limestone in 1994. This database also supplied the names of the vessels used to move the commodities, the tons carried by each vessel, and vessel sizes. A summary of 1994 dock to dock data has been provided in Table S1.2.

(2). Vessel Class Operating Characteristics. Vessel class operating characteristics, such as vessel speed, unloading rates, time in locks, etc, are presented in Table S1.4. This data was used by a computer model to develop total round trip times for various origin/destination commodity pairings. These round trip times were then used with vessel operating costs to develop the transportation costs associated with the water leg of the bulk commodity movement.

TABLE S1.4. VESSEL OPERATING CHARACTERISTICS.

TRANSIT TIMES				UNLOADING RATES SELF UNLOADERS	
VESSEL CLASS	SOO LOCKS (MIN)	WELLAND CANAL (MIN)	ST. LAWRENCE RIVER (MIN)	IRON ORE LIMESTONE (S.T./HOUR)	COAL GRAIN (S.T./HOUR)
1	69	660	0		
2	69	660	217		
3	69	660	217	5,600	4,000
4	69	840	217	6,500	3,000
5	67	840	217	7,400	3,700
6	72	840	252	6,700	3,000
7	70	1,080	259	7,400	3,700
8	72			7,200	7,000
9	100			7,200	7,000
10	104			11,200	10,000

(3). Vessel Class Operating Costs. Transportation costs are related to daily vessel operating costs and vessel operating characteristics. Daily vessel operating costs for the range of vessel sizes that use the Great Lakes were obtained from the Maritime Administration, U.S. Department of Commerce. Operating costs for the range of vessel classes used in transporting Ashtabula's bulk commodities are shown in Table S1.5. These vessel operating costs included fixed and variable costs. Variable costs included such costs as wages, subsistence, stores and supplies, insurance, maintenance and repair, fuel and other. These variable costs are costs per day.

(4). Yearly Water Transportation Costs By Channel Depth. Shipping transportation costs were developed for Ashtabula Harbor based on 1994 dock-to-dock Waterborne Commerce Statistics. Table S1.6 lists the shipping costs associated with Ashtabula Harbor channel depths ranging from 28 feet through 15 feet. The analysis focused on three commodities: iron ore, coal and limestone. Shipping costs were developed based on origin/destination commodity pairs.

TABLE S1.5. VESSEL OPERATING COSTS

GREAT LAKES VESSEL COSTS - CLASS	2 DERIVED	3 DERIVED	4 DERIVED	5 92,94,LF	6 92,94,LF	7 92,94,LF	8 92,94,LF	9 DERIVED	10 92,94,LF
VARIABLE OPERATING COSTS									
WAGES	$4,873	$4,873	$4,873	$5,500	$7,900	$8,000	$8,200	$8,500	$8,500
SUBSISTENCE	$279	$279	$279	$300	$300	$310	$310	$325	$325
STORES,SUPPLIES & EQUIP	$406	$488	$609	$650	$650	$650	$700	$708	$800
INSURANCE	$2,024	$2,116	$2,208	$2,300	$2,700	$2,700	$2,800	$3,309	$3,750
MAINTENANCE AND REPAIR	$553	$633	$636	$650	$700	$750	$950	$1,045	$1,150
FUEL	$1,303	$1,983	$2,530	$2,523	$1,648	$1,847	$2,498	$3,306	$3,372
OTHER	$417	$458	$500	$500	$500	$550	$600	$700	$700
TOTAL	$9,855	$10,830	$11,636	$12,423	$14,398	$14,807	$16,058	$17,893	$18,597
CONSTRUCTION COSTS	$49.5	$55.0	$60.5	$66.0	$71.5	$77.0	$93.5	$104.5	$121.0

There were seven origin/destination pairs associated with iron ore movements. There were 25 origin/destination pairs associated with the coal movements. There were four origin/destination pairs associated with limestone.

The shipping transportation costs presented in Table S1.6 were developed using two computer based transportation cost programs: Comnav1 and Comnav2. These transportation costs by channel depth are based on May 1996 price levels.

These two transportation cost programs utilize origin-destination routes by commodity; information on the size, physical operating characteristics and financial characteristics of the vessels typically used in transporting goods over a specific origin-destination route; the physical characteristics of the origin harbors, intermediate connecting channels and destination harbors channel depths; vessel underkeel clearances; and variable water levels in estimating water transportation costs.

A range of physical vessel operating characteristics and vessel financial costs are used in determining cost per ton transportation costs by vessel class by channel depth, on a monthly basis, for individual trade routes. This cost is used in conjunction with monthly commodity tonnage movements to estimate monthly transportation costs. Total annual transportation costs presented in Table S1.6 represent the summation of all individual months (April-December) of the navigation season for a range of potential channel depths at Ashtabula Harbor. The inputs and outputs of each computer model will now be discussed.

i. Comnav1. Comnav 1 computes the transportation cost in dollars per ton for a range of operating drafts for a number of prototype vessels carrying a specific commodity on a specific trade route. The Comnav 1 program first calculates the tonnage capacity of the prototype vessels for various operating drafts. Input needed for the program includes maximum mid summer operating draft, maximum load at mid-summer operating draft, and the immersion factor of the vessel. The immersion factor reflects the number of short tons needed to be placed into the vessel in order to depress the vessel one inch in the water. The program calculates each individual ships' unique carrying capacity given the vessels' draft. Next the program calculates the hourly vessel operating cost using the financial characteristics of the prototype vessels. The fixed cost is based on the construction cost, season length, amortization rate and profit factor. The variable cost is based on wages, supplies, fuel, etc., plus an overhead factor.

Comnav 1 then calculates the total transit time by using physical characteristics of the vessel plus the sailing distance between the origin/destination harbors. The total transit time at a given operating draft is multiplied by the hourly vessel operating cost to yield the transportation cost. This cost is divided by the number of tons carried at a given operating draft to arrive at the transportation cost per ton. The major outputs of Comnav 1 are a transportation cost per ton matrix by water column and a tons per trip matrix by water column.

TABLE S1.6. YEARLY SHIPPING COSTS BY CHANNEL DEPTH – ASHTABULA HARBOR

1. WATER TRANSPORTATION COSTS- IRON ORE.

ASHTABULA HARBOR CHANNEL DEPTH	DULUTH MINNESOTA	ESCANABA MICHIGAN	PRESQUE ISLE MICHIGAN	SAINT LAWRENCE RIVER	SILVER BAY MINNESOTA	SUPERIOR WISCONSIN	TWO HARBORS MINNESOTA	TOTAL IRON ORE WATER COSTS
TONS	193,190	201,222	2,000,902	377,445	220,928	1,348,175	27,690	4,369,552
28	$1,682,000	$1,039,000	$13,142,000	$3,654,000	$1,362,000	$9,138,000	$281,000	$30,298,000
27	$1,682,000	$1,039,000	$13,142,000	$3,654,000	$1,362,000	$9,138,000	$281,000	$30,298,000
26	$1,687,000	$1,051,000	$13,174,000	$3,664,000	$1,365,000	$9,158,000	$281,000	$30,380,000
25	$1,711,000	$1,086,000	$13,351,000	$3,724,000	$1,383,000	$9,274,000	$285,000	$30,814,000
24	$1,768,000	$1,134,000	$13,775,000	$3,865,000	$1,426,000	$9,545,000	$294,000	$31,807,000
23	$1,855,000	$1,189,000	$14,431,000	$4,072,000	$1,490,000	$9,958,000	$308,000	$33,303,000
22	$1,964,000	$1,253,000	$15,251,000	$4,320,000	$1,572,000	$10,465,000	$326,000	$35,151,000
21	$2,092,000	$1,324,000	$16,204,000	$4,603,000	$1,666,000	$11,051,000	$347,000	$37,287,000
20	$2,240,000	$1,406,000	$17,308,000	$4,928,000	$1,773,000	$11,725,000	$371,000	$39,751,000
19	$2,411,000	$1,500,000	$18,598,000	$5,306,000	$1,897,000	$12,594,000	$399,000	$42,705,000
18	$2,615,000	$1,609,000	$20,086,000	$5,752,000	$2,040,000	$13,389,000	$432,000	$45,923,000
17	$2,861,000	$1,737,000	$21,952,000	$6,280,000	$2,209,000	$14,433,000	$472,000	$49,944,000
16	$3,160,000	$1,889,000	$24,187,000	$6,922,000	$2,413,000	$15,675,000	$520,000	$54,766,000
15	$3,537,000	$2,075,000	$26,985,000	$7,717,000	$2,660,000	$17,179,000	$580,000	$60,733,000

2. WATER TRANSPORTATION COSTS-COAL

ASHTABULA HARBOR CHANNEL DEPTH	ADVANCE MICHIGAN	BATH ONTARIO	CHARLEVOIX MICHIGAN	CLARKSON ONTARIO	COURTWRIGHT ONTARIO	DETROIT MICHIGAN	DUNKIRK NEW YORK	GLADSTONE MICHIGAN
TONS	79,830	54,416	180,328	117,483	428,056	35,972	20,905	17,951
28	$813,000	$242,000	$1,213,000	$441,000	$1,143,000	$117,000	$50,000	$182,000
27	$813,000	$242,000	$1,213,000	$441,000	$1,143,000	$117,000	$50,000	$182,000
26	$813,000	$242,000	$1,213,000	$441,000	$1,144,000	$117,000	$50,000	$182,000
25	$813,000	$244,000	$1,213,000	$441,000	$1,149,000	$117,000	$50,000	$182,000
24	$813,000	$248,000	$1,213,000	$443,000	$1,169,000	$117,000	$50,000	$182,000
23	$813,000	$258,000	$1,213,000	$448,000	$1,208,000	$117,000	$50,000	$182,000
22	$813,000	$271,000	$1,215,000	$462,000	$1,263,000	$117,000	$50,000	$182,000
21	$813,000	$287,000	$1,222,000	$485,000	$1,328,000	$117,000	$50,000	$182,000
20	$818,000	$305,000	$1,248,000	$514,000	$1,404,000	$117,000	$50,000	$184,000
19	$838,000	$327,000	$1,306,000	$548,000	$1,492,000	$119,000	$50,000	$190,000
18	$885,000	$352,000	$1,395,000	$589,000	$1,595,000	$124,000	$50,000	$202,000
17	$957,000	$381,000	$1,507,000	$637,000	$1,718,000	$134,000	$50,000	$220,000
16	$1,052,000	$418,000	$1,644,000	$695,000	$1,867,000	$146,000	$51,000	$244,000
15	$1,173,000	$462,000	$1,810,000	$767,000	$2,051,000	$161,000	$52,000	$273,000

ASHTABULA HARBOR CHANNEL DEPTH	GRAND HAVEN MICHIGAN	GREEN BAY WISCONSIN	MANISTEE HARBOR MICHIGAN	MARINETTE WISCONSIN	MARYSVILLE MICHIGAN	MILWAUKEE WISCONSIN	NANTICOKE ONTARIO	NIAGARA RIVER NEW YORK	ONTONAGON HARBOR MICHIGAN
TONS	11,597	280,760	78,659	14,425	14,133	493,786	939,672	101,579	32,393
28	$159,000	$3,392,000	$783,000	$156,000	$54,000	$5,419,000	$1,504,000	$294,000	$425,000
27	$159,000	$3,392,000	$783,000	$156,000	$54,000	$5,419,000	$1,504,000	$294,000	$425,000
26	$159,000	$3,392,000	$783,000	$156,000	$54,000	$5,419,000	$1,504,000	$294,000	$425,000
25	$159,000	$3,392,000	$783,000	$156,000	$54,000	$5,419,000	$1,508,000	$294,000	$425,000
24	$159,000	$3,392,000	$783,000	$156,000	$54,000	$5,419,000	$1,525,000	$294,000	$425,000
23	$159,000	$3,392,000	$783,000	$156,000	$54,000	$5,419,000	$1,566,000	$294,000	$425,000
22	$159,000	$3,392,000	$783,000	$156,000	$54,000	$5,420,000	$1,621,000	$294,000	$425,000
21	$159,000	$3,393,000	$783,000	$156,000	$55,000	$5,434,000	$1,685,000	$294,000	$425,000
20	$159,000	$3,411,000	$787,000	$157,000	$55,000	$5,511,000	$1,759,000	$297,000	$428,000
19	$159,000	$3,493,000	$803,000	$159,000	$58,000	$5,735,000	$1,846,000	$307,000	$438,000
18	$159,000	$3,691,000	$848,000	$168,000	$62,000	$6,145,000	$1,951,000	$325,000	$463,000
17	$161,000	$4,008,000	$921,000	$182,000	$67,000	$6,716,000	$2,070,000	$350,000	$503,000
16	$174,000	$4,421,000	$1,019,000	$202,000	$74,000	$7,445,000	$2,219,000	$382,000	$556,000
15	$195,000	$4,940,000	$1,145,000	$228,000	$83,000	$8,371,000	$2,403,000	$422,000	$624,000

TABLE S1.6. YEARLY SHIPPING COSTS BY CHANNEL DEPTH - ASHTABULA HARBOR-Continued

2. WATER TRANSPORTATION COSTS- COAL-Continued.

ASHTABULA HARBOR CHANNEL DEPTH	PICTON ONTARIO	PORT STANLEY ONTARIO	PORT WASHINGTON WISCONSIN	PRESQUE ISLE MICHIGAN	ST. CLAIR MICHIGAN	ST. LAW RIVER & ABOVE	SUPERIOR WISCONSIN	THUNDER BAY ONTARIO	TOTAL COAL WATER COSTS
TONS	153,073	66,761	334,574	494,778	306,505	336,235	33,936	195,657	4,823,464
28	$ 672,000	$ 98,000	$3,284,000	$2,773,000	$ 923,000	$2,569,000	$474,000	$1,479,000	$28,659,000
27	$ 672,000	$ 98,000	$3,284,000	$2,773,000	$ 923,000	$2,569,000	$474,000	$1,479,000	$28,659,000
26	$ 673,000	$ 98,000	$3,284,000	$2,777,000	$ 923,000	$2,570,000	$474,000	$1,479,000	$28,666,000
25	$ 676,000	$ 98,000	$3,284,000	$2,798,000	$ 923,000	$2,585,000	$474,000	$1,488,000	$28,725,000
24	$ 688,000	$ 98,000	$3,284,000	$2,847,000	$ 923,000	$2,637,000	$474,000	$1,518,000	$28,911,000
23	$ 714,000	$ 98,000	$3,284,000	$2,924,000	$ 923,000	$2,748,000	$474,000	$1,581,000	$29,283,000
22	$ 751,000	$ 99,000	$3,285,000	$3,025,000	$ 927,000	$2,902,000	$474,000	$1,669,000	$29,809,000
21	$ 795,000	$100,000	$3,297,000	$3,162,000	$ 940,000	$3,084,000	$475,000	$1,773,000	$30,494,000
20	$ 846,000	$103,000	$3,350,000	$3,344,000	$ 970,000	$3,295,000	$482,000	$1,895,000	$31,489,000
19	$ 906,000	$107,000	$3,491,000	$3,563,000	$1,014,000	$3,540,000	$502,000	$2,036,000	$33,027,000
18	$ 974,000	$111,000	$3,734,000	$3,819,000	$1,074,000	$3,826,000	$540,000	$2,201,000	$35,283,000
17	$1,057,000	$118,000	$4,066,000	$4,121,000	$1,152,000	$4,168,000	$593,000	$2,397,000	$38,254,000
16	$1,157,000	$125,000	$4,483,000	$4,481,000	$1,248,000	$4,582,000	$659,000	$2,636,000	$41,980,000
15	$1,280,000	$134,000	$5,006,000	$4,914,000	$1,366,000	$5,094,000	$743,000	$2,931,000	$46,628,000

3. WATER TRANSPORTATION COSTS-LIMESTONE

ASHTABULA HARBOR CHANNEL DEPTH	CALCITE MICHIGAN	MARBLEHEAD OHIO	PORT INLAND MICHIGAN	STONEPORT MICHIGAN	TOTAL LIMESTONE WATER COSTS
TONS	177,817	103,491	315,986	70,004	667,298
28	$1,001,000	$293,000	$1,870,000	$484,000	$3,648,000
27	$1,001,000	$293,000	$1,870,000	$484,000	$3,648,000
26	$1,003,000	$293,000	$1,874,000	$484,000	$3,654,000
25	$1,017,000	$294,000	$1,891,000	$484,000	$3,686,000
24	$1,047,000	$294,000	$1,931,000	$484,000	$3,756,000
23	$1,095,000	$295,000	$1,998,000	$485,000	$3,873,000
22	$1,156,000	$298,000	$2,089,000	$486,000	$4,029,000
21	$1,231,000	$306,000	$2,200,000	$491,000	$4,228,000
20	$1,317,000	$317,000	$2,330,000	$502,000	$4,466,000
19	$1,419,000	$331,000	$2,481,000	$526,000	$4,757,000
18	$1,541,000	$348,000	$2,655,000	$564,000	$5,108,000
17	$1,687,000	$368,000	$2,862,000	$613,000	$5,530,000
16	$1,869,000	$393,000	$3,110,000	$673,000	$6,045,000
15	$2,100,000	$425,000	$3,413,000	$749,000	$6,687,000

4. TOTAL WATER TRANSPORTATION COSTS.

ASHTABULA HARBOR CHANNEL DEPTH	TOTAL IRON ORE WATER COSTS	TOTAL COAL WATER COSTS	TOTAL LIMESTONE WATER COSTS	TOTAL WATER COSTS
28	$30,298,000	$28,659,000	$3,648,000	$ 62,605,000
27	$30,298,000	$28,659,000	$3,648,000	$ 62,605,000
26	$30,380,000	$28,666,000	$3,654,000	$ 62,700,000
25	$30,814,000	$28,725,000	$3,686,000	$ 63,225,000
24	$31,807,000	$28,911,000	$3,756,000	$ 64,474,000
23	$33,303,000	$29,283,000	$3,873,000	$ 66,459,000
22	$35,151,000	$29,809,000	$4,029,000	$ 68,989,000
21	$37,287,000	$30,494,000	$4,228,000	$ 72,009,000
20	$39,751,000	$31,489,000	$4,466,000	$ 75,706,000
19	$42,705,000	$33,027,000	$4,757,000	$ 80,489,000
18	$45,923,000	$35,283,000	$5,108,000	$ 86,314,000
17	$49,944,000	$38,254,000	$5,530,000	$ 93,728,000
16	$54,766,000	$41,980,000	$6,045,000	$102,791,000
15	$60,733,000	$46,628,000	$6,687,000	$114,048,000

ii. Comnav2. The second program, Comnav2, uses information on channel depths, vessel drafts, and vessel underkeel clearances for the origin harbor, destination harbor and connecting channels. It also incorporates stage-duration-frequency curves to derive a monthly vessel operating draft. The unit-cost per ton associated with these drafts are determined from the cost per ton-draft matrix developed in Comnav1. These costs per ton are then multiplied by the tonnage allocation for that month, to calculate monthly transportation costs.

Comnav 2 uses historical lake level elevations and stage frequencies for a variety of nodes on a given trade route, to establish draft frequencies for that trade route. For example, say the delivery of iron ore from Duluth Superior, to Ashtabula Harbor was to be modeled. The nodes that would be used in establishing the monthly draft frequencies for this route might include: Duluth Harbor, Vidal Shoals, Lake Huron, Livingstone Channel, Lake Erie and Ashtabula Harbor. Each point within the trade route is uniquely represented within the transportation cost model. Stage-duration frequency curves are transformed, after identification of an average channel bottom elevation and a representative underkeel clearance, into draft-frequency relationships.

For example, all locations below Lake Superior are combined into a composite draft-frequency curve and each point of the origin harbor draft-frequency curve is related to a range of points (ie. drafts) along the composite draft frequency curve. The program then uses the draft-frequencies, the Coast Guard load line limits, and underkeel clearances to establish the effective draft by determining the constraining points on the system by month. The program then uses the effective draft to read the tonnage capacity off the draft tonnage capacity curve. It also uses the effective draft to read the cost per ton off the draft/cost per ton matrix table developed by Comnav1. The cost per ton is then multiplied by the monthly tonnage allocated by vessel size, and aggregated by month to arrive at total annual transportation costs.

(5). Average Annual "With Project" Condition Water Transportation Costs. Table S1.6 contains water transportation costs for iron ore, coal and limestone, for a range of channel depths at Ashtabula Harbor. Iron ore water transportation costs for a 27 foot Ashtabula Harbor channel depth, represents "With Project" condition water transportation costs. Since this is a cost that would be incurred each year during the 50 year evaluation period, these are average annual costs. Average annual "With Project" condition water costs for iron ore came to $ 30,298,000. Similarly, average annual "With Project" condition water costs for coal can be found under the column labeled "ASHTABULA HARBOR CHANNEL DEPTH-27 FEET", in the coal transportation cost section of Table S1.6. Average annual "With Project" condition water costs for coal came to $ 28,659,000. Finally, annual "With Project" condition water costs for limestone can be found under the column labeled "ASHTABULA HARBOR CHANNEL DEPTH- 27 FEET", in the limestone transportation cost section of Table S1.6. Average annual "With Project" condition water costs for limestone came to $ 3,648,000. The total "With Project" condition average annual water leg costs came to $62,605,000.

b. "With Project" Condition Transportation Costs-Rail Leg. A number of pieces of data need to be generated in order to calculate "With Project" condition rail costs. One needs to know the commodities affected (iron ore and coal), the location of the final users of iron ore that is received at Ashtabula Harbor, the location of the coal mines that feed Ashtabulas coal shipments, the railroads used in moving the iron ore and coal, and a current cost per ton for the various rail routes under "With Project" conditions. These various inputs will now be discussed.

(1). Rail Route Origin/Destinations Of Commodities Evaluated. Iron ore is the major commodity received at Ashtabula Harbor. Iron ore receipts in 1994 were 4,369,552 tons and account for approximately 42 percent (1994) of the tonnage moving through the harbor. The iron ore received at Ashtabula Harbor is bound for steel plants located in Youngstown, Ohio and Wierton, West Virginia. Approximately 40 percent of the iron ore goes to Ohio and 60 percent to West Virginia.

Ashtabula shipped 4,823,464 tons of coal in 1994. This accounted for approximately 46 percent (1994) of the tonnage moving through the harbor. The coal bound by rail for Ashtabula is primarily from mines in Ohio, Pennsylvania and West Virginia. The coal mine districts in Pennsylvania include the Big Sandy District and the Eastern Kentucky District. Coal mine districts in southern West Virginia include the Coal River District, Logan River District and the New River District. A total of 209 mines were active in the system in 1993. Coal is shipped to Ashtabula from basically four locations: Masontown, Pennsylvania; Cornelia West Virginia; Wanna, West Virginia and Powhatan, Ohio.

(2). "With Project" Rail Route Transportation Costs Per Ton. "With Project" condition rail route transportation costs per ton were obtained for a number of rail routes originating from/leading to Ashtabula, for iron ore and coal. The rail costs per ton were obtained from the Tennessee Valley Authority (TVA). The TVA maintains a rail cost model data base. The TVA can generate rail costs for a wide range of commodities and transportation routes.
A summary of rail costs obtained from the TVA for "With Project" condition rail transportation costs per ton are presented in Table S1.7. Rail costs were obtained for iron ore and coal movements. The development of the rail bill rate took into consideration the number of tons each rail car carries, the number of rail cars per train, the distance between the rail origin/destination routes and the number of railroads involved in the movement. Rail costs were developed for iron ore movements from Ashtabula to Youngstown, Ohio and Wierton, West Virginia. Rail costs were developed for coal movements from Masontown Pennsylvania; Cornelia, West Virginia; Wanna, West Virginia and Pohatan, Ohio to Ashtabula.

(3). "With Project" Condition Weighted Rail Transportation Costs. Given the percent of total tons moved by rail route by commodity, and a cost per ton to move the commodity by rail route, a weighted rail rate can be developed for iron ore and coal under the "With Project" condition. The derivation of "With Project" condition weighted rail rates, by commodity, is presented in Table S1.8. Weighted rail rates for iron ore and coal, under "With Project" Conditions, came to $4.30 and $11.65 respectively.

The rail costs associated with the various origin/destination routes can now be calculated. These rail costs are simply the number of tons associated with each origin/destination route during the 1994 commercial navigation season times the weighted rail cost per ton by commodity. This procedure is presented in Table S1.9.

TABLE S1.7. "WITH PROJECT" CONDITION RAIL COSTS PER TON BY RAIL ROUTE.

	$/Ton	Rail Carrier
1. IRON ORE		
Rail Costs From Ashtabula Harbor Ohio, To:		
Youngstown, Ohio	$ 3.52	Conrail
Wierton, West Virginia	$ 4.82	Conrail
2. COAL		
Rail Costs To Ashtabula Harbor Ohio, From:		
Masontown, Pennsylvania	$10.13	Conrail
Cornelia, West Virginia	$15.53	Conrail
Wanna, West Virginia	$10.93	Conrail
Powhatan, Ohio	$ 9.51	Conrail

TABLE S1.8. YEARLY "WITH PROJECT" CONDITION RAIL COSTS FOR IRON ORE AND COAL.

Destination	1994 Tons	Percent Of Total Tons By Destin	Ashtabula Rail $/Ton	Weighted Ashtabula Rail Costs By Destin/Org
A. IRON ORE				
Youngstown, Ohio	4,369,552	40%	$ 3.52	$ 1.41
Wierton, W. Virginia	4,369,552	60%	$ 4.82	$ 2.89

				$ 4.30
Origin				
B. COAL				
Masontown, Pa.	4,823,464	35%	$10.13	$ 3.55
Cornelia,W. VA.	4,823,464	26%	$15.13	$ 4.04
Wanna W. VA.	4,823,464	25%	$10.93	$ 2.73
Powhatan,Oh.	4,823,464	14%	$ 9.51	$ 1.33

				$11.65

TABLE S1.9. "WITH PROJECT" CONDITION ANNUAL RAIL/TRUCK TRANSPORTATION COSTS FOR IRON ORE, COAL AND IMESTONE

ORIGIN PORT	TONS OF IRON ORE BY OD PAIR	PERCENT OF TOTAL TONS OF IRON ORE BY OD PAIR	WITH PROJECT IRON ORE RAIL COSTS PER TON	TOTAL WITH PROJECT IRON ORE RAIL COSTS
WITH PROJECT CONDITION RAIL TRANSPORTATION COSTS-IRON ORE				
DULUTH, MINNESOTA	193,190	4.42%	$4.30	$ 830,700
ESCANABA, MICHIGAN	201,222	4.61%	$4.30	$ 865,300
PRESQUE ISLE, MICHIGAN	2,000,902	45.79%	$4.30	$ 8,603,900
ST. LAWRENCE RIVER	377,445	8.64%	$4.30	$ 1,623,000
SILVER BAY, MINNESOTA	220,928	5.06%	$4.30	$ 950,000
SUPERIOR WISCONSIN	1,348,175	30.85%	$4.30	$ 5,797,200
TWO HARBORS MINNESOTA	27,690	0.63%	$4.30	$ 119,100
	4,369,552	100.00%		$18,789,200

WITH PROJECT CONDITION RAIL TRANSPORTATION COSTS-COAL

DESTINATION PORT	TONS OF COAL BY OD PAIR	PERCENT OF TOTAL TONS OF COAL BY OD PAIR	WITH PROJECT COAL RAIL COSTS PER TON	TOTAL WITH PROJECT COAL RAIL COSTS
ADVANCE, MICHIGAN	79,830	1.66%	$11.65	$ 929,800
BATH, ONTARIO	54,416	1.13%	$11.65	$ 633,800
CHARLEVOIX, MICHIGAN	180,328	3.74%	$11.65	$ 2,100,300
CLARKSON, ONTARIO	117,483	2.44%	$11.65	$ 1,368,300
COURTWRIGHT, ONTARIO	428,056	8.87%	$11.65	$ 4,985,700
DETROIT, MICHIGAN	35,972	0.75%	$11.65	$ 419,000
DUNKIRK, NEW YORK	20,905	0.43%	$11.65	$ 243,500
GLADSTONE, MICHIGAN	17,951	0.37%	$11.65	$ 209,100
GRAND HAVEN, MICHIGAN	11,597	0.24%	$11.65	$ 135,100
GREENBAY, WISCONSIN	280,760	5.82%	$11.65	$ 3,270,100
MANISTEE HARBOR, MICHIGAN	78,659	1.63%	$11.65	$ 916,200
MARINETTE, WISCONSIN	14,425	0.30%	$11.65	$ 168,000
MARYSVILLE, MICHIGAN	14,133	0.29%	$11.65	$ 164,600
MILWAUKEE, WISCONSIN	493,786	10.24%	$11.65	$ 5,751,200
NANTICOKE, ONTARIO	939,672	19.48%	$11.65	$10,944,500
NIAGARA RIVER, NEW YORK	101,579	2.11%	$11.65	$ 1,183,100
ONTONAGON HARBOR, MICHIGAN	32,393	0.67%	$11.65	$ 377,300
PICTON, ONTARIO	153,073	3.17%	$11.65	$ 1,782,900
PORT STANLEY, ONTARIO	66,761	1.38%	$11.65	$ 777,600
PORT WASHINGTON, WI	334,574	6.94%	$11.65	$ 3,896,900
PRESQUE ISLE, MICHIGAN	494,778	10.26%	$11.65	$ 5,762,800
ST. CLAIR, MICHIGAN	306,505	6.35%	$11.65	$ 3,569,900
ST. LAWRENCE RIVER & ABOVE	336,235	6.97%	$11.65	$ 3,916,200
SUPERIOR WISCONSIN	33,936	0.70%	$11.65	$ 395,300
THUNDERBAY, ONTARIO	195,657	4.06%	$11.65	$ 2,278,900
	4,823,464	100.00%		$56,180,100
WITH PROJECT CONDITION TRUCK TRANSPORTATION COSTS-LIMESTONE				
CALCITE, MICHIGAN	177,817	26.65%	$2.50	$ 444,500
MARBLEHEAD, OHIO	103,491	15.51%	$2.50	$ 258,700
PORT INLAND , MICHIGAN	315,986	47.35%	$2.50	$ 790,000
STONEPORT, MICHIGAN	70,004	10.49%	$2.50	$ 175,000
	667,298	100.00%		$ 1,668,200
TOTAL WITH PROJECT CONDITION RAIL/TRUCK COSTS				$76,637,500

(4). Average Annual "With Project" Condition Rail Transportation Costs. The rail transportation costs in Table S1.9 are rail costs that would be incurred each year during the 50 year evaluation period. Since these rail costs are the same for every year in the 50 year evaluation period, these are average annual costs. Average annual "With Project" condition rail costs for iron ore came to $ 18,789,200. Average annual "With Project" condition rail costs for coal came to $ 56,180,100. There was no average annual rail costs associated with limestone movements. The total "With Project" condition average annual rail leg costs came to $74,969,300.

c. "With Project" Condition Transportation Costs- Truck Leg. Limestone receipts were 667,298 tons in 1994. Limestone comes from Lake Huron ports to Ashtabula by water and then is transported by truck to end users in the local area. The service area for such a move is typically 25 to 30 miles.

A typical cost per ton rate for delivering limestone was developed from data provided by the TVA. This cost was based upon truck costs per hour ($55), average truck speed (50 miles per hour), truck round trip distance, absence of a backhaul, and number of tons moved per trip (22 tons per trip). Based upon a one way distance of 25 miles, the delivered cost per ton for limestone came to $2.50. This cost per ton value was used in Table S1.9 to develop "With Project" condition limestone truck transportation costs. The limestone truck transportation cost per ton was multiplied times the number of tons delivered by origin/destination route. This resulted in limestone "With Project" condition truck transportation costs by origin/destination route. Total origin/destination "With Project" condition limestone truck transportation costs came to $1,668,200. Since these truck costs are the same for every year in the 50 year evaluation period, these are average annual costs.

d. Total "With Project" Condition Average Annual Transportation Costs. Table S1.10 summarizes total "With Project" condition average annual transportation costs. These transportation costs have two components. These components for iron ore and coal consist of a water leg portion and a rail leg portion. Limestone transportation costs have a water leg component and a truck leg component. Average annual "With Project" condition water transportation costs came to $ 62,605,000. Average annual "With Project" condition rail transportation costs came to $ 74,969,300. Average annual "With Project" condition truck transportation costs came to $1,668,200. Average annual "With Project" condition rail/truck transportation costs came to $ 76,637,500. Total "With Project" condition average annual transportation costs, for iron ore, coal and limestone came to $ 139,242,500.

4. Derivation Of "Without Project" Condition Transportation Costs. Assume the evaluation period has a 50 year time frame: from 2006 to the year 2055. Assume the "Without Project" condition (no action plan) channel depths and maintenance scenario for that time frame is as follows:

Starting in project year one (2006), all harbor channels are at authorized depths. This means the Outer Harbor and lower Ashtabula River have channel depths of 28/27 and 27 feet measured from Low Water Datum. The channel near the Fifth Street Bridge has a channel depth of 18 feet

TABLE S1.10. TOTAL "WITH PROJECT" CONDITION AVERAGE ANNUAL TRANSPORTATION COSTS FOR IRON ORE, COAL AND LIMESTONE

ORIGIN DESTINATION PAIR	AVERAGE ANNUAL WATER COSTS	AVERAGE ANNUAL RAIL/TRUCK COSTS	TOTAL AVERAGE ANNUAL TRANSPRTATN COSTS
IRON ORE			
DULUTH, MINNESOTA	$ 1,682,000	$ 830,700	$ 2,512,700
ESCANABA, MICHIGAN	$ 1,039,000	$ 865,300	$ 1,904,300
PRESQUE ISLE, MICHIGAN	$13,142,000	$ 8,603,900	$21,745,900
ST. LAWRENCE RIVER	$ 3,654,000	$ 1,623,000	$ 5,277,000
SILVER BAY, MINNESOTA	$ 1,362,000	$ 950,000	$ 2,312,000
SUPERIOR WISCONSIN	$ 9,138,000	$ 5,797,200	$14,935,200
TWO HARBORS MINNESOTA	$ 281,000	$ 119,100	$ 400,100
	$30,298,000	$18,789,200	$49,087,200
COAL			
ADVANCE, MICHIGAN	$ 813,000	$ 929,800	$ 1,742,800
BATH, ONTARIO	$ 242,000	$ 633,800	$ 875,800
CHARLEVOIX, MICHIGAN	$ 1,213,000	$ 2,100,300	$ 3,313,300
CLARKSON, ONTARIO	$ 441,000	$ 1,368,300	$ 1,809,300
COURTWRIGHT, ONTARIO	$ 1,143,000	$ 4,985,700	$ 6,128,700
DETROIT, MICHIGAN	$ 117,000	$ 419,000	$ 536,000
DUNKIRK, NEW YORK	$ 50,000	$ 243,500	$ 293,500
GLADSTONE, MICHIGAN	$ 182,000	$ 209,100	$ 391,100
GRAND HAVEN, MICHIGAN	$ 159,000	$ 135,100	$ 294,100
GREENBAY, WISCONSIN	$ 3,392,000	$ 3,270,100	$ 6,662,100
MANISTEE HARBOR, MICHIGAN	$ 783,000	$ 916,200	$ 1,699,200
MARINETTE, WISCONSIN	$ 156,000	$ 168,000	$ 324,000
MARYSVILLE, MICHIGAN	$ 54,000	$ 164,600	$ 218,600
MILWAUKEE, WISCONSIN	$ 5,419,000	$ 5,751,200	$11,170,200
NANTICOKE, ONTARIO	$ 1,504,000	$10,944,500	$12,448,500
NIAGARA RIVER, NEW YORK	$ 294,000	$ 1,183,100	$ 1,477,100
ONTONAGON HARBOR, MICHIGAN	$ 425,000	$ 377,300	$ 802,300
PICTON, ONTARIO	$ 672,000	$ 1,782,900	$ 2,454,900
PORT STANLEY, ONTARIO	$ 98,000	$ 777,600	$ 875,600
PORT WASHINGTON, WI	$ 3,284,000	$ 3,896,900	$ 7,180,900
PRESQUE ISLE, MICHIGAN	$ 2,773,000	$ 5,762,800	$ 8,535,800
ST. CLAIR, MICHIGAN	$ 923,000	$ 3,569,900	$ 4,492,900
ST. LAWRENCE RIVER & ABOVE	$ 2,569,000	$ 3,916,200	$ 6,485,200
SUPERIOR WISCONSIN	$ 474,000	$ 395,300	$ 869,300
THUNDERBAY, ONTARIO	$ 1,479,000	$ 2,278,900	$ 3,757,900
	$28,659,000	$56,180,100	$84,839,100
LIMESTONE			
CALCITE, MICHIGAN	$ 1,001,000	$ 444,500	$ 1,445,500
MARBLEHEAD, OHIO	$ 293,000	$ 258,700	$ 551,700
PORT INLAND, MICHIGAN	$ 1,870,000	$ 790,000	$ 2,660,000
STONEPORT, MICHIGAN	$ 484,000	$ 175,000	$ 659,000
	$ 3,648,000	$ 1,668,200	$ 5,316,200
TOTAL W P AVG ANNUAL TRNSPRTATION CSTS	$62,605,000	$76,637,500	$139,242,500

measured from Low Water Datum. By this time, polluted bottom sediments located above the Fifth Street Bridge will have migrated to below the Fifth Street Bridge. Commercial navigation channel maintenance will cease in 2006. The commercial navigation channels in the Harbor will be allowed to silt up. Based upon the shoaling rate analysis provided in Section 2, it is assumed the channels will shoal up at rates of from .33 to .50 feet per year. It is assumed all channels will shoal to a depth of 17 feet measured from Low Water Datum.

"Without Project" condition average annual transportation costs need to be developed, based upon the anticipated responses of bulk commodity users to the "Without Project" condition maintenance scenario. Bulk commodity users have two choices: (1)-continue to use Ashtabula Harbor throughout the 50 year evaluation period or, (2)-use Ashtabula Harbor to move their commodities for some portion of the 50 year evaluation period and then use some alternate port or transportation mode for the remaining portion of the fifty year evaluation period.

Obviously, the hardest part of the "Without Project" condition transportation cost evaluation is determining whether a switch to an alternate port will be made. In order to determine this, one needs yearly total transportation costs associated with using Ashtabula Harbor at a range of Ashtabula Harbor channel depths, and yearly total transportation costs associated with using the alternate port. This analysis needs to be performed for each commodity, origin/destination pair. One also needs to know what the alternate ports are in order to calculate alternate port total transportation costs.

End users will consider sourcing their commodities through alternative Lake Erie ports once the water column of Ashtabula's access channels reach a critical economic point compared to currently maintained channel depths. The Ashtabula Harbor water column depth at which this shift to an alternate port would take place, can vary by origin-destination pair among the various commodities evaluated. End users would shift their commodity movements to alternate ports when the <u>yearly total transportation cost</u> (water and rail/truck combined) per origin/destination pair for using Ashtabula Harbor, is greater than the <u>yearly total transportation cost</u> (water and rail/truck combined) per origin/destination pair for using an alternate port.

Once it is determined that a switch to an alternate port will be made, the project evaluation year in which this switch will be made needs to be determined. This switch year can be calculated, based on Ashtabula Harbors channel depths in project year 1, the shoaling rates of Ashtabula Harbors various channels and a channel depth/total transportation cost matrix by commodity by origin/destination pair associated with using Ashtabula Harbor.

Given Ashtabula Harbor's channel depths in project year 1, an annual harbor shoaling rate, transportation costs by channel depth associated with continuing to use Ashtabula Harbor, and total transportation costs associated with using alternate ports, one can develop a "Without Project" condition time stream of transportation costs, by commodity, by origin/destination pair.

If the end user opts to use Ashtabula Harbor throughout the 50 year evaluation period, the "Without Project" condition transportation cost time stream is composed of water and rail/truck costs associated with <u>using Ashtabula Harbor</u>. Water costs will continue to increase, under "Without Project" conditions, until Ashtabula Harbor channel depths reach some equilibrium channel depth. This equilibrium channel depth is assumed to be 17 feet, measured from Low Water Datum. This time stream of "Without Project" condition water transportation costs can be converted to an average annual value given an annual interest rate of 7.625 percent, a 50 year evaluation period and May 1996 price levels. Rail/truck costs under "Without Project" conditions will be the rail/truck costs associated with continuing to use Ashtabula Harbor. These rail/truck costs will remain the same over the 50 year evaluation period. These annual rail/truck costs are equal to average annual rail/truck costs. If the end user uses Ashtabula harbor for a portion of the 50 year evaluation period and an alternate port for the remaining portion of the 50 year evaluation period, "Without Project" condition transportation costs now involve transportation costs associated with using Ashtabula Harbor and the alternate port. Water and rail/truck transportation costs would be associated with Ashtabula Harbor up to the time the switch to an alternate port is made. The switch to an alternate port will occur at the Ashtabula Harbor channel depth at which the total transportation costs (water and rail/truck) associated with using Ashtabula Harbor is more costly than the total transportation costs (water and rail/truck) associated with using the alternate port. Once the move to usage of the alternate port has been made, the end users would have their commodities delivered to alternate ports by water and use railroads and or trucks to complete the inland movement of their product to their facilities. Now "Without Project" condition total transportation costs are composed of water costs, rail costs and truck costs associated with using the alternate port.

The time stream of "Without Project" condition water transportation costs, assuming a switch will be made to an alternate port, will have water transportation costs associated with using Ashtabula Harbor up to the project evaluation year in which the switch to the alternate port is made. The annual water transportation costs will increase until the year at which the switch to an alternate port is made. Water transportation costs for all subsequent years will be the same and be equal to water transportation costs associated with using the alternate port. This time stream of "Without Project" condition water transportation costs needs to be converted to an average annual value using an annual interest rate of 7.625 percent, a 50 year evaluation period and May 1996 price levels.

The time stream of "Without Project" condition rail transportation costs, assuming a switch will be made to an alternate port, will be a step function. Rail transportation costs will be associated with using Ashtabula Harbor up to the project evaluation year in which the switch to the alternate port is made. The annual rail transportation costs associated with using Ashtabula harbor will be the same for all years that Ashtabula Harbor is used. Rail transportation costs for all subsequent years will be the same and be equal to rail transportation costs associated with using the alternate port. This time stream of "Without Project" condition rail transportation costs needs to be converted to an average annual value using an annual interest rate of 7.625 percent, a 50 year evaluation period and May 1996 price levels.

The time stream of "Without Project" condition truck transportation costs, assuming a switch will be made to an alternate port, will also be a step function. Truck transportation costs will be associated with using Ashtabula Harbor up to the project evaluation year in which the switch to the alternate port is made. The annual truck transportation costs associated with using Ashtabula harbor will be the same for all years that Ashtabula Harbor is used. Truck transportation costs for all subsequent years will be the same and be equal to truck transportation costs associated with using the alternate port. This time stream of "Without Project" condition truck transportation costs needs to be converted to an average annual value using an annual interest rate of 7.625 percent, a 50 year evaluation period and May 1996 prices.

The number of miles the commodity travels by water or by rail/truck may increase/decrease, based upon the location of the alternate port(s) with respect to Ashtabula Harbor and the various origins and destinations of the commodities evaluated. These annual time streams of "Without Project" condition transportation costs (water, rail, truck, etc.) must then be converted to average annual dollar values. This can be done using a 50 year evaluation period, a 7.625 percent annual discount rate and May 1996 prices.

Total "Without Project" condition transportation costs for iron ore and coal will have a water leg and a rail leg component. Total "Without Project" condition limestone transportation costs consist of water costs and truck costs. Since limestone is used locally, it is assumed all limestone tonnages will be trucked back to the Ashtabula Harbor area from the alternate port.

Before "Without Project" condition average annual transportation cost time streams associated with the water leg, the rail leg and the truck leg can be computed, the following information is needed: what alternate port(s) will be used by commodity; how many tons will go through the alternate port(s); shoaling rates and resultant channel depths at Ashtabula Harbor for each year in the "Without Project" condition evaluation period; total transportation costs at Ashtabula Harbor under varying channel depths; total transportation costs for using the alternate port(s) and Ashtabulas channel depths at which a switch is made to usage of an alternate port. The development of this data follows.

a. Alternate Ports Evaluated. Two alternate ports were evaluated: Conneaut, Ohio and Cleveland, Ohio. First, it had to be determined whether these ports could handle Ashtabula's 1994 tonnages. The annual iron ore and coal throughput capacities of these Harbors were obtained from published sources. These throughput capacities were then compared to 1994 tonnage levels to determine the ports' excess capacity. This excess capacity was then compared to Ashtabula's 1994 tonnage levels. If the ports' excess capacity was higher than Ashtabula's 1994 tonnage levels, by commodity, then that port would be considered as a potential alternate port.

(1) Excess Port Capacity. The annual iron ore and coal throughput capacities for Ashtabula and Conneaut are listed in Table S1.11. Actual tonnage handled at Conneaut during the 1994 commercial navigation season is also presented in Table S1.11. The difference between Conneauts maximum capacity and the 1994 actual tonnages is the excess tonnage capacity Conneaut would be capable of handling on an annual basis, for purposes of this report. Based upon Table S1.11, Conneaut has the capacity to handle additional receipts of 6,487,635 tons of iron ore and additional shipments of 6,873,585 tons of coal. These excess capacities are well above the 4,369,552 tons of iron ore and 4,823,464 tons of coal moved through Ashtabula in 1994. In addition, Conneaut can also handle the 667,298 tons of limestone that entered Ashtabula Harbor in 1994.

TABLE S1.11 - ANNUAL PORT CAPACITIES AND EXCESS CAPACITY, BY COMMODITY

PORT	IRON ORE CAPACITY	1994 (1) RECEIPTS	AVAILABLE EXCESS ORE CAPACITY	: COAL CAPACITY	1994 (1) SHIPMENTS	AVAILABLE EXCESS COAL CAPACITY
ASHTABULA	15,000,000	4,369,552	10,630,448	7,000,000	4,823,464	2,176,536
CONNEAUT	8,000,000	1,512,365	6,487,635	10,000,000	3,126,415	6,873,585
CLEVELAND	7,800,000	1,220,000	6,380,000			

(1) SOURCE: WATERBORNE COMMERCE STATISTICS OF THE UNITED STATES, 1994

Cleveland's excess iron ore capacity is such that it could handle all of Ashtabula's 1994 iron ore tonnages. Cleveland has no coal shipment capabilities at the present time.

b. Alternate Ports Chosen. The alternate port for coal and limestone chosen for this evaluation is Conneaut Harbor. Conneaut harbor is located 14 miles east of Ashtabula. This port has existing dock infrastructure capacity that can accommodate additional coal shipments and limestone receipts. It also has the rail connections needed to deliver the coal from Ohio, Pennsylvania and West Virginia. Cleveland is the next logical port that could be used for coal shipments. However, Cleveland has no coal handling capability currently. Consequently, Cleveland was not considered as an alternate port for coal shipments.

The potential alternate ports for iron ore were Cleveland Ohio and Conneaut Ohio. Total iron ore transportation costs (water and rail) were developed based on using Cleveland Harbor and Conneaut Harbor as the alternate ports. The rail costs per ton associated with using Cleveland Harbor resulted in total iron ore transportation costs via Cleveland always being less than total iron ore transportation costs via Conneaut. Consequently, Cleveland Harbor was chosen as the alternate port for iron ore receipts. Cleveland has existing dock infrastructure capacity that can accommodate Ashtabula's iron ore receipts. It also has the rail connections needed to deliver the iron ore to steel plants located in Youngstown, Ohio and Wierton, West Virginia.

(1). Tons Moving Through The Alternate Ports. Table S1.11 indicates Conneaut has excess capacity which can be used to handle all coal and limestone tonnage coming from Ashtabula Harbor under the "Without Project" condition. Consequently, once the switch is made to an alternate port for coal and limestone, it is assumed this coal and limestone will use Conneaut Harbor as the alternate port. Also, Cleveland has enough excess iron ore capacity to handle all 4,369,552 tons of iron ore that moved through Ashtabula in 1994. Therefore, once Ashtabula's channels have shoaled to a channel depth where it is economically viable to consider using an alternate port for the movement of iron ore, the alternate port would be Cleveland, Ohio.

c. Ashtabula Harbor Shoaling Rates. For purposes of this report, it is assumed no channel maintenance is performed under the "Without Project" condition. The channel shoaling rate at Ashtabula Harbor is assumed to be .5 feet per year for iron ore and limestone located in the Outer Harbor, and .33 feet per year for coal and limestone located on the River. (See Section 2, Shoaling Rates). Channels will silt to their assumed equilibrium level, which is 17 feet LWD. Available Outer Harbor and River channel depths under the "Without Project" condition are 28/27 and 27/18 feet LWD at project year 1. Given the above, expected channel equilibrium will be reached in the Outer Harbor in the year 2028 for a starting channel depth of 28 feet and on the River in 2036 with a starting channel depth of 27 feet. Table S1.12 presents annual shoaling rates at Ashtabula Harbor, over the 50 year evaluation period, and the resulting Ashtabula Harbor channel depths.

d. Total Yearly Transportation Costs At Ashtabula Harbor Under Varying Channel Depths. Total "Without Project" condition transportation costs were calculated for a range of channel depths at Ashtabula Harbor, for iron ore, coal and limestone. These calculations assumed all tonnages stayed at Ashtabula Harbor throughout the 50 year evaluation period. These "Without Project" condition transportation costs consist of water costs and rail costs associated with using Ashtabula Harbor. Iron ore and coal had a water component and a rail component. Transportation costs for limestone had a water cost and a truck cost component. Total yearly transportation costs for iron ore, coal and limestone, for a range of Ashtabula Harbor channel depths, were developed for each commodity origin/destination pair shown in Table S1.2. Table S1.6 presented annual water transportation costs at Ashtabula Harbor for the three commodities for Ashtabula channel depths ranging from 28 feet to 15 feet measured from Low Water Datum.

Weighted rail costs per ton were developed for iron ore and coal movements through Ashtabula Harbor, in Table S1.8. These weighted rail costs per ton were then multiplied by the number of tons moved on a given origin/destination. This resulted in annual rail costs associated with moving iron ore and coal through Ashtabula Harbor. Table S1.9 presented rail costs associated with using Ashtabula Harbor for each of the origin/destination routes evaluated. These fixed rail costs were then added to the water costs by channel depth presented in Table S1.6, to arrive at total transportation costs associated with using Ashtabula Harbor over the 50 year evaluation period, given "Without Project" conditions. These total annual transportation costs for iron ore and coal, by channel depth, are summarized in Table S1.13.

Total "Without Project" condition transportation costs for limestone, associated with using Ashtabula Harbor over the 50 year evaluation period, are composed of water costs and truck costs. Water limestone transportation costs, by origin/destination, associated with using Ashtabula Harbor under varying channels depths, is presented in Table S1.6. Limestone truck transportation costs, by origin/destination, associated with using Ashtabula as the transshipment port, are presented in Table S1.9. These water and truck limestone transportation costs were added together and are presented in Table S1.13, by channel depth.

TABLE S1.12 - "WITHOUT" PROJECT CONDITION ASHTABULA HARBOR SHOALING RATES, AND CHANNEL DEPTHS BY PROJECT EVALUATION YEAR.

CALENDAR YEAR	EVALUATION YEAR	OUTER HARBOR SHOALING RATE	OUTER HARBOR CHANNEL DEPTH	RIVER SHOALING RATE	RIVER CHANNEL DEPTH
2006	1	0.5	28.0	.33	27.0
2007	2	0.5	27.5	.33	26.6
2008	3	0.5	27.0	.33	26.3
2009	4	0.5	26.5	.33	26.0
2010	5	0.5	26.0	.33	25.6
2011	6	0.5	25.5	.33	25.3
2012	7	0.5	25.0	.33	25.0
2013	8	0.5	24.5	.33	24.6
2014	9	0.5	24.0	.33	24.3
2015	10	0.5	23.5	.33	24.0
2016	11	0.5	23.0	.33	23.6
2017	12	0.5	22.5	.33	23.3
2018	13	0.5	22.0	.33	23.0
2019	14	0.5	21.5	.33	22.6
2020	15	0.5	21.0	.33	22.3
2021	16	0.5	20.5	.33	22.0
2022	17	0.5	20.0	.33	21.6
2023	18	0.5	19.5	.33	21.3
2024	19	0.5	19.0	.33	21.0
2025	20	0.5	18.5	.33	20.6
2026	21	0.5	18.0	.33	20.3
2027	22	0.5	17.5	.33	20.0
2028	23	0.5	17.0	.33	19.6
2029	24	0.0	17.0	.33	19.3
2030	25	0.0	17.0	.33	19.0
2031	26	0.0	17.0	.33	18.6
2032	27	0.0	17.0	.33	18.3
2033	28	0.0	17.0	.33	18.0
2034	29	0.0	17.0	.33	17.6
2035	30	0.0	17.0	.33	17.3
2036	31	0.0	17.0	.00	17.0
2037	32	0.0	17.0	.00	17.0
2038	33	0.0	17.0	.00	17.0
2039	34	0.0	17.0	.00	17.0
2040	35	0.0	17.0	.00	17.0
2041	36	0.0	17.0	.00	17.0
2042	37	0.0	17.0	.00	17.0
2043	38	0.0	17.0	.00	17.0
2044	39	0.0	17.0	.00	17.0
2045	40	0.0	17.0	.00	17.0
2046	41	0.0	17.0	.00	17.0
2047	42	0.0	17.0	.00	17.0
2048	43	0.0	17.0	.00	17.0
2049	44	0.0	17.0	.00	17.0
2050	45	0.0	17.0	.00	17.0
2051	46	0.0	17.0	.00	17.0
2052	47	0.0	17.0	.00	17.0
2053	48	0.0	17.0	.00	17.0
2054	49	0.0	17.0	.00	17.0
2055	50	0.0	17.0	.00	17.0

TABLE S1.13-TOTAL (WATER AND RAIL/TRUCK) TRANSPORTATION COSTS ASSOCIATED WITH USING ASHTABULA HARBOR BY CHANNEL DEPTH.

1. TOTAL TRANSPORTATION COSTS (WATER AND RAIL)- IRON ORE.

ASHTABULA HARBOR CHANNEL DEPTH	DULUTH MINNESOTA	ESCANABA MICHIGAN	PRESQUE ISLE MICHIGAN	SAINT LAWRENCE RIVER	SILVER BAY MINNESOTA	SUPERIOR WISCONSIN	TWO HARBORS MINNESOTA	TOTAL WOP IRON ORE TRANSPORTATION COSTS
TONS	193,190	201,222	2,000,902	377,445	220,928	1,348,175	27,690	4,369,552
28	$2,512,700	$1,904,300	21,745,900	$5,277,000	$2,312,000	$14,935,200	$400,100	$49,087,200
27	$2,512,700	$1,904,300	$21,745,900	$5,277,000	$2,312,000	$14,935,200	$400,100	$49,087,200
26	$2,517,700	$1,916,300	$21,777,900	$5,287,000	$2,315,000	$14,955,200	$400,100	$49,169,200
25	$2,541,700	$1,951,300	$21,954,900	$5,347,000	$2,333,000	$15,071,200	$404,100	$49,603,200
24	$2,598,700	$1,999,300	$22,378,900	$5,488,000	$2,376,000	$15,342,200	$413,100	$50,596,200
23	$2,685,700	$2,054,300	$23,034,900	$5,695,000	$2,440,000	$15,755,200	$427,100	$52,092,200
22	$2,794,700	$2,118,300	$23,854,900	$5,943,000	$2,522,000	$16,262,200	$445,100	$53,940,200
21	$2,922,700	$2,189,300	$24,807,900	$6,226,000	$2,616,000	$16,848,200	$466,100	$56,076,200
20	$3,070,700	$2,271,300	$25,911,900	$6,551,000	$2,723,000	$17,522,200	$490,100	$58,540,200
19	$3,241,700	$2,365,300	$27,201,900	$6,929,000	$2,847,000	$18,391,200	$518,100	$61,494,200
18	$3,445,700	$2,474,300	$28,689,900	$7,375,000	$2,990,000	$19,186,200	$551,100	$64,712,200
17	$3,691,700	$2,602,300	$30,555,900	$7,903,000	$3,159,000	$20,230,200	$591,100	$68,733,200
16	$3,990,700	$2,754,300	$32,790,900	$8,545,000	$3,363,000	$21,472,200	$639,100	$73,555,200
15	$4,367,700	$2,940,300	$35,588,900	$9,340,000	$3,610,000	$22,976,200	$699,100	$79,522,200
<u>CLEVELAND TRANSPORTATION COSTS</u>								
WATER	$ 1,610,000	$ 974,000	$12,417,000	$3,831,000	$1,302,000	$8,768,000	$268,000	$29,170,000
RAIL	$ 889,400	$ 926,400	$ 9,212,200	$1,737,800	$1,017,200	$6,207,000	$127,500	$20,117,500
	$2,499,400	$1,900,400	$21,629,200	$5,568,800	$2,319,200	$14,975,000	$395,500	$49,287,500
ASHTABULA HARBOR CHANNEL DEPTH AT WHICH SWITCH IS MADE	28.00	27.00	28.00	23.61	25.77	25.83	28.00	25.73
ASHTABULA HARBOR- STARTING CHANNEL DEPTH	28.00	27.00	28.00	27.00	28.00	27.00	28.00	
CHANNEL SHOALING RATE-FEET PER YEAR	.50	.50	.50	.50	.50	.50	.50	

2. TOTAL TRANSPORTATION COSTS (WATER AND RAIL)- COAL

ASHTABULA HARBOR CHANNEL DEPTH	ADVANCE MICHIGAN	BATH ONTARIO	CHARLEVOIX MICHIGAN	CLARKSON ONTARIO	COURTWRIGHT ONTARIO	DETROIT MICHIGAN	DUNKIRK NEW YORK	GLADSTONE MICHIGAN
TONS	79,830	54,416	180,328	117,483	428,056	35,972	20,905	17,951
28	$1,742,800	$ 875,800	$3,313,300	$1,809,300	$6,128,700	$536,000	$293,500	$391,100
27	$1,742,800	$ 875,800	$3,313,300	$1,809,300	$6,128,700	$536,000	$293,500	$391,100
26	$1,742,800	$ 875,800	$3,313,300	$1,809,300	$6,129,700	$536,000	$293,500	$391,100
25	$1,742,800	$ 877,800	$3,313,300	$1,809,300	$6,134,700	$536,000	$293,500	$391,100
24	$1,742,800	$ 881,800	$3,313,300	$1,811,300	$6,154,700	$536,000	$293,500	$391,100
23	$1,742,800	$ 891,800	$3,313,300	$1,816,300	$6,193,700	$536,000	$293,500	$391,100
22	$1,742,800	$ 904,800	$3,315,300	$1,830,300	$6,248,700	$536,000	$293,500	$391,100
21	$1,742,800	$ 920,800	$3,322,300	$1,853,300	$6,313,700	$536,000	$293,500	$391,100
20	$1,747,800	$ 938,800	$3,348,300	$1,882,300	$6,389,700	$536,000	$293,500	$393,100
19	$1,767,800	$ 960,800	$3,406,300	$1,916,300	$6,477,700	$538,000	$293,500	$399,100
18	$1,814,800	$ 985,800	$3,495,300	$1,957,300	$6,580,700	$543,000	$293,500	$411,100
17	$1,886,800	$1,014,800	$3,607,300	$2,005,300	$6,703,700	$553,000	$293,500	$429,100
16	$1,981,800	$1,051,800	$3,744,300	$2,063,300	$6,852,700	$565,000	$294,500	$453,100
15	$2,102,800	$1,095,800	$3,910,300	$2,135,300	$7,036,700	$580,000	$295,500	$482,100
CONNEAUT TRANSPORTATION COSTS								
WATER	$831,000	$ 236,000	$1,239,000	$ 428,000	$1,195,000	$127,000	$ 45,000	$185,000
RAIL	$962,000	$ 655,700	$2,173,000	$1,415,700	$5,158,200	$433,500	$251,900	$216,300
	$1,793,000	$ 891,700	$3,412,000	$1,843,700	$6,353,200	$560,500	$296,900	$401,300
ASHTABULA HARBOR CHANNEL DEPTH AT WHICH SWITCH IS MADE	18.46	23.01	18.94	21.42	20.48	16.38	15.00	18.82
ASHTABULA HARBOR-STARTING CHANNEL DEPTH	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
CHANNEL SHOALING RATE-FEET PER YEAR	.33	.33	.33	.33	.33	.33	.33	.33

TABLE S1.13-CONTINUED

2. TOTAL TRANSPORTATION COSTS (WATER AND RAIL)- COAL (Continued)

ASHTABULA HARBOR CHANNEL DEPTH	GRAND HAVEN MICHIGAN	GREEN BAY WISCONSIN	MANISTEE HARBOR MICHIGAN	MARINETTE WISCONSIN	MARYSVILLE MICHIGAN	MILWAUKEE WISCONSIN	NANTICOKE ONTARIO	NIAGARA RIVER NEW YORK	ONTONAGON HARBOR MICHIGAN
TONS	11,597	280,760	78,659	14,425	14,133	493,786	939,672	101,579	32,393
28	$294,100	$6,662,100	$1,699,200	$324,000	$218,600	$11,170,200	$12,448,500	$1,477,100	$ 802,300
27	$294,100	$6,662,100	$1,699,200	$324,000	$218,600	$11,170,200	$12,448,500	$1,477,100	$ 802,300
26	$294,100	$6,662,100	$1,699,200	$324,000	$218,600	$11,170,200	$12,448,500	$1,477,100	$ 802,300
25	$294,100	$6,662,100	$1,699,200	$324,000	$218,600	$11,170,200	$12,452,500	$1,477,100	$ 802,300
24	$294,100	$6,662,100	$1,699,200	$324,000	$218,600	$11,170,200	$12,469,500	$1,477,100	$ 802,300
23	$294,100	$6,662,100	$1,699,200	$324,000	$218,600	$11,170,200	$12,510,500	$1,477,100	$ 802,300
22	$294,100	$6,662,100	$1,699,200	$324,000	$218,600	$11,171,200	$12,565,500	$1,477,100	$ 802,300
21	$294,100	$6,663,100	$1,699,200	$324,000	$219,600	$11,185,200	$12,629,500	$1,477,100	$ 802,300
20	$294,100	$6,681,100	$1,703,200	$325,000	$219,600	$11,262,200	$12,703,500	$1,480,100	$ 805,300
19	$294,100	$6,763,100	$1,719,200	$327,000	$222,600	$11,486,200	$12,790,500	$1,490,100	$ 815,300
18	$294,100	$6,961,100	$1,764,200	$336,000	$226,600	$11,896,200	$12,895,500	$1,508,100	$ 840,300
17	$296,100	$7,278,100	$1,837,200	$350,000	$231,600	$12,467,200	$13,014,500	$1,533,100	$ 880,300
16	$309,100	$7,691,100	$1,935,200	$370,000	$238,600	$13,196,200	$13,163,500	$1,565,100	$ 933,300
15	$330,100	$8,210,100	$2,061,200	$396,000	$247,600	$14,122,200	$13,347,500	$1,605,100	$1,001,300
CONNEAUT TRANSPORTATION COSTS									
WATER	$162,000	$3,453,000	$ 798,000	$159,000	$ 57,000	$ 5,575,000	$ 1,410,000	$ 275,000	$ 451,000
RAIL	$139,700	$3,383,200	$ 947,900	$173,800	$170,300	$ 5,950,300	$11,323,300	$1,224,100	$ 390,300
	$301,700	$6,836,200	$1,745,900	$332,800	$227,300	$11,525,300	$12,733,300	$1,499,100	$ 841,300
ASHTABULA HARBOR CHANNEL DEPTH AT WHICH SWITCH IS MADE	16.57	18.63	18.41	18.36	17.86	18.90	19.66	18.50	17.98
ASHTABULA HARBOR- STARTING CHANNEL DEPTH	27.00	27.00	27.00	27.00	28.00	27.00	27.00	27.00	27.00
CHANNEL SHOALING RATE- FEET PER YEAR	.33	.33	.33	.33	.50	.33	.33	.33	.33

2. TOTAL TRANSPORTATION COSTS (WATER AND RAIL)- COAL (Continued)

ASHTABULA HARBOR CHANNEL DEPTH	PICTON ONTARIO	PORT STANLEY ONTARIO	PORT WASHINGTON WISCONSIN	PRESQUE ISLE MICHIGAN	ST. CLAIR MICHIGAN	ST. LAW RIVER & ABOVE	SUPERIOR WISCONSIN	THUNDER BAY ONTARIO	TOTAL COAL TRANSPORTATION COSTS
TONS	153,073	66,761	334,574	494,778	306,505	336,235	33,936	195,657	4,823,464
28	$2,454,900	$875,600	$7,180,900	$ 8,535,800	$4,492,900	$6,485,200	$ 869,300	$3,757,900	$ 84,839,100
27	$2,454,900	$875,600	$7,180,900	$ 8,535,800	$4,492,900	$6,485,200	$ 869,300	$3,757,900	$ 84,839,100
26	$2,455,900	$875,600	$7,180,900	$ 8,539,800	$4,492,900	$6,486,200	$ 869,300	$3,757,900	$ 84,846,100
25	$2,458,900	$875,600	$7,180,900	$ 8,560,800	$4,492,900	$6,501,200	$ 869,300	$3,766,900	$ 84,905,100
24	$2,470,900	$875,600	$7,180,900	$ 8,609,800	$4,492,900	$6,553,200	$ 869,300	$3,796,900	$ 85,091,100
23	$2,496,900	$875,600	$7,180,900	$ 8,686,800	$4,492,900	$6,664,200	$ 869,300	$3,859,900	$ 85,463,100
22	$2,533,900	$876,600	$7,181,900	$ 8,787,800	$4,496,900	$6,818,200	$ 869,300	$3,947,900	$ 85,989,100
21	$2,577,900	$877,600	$7,193,900	$ 8,924,800	$4,509,900	$7,000,200	$ 870,300	$4,051,900	$ 86,674,100
20	$2,628,900	$880,600	$7,246,900	$ 9,106,800	$4,539,900	$7,211,200	$ 877,300	$4,173,900	$ 87,669,100
19	$2,688,900	$884,600	$7,387,900	$ 9,325,800	$4,583,900	$7,456,200	$ 897,300	$4,314,900	$ 89,207,100
18	$2,756,900	$888,600	$7,630,900	$ 9,581,800	$4,643,900	$7,742,200	$ 935,300	$4,479,900	$ 91,463,100
17	$2,839,900	$895,600	$7,962,900	$ 9,883,800	$4,721,900	$8,084,200	$ 988,300	$4,675,900	$ 94,434,100
16	$2,939,900	$902,600	$8,379,900	$10,243,800	$4,817,900	$8,498,200	$1,054,300	$4,914,900	$ 98,160,100
15	$3,062,900	$911,600	$8,902,900	$10,676,800	$4,935,900	$9,010,200	$1,138,300	$5,209,900	$102,808,100
CONNEAUT TRANSPORTATION COSTS									
WATER	$ 656,000	$108,000	$3,339,000	$ 2,822,000	$ 965,000	$2,532,000	$ 480,000	$1,500,000	$ 29,028,000
RAIL	$1,844,600	$804,500	$4,031,700	$ 5,962,200	$3,693,500	$4,051,700	$ 408,900	$2,357,700	$ 58,124,000
	$2,500,600	$912,500	$7,370,700	$ 8,784,200	$4,658,500	$6,583,700	$ 888,900	$3,857,700	$ 87,152,000
ASHTABULA HARBOR CHANNEL DEPTH AT WHICH SWITCH IS MADE	22.90	15.00	19.12	22.04	17.81	23.73	19.42	23.03	20.52
ASHTABULA HARBOR-STARTING CHANNEL DEPTH	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00	
CHANNEL SHOALING RATE- FEET PER YEAR	.33	.33	.33	.33	.33	.33	.33	.33	

TABLE S1.13-CONTINUED

3. TOTAL TRANSPORTATION COSTS (WATER AND TRUCK)- Limestone

TONS	177,817	103,491	315,986	70,004	667,298
ASHTABULA HARBOR CHANNEL DEPTH	CALCITE MICHIGAN	PORT MARBLEHEAD OHIO	INLAND MICHIGAN	STONEPORT MICHIGAN	TOTAL LIMESTONE TRANSPORTATION COSTS
28	$1,445,500	$551,700	$2,660,000	$659,000	$5,316,200
27	$1,445,500	$551,700	$2,660,000	$659,000	$5,316,200
26	$1,447,500	$551,700	$2,664,000	$659,000	$5,322,200
25	$1,461,500	$552,700	$2,681,000	$659,000	$5,354,200
24	$1,491,500	$552,700	$2,721,000	$659,000	$5,424,200
23	$1,539,500	$553,700	$2,788,000	$660,000	$5,541,200
22	$1,600,500	$556,700	$2,879,000	$661,000	$5,697,200
21	$1,675,500	$564,700	$2,990,000	$666,000	$5,896,200
20	$1,761,500	$575,700	$3,120,000	$677,000	$6,134,200
19	$1,863,500	$589,700	$3,271,000	$701,000	$6,425,200
18	$1,985,500	$606,700	$3,445,000	$739,000	$6,776,200
17	$2,131,500	$626,700	$3,652,000	$788,000	$7,198,200
16	$2,313,500	$651,700	$3,900,000	$848,000	$7,713,200
15	$2,544,500	$683,700	$4,203,000	$924,000	$8,355,200
CONNEAUT TRANSPORTATION COSTS					
WATER	$1,027,000	$310,000	$1,907,000	$497,000	$3,741,000
TRUCK	$ 586,800	$341,500	$1,042,800	$231,000	$2,202,100
	$1,613,800	$651,500	$2,949,800	$728,000	$5,943,100
ASHTABULA HARBOR CHANNEL DEPTH AT WHICH SWITCH IS MADE					
	21.82	16.01	21.36	18.29	20.80
ASHTABULA HARBOR- STARTING CHANNEL DEPTH					
	28.00	28.00	28.00	18.00	
CHANNEL SHOALING RATE- FEET PER YEAR					
	.50	.50	.50	.33	

4. TOTAL TRANSPORTATION COSTS.

ASHTABULA HARBOR CHANNEL DEPTH	TOTAL IRON ORE TRANSPORT COSTS	TOTAL COAL TRANSPORT COSTS	TOTAL LIMESTONE TRANSPORT COSTS	TOTAL TRANSPORT COSTS
28	$49,087,200	$ 84,839,100	$5,316,200	$139,242,500
27	$49,087,200	$ 84,839,100	$5,316,200	$139,242,500
26	$49,169,200	$ 84,846,100	$5,322,200	$139,337,500
25	$49,603,200	$ 84,905,100	$5,354,200	$139,862,500
24	$50,596,200	$ 85,091,100	$5,424,200	$141,111,500
23	$52,092,200	$ 85,463,100	$5,541,200	$143,096,500
22	$53,940,200	$ 85,989,100	$5,697,200	$145,626,500
21	$56,076,200	$ 86,674,100	$5,896,200	$148,646,500
20	$58,540,200	$ 87,669,100	$6,134,200	$152,343,500
19	$61,494,200	$ 89,207,100	$6,425,200	$157,126,500
18	$64,712,200	$ 91,463,100	$6,776,200	$162,951,500
17	$68,733,200	$ 94,434,100	$7,198,200	$170,365,500
16	$73,555,200	$ 98,160,100	$7,713,200	$179,428,500
15	$79,522,200	$102,808,100	$8,355,200	$190,685,500

e. Total Yearly Transportation Costs Associated With Using An Alternate Port. Yearly total transportation costs were recomputed for each origin/destination commodity pair, by commodity, assuming the commodities would be sourced through Conneaut for coal and limestone, and through Cleveland for iron ore. For iron ore and coal, total transportation costs associated with using an alternate port would have a water component and a rail component. For limestone, total transportation costs associated with using an alternate port are composed of water costs and a truck cost.

For limestone, it is assumed the end users in the local Ashtabula area, will still need limestone, even though the water portion of the commodity movement is now assumed to pass through the port of Conneaut. Limestone is now delivered to Conneaut Harbor by vessel. Now the limestone must be moved to the end users located in the Ashtabula area. In order to get the limestone from Conneaut to Ashtabula, it is assumed the limestone is moved by truck. Thus total transportation costs for limestone, associated with using an alternate port, is composed of a water cost to Conneaut and a truck cost from Conneaut to limestone end users located in Ashtabula.

Table S1.14 summarizes total yearly transportation costs associated with using an alternate port. Annual alternate port water costs came to $61,939,000. Annual alternate port rail/truck costs came to $80,443,600. Total annual alternate port transportation costs came to $142,382,600. The derivation of these various water, rail and truck costs follows.

(1). Water Costs Associated With Using An Alternate Port. The two water transportation cost models were rerun using Conneaut and Cleveland as the transshipment port. Water transportation costs were rerun for iron ore, coal and limestone. Distances between the origin/destination pairs were recalculated, based on using Conneaut as the transshipment port for coal and limestone and Cleveland as the transshipment port for iron ore. This added essentially 26 miles to each round trip water route for coal and limestone. For iron ore, the round trip distance was decreased by 86 miles.

The tonnages, vessels used, tons moved by origin/destination pair, and vessel operating costs were the same as used in calculating "With Project" condition transportation costs. Harbor depths at Cleveland and Conneaut were assumed to be 28 feet and 27 feet respectively, measured from Low Water Datum. These water transportation costs associated with using Cleveland Harbor and Conneaut Harbor, are presented in Table S 1.14. They are also located in Table S 1.13 under the heading "Cleveland Transportation Costs-Water" and "Conneaut Transportation Costs-Water".

(2). Rail Costs Associated With Using An Alternate Port. Total rail costs were calculated for iron ore and coal, using Cleveland and Conneaut Harbor respectively, as the transshipment port. It was assumed the iron ore destination areas (Youngstown Ohio, Wierton, West Virginia) and the coal origin areas (Masontown, Pennsylvaniaa.; Cornelia, West Virginia; Wanna, West

TABLE S1.14- ANNUAL WITHOUT PROJECT CONDITION WATER AND RAIL/TRUCK TRANSPORTATION COSTS FOR IRON ORE, COAL AND LIMESTONE-VIA CLEVELAND & CONNEAUT HARBOR

ORIGIN DESTINATION PAIR	ANNUAL WATER COSTS	ANNUAL RAIL COSTS	TOTAL ANNUAL TRANSPORTATION COSTS
IRON ORE-ALTERNATE PORT-CLEVELAND			
DULUTH, MINNESOTA	$ 1,610,000	$ 889,400	$ 2,499,400
ESCANABA, MICHIGAN	$ 974,000	$ 926,400	$ 1,900,400
PRESQUE ISLE, MICHIGAN	$12,417,000	$ 9,212,200	$21,629,200
ST. LAWRENCE RIVER	$ 3,831,000	$ 1,737,800	$ 5,568,800
SILVER BAY, MINNESOTA	$ 1,302,000	$ 1,017,200	$ 2,319,200
SUPERIOR WISCONSIN	$ 8,768,000	$ 6,207,000	$14,975,000
TWO HARBORS MINNESOTA	$ 268,000	$ 127,500	$ 395,500
	$29,170,000	$20,117,500	$49,287,500
COAL-ALTERNATE PORT-CONNEAUT			
ADVANCE, MICHIGAN	$ 831,000	$ 962,000	$ 1,793,000
BATH, ONTARIO	$ 236,000	$ 655,700	$ 891,700
CHARLEVOIX, MICHIGAN	$ 1,239,000	$ 2,173,000	$ 3,412,000
CLARKSON, ONTARIO	$ 428,000	$ 1,415,700	$ 1,843,700
COURTWRIGHT, ONTARIO	$ 1,195,000	$ 5,158,200	$ 6,353,200
DETROIT, MICHIGAN	$ 127,000	$ 433,500	$ 560,500
DUNKIRK, NEW YORK	$ 45,000	$ 251,900	$ 296,900
GLADSTONE, MICHIGAN	$ 185,000	$ 216,300	$ 401,300
GRAND HAVEN, MICHIGAN	$ 162,000	$ 139,700	$ 301,700
GREENBAY, WISCONSIN	$ 3,453,000	$ 3,383,200	$ 6,836,200
MANISTEE HARBOR, MICHIGAN	$ 798,000	$ 947,900	$ 1,745,900
MARINETTE, WISCONSIN	$ 159,000	$ 173,800	$ 332,800
MARYSVILLE, MICHIGAN	$ 57,000	$ 170,300	$ 227,300
MILWAUKEE, WISCONSIN	$ 5,575,000	$ 5,950,300	$11,525,300
NANTICOKE, ONTARIO	$ 1,410,000	$11,323,300	$12,733,300
NIAGARA RIVER, NEW YORK	$ 275,000	$ 1,224,100	$ 1,499,100
ONTONAGON HARBOR, MICHIGAN	$ 451,000	$ 390,300	$ 841,300
PICTON, ONTARIO	$ 656,000	$ 1,844,600	$ 2,500,600
PORT STANLEY, ONTARIO	$ 108,000	$ 804,500	$ 912,500
PORT WASHINGTON, WI	$ 3,339,000	$ 4,031,700	$ 7,370,700
PRESQUE ISLE, MICHIGAN	$ 2,822,000	$ 5,962,200	$ 8,784,200
ST. CLAIR, MICHIGAN	$ 965,000	$ 3,693,500	$ 4,658,500
ST. LAWRENCE RIVER & ABOVE	$ 2,532,000	$ 4,051,700	$ 6,583,700
SUPERIOR WISCONSIN	$ 480,000	$ 408,900	$ 888,900
THUNDERBAY, ONTARIO	$ 1,500,000	$ 2,357,700	$ 3,857,700
	$29,028,000	$58,124,000	$87,152,000
LIMESTONE-ALTERNATE PORT=CONNEAUT	ANNUAL WATER COSTS	ANNUAL TRUCK COSTS	ANNUAL TOTAL COSTS
CALCITE, MICHIGAN	$ 1,027,000	$ 586,800	$ 1,613,800
MARBLEHEAD, OHIO	$ 310,000	$ 341,500	$ 651,500
PORT INLAND, MICHIGAN	$ 1,907,000	$ 1,042,800	$ 2,949,800
STONEPORT, MICHIGAN	$ 497,000	$ 231,000	$ 728,000
	$ 3,741,000	$ 2,202,100	$ 5,943,100
TOTAL ALT PORT TRANSPORTATION COSTS	$61,939,000	$80,443,600	$142,382,600

Virginia and Powhatan, Ohio) would still be used even though the commodities now moved through Cleveland and Conneaut Harbor respectively. Rail costs per ton associated with using the alternate ports were obtained from the Tennessee Valley Authority and are summarized in Table S1.15.

These rail costs per ton were weighted by the number of tons going to/coming from the destination/origin areas in 1994. These calculations are presented in Table S1.16. This resulted in weighted rail costs per ton associated with using the alternate ports. Weighted rail costs for iron ore and coal, associated with using Cleveland Harbor and Conneaut Harbor as the transshipment point, came to $4.60 and $12.05 respectively.

The rail costs associated with the various origin/destination routes can now be calculated for using Cleveland Harbor and Conneaut Harbor as the transshipment port. These rail costs are simply the number of tons associated with each origin/destination route during the 1994 commercial navigation season times the weighted rail cost per ton by commodity associated with using Cleveland Harbor or Conneaut Harbor as the transshipment port. This procedure is presented in Table S1.17 and summarized in Table S1.13 under the headings "Cleveland Transportation Costs-Rail" and "Conneaut Transportation Costs-Rail". "Without Project" condition iron ore rail costs associated with using Cleveland Harbor came to $20,117,500. "Without Project" condition coal rail costs associated with using Conneaut Harbor came to $58,124,000.

(3). Truck Costs Associated With Using An Alternate Port. The end users of limestone are located in the general area of Ashtabula Harbor. Consequently, if the water portion of the transportation leg takes the commodity to Conneaut, the limestone must then be transported from Conneaut to the location of the end users: Ashtabula Harbor. This movement can be made by truck or by rail. Truck costs were developed for sourcing limestone from Conneaut to end users located in the Ashtabula Area. In order to service the Ashtabula area limestone users from Conneaut, it was assumed the service area would now be 33 miles, as compared to 25 miles under "With Project" conditions. Given a service distance of 33 miles, a $55 per hour truck cost, an average speed of 50 miles per hour on the route, and 22 tons per trip, the cost per ton came to $3.30 when sourcing limestone from Conneaut. Compared to rail costs from Conneaut to Ashtabula to move limestone, the truck cost was lower. Consequently truck costs of $3.30 was used as the land transportation cost associated with sourcing limestone through Conneaut.

Now truck transportation costs, by origin destination, can be developed given the alternate port is Conneaut. Limestone trucking costs via Conneaut, by origin/destination port, are simply truck costs per ton associated with using Conneaut Harbor, times the number of tons moved over the origin/destination route. This procedure is presented in Table S1.17 and summarized in Table S1.13, "Section 3, Conneaut Transportation Costs, Truck". Total annual limestone truck costs associated with using Conneaut Harbor came to $2,202,100.

TABLE S1.15. RAIL COSTS PER TON BY RAIL ROUTE FOR ALTERNATE PORTS: CLEVELAND AND CONNEAUT HARBOR.

	Rail $/Ton	Carrier
1. IRON ORE		
Rail Costs From Cleveland Harbor Ohio, To:		
Youngstown, Ohio	$ 5.27	Conrail
Wierton, West Virginia	$ 4.16	Conrail
2. COAL		
Rail Costs To Conneaut Harbor Ohio, From:		
Masontown, Pennsylvania	$10.29	Conrail
Cornelia, West Virginia	$16.27	Conrail
Wanna, West Virginia	$11.00	Conrail
Powhatan, Ohio	$10.49	Conrail

TABLE S1.16. WEIGHTED RAIL COSTS PER TON, VIA CONNEAUT AND CLEVELAND, BY RAIL ROUTE.

1. IRON ORE- Rail Costs From Cleveland Harbor Ohio, To:

Destination	1994 Tons	Percent Of Total Tons By Destin	Cleveland Rail $/Ton	Weighted Cleveland Rail Costs By Destin/Org
A. IRON ORE				
Youngstown, Ohio	4,369,552	40%	$5.27	$2.10
Wierton, W. Virginia	4,369,552	60%	$4.16	$2.50

				$4.60

2. COAL- Rail Costs To Conneaut Ohio, From:

Origin	1994 Tons	Percent Of Total Tons By Destin	Conneaut Rail $/Ton	Weighted Conneaut Rail Costs By Destin/Org
B. COAL				
Masontown, PA	4,823,464	35%	$10.29	$ 3.60
Cornelia,W. VA	4,823,464	26%	$16.27	$ 4.23
Wanna, W. VA	4,823,464	25%	$11.00	$ 2.75
Powhatan, OH	4,823,464	14%	$10.49	$ 1.47

				$12.05

TABLE S 1.17- ALTERNATE PORT WITHOUT PROJECT CONDITION RAIL TRANSPORTATION COSTS-IRON ORE, COAL, LIMESTONE

ORIGIN PORT	TONS OF IRON ORE BY OD PAIR	% OF TOTAL TONS OF IRON ORE BY OD PAIR	TOTAL WITHOUT PROJECT IRON ORE COSTS PER TON	WITHOUT PROJECT IRON ORE RAIL COSTS
WITHOUT PROJECT CONDITION RAIL TRANSPORTATION COSTS-IRON ORE-CLEVELAND				
DULUTH, MINNESOTA	193,190	4.42%	$4.60	$ 889,400
ESCANABA, MICHIGAN	201,222	4.61%	$4.60	$ 926,400
PRESQUE ISLE, MICHIGAN	2,000,902	45.79%	$4.60	$ 9,212,200
ST. LAWRENCE RIVER	377,445	8.64%	$4.60	$ 1,737,800
SILVER BAY, MINNESOTA	220,928	5.06%	$4.60	$ 1,017,200
SUPERIOR WISCONSIN	1,348,175	30.85%	$4.60	$ 6,207,000
TWO HARBORS MINNESOTA	27,690	0.63%	$4.60	$ 127,500
	4,369,552	100.00%		$20,117,500

WITHOUT PROJECT CONDITION RAIL TRANSPORTATION COSTS-COAL-CONNEAUT

	TONS OF COAL BY OD PAIR	% OF TOTAL TONS OF COAL BY OD PAIR	WITHOUT PROJECT COAL RAIL COSTS PER TON	TOTAL WITHOUT PROJECT COAL RAIL COSTS
ADVANCE, MICHIGAN	79,830	1.66%	$12.05	$ 962,000
BATH, ONTARIO	54,416	1.13%	$12.05	$ 655,700
CHARLEVOIX, MICHIGAN	180,328	3.74%	$12.05	$ 2,173,000
CLARKSON, ONTARIO	117,483	2.44%	$12.05	$ 1,415,700
COURTWRIGHT, ONTARIO	428,056	8.87%	$12.05	$ 5,158,200
DETROIT, MICHIGAN	35,972	0.75%	$12.05	$ 433,500
DUNKIRK, NEW YORK	20,905	0.43%	$12.05	$ 251,900
GLADSTONE, MICHIGAN	17,951	0.37%	$12.05	$ 216,300
GRAND HAVEN, MICHIGAN	11,597	0.24%	$12.05	$ 139,700
GREENBAY, WISCONSIN	280,760	5.82%	$12.05	$ 3,383,200
MANISTEE HARBOR, MICHIGAN	78,659	1.63%	$12.05	$ 947,900
MARINETTE, WISCONSIN	14,425	0.30%	$12.05	$ 173,800
MARYSVILLE, MICHIGAN	14,133	0.29%	$12.05	$ 170,300
MILWAUKEE, WISCONSIN	493,786	10.24%	$12.05	$ 5,950,300
NANTICOKE, ONTARIO	939,672	19.48%	$12.05	$11,323,300
NIAGARA RIVER, NEW YORK	101,579	2.11%	$12.05	$ 1,224,100
ONTONAGON HARBOR, MICHIGAN	32,393	0.67%	$12.05	$ 390,300
PICTON, ONTARIO	153,073	3.17%	$12.05	$ 1,844,600
PORT STANLEY, ONTARIO	66,761	1.38%	$12.05	$ 804,500
PORT WASHINGTON, WI	334,574	6.94%	$12.05	$ 4,031,700
PRESQUE ISLE, MICHIGAN	494,778	10.26%	$12.05	$ 5,962,200
ST. CLAIR, MICHIGAN	306,505	6.35%	$12.05	$ 3,693,500
ST. LAWRENCE RIVER & ABOVE	336,235	6.97%	$12.05	$ 4,051,700
SUPERIOR WISCONSIN	33,936	0.70%	$12.05	$ 408,900
THUNDERBAY, ONTARIO	195,657	4.06%	$12.05	$ 2,357,700
	4,823,464	100.00%		$58,124,000

WITHOUT PROJECT CONDITION TRUCK TRANSPORTATION COSTS-LIMESTONE-CONNEAUT

CALCITE, MICHIGAN	177,817	26.65%	$3.30	$ 586,800
MARBLEHEAD, OHIO	103,491	15.51%	$3.30	$ 341,500
PORT INLAND , MICHIGAN	315,986	47.35%	$3.30	$ 1,042,800
STONEPORT, MICHIGAN	70,004	10.49%	$3.30	$ 231,000
	667,298	100.00%		$ 2,202,100

TOTAL ALTERNATE PORT WITHOUT PROJECT CONDITION YEARLY RAIL/TRUCK COSTS $80,443,600

f. Determination Of Whether A Switch Would Be Made To An Alternate Port. Table S1.13 now contains all the ingredients needed to determine whether a switch would be made to an alternate port over the 50 year evaluation period. Table S1.13 has total annual transportation costs (water and rail/truck) associated with staying at Ashtabula Harbor over a range of channel depths. Iron ore and coal total transportation costs, associated with using Ashtabula Harbor throughout the 50 year evaluation period, have a water and a rail component. Limestone total transportation costs, associated with using Ashtabula Harbor throughout the 50 year evaluation period, has a water and a truck component. Assuming channel equilibrium is 17 feet, measured from LWD, the total transportation costs associated with the 17 foot channel depth is the maximum annual transportation cost that would be incurred if bulk commodity users continued to source their bulk commodities through Ashtabula Harbor throughout the 50 year evaluation period.

Table S1.13 also has total transportation costs associated with using the alternate ports: Cleveland Harbor for iron ore and Conneaut Harbor for coal and limestone. For iron ore and coal, these alternate port total transportation costs contain a water and a rail component. For limestone, the alternate port total transportation cost is composed of a water and truck cost. These yearly total transportation costs associated with using the alternate port (Cleveland for iron ore and Conneaut for coal or limestone) were then compared to the range of yearly total transportation costs associated with using Ashtabula Harbor at various channel depths. If the yearly total transportation cost associated with using the alternate port fell within the range of yearly total transportation costs for various Ashtabula Harbor channel depths (28 foot channel depth to a 17 foot channel depth, LWD), then the commodity would switch to using the alternate port. If the transportation costs associated with using Ashtabula Harbor, regardless of channel depth at Ashtabula, were always less than the yearly transportation cost associated with using an alternate port (Cleveland for iron ore and Conneaut for coal or limestone), then the commodity would be sourced through Ashtabula Harbor throughout the 50 year evaluation period.

With respect to iron ore, it was always cheaper to switch to the alternate port, Cleveland. However, this was not always true for coal shipments or limestone receipts. Usage of Ashtabula Harbor for every year in the 50 year evaluation period was less expensive for a number of origin/destination routes, on a total water and rail transportation cost basis, then switching to Conneaut Harbor. Consequently, a number of origin/destination routings for coal and limestone continued to use Ashtabula Harbor throughout the complete 50 year evaluation period under "Without" project conditions.

g. Ashtabula Harbor Depths At Which Tons Will Move Through An Alternate Port. Once it was determined that a switch would be made, the next question would be at what channel depth and in what project year would the switch take place. The channel depth at which Ashtabula's total transportation cost (water and rail/truck costs) equaled the alternate ports (Cleveland, Conneaut) total transportation costs (water and rail/truck costs), was the Ashtabula Harbor channel depth at which shippers would begin to use the alternate port.

This channel depth could be interpolated from the data presented in Table S1.13. This interpolation process is summarized in Table S1.13 under the heading "Ashtabula Harbor Depth At Which Switch Is Made".

This channel depth can now be converted to a project year given the channel starting depth and Table S1.12. Table S1.12 presents Ashtabula Harbor shoaling rates, and the depths of Ashtabula Harbor channels for each year in the 50 year project evaluation period. Given the Ashtabula Harbor dock location associated with servicing a specific origin/destination route, one can determine the starting channel depth in project year one. Given the depth of the channel at the time of the switch, one can use Table S1.12 to determine what project year this channel depth is achieved. This is accomplished by taking the starting channel depth and subtracting from it the yearly shoaling rate. The resulting channel depth is then compared to the channel depth at which the switch takes place. If the resulting channel depth is greater than the switch depth, the process is repeated. This is continued until the channel depth at which the switch is made is reached. One then looks at the project evaluation year that corresponds to that channel depth to find the project evaluation year at which the switch is made.

For example, for coal destined for Advance Michigan, the Ashtabula Harbor channel depth at which the switch to an alternate port (Conneaut) takes place is 18.46 feet. Table S1.12 indicates Ashtabula Rivers starting channel depth is 27 feet. Consequently, given a .33 foot per year shoaling rate on the River, Ashtabula River achieves an 18.46 foot depth in project year 27.

h. Derivation Of "Without Project" Condition Average Annual Total Transportation Costs. "Without Project" condition average annual total transportation costs involve developing a time stream of transportation costs for each commodity origin/destination route, for each mode of transport used. Transportation cost time streams need to be developed for the water portion of the commodity movement, the rail portion of the commodity movement, and the truck portion of the commodity movement for each year of the 50 year evaluation period. These time streams of "Without Project" condition transportation costs can then be converted to an average annual dollar equivalent based on a 7.625 percent annual interest rate, a 50 year project life and May 1996 prices. The development of these transportation costs time streams, by transportation mode, follows.

(1). "Without Project" Condition Average Annual Transportation Costs-Water Leg. The "Without Project" condition water transportation costs will change from year to year over the 50 year evaluation period. This is true whether the specific tonnages associated with various origin/destination routes stay at Ashtabula Harbor over the 50 year evaluation period, or if they switch to an alternate port sometime during the 50 year evaluation period.

If the tonnages from a specific origin/destination route stay at Ashtabula Harbor, shippers will begin to experience decreasing Ashtabula Harbor channel depths: .5 feet or .33 feet per year, starting in project year 1. The decrease in channel depths will continue until the channel reaches its assumed equilibrium channel depth: 17 feet LWD. Decreases in channel depths convert to increases in water transportation costs. Water transportation costs will increase until the Ashtabula Harbor channel reaches its equilibrium level. From this time on, water transportation costs stay constant for the remainder of the project evaluation period. This time stream of water transportation costs must then be converted to average annual "Without Project" condition water leg transportation costs.

"Without Project" condition water transportation costs will also change for origin/destination route tonnages that switch to an alternate port. Water transportation costs equals Ashtabula Harbor water transportation costs associated with available Ashtabula Harbor channel depths up to the time of the switch. After the switch is made, water transportation costs equals water transportation costs associated with using the alternate port. These alternate port water transportation costs will remain constant from the year in which the switch is made to the end of the plan evaluation period. This time stream of water transportation costs must then be converted to average annual "Without Project" condition water leg transportation costs.

i. "Without Project" Condition Average Annual Water Transportation Costs, By Origin Destination. Table S1.6 provided yearly water transportation costs for using Ashtabula Harbor at a range of Ashtabula Harbor channel depths. Table S1.13 provided yearly water transportation costs associated with using the alternate ports- Cleveland and Conneaut Harbor. Table S1.13 also provided the Ashtabula Harbor channel depth at which a switch to an alternate port would be made, if such a switch would be economically feasible. Finally, Table S1.12 provided "Without Project" condition Ashtabula Harbor channel depths for each year of the 50 year evaluation period. Given this data, one can develop the "Without Project" condition time stream of water transportation costs associated with each origin/destination commodity route pairing. "Without Project" condition water transportation cost time streams were developed for each of the 7 iron ore origin/destination routes, each of the 25 coal origin/destination routes and each of the 4 limestone origin\destination routes.

For example, the derivation of average annual "Without Project" condition water transportation costs for coal shipments to Advance, Michigan; will now be discussed. Table S1.18 presents the derivation of the "Without Project" condition coal water transportation cost time stream for this origin/destination route. It also presents the conversion of these annual costs to present worth values and the conversion of these present worth values to average annual dollar values.

Table S1.6 presented water transportation costs associated with moving coal to Advance, Michigan; for a range of Ashtabula Harbor channel depths. Water transportation costs were developed for Ashtabula Harbor channel depths ranging from 28 feet to 15 feet, in one foot increments. These transportation costs by channel depth were used in Table S1.18 to develop water transportation costs for the various channel depths that would occur over the evaluation period under "Without Project" Conditions. Table S1.13 indicated the Ashtabula Harbor channel depth at which a switch would be made was 18.46 feet for this origin/destination route. This channel depth will be reached in project evaluation year 27. At this time, coal would be sourced through Conneaut. The water transportation cost for sourcing coal through Conneaut came to $831,000 (See Table S1.13, Conneaut Transportation Costs-Water.).

Consequently, "Without Project" condition water transportation costs from project year 1 to project year 26 will come from continuing to use Ashtabula Harbor. Table S1.12 provides a summary of Ashtabula Harbor channel depths throughout the 50 year "Without Project" condition evaluation period. Under "Without Project" conditions, in project year 1, Ashtabula's

TABLE S1.18. WITHOUT PROJECT CONDITION AVERAGE ANNUAL WATER TRANSPORTATION COSTS-ADVANCE, MICHIGAN.

ADVANCE, MICHIGAN-COAL SHIPMENTS SWITCH TO CONNEAUT WHEN ASHTABULA'S CHANNEL DEPTH EQUALS 18.46

ALTERNATE PORT=CONNEAUT-TOTAL CONNEAUT TRANSPORTATION COST	$1,792,975
WOP WATER AVERAGE ANNUAL TRANSPORTATION COSTS- 50 YEAR	$ 816,600

ASHTABULA HARBOR WATER TRANSPORTATION COSTS BY CHANNEL DEPTH

CHANNEL DEPTH	WATER TRANS COST	INTERPOLATED WATER TRANS COST
28.0	$813,000	$813,000
27.0	$813,000	$813,000
26.0	$813,000	$813,000
25.0	$813,000	$813,000
24.0	$813,000	$813,000
23.0	$813,000	$813,000
22.0	$813,000	$813,000
21.0	$813,000	$813,000
20.0	$818,000	$818,000
19.0	$838,000	$838,000
18.0	$885,000	$885,000
17.0	$957,000	$957,000

YEAR	PROJECT YEAR	ASHTABULA CHANNEL STARTING DEPTH	AMOUNT SHOALED PER YEAR	ASHTABULA CHANNEL DEPTH BEGINNING OF YEAR	WATER TRANSPORT COSTS	PRESENT WORTH FACTOR	50 YEAR PRESENT WORTH WATER TRANSPORT COSTS
2006	1	27.0	0.333333333	27.0	$813,000	0.92915	$755,401
2007	2	27.0	0.333333333	26.7	$813,000	0.86332	$701,882
2008	3	27.0	0.333333333	26.3	$813,000	0.80216	$652,155
2009	4	27.0	0.333333333	26.0	$813,000	0.74533	$605,952
2010	5	27.0	0.333333333	25.7	$813,000	0.69252	$563,021
2011`	6	27.0	0.333333333	25.3	$813,000	0.64346	$523,132
2012	7	27.0	0.333333333	25.0	$813,000	0.59787	$486,070
2013	8	27.0	0.333333333	24.7	$813,000	0.55551	$451,633
2014	9	27.0	0.333333333	24.3	$813,000	0.51616	$419,635
2015	10	27.0	0.333333333	24.0	$813,000	0.47959	$389,905
2016	11	27.0	0.333333333	23.7	$813,000	0.44561	$362,281
2317	12	27.0	0.333333333	23.3	$813,000	0.41404	$336,614
2018	13	27.0	0.333333333	23.0	$813,000	0.38471	$312,766
2019	14	27.0	0.333333333	22.7	$813,000	0.35745	$290,607
2020	15	27.0	0.333333333	22.3	$813,000	0.33213	$270,018
2021	16	27.0	0.333333333	22.0	$813,000	0.30860	$250,888
2022	17	27.0	0.333333333	21.7	$813,000	0.28673	$233,113
2023	18	27.0	0.333333333	21.3	$813,000	0.26642	$216,598
2024	19	27.0	0.333333333	21.0	$813,000	0.24754	$201,252
2025	20	27.0	0.333333333	20.7	$814,667	0.23000	$187,377
2026	21	27.0	0.333333333	20.3	$816,333	0.21371	$174,458
2027	22	27.0	0.333333333	20.0	$818,000	0.19857	$162,429
2028	23	27.0	0.333333333	19.7	$824,667	0.18450	$152,151
2029	24	27.0	0.333333333	19.3	$831,333	0.17143	$142,515
2030	25	27.0	0.333333333	19.0	$838,000	0.15928	$133,480
2031	26	27.0	0.333333333	18.7	$853,667	0.14800	$126,342
2032	27	27.0	0.333333333	18.3	$831,000	0.13751	$114,274
2033	28	27.0	0.333333333	18.0	$831,000	0.12777	$106,177
2034	29	27.0	0.333333333	17.7	$831,000	0.11872	$98,655
2035	30	27.0	0.333333333	17.3	$831,000	0.11031	$91,666
2036	31	27.0	0.333333333	17.0	$831,000	0.10249	$85,171
2037	32	27.0	0.000000000	17.0	$831,000	0.09523	$79,137
2038	33	27.0	0.000000000	17.0	$831,000	0.08848	$73,530
2039	34	27.0	0.000000000	17.0	$831,000	0.08222	$68,321
2040	35	27.0	0.000000000	17.0	$831,000	0.07639	$63,480
2041	36	27.0	0.000000000	17.0	$831,000	0.07098	$58,983
2042	37	27.0	0.000000000	17.0	$831,000	0.06595	$54,804
2043	38	27.0	0.000000000	17.0	$831,000	0.06128	$50,921
2044	39	27.0	0.000000000	17.0	$831,000	0.05694	$47,314
2045	40	27.0	0.000000000	17.0	$831,000	0.05290	$43,962
2046	41	27.0	0.000000000	17.0	$831,000	0.04915	$40,847
2047	42	27.0	0.000000000	17.0	$831,000	0.04567	$37,953
2048	43	27.0	0.000000000	17.0	$831,000	0.04244	$35,264
2049	44	27.0	0.000000000	17.0	$831,000	0.03943	$32,766
2050	45	27.0	0.000000000	17.0	$831,000	0.03664	$30,444
2051	46	27.0	0.000000000	17.0	$831,000	0.03404	$28,288
2052	47	27.0	0.000000000	17.0	$831,000	0.03163	$26,283
2053	48	27.0	0.000000000	17.0	$831,000	0.02939	$24,421
2054	49	27.0	0.000000000	17.0	$831,000	0.02731	$22,691
2055	50	27.0	0.000000000	17.0	$831,000	0.02537	$21,084
		ACCUMULATED PRESENT WORTH					$10,438,112
		AVG ANNUAL EQUIVL FACTOR					0.07823
		AVERAGE ANNUAL $ VALUE					$816,625

channel depth will be 27 feet. Table S1.6 indicates Advance, Michigan's coal water transportation costs associated with using a 27 foot channel at Ashtabula Harbor equals $813,000. This is the "Without Project" condition water transportation cost for evaluation year one shown in Table S1.18.

Under "Without Project" conditions it is assumed no new dike disposal facilities will be built. Polluted bottom sediments will have migrated downstream to below the Fifth Street Bridge by project evaluation year 1. Dredging will be discontinued and the navigation channels will begin to shoal. Table S1.12 indicates that in project year 2 under "Without Project" conditions, Ashtabula's river channel depth will be 26.66 feet. In project year 3, Ashtabula's River channel depth will be 26.33 feet. In project year 4, Ashtabula's River channel depth will be 26.00 feet. Water transportation costs associated with a 26 foot channel depth are $813,000. Since Table S1.6 presents water transportation costs for this route given a 26 foot channel depth at Ashtabula, the water transportation cost associated with a 26.66 foot channel depth and a 26.33 foot channel depth can be interpolated. This interpolation process is presented in Table S1.18. The "Without Project" condition water transportation costs associated with project evaluation years 2, 3 and 4 came to $813,000.

This interpolation process is continued until a switch is made to the use of an alternate harbor. Table S1.13 indicates tonnages on this coal route will shift to Conneaut once Ashtabula Harbor channel depths have reached 18.46 feet. Table S1.12 indicates that this channel depth should be reached in project evaluation year 27, or the year 2032. Now water transportation costs in project evaluation year 27 are water transportation costs associated with using the alternate port: Conneaut Harbor. Water transportation costs for moving coal from Conneaut to Advance, Michigan are $831,000 per year. These are "Without Project" condition water transportation costs for this origin/destination route for project evaluation years 27 through 50.

This time stream of water transportation cost is converted to its present worth in Table S1.18 using an annual interest rate of 7.625 percent, a 50 year project life. These present worth values were then summed. The present worth of this time stream of "Without Project" condition water transportation costs came to $10,438,112. This present worth value was then converted to an average annual value using a fifty year evaluation period, an annual interest rate of 7.625 percent and May 1996 price levels. The average annual "Without Project" condition value of this water transportation cost time stream came to $816,600.

This process was repeated for each of the remaining 24 coal origin/destination routes as well as the 7 iron ore origin/destination routes and the 4 limestone origin destination routes. Table S1.19 presents a summary of "Without Project" condition average annual water transportation costs for all iron ore, coal and limestone origin/destination routes. "Without Project" Condition average annual water transportation costs for iron ore came to $30,062,600. "Without Project" condition average annual water transportation costs for coal came to $28,881,600. "Without Project" condition average annual water transportation costs for limestone came to $3,756,500. Total "Without Project" condition average annual water transportation costs came to $62,700,700.

TABLE S1.19. WITHOUT PROJECT CONDITION AVERAGE ANNUAL WATER TRANSPORTATION COSTS-IRON ORE, COAL, LIMESTONE.

ORIGIN DESTINATION PAIR	50 YEAR AVERAGE ANNUAL WATER COSTS
IRON ORE-ALTERNATE PORT= CLEVELAND	
DULUTH, MINNESOTA	$ 1,669,300
ESCANABA, MICHIGAN	$ 1,039,000
PRESQUE ISLE, MICHIGAN	$13,116,700
ST. LAWRENCE RIVER	$ 3,782,000
SILVER BAY, MINNESOTA	$ 1,321,200
SUPERIOR WISCONSIN	$ 8,853,400
TWO HARBORS MINNESOTA	$ 281,000
	$30,062,600
COAL-ALTERNATE PORT=CONNEAUT	
ADVANCE, MICHIGAN	$ 816,600
BATH, ONTARIO	$ 241,100
CHARLEVOIX, MICHIGAN	$ 1,221,300
CLARKSON, ONTARIO	$ 440,100
COURTWRIGHT, ONTARIO	$ 1,182,600
DETROIT, MICHIGAN	$ 118,900
DUNKIRK, NEW YORK	$ 50,000
GLADSTONE, MICHIGAN	$ 182,700
GRAND HAVEN, MICHIGAN	$ 159,200
GREENBAY, WISCONSIN	$ 3,405,200
MANISTEE HARBOR, MICHIGAN	$ 786,000
MARINETTE, WISCONSIN	$ 156,600
MARYSVILLE, MICHIGAN	$ 55,000
MILWAUKEE, WISCONSIN	$ 5,454,100
NANTICOKE, ONTARIO	$ 1,528,700
NIAGARA RIVER, NEW YORK	$ 292,300
ONTONAGON HARBOR, MICHIGAN	$ 429,200
PICTON, ONTARIO	$ 671,300
PORT STANLEY, ONTARIO	$ 101,100
PORT WASHINGTON, WI	$ 3,299,000
PRESQUE ISLE, MICHIGAN	$ 2,821,400
ST. CLAIR, MICHIGAN	$ 937,700
ST. LAWRENCE RIVER & ABOVE	$ 2,559,600
SUPERIOR WISCONSIN	$ 475,500
THUNDERBAY, ONTARIO	$ 1,496,400
	$28,881,600
LIMESTONE-ALTERNATE PORT= CONNEAUT	WATER COSTS
CALCITE, MICHIGAN	$ 1,029,800
MARBLEHEAD, OHIO	$ 312,600
PORT INLAND, MICHIGAN	$ 1,916,700
STONEPORT, MICHIGAN	$ 497,400
	$ 3,756,500
TOTAL WOP AA WATER TRANSPORTATION COSTS	$62,700,700

(2). "Without Project" Condition Average Annual Transportation Costs-Rail Leg. The process of deriving "Without Project" condition average annual water costs was paralleled when deriving "Without Project" condition average annual rail costs. Average annual "Without Project" condition rail costs need to be developed for iron ore and coal.

Annual "Without Project" condition iron ore and coal rail transportation costs may or may not change from year to year over the 50 year evaluation period. If the tonnage uses Ashtabula Harbor as the transshipment point for each year of the 50 year evaluation period under "Without Project" conditions, rail costs will not change. Under this scenario, iron ore and coal rail costs under "Without Project" conditions equals iron ore and coal rail costs under "With Project" conditions. However, if the commodity eventually shifts to an alternate port, the iron ore or coal rail transportation cost time stream will be a step function.

Iron ore or coal rail costs under "Without Project" conditions will be the same as "With Project" condition rail costs up to the evaluation year when movement to an alternate port takes place. Iron ore or coal rail transportation costs after this switch year, would be rail costs associated with using the alternate port: Cleveland or Conneaut. This time stream of "Without Project" condition rail costs can then be converted to a present value and this present value converted to an average annual dollar value. Present worth values were calculated using a 7.625 percent annual interest rate. These present worth values were converted to average annual values using a 50 year evaluation period, a 7.625 percent annual interest rate and May 1996 price levels. The derivation of "Without Project" condition iron ore and coal rail transportation cost time streams, by origin/destination pair, follows.

In order to compute "Without Project" condition rail transportation costs, one needs annual rail transportation costs for all commodities when they pass through Ashtabula Harbor. For those commodities that shift to an alternate port, annual rail costs associated with using the alternate port are also needed. This data can then be used to derive the "Without Project" condition rail transportation costs for each year of the 50 year evaluation period, for each of the origin/destination pairs evaluated.

Table S1.20 documents the development of this "Without Project" condition rail transportation cost time stream for coal moving to Advance, Michigan. Table S1.13 indicated that coal moved on this route would shift to an alternate port in project evaluation year 27. Consequently, "Without Project" condition rail transportation costs from project evaluation year 1 to project evaluation year 26 will be rail costs associated with using Ashtabula Harbor as the transshipment port. Table S1.9 indicated annual rail costs associated with using Ashtabula Harbor for this origin/destination movement is $ 929,796. Thus annual rail transportation costs are $ 929,796 for project evaluation years 1 through 26 under "Without Project" conditions.

Table S1.13 provided annual rail costs associated with moving commodities through the alternate port: Conneaut. Table S1.13 indicates annual rail costs, associated with coal going to Advance, Michigan, via Conneaut Harbor, are $ 961,975. Thus "Without Project" condition rail transportation costs from project evaluation year 27 to project evaluation year 50 will be $961,975.

TABLE S1.20. - "WITHOUT PROJECT" CONDITION AVERAGE ANNUAL RAIL TRANSPORTATION COSTS- ADVANCE, MICHIGAN.

PROJECT YEAR	RAIL TRANSPORT COSTS	PRESENT WORTH FACTOR	50 YEAR PRESENT WORTH RAIL TRANSPORT COSTS
1	$929,796	0.92915	$863,922
2	$929,796	0.86332	$802,715
3	$929,796	0.80216	$745,844
4	$929,796	0.74533	$693,003
5	$929,796	0.69252	$643,905
6	$929,796	0.64346	$598,286
7	$929,796	0.59787	$555,899
8	$929,796	0.55551	$516,514
9	$929,796	0.51616	$479,920
10	$929,796	0.47959	$445,919
11	$929,796	0.44561	$414,327
12	$929,796	0.41404	$384,972
13	$929,796	0.38471	$357,698
14	$929,796	0.35745	$332,356
15	$929,796	0.33213	$308,809
16	$929,796	0.30860	$286,931
17	$929,796	0.28673	$266,602
18	$929,796	0.26642	$247,714
19	$929,796	0.24754	$230,164
20	$929,796	0.23000	$213,857
21	$929,796	0.21371	$198,706
22	$929,796	0.19857	$184,628
23	$929,796	0.18450	$171,548
24	$929,796	0.17143	$159,394
25	$929,796	0.15928	$148,101
26	$929,796	0.14800	$137,609
27	$961,975	0.13751	$132,284
28	$961,975	0.12777	$122,912
29	$961,975	0.11872	$114,204
30	$961,975	0.11031	$106,113
31	$961,975	0.10249	$98,595
32	$961,975	0.09523	$91,610
33	$961,975	0.08848	$85,120
34	$961,975	0.08222	$79,089
35	$961,975	0.07639	$73,486
36	$961,975	0.07098	$68,279
37	$961,975	0.06595	$63,442
38	$961,975	0.06128	$58,947
39	$961,975	0.05694	$54,771
40	$961,975	0.05290	$50,891
41	$961,975	0.04915	$47,285
42	$961,975	0.04567	$43,935
43	$961,975	0.04244	$40,822
44	$961,975	0.03943	$37,930
45	$961,975	0.03664	$35,243
46	$961,975	0.03404	$32,746
47	$961,975	0.03163	$30,426
48	$961,975	0.02939	$28,270
49	$961,975	0.02731	$26,268
50	$961,975	0.02537	$24,407

			$11,936,419
			0.07823

			$933,845

This completes the "Without Project" condition time stream of rail transportation costs associated with moving coal to Advance, Michigan. This time stream of rail transportation cost was converted to its present worth in Table S1.20 using an annual interest rate of 7.625 percent. These present worth values were then summed. The present worth of this time stream of "Without Project" condition rail transportation costs came to $11,936,419. This present worth value was then converted to an average annual value using a fifty year evaluation period, an annual interest rate of 7.625 percent and May 1996 price levels. The average annual "Without Project" condition value of this rail transportation cost time stream came to $933,800.

This process was repeated for each of the remaining 24 coal origin/destination routes as well as the 7 iron ore origin/destinations. Table S1.21 presents a summary of "Without Project" condition average annual rail transportation costs for all iron ore and coal origin/destination routes. "Without Project" Condition average annual rail transportation costs for iron ore came to $19,262,200 and for coal came to $56,584,900.

(3)."Without Project" Condition Average Annual Transportation Costs-Truck Leg- Limestone. Under "Without Project" conditions, limestone may continue to use Ashtabula Harbor over the 50 year revaluation period. Alternatively, limestone may be sourced for part of the 50 year evaluation period through Ashtabula, and the remaining years of the 50 year evaluation period through the alternate port of Conneaut. In either case, the limestone is used locally around Ashtabula and has a truck cost component.

If the limestone continues to be sourced through Ashtabula over the 50 year evaluation period in the "Without Project" condition, "Without Project" condition land transportation costs consists of truck costs associated with using Ashtabula Harbor.

However, if the limestone is eventually sourced through an alternate port, Total "Without Project" condition land transportation costs have a truck cost associated with using Ashtabula Harbor for a period of time and a truck cost associated with using Conneaut Harbor for a period of time during the 50 year evaluation period. Truck costs associated with using Ashtabula Harbor are used up to the year in which the switch is made to the alternate port of Conneaut. Once the switch to an alternate port is made, "Without Project" condition land transportation costs consist of truck costs associated with moving the limestone to end users via Conneaut Harbor.

This time stream of "Without Project" condition truck transportation costs for limestone can now be converted to an average annual dollar value given a 50 year evaluation period, a 7.625 % annual interest rate and May 1996 price levels.

Table S1.22 documents the development of this "Without Project" condition truck transportation cost time stream for limestone coming from Calcite Michigan. Table S1.13 indicated that limestone moved on this route would shift to an alternate port when Ashtabula Harbor channel depths equal 21.82 feet. Given that limestone is delivered to the Outer Harbor area where starting channel depths are 28 feet, an annual shoaling rate of .5 feet per year, the Outer Harbor channels reach a channel depth of 21.82 feet in project evaluation year 14 (See Table S1.12.). Consequently, "Without Project" condition limestone truck transportation costs from project evaluation year 1 to project evaluation year 13 are equal to truck transportation costs associated with using Ashtabula Harbor: $444,543 (See Table S1.9.). Table S1.13 indicated annual truck costs associated with using Conneaut Harbor as the transshipment port, for limestone coming

TABLE S1.21- WITHOUT PROJECT CONDITION AVERAGE ANNUAL RAIL /TRUCK TRANSPORTATION COSTS- FOR IRON ORE, COAL AND LIMESTONE

ORIGIN DESTINATION PAIR	50 YEAR AVERAGE ANNUAL RAIL COSTS
IRON ORE-ALTERNATE PORT=CLEVELAND	
DULUTH, MINNESOTA	$ 845,100
ESCANABA, MICHIGAN	$ 865,300
PRESQUE ISLE, MICHIGAN	$ 8,632,800
ST. LAWRENCE RIVER	$ 1,690,400
SILVER BAY, MINNESOTA	$ 996,000
SUPERIOR WISCONSIN	$ 6,113,500
TWO HARBORS MINNESOTA	$ 119,100
	$19,262,200
COAL-ALTERNATE PORT=CONNEAUT	
ADVANCE, MICHIGAN	$ 933,800
BATH, ONTARIO	$ 642,500
CHARLEVOIX, MICHIGAN	$ 2,110,300
CLARKSON, ONTARIO	$ 1,381,000
COURTWRIGHT, ONTARIO	$ 5,021,900
DETROIT, MICHIGAN	$ 419,000
DUNKIRK, NEW YORK	$ 243,500
GLADSTONE, MICHIGAN	$ 210,100
GRAND HAVEN, MICHIGAN	$ 135,100
GREENBAY, WISCONSIN	$ 3,284,300
MANISTEE HARBOR, MICHIGAN	$ 920,100
MARINETTE, WISCONSIN	$ 168,700
MARYSVILLE, MICHIGAN	$ 165,700
MILWAUKEE, WISCONSIN	$ 5,779,300
NANTICOKE, ONTARIO	$11,006,400
NIAGARA RIVER, NEW YORK	$ 1,188,300
ONTONAGON HARBOR, MICHIGAN	$ 378,700
PICTON, ONTARIO	$ 1,805,600
PORT STANLEY, ONTARIO	$ 777,600
PORT WASHINGTON, WISCONSIN	$ 3,917,100
PRESQUE ISLE, MICHIGAN	$ 5,825,600
ST. CLAIR, MICHIGAN	$ 3,583,100
ST. LAWRENCE RIVER & ABOVE	$ 3,979,400
SUPERIOR WISCONSIN	$ 397,500
THUNDERBAY, ONTARIO	$ 2,310,300
	$56,584,900
LIMESTONE-ALTERNATE PORT=CONNEAUT	AVERAGE ANNUAL TRUCK COSTS
CALCITE, MICHIGAN	$ 497,000
MARBLEHEAD, OHIO	$ 258,700
PORT INLAND, MICHIGAN	$ 876,100
STONEPORT, MICHIGAN	$ 228,200
	$ 1,860,000
TOTAL WOP AVG ANNUAL RAIL/TRUCK TRANSPORTATION COSTS	$77,707,100

from Calcite, Michigan; came to $ 586,796. Thus annual truck transportation costs are $444,543 for project evaluation years 1 through 13 and $586,796 for project evaluation years 14 through 50 under "Without Project" conditions.

This completes the "Without Project" condition time stream of truck transportation costs associated with moving limestone from Calcite, Michigan. This time stream of truck transportation cost was converted to its present worth value in Table S1.22 using an annual interest rate of 7.625 percent. These present worth values were then summed. The present worth of this time stream of "Without Project" condition Truck transportation costs came to $6,352,532. This present worth value was then converted to an average annual value using a fifty year evaluation period, an annual interest rate of 7.625 percent and May 1996 price levels. The average annual "Without Project" condition value of this truck transportation cost time stream came to $496,990.

This process was repeated for each of the remaining 3 limestone origin/destination routes. Table S1.21 presents a summary of "Without Project" condition average annual truck transportation costs for all limestone commodity routes. "Without Project" Condition average annual truck transportation costs for limestone came to $1,860,000.

(4). Total "Without Project" Condition Average Annual Transportation Costs-. Table S1.23 summarizes Total "Without Project" Condition Average annual Commercial Navigation Transportation Costs for iron ore, coal and limestone. These costs are broken down into average annual water costs, average annual rail costs and average annual truck costs, by commodity by origin/destination route. "Without Project" condition average annual water costs came to $62,700,700. "Without Project" condition average annual rail/truck costs came to $77,707,100. Total "Without Project" condition average annual water and rail/truck costs came to $140,407,800.

Total "Without Project" condition average annual transportation costs for iron ore came to $49,324,800. Total "Without Project" condition average annual transportation costs for coal came to $85,466,500. Total "Without Project" condition average annual transportation costs for limestone came to $5,616,500. Total "Without Project" condition average annual transportation costs for all three commodities came to $140,407,800.

5. Average Annual Commercial Navigation Benefits. Commercial navigation benefits have been defined as the difference in average annual commercial navigation transportation costs between the "Without Project" condition and the "With Project" condition. Table S1.23 summarized total "Without Project" condition average annual commercial navigation transportation costs, by origin/destination route. Total "Without Project" condition water and rail/truck average annual transportation costs came to $140,407,800. Table S1.10 summarized total "With Project" condition average annual commercial navigation transportation costs. Total "With Project" condition average annual transportation costs came to $139,242,500. Average annual commercial navigation transportation benefits (Table S1.24) associated with performing a onetime cleanup of polluted bottom sediments are $1,165,300 (May 1996 prices).

These benefits were updated from May 1996 to to September 1996 prices using the Engineering News Record Construction Cost index ((1.017909). Average Annual Commercial Navigation Benefits in September 1996 prices are $1,186,200.

TABLE S1.22. - "WITHOUT PROJECT" CONDITION AVERAGE ANNUAL LIMESTONE TRUCK TRANSPORTATION COSTS- CALCITE, MICHIGAN.

PROJECT YEAR	TRUCK TRANSPORT COSTS	PRESENT WORTH FACTOR	50 YEAR PRESENT WORTH TRUCK TRANSPORT COSTS
1	$444,543	0.92915	$413,048
2	$444,543	0.86332	$383,784
3	$444,543	0.80216	$356,594
4	$444,543	0.74533	$331,330
5	$444,543	0.69252	$307,856
6	$444,543	0.64346	$286,045
7	$444,543	0.59787	$265,779
8	$444,543	0.55551	$246,949
9	$444,543	0.51616	$229,454
10	$444,543	0.47959	$213,197
11	$444,543	0.44561	$198,093
12	$444,543	0.41404	$184,058
13	$444,543	0.38471	$171,018
14	$586,796	0.35745	$209,750
15	$586,796	0.33213	$194,890
16	$586,796	0.30860	$181,083
17	$586,796	0.28673	$168,253
18	$586,796	0.26642	$156,333
19	$586,796	0.24754	$145,257
20	$586,796	0.23000	$134,966
21	$586,796	0.21371	$125,404
22	$586,796	0.19857	$116,519
23	$586,796	0.18450	$108,264
24	$586,796	0.17143	$100,594
25	$586,796	0.15928	$93,467
26	$586,796	0.14800	$86,845
27	$586,796	0.13751	$80,692
28	$586,796	0.12777	$74,975
29	$586,796	0.11872	$69,664
30	$586,796	0.11031	$64,728
31	$586,796	0.10249	$60,142
32	$586,796	0.09523	$55,881
33	$586,796	0.08848	$51,922
34	$586,796	0.08222	$48,244
35	$586,796	0.07639	$44,826
36	$586,796	0.07098	$41,650
37	$586,796	0.06595	$38,699
38	$586,796	0.06128	$35,957
39	$586,796	0.05694	$33,410
40	$586,796	0.05290	$31,043
41	$586,796	0.04915	$28,843
42	$586,796	0.04567	$26,800
43	$586,796	0.04244	$24,901
44	$586,796	0.03943	$23,137
45	$586,796	0.03664	$21,498
46	$586,796	0.03404	$19,975
47	$586,796	0.03163	$18,560
48	$586,796	0.02939	$17,245
49	$586,796	0.02731	$16,023
50	$586,796	0.02537	$14,888

			$6,352,532
			0.07823

			$496,990

TABLE S1.23- TOTAL AVERAGE ANNUAL WITHOUT PROJECT CONDITION TRANSPORTATION COSTS- Iron Ore, Coal, Limestone.

ORIGIN DESTINATION PAIR	50 YEAR AVERAGE ANNUAL WOP WATER COSTS	50 YEAR AVERAGE ANNUAL WOP RAIL COSTS	TOTAL AVERAGE ANNUAL WOP TRANSPORTATION COSTS
IRON ORE-ALTERNATE PORT= CLEVELAND			
DULUTH, MINNESOTA	$ 1,669,300	$ 845,100	$ 2,514,400
ESCANABA, MICHIGAN	$ 1,039,000	$ 865,300	$ 1,904,300
PRESQUE ISLE, MICHIGAN	$13,116,700	$ 8,632,800	$ 21,749,500
ST. LAWRENCE RIVER	$ 3,782,000	$ 1,690,400	$ 5,472,400
SILVER BAY, MINNESOTA	$ 1,321,200	$ 996,000	$ 2,317,200
SUPERIOR WISCONSIN	$ 8,853,400	$ 6,113,500	$ 14,966,900
TWO HARBORS MINNESOTA	$ 281,000	$ 119,100	$ 400,100
	$30,062,600	$19,262,200	$ 49,324,800
COAL-ALTERNATE PORT=CONNEAUT			
ADVANCE, MICHIGAN	$ 816,600	$ 933,800	$ 1,750,400
BATH, ONTARIO	$ 241,100	$ 642,500	$ 883,600
CHARLEVOIX, MICHIGAN	$ 1,221,300	$ 2,110,300	$ 3,331,600
CLARKSON, ONTARIO	$ 440,100	$ 1,381,000	$ 1,821,100
COURTWRIGHT, ONTARIO	$ 1,182,600	$ 5,021,900	$ 6,204,500
DETROIT, MICHIGAN	$ 118,900	$ 419,000	$ 537,900
DUNKIRK, NEW YORK	$ 50,000	$ 243,500	$ 293,500
GLADSTONE, MICHIGAN	$ 182,700	$ 210,100	$ 392,800
GRAND HAVEN, MICHIGAN	$ 159,200	$ 135,100	$ 294,300
GREENBAY, WISCONSIN	$ 3,405,200	$ 3,284,300	$ 6,689,500
MANISTEE HARBOR, MICHIGAN	$ 786,000	$ 920,100	$ 1,706,100
MARINETTE, WISCONSIN	$ 156,600	$ 168,700	$ 325,300
MARYSVILLE, MICHIGAN	$ 55,000	$ 165,700	$ 220,700
MILWAUKEE, WISCONSIN	$ 5,454,100	$ 5,779,300	$ 11,233,400
NANTICOKE, ONTARIO	$ 1,528,700	$11,006,400	$ 12,535,100
NIAGARA RIVER, NEW YORK	$ 292,300	$ 1,188,300	$ 1,480,600
ONTONAGON HARBOR, MICHIGAN	$ 429,200	$ 378,700	$ 807,900
PICTON, ONTARIO	$ 671,300	$ 1,805,600	$ 2,476,900
PORT STANLEY, ONTARIO	$ 101,100	$ 777,600	$ 878,700
PORT WASHINGTON, WI	$ 3,299,000	$ 3,917,100	$ 7,216,100
PRESQUE ISLE, MICHIGAN	$ 2,821,400	$ 5,825,600	$ 8,647,000
ST. CLAIR, MICHIGAN	$ 937,700	$ 3,583,100	$ 4,520,800
ST. LAWRENCE RIVER & ABOVE	$ 2,559,600	$ 3,979,400	$ 6,539,000
SUPERIOR WISCONSIN	$ 475,500	$ 397,500	$ 873,000
THUNDERBAY, ONTARIO	$ 1,496,400	$ 2,310,300	$ 3,806,700
	$28,881,600	$56,584,900	$ 85,466,500
LIMESTONE-ALTERNATE PORT= CONNEAUT	WATER COSTS	TRUCK COSTS	TOTAL COSTS
CALCITE, MICHIGAN	$ 1,029,800	$ 497,000	$ 1,526,800
MARBLEHEAD, OHIO	$ 312,600	$ 258,700	$ 571,300
PORT INLAND, MICHIGAN	$ 1,916,700	$ 876,100	$ 2,792,800
STONEPORT, MICHIGAN	$ 497,400	$ 228,200	$ 725,600
	$ 3,756,500	$ 1,860,000	$ 5,616,500
TOTAL ALTERNATE PORT TRANSPORTATION COSTS	$62,700,700	$77,707,100	$140,407,800

TABLE S1.24. AVERAGE ANNUAL COMMERCIAL NAVIGATION TRANSPORTATION BENEFITS FOR A ONE TIME CLEANUP OF POLLUTED BOTTOM SEDIMENTS.

ORIGIN DESTINATION PAIR	AVERAGE ANNUAL WOP TRANSPORT COSTS	AVERAGE ANNUAL With Project TRANSPORT COSTS	TOTAL AVERAGE ANNUAL TRANSPORTATION BENEFITS
IRON ORE			
DULUTH, MINNESOTA	$ 2,514,400	$ 2,512,700	$ 1,700
ESCANABA, MICHIGAN	$ 1,904,300	$ 1,904,300	$ 0
PRESQUE ISLE, MICHIGAN	$ 21,749,500	$ 21,745,900	$ 3,600
ST. LAWRENCE RIVER	$ 5,472,400	$ 5,277,000	$195,400
SILVER BAY, MINNESOTA	$ 2,317,200	$ 2,312,000	$ 5,200
SUPERIOR WISCONSIN	$ 14,966,900	$ 14,935,200	$ 31,700
TWO HARBORS MINNESOTA	$ 400,100	$ 400,100	$ 0
	$ 49,324,800	$ 49,087,200	$ 237,600
COAL			
ADVANCE, MICHIGAN	$ 1,750,400	$ 1,742,800	$ 7,600
BATH, ONTARIO	$ 883,600	$ 875,800	$ 7,800
CHARLEVOIX, MICHIGAN	$ 3,331,600	$ 3,313,300	$ 18,300
CLARKSON, ONTARIO	$ 1,821,100	$ 1,809,300	$ 11,800
COURTWRIGHT, ONTARIO	$ 6,204,500	$ 6,128,700	$ 75,800
DETROIT, MICHIGAN	$ 537,900	$ 536,000	$ 1,900
DUNKIRK, NEW YORK	$ 293,500	$ 293,500	$ 0
GLADSTONE, MICHIGAN	$ 392,800	$ 391,100	$ 1,700
GRAND HAVEN, MICHIGAN	$ 294,300	$ 294,100	$ 200
GREENBAY, WISCONSIN	$ 6,689,500	$ 6,662,100	$ 27,400
MANISTEE HARBOR, MICHIGAN	$ 1,706,100	$ 1,699,200	$ 6,900
MARINETTE, WISCONSIN	$ 325,300	$ 324,000	$ 1,300
MARYSVILLE, MICHIGAN	$ 220,700	$ 218,600	$ 2,100
MILWAUKEE, WISCONSIN	$ 11,233,400	$ 11,170,200	$ 63,200
NANTICOKE, ONTARIO	$ 12,535,100	$ 12,448,500	$ 86,600
NIAGARA RIVER, NEW YORK	$ 1,480,600	$ 1,477,100	$ 3,500
ONTONAGON HARBOR, MICHIGAN	$ 807,900	$ 802,300	$ 5,600
PICTON, ONTARIO	$ 2,476,900	$ 2,454,900	$ 22,000
PORT STANLEY, ONTARIO	$ 878,700	$ 875,600	$ 3,100
PORT WASHINGTON, WI	$ 7,216,100	$ 7,180,900	$ 35,200
PRESQUE ISLE, MICHIGAN	$ 8,647,000	$ 8,535,800	$ 111,200
ST. CLAIR, MICHIGAN	$ 4,520,800	$ 4,492,900	$ 27,900
ST. LAWRENCE RIVER & ABOVE	$ 6,539,000	$ 6,485,200	$ 53,800
SUPERIOR WISCONSIN	$ 873,000	$ 869,300	$ 3,700
THUNDERBAY, ONTARIO	$ 3,806,700	$ 3,757,900	$ 48,800
	$ 85,466,500	$ 84,839,100	$ 627,400
LIMESTONE			
CALCITE, MICHIGAN	$ 1,526,800	$ 1,445,500	$ 81,300
MARBLEHEAD, OHIO	$ 571,300	$ 551,700	$ 19,600
PORT INLAND, MICHIGAN	$ 2,792,800	$ 2,660,000	$ 132,800
STONEPORT, MICHIGAN	$ 725,600	$ 659,000	$ 66,600
	$ 5,616,500	$ 5,316,200	$ 300,300
TOTAL ALT PORT TRANSPORTATION COSTS	$140,407,800	$139,242,500	$1,165,300

C. COMMERCIAL NAVIGATION BENEFIT RE-EVALUATION

1. Re-evaluation Introduction Table S1.24 provides a summary of average annual commercial navigation transportation benefits, by origin/destination pair. These average annual benefits reflect a 7.625 percent annual interest rate, a 50 year project life and May 1996 price levels.

Given the length of time that has elapsed since the evaluation had been performed, a re-evaluation of the benefits was completed. The current report reflects October 2000 prices and the current Federal Discount Rate is 6.375%. Consequently, the re-evaluation would need to reflect the new price level and interest rate.

The analysis was based on origin/destination patterns and tonnages that took place in Calendar Year 1994. The first step in the re-evaluation would be to determine if these tonnages were still representative of the 50 year project evaluation period. If these tonnages were found to be representative, the origin/destination patterns of 1994, as well as the vessel sizes used in these movements, would also still be representative of traffic patterns that would take place over the 50 year evaluation period.

2. Determination Of Representative Tonnages And Traffic Patterns. An analysis of historical tonnages through 1998 was performed. These tonnages were then compared to the 1994 levels to see how the 1994 season compared to the last five to ten years of commodity movements through Ashtabula. The analysis is provided below in Table S1.25. Based upon Table S1.25, it was determined that the 1994 season would be representative of tonnages moving through Ashtabula Harbor over the last five to ten years. Consequently, the 1994 tonnages and origin/destination routes, and vessels used to carry these tonnages would be representative of the tonnages, routes and vessels that would be used during the 50 year project evaluation period.

Table S1.25 Historical Ashtabula Tonnages, By Commodity- 1985 to 1998

Year	Iron Ore	Coal	Limestone	Subtotal	Total Harbor Tonnage	Big 3 As % Of Total Tonnage
1985	1,876,000	4,449,000	447,900	6,772,900	7,039,000	96.22%
1986	2,775,000	3,685,000	346,000	6,806,000	7,164,000	95.00%
1987	2,084,000	6,077,000	266,700	8,427,700	8,888,000	94.82%
1988	3,070,000	5,991,000	550,600	9,611,600	10,335,000	93.00%
1989	4,670,000	4,763,000	438,500	9,871,500	10,387,700	95.03%
1990	5,589,000	5,328,000	480,000	11,397,000	11,852,000	96.16%
1991	5,008,000	4,784,000	476,000	10,268,000	10,638,000	96.52%
1992	4,326,000	5,340,000	516,000	10,182,000	10,572,000	96.31%
1993	4,685,000	3,445,000	409,000	8,539,000	8,979,000	95.10%
1994	4,369,600	4,823,500	667,300	9,860,400	10,368,500	95.10%
1995	3,865,000	5,152,000	617,000	9,634,000	10,010,000	96.24%
1996	3,299,000	5,231,000	641,000	9,171,000	9,523,000	96.30%
1997	3,187,000	7,682,000	724,000	11,593,000	11,929,000	97.18%
1998	6,052,000	8,320,000	676,000	15,048,000	15,602,000	96.45%
10 Yr Avg 89-98	4,505,060	5,486,850	564,480	10,556,390	10,986,120	96.09%
5 Yr Avg 94-98	4,154,520	6,241,700	665,060	11,061,280	11,486,500	96.30%

3. Re-evaluation Update Process. The re-evaluation could now concentrate on updating the 1994 evaluation with respect to price levels and interest rates. The 1994 evaluation compiled Without Project and With Project condition transportation costs by origin/destination pair based on various tonnages being moved by specific vessel classes.

The update would take transportation costs from May 1996 prices and a 7 5/8% annual interest rate to October 2000 prices and a 6 3/8% annual interest rate. The update would concentrate on building water and rail transportation costs update indices. The development of these indices follows, as well as the actual update of transportation costs.

a. Update Of With Project Water Related Transportation Costs. The water indices would be keyed to vessel size, since water transportation costs by origin/destination pair involve in many cases multiple ship sizes. An update factor would be developed for each origin/destination pair (7 for iron ore, 25 for coal and 4 for limestone). This update factor would be weighted by the percentage of commodity carried by various vessel sizes. The update factor by various vessel sizes would be based on the difference between ship operating costs (fixed and variable) in May 1996 prices to ship operating costs in October 2000 prices.

The May 1996 ship operating costs were presented in Table S1.5. October 2000 ship operating costs were developed using ship operating costs provided in the Soo Locks Study. This resulted in a vessel class size operating cost update factor. These vessel class operating costs update factors are presented in Table S1.26.

These update factors by vessel size could now be used to develop a weighted water transportation cost update index by origin/destination pair. Table S1.2 provided tons moved by vessel class for each origin/destination pair. The percent of tons moved by vessel class for each origin/destination pair was calculated. These percent of tons moved by vessel class were used as weights to develop a weighted water transportation cost update factor for each origin/destination pair evaluated, by commodity. A summary of these weighted water update index factors are provided in Table S1.27.

These weighted water update factors could now be applied to water transportation costs for individual origin/destination pairs, by channel depth. This would provide basic water transportation costs by channel depth needed to calculate Without Project and With Project condition average annual transportation costs that reflected October 2000 prices and a 6 3/8 percent annual interest rate. The With Project condition update is simply May 1996 water transportation costs times the update factor. This update is provided in Table S 1.28.

b. Update Of With Project and Without Project Condition Rail/Truck Transportation Costs
Update indices were developed for Without Project and With Project condition rail/truck transportation costs. Railroad transportation costs for iron ore and coal were updated using railroad transportation cost indices keyed to these two commodities. Limestone transportation costs were updated using an index that represented changes in local trucking costs. These update factors are presented in Table S1.29. These update factors were then applied to rail/truck costs associated with staying at Ashtabula Harbor and those rail/truck costs associated with using an alternate port. These updates are presented in Tables S1.30 and S1.31 for the rail/truck costs associated with staying at Ashtabula Harbor and those rail/truck costs associated with using an alternate port, respectively.

S1.26 Derivation Of Water Transportation Cost Update Factors By Vessel Size

1. May 1996 Vessel Construction and Operating Costs.

Interest rate =	7.6250%
Project Life	50
Profit Factor	10.00%
Overhead Factor	15.00%

Great Lakes Vessel Costs	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10
Total Daily Fixed Costs									
Construction Costs 7.6250%	$49,500,000	$55,000,000	$60,500,000	$66,000,000	$71,500,000	$77,000,000	$93,500,000	$104,500,000	$121,000,000
Amortization Rate	0.0782349	0.0782349	0.0782349	0.0782349	0.0782349	0.0782349	0.0782349	0.0782349	0.0782349
Annual Fixed Cost/Year	$3,872,628	$4,302,920	$4,733,212	$5,163,505	$5,593,797	$6,024,089	$7,314,965	$8,175,549	$9,466,425
Season Length	275	275	275	275	275	275	275	275	275
Fixed Costs Per Day	$14,082	$15,647	$17,212	$18,776	$20,341	$21,906	$26,600	$29,729	$34,423
Profit Factor	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
Total Daily Fixed Costs	$15,491	$17,212	$18,933	$20,654	$22,375	$24,096	$29,260	$32,702	$37,866
Daily Variable Operating Costs									
Wages	$4,873	$4,873	$4,873	$5,500	$7,900	$8,000	$8,200	$8,500	$8,500
Subsistence	$279	$279	$279	$300	$300	$310	$310	$325	$325
Stores, Supplies & Equip	$406	$488	$609	$650	$650	$650	$700	$708	$800
Insurance	$2,024	$2,116	$2,208	$2,300	$2,700	$2,700	$2,800	$3,309	$3,750
Maintenance & Repair	$553	$633	$636	$650	$700	$750	$950	$1,045	$1,150
Fuel	$1,303	$1,983	$2,530	$2,523	$1,648	$1,847	$2,498	$3,306	$3,372
Other	$417	$458	$500	$500	$500	$550	$600	$700	$700
Daily Variable Operating Costs	$9,855	$10,830	$11,635	$12,423	$14,398	$14,807	$16,058	$17,893	$18,597
Total Daily Variable Costs									
Daily Variable Costs	$9,855	$10,830	$11,635	$12,423	$14,398	$14,807	$16,058	$17,893	$18,597
Overhead Factor	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%
Total Daily Variable Costs	$11,333	$12,455	$13,380	$14,286	$16,558	$17,028	$18,467	$20,577	$21,387
Total Hourly Vessel Costs									
Total Daily Fixed Costs	$15,491	$17,212	$18,933	$20,654	$22,375	$24,096	$29,260	$32,702	$37,866
Total Daily Variable Costs	$11,333	$12,455	$13,380	$14,286	$16,558	$17,028	$18,467	$20,577	$21,387
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Total Daily Vessel Costs	$26,824	$29,666	$32,313	$34,940	$38,933	$41,124	$47,727	$53,279	$59,252

2. October 2000 Vessel Construction and Operating Costs.

Interest rate =	6.3750%
Project Life	50
Profit Factor	10.00%
Overhead Factor	12.00%

Great Lakes Vessel Costs	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10
Total Daily Fixed Costs									
Construction Costs 6.375%	$44,719,136	$49,687,929	$54,656,722	$59,873,172	$66,393,733	$75,522,520	$91,141,654	$106,730,577	$106,730,577
Amortization Rate	0.0667890	0.0667890	0.0667890	0.0667890	0.0667890	0.0667890	0.0667890	0.0667890	0.0667890
Annual Fixed Cost/Year	$2,986,745	$3,318,605	$3,650,466	$3,998,867	$4,434,369	$5,044,071	$6,087,257	$7,128,425	$7,128,425
Season Length	275	275	275	275	275	275	275	275	275
Fixed Costs Per Day	$10,861	$12,068	$13,274	$14,541	$16,125	$18,342	$22,135	$25,922	$25,922
Profit Factor	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
Total Daily Fixed Costs	$11,947	$13,274	$14,602	$15,995	$17,737	$20,176	$24,349	$28,514	$28,514
Daily Variable Operating Costs									
Wages	$10,547	$10,547	$10,547	$10,651	$10,781	$10,913	$11,330	$11,821	$11,821
Subsistence	$300	$300	$300	$300	$300	$350	$350	$350	$350
Stores, Supplies & Equip	$431	$518	$646	$674	$709	$758	$896	$1,043	$1,043
Insurance	$937	$979	$1,022	$1,271	$1,582	$2,018	$2,744	$3,381	$3,381
Maintenance & Repair	$1,624	$1,859	$1,868	$1,972	$2,102	$2,284	$2,470	$2,581	$2,581
Fuel	$1,424	$2,167	$2,765	$3,135	$3,408	$3,822	$4,418	$4,883	$4,883
Other	$918	$1,009	$1,101	$1,120	$1,143	$1,176	$1,215	$1,241	$1,241
Total	$16,181	$17,379	$18,249	$19,123	$20,025	$21,321	$23,423	$25,300	$25,300
Total Daily Variable Costs									
Daily Variable Costs	$16,181	$17,379	$18,249	$19,123	$20,025	$21,321	$23,423	$25,300	$25,300
Overhead Factor	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%
Total Daily Variable Costs	$18,122	$19,464	$20,438	$21,418	$22,428	$23,880	$26,234	$28,336	$28,336
Total Hourly Vessel Costs									
Total Daily Fixed Costs	11,947	$13,274	$14,602	$15,995	$17,737	$20,176	$24,349	$28,514	$28,514
Total Daily Variable Costs	$18,122	$19,464	$20,438	$21,418	$22,428	$23,880	$26,234	$28,336	$28,336
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Total Daily Vessel Costs	$30,069	$32,738	$35,040	$37,413	$40,165	$44,056	$50,583	$56,849	$56,849

3. Update Factors From May 1996 Prices And 7 5/8 % Interest To October 2000 Prices And 6 3/8% Interest.

	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10
October 2000 Daily Vessel Operating Costs	$30,069	$32,738	$35,040	$37,413	$40,165	$44,056	$50,583	$56,849	$56,849
May 1996 Daily Vessel Operating Costs	$26,824	$29,666	$32,313	$34,940	$38,933	$41,124	$47,727	$53,279	$59,252
Vessel Class Operating Costs Update Factor	1.12100	1.10356	1.08440	1.07077	1.03165	1.07128	1.05985	1.06701	0.95945

Table S1.27 Weighted Water Transportation Update Index By Origin/Destination Pair

Port	Vessel Size	Tonnages	% Of Tons Moved	Vessel Class Update Factor	Weighted OD Update Factor
Iron Ore - Receipts					
Duluth, Mn					
	5	25,365	13.13%	1.070765683	0.14058684
	6	30,147	15.60%	1.031647721	0.160987028
	7	78,550	40.66%	1.071283654	0.435578089
	10	59,128	30.61%	0.959445235	0.293649143
		-----------	-----------		-------------
		193,190	100.00%		1.0308
Escanaba, Mi					
	5	49,104	24.40%	1.070765683	0.261297861
	6	41,780	20.76%	1.031647721	0.214202432
	7	66,871	33.23%	1.071283654	0.356013802
	8	43,467	21.60%	1.059852688	0.228944235
		-----------	-----------		-------------
		201,222	100.00%		1.060605
Presque Is, Mi					
	5	252,797	12.63%	1.070765683	0.135282164
	6	324,182	16.20%	1.031647721	0.167145428
	7	812,999	40.63%	1.071283654	0.435279958
	8	55,441	2.77%	1.059852688	0.029366402
	10	555,483	27.76%	0.959445235	0.266357631
		-------------	----------		----------------
		2,000,902	100.00%		1.0334
St Lawrence River And Above					
	7	377,445	100.00%	1.071283654	1.071283654
Silver Bay, Mn.					
	8	26,682	12.08%	1.059852688	0.12800093
	10	194,246	87.92%	0.959445235	0.843570752
		-----------	-----------		----------------
		220,928	100.00%		0.9716
Superior, Wisconsin					
	7	138,019	10.24%	1.071283654	0.109672334
	8	564,628	41.88%	1.059852688	0.443875983
	10	645,528	47.88%	0.959445235	0.4593979
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		1,348,175	100.00%		1.0129
Two Harbors, Mn.					
	8	27,690	100.00%	1.059852688	1.059852688
Total Iron Ore Receipts			4,369,552		

Table S1.27 -Continued

Port	Vessel Size	Tonnages	% Of Tons Moved	Vessel Class Update Factor	Weighted OD Update Factor
Coal -Shipments					
Advance, Mi					
	5	79,830	100.00%	1.070765683	1.070765683
Bath, Ont					
	7	54,416	100.00%	1.071283654	1.071283654
Charlevoix, Mi.					
	5	155,726	86.36%	1.070765683	0.924682006
	7	24,602	13.64%	1.071283654	0.146154343
		180,328	100.00%		1.0708
Clarkson, Ont					
	7	117,483	100.00%	1.071283654	1.071283654
Courtright, Ont					
	7	428,056	100.00%	1.071283654	1.071283654
Detroit, Mi					
	8	35,972	100.00%	1.059852688	1.059852688
Dunkirk Harbor, NY					
	5	20,905	100.00%	1.070765683	1.070765683
Gladstone, Mi					
	8	17,951	100.00%	1.059852688	1.059852688
Grand Haven, Mi.					
	6	11,597	100.00%	1.031647721	1.031647721
Greenbay, Wis					
	5	280,760	100.00%	1.070765683	1.070765683
Manistee Harbor, Mi.					
	5	52,449	66.68%	1.070765683	0.713975379
	6	26,210	33.32%	1.031647721	0.343755791
		78,659	100.00%		1.0577
Marinette, Wi.					
	6	14,425	100.00%	1.031647721	1.031647721
Marysville, Mi					
	7	14,133	100.00%	1.071283654	1.071283654
Milwaukee, Wi					
	5	111,214	22.52%	1.070765683	0.241165474
	6	15,051	3.05%	1.031647721	0.031445464
	7	339,213	68.70%	1.071283654	0.735932858
	8	28,308	5.73%	1.059852688	0.060759742
		493,786	100.00%		1.0693
Nanticoke, Ont					
	7	939,672	100.00%	1.071283654	1.071283654
Niagara River, NY					
	5	101,579	100.00%	1.070765683	1.070765683
Ontonagon Harbor, Mi					
	8	32,393	100.00%	1.059852688	1.059852688

Table S1.27 -Continued

Port	Vessel Size	Tonnages	% Of Tons Moved	Vessel Class Update Factor	Weighted OD Update Factor
Picton, Ont					
	7	153,073	100.00%	1.071283654	1.071283654
Port Stanley, Ont					
	7	66,761	100.00%	1.071283654	1.071283654
Port Washington, Wi					
	5	144,867	43.30%	1.070765683	0.463630205
	7	158,891	47.49%	1.071283654	0.508758394
	8	30,816	9.21%	1.059852688	0.097617927
		334,574	100.00%		1.0700
Presque Is, Mi					
	6	88,654	17.92%	1.031647721	0.184849967
	7	84,987	17.18%	1.071283654	0.184012191
	8	201,129	40.65%	1.059852688	0.430833851
	10	120,008	24.25%	0.959445235	0.232712659
		494,778	100.00%		1.0324
St. Clair, Mi					
	5	71,177	23.22%	1.070765683	0.248654635
	6	80,720	26.34%	1.031647721	0.27169085
	7	27,856	9.09%	1.071283654	0.097361144
	8	126,752	41.35%	1.059852688	0.438291212
		306,505	100.00%		1.0560
St. Lawrence River And Above					
	7	336,235	100.00%	1.071283654	1.071283654
Superior, Wi.					
	7	18,110	53.37%	1.071283654	0.571692214
	8	15,826	46.63%	1.059852688	0.494260627
		33,936	100.00%		1.0660
Thunderbay, Ont.					
	7	195,657	100.00%	1.071283654	1.071283654
Total Coal Shipments		4,823,464			
Limestone - Receipts					
Calcite, Mi.					
	5	177,817	100.00%	1.070765683	1.070765683
Marblehead, Oh.					
	5	18,988	18.35%	1.070765683	0.196458618
	6	60,162	58.13%	1.031647721	0.599723553
	8	24,341	23.52%	1.059852688	0.2492765
		103,491	100.00%		1.045
Port Inland, Mi					
	5	286,836	90.77%	1.070765683	0.971986561
	6	29,150	9.23%	1.031647721	0.095170454
		315,986	100.00%		1.067157015
Stoneport, Mi.					
	5	70,004	100.00%	1.070765683	1.070765683
Total Limestone Receipts		667,298			

TABLE S1.28-Update Of With Project Condition Average Annual Water Transportation Costs From May 1996 To October 2000

ORIGIN DESTINATION PAIR	May-96 Average Annual Water Costs	Water Update Factor From May-96 To Oct-00	Oct-00 Average Annual Water Costs	Rounded Oct-00 Average Annual Water Costs
IRON ORE				
DULUTH, MINNESOTA	$ 1,682,000	103.08%	$ 1,733,807	$ 1,733,800
ESCANABA, MICHIGAN	$ 1,039,000	106.05%	$ 1,101,816	$ 1,101,800
PRESQUE ISLE, MICHIGAN	$13,142,000	103.34%	$13,581,358	$13,581,400
ST. LAWRENCE RIVER	$ 3,654,000	107.13%	$ 3,914,470	$ 3,914,500
SILVER BAY, MINNESOTA	$ 1,362,000	97.16%	$ 1,323,281	$ 1,323,300
SUPERIOR WISCONSIN	$ 9,138,000	101.29%	$ 9,256,303	$ 9,256,300
TWO HARBORS MINNESOTA	$ 281,000	105.99%	$ 297,819	$ 297,800
	$30,298,000		$31,208,854	$31,208,900
COAL				
ADVANCE, MICHIGAN	$ 813,000	107.08%	$ 870,533	$ 870,500
BATH, ONTARIO	$ 242,000	107.13%	$ 259,251	$ 259,300
CHARLEVOIX, MICHIGAN	$ 1,213,000	107.08%	$ 1,298,924	$ 1,298,900
CLARKSON, ONTARIO	$ 441,000	107.13%	$ 472,436	$ 472,400
COURTWRIGHT, ONTARIO	$ 1,143,000	107.13%	$ 1,224,477	$ 1,224,500
DETROIT, MICHIGAN	$ 117,000	105.99%	$ 124,003	$ 124,000
DUNKIRK, NEW YORK	$ 50,000	107.08%	$ 53,538	$ 53,500
GLADSTONE, MICHIGAN	$ 182,000	105.99%	$ 192,893	$ 192,900
GRAND HAVEN, MICHIGAN	$ 159,000	103.16%	$ 164,032	$ 164,000
GREENBAY, WISCONSIN	$ 3,392,000	107.08%	$ 3,632,037	$ 3,632,000
MANISTEE HARBOR, MICHIGAN	$ 783,000	105.77%	$ 828,204	$ 828,200
MARINETTE, WISCONSIN	$ 156,000	103.16%	$ 160,937	$ 160,900
MARYSVILLE, MICHIGAN	$ 54,000	107.13%	$ 57,849	$ 57,800
MILWAUKEE, WISCONSIN	$ 5,419,000	106.93%	$ 5,794,556	$ 5,794,600
NANTICOKE, ONTARIO	$ 1,504,000	107.13%	$ 1,611,211	$ 1,611,200
NIAGARA RIVER, NEW YORK	$ 294,000	107.08%	$ 314,805	$ 314,800
ONTONAGON HARBOR, MICHIGAN	$ 425,000	105.99%	$ 450,437	$ 450,400
PICTON, ONTARIO	$ 672,000	107.13%	$ 719,903	$ 719,900
PORT STANLEY, ONTARIO	$ 98,000	107.13%	$ 104,986	$ 105,000
PORT WASHINGTON, WISCONSIN	$ 3,284,000	107.00%	$ 3,513,901	$ 3,513,900
PRESQUE ISLE, MICHIGAN	$ 2,773,000	103.24%	$ 2,862,869	$ 2,862,900
ST. CLAIR, MICHIGAN	$ 923,000	105.60%	$ 974,686	$ 974,700
ST. LAWRENCE RIVER & ABOVE	$ 2,569,000	107.13%	$ 2,752,128	$ 2,752,100
SUPERIOR WISCONSIN	$ 474,000	106.60%	$ 505,262	$ 505,300
THUNDERBAY, ONTARIO	$ 1,479,000	107.13%	$ 1,584,429	$ 1,584,400
	$28,659,000		$30,528,286	$30,528,100
LIMESTONE				
CALCITE, MICHIGAN	$1,001,000	107.08%	$1,071,836	$1,071,800
MARBLEHEAD, OHIO	$ 293,000	104.55%	$ 306,319	$ 306,300
PORT INLAND, MICHIGAN	$1,870,000	106.72%	$1,995,584	$1,995,600
STONEPORT, MICHIGAN	$ 484,000	107.08%	$ 518,251	$ 518,300
	$3,648,000		$3,891,990	$3,892,000
Total WP AA Water Costs	$62,605,000			$65,629,000

Table S1.29- Rail/Truck Transportation Cost Update Factor

Iron Ore Update Index

Railroads, Linehaul operating, not seasonally adjusted-Metallic Ores

Oct 2000 Index	102.1
May 1996 index	103.3
Iron Ore Rail update factor	0.988383349

Coal Update Index

Railroads, Linehaul operating, not seasonally adjusted-Coal

Oct 2000 Index	108.8
May 1996 index	106.7
Coal Rail update factor	1.01968135

Limestone Update Index

Local Trucking Without Storage-Dump Trucking

Oct 2000 Index	118.0
May 1996 index	102.5
Limestone Truck update factor	1.151219512

SUMMARY OF RAIL/TRUCK UPDATE INDEXES

Iron Ore Update Index	0.988383349
Coal Update Index	1.01968135
Limestone Update Index	1.151219512

Table S1.30 - Update Of Rail/Truck Transportation Costs Associated With Staying At Ashtabula Harbor, From May 1996 To October 2000.

ORIGIN DESTINATION PAIR	May-96 ANNUAL RAIL/TRUCK COSTS	UPDATE FACTOR From May-96 To Oct-00	Oct-00 ANNUAL RAIL/TRUCK COSTS
IRON ORE			
DULUTH, MINNESOTA	$ 830,700	0.988383349	$ 821,100
ESCANABA, MICHIGAN	$ 865,300	0.988383349	$ 855,200
PRESQUE ISLE, MICHIGAN	$ 8,603,900	0.988383349	$ 8,504,000
ST. LAWRENCE RIVER	$ 1,623,000	0.988383349	$ 1,604,100
SILVER BAY, MINNESOTA	$ 950,000	0.988383349	$ 939,000
SUPERIOR WISCONSIN	$ 5,797,200	0.988383349	$ 5,729,900
TWO HARBORS MINNESOTA	$ 119,100	0.988383349	$ 117,700
	$18,789,200		$18,571,000
COAL			
ADVANCE, MICHIGAN	$ 929,800	1.01968135	$ 948,100
BATH, ONTARIO	$ 633,800	1.01968135	$ 646,300
CHARLEVOIX, MICHIGAN	$ 2,100,300	1.01968135	$ 2,141,600
CLARKSON, ONTARIO	$ 1,368,300	1.01968135	$ 1,395,200
COURTWRIGHT, ONTARIO	$ 4,985,700	1.01968135	$ 5,083,800
DETROIT, MICHIGAN	$ 419,000	1.01968135	$ 427,200
DUNKIRK, NEW YORK	$ 243,500	1.01968135	$ 248,300
GLADSTONE, MICHIGAN	$ 209,100	1.01968135	$ 213,200
GRAND HAVEN, MICHIGAN	$ 135,100	1.01968135	$ 137,800
GREENBAY, WISCONSIN	$ 3,270,100	1.01968135	$ 3,334,500
MANISTEE HARBOR, MICHIGAN	$ 916,200	1.01968135	$ 934,200
MARINETTE, WISCONSIN	$ 168,000	1.01968135	$ 171,300
MARYSVILLE, MICHIGAN	$ 164,600	1.01968135	$ 167,800
MILWAUKEE, WISCONSIN	$ 5,751,200	1.01968135	$ 5,864,400
NANTICOKE, ONTARIO	$10,944,500	1.01968135	$11,159,900
NIAGARA RIVER, NEW YORK	$ 1,183,100	1.01968135	$ 1,206,400
ONTONAGON HARBOR, MICHIGAN	$ 377,300	1.01968135	$ 384,700
PICTON, ONTARIO	$ 1,782,900	1.01968135	$ 1,818,000
PORT STANLEY, ONTARIO	$ 777,600	1.01968135	$ 792,900
PORT WASHINGTON, WISCONSIN	$ 3,896,900	1.01968135	$ 3,973,600
PRESQUE ISLE, MICHIGAN	$ 5,762,800	1.01968135	$ 5,876,200
ST. CLAIR, MICHIGAN	$ 3,569,900	1.01968135	$ 3,640,200
ST. LAWRENCE RIVER & ABOVE	$ 3,916,200	1.01968135	$ 3,993,300
SUPERIOR WISCONSIN	$ 395,300	1.01968135	$ 403,100
THUNDERBAY, ONTARIO	$ 2,278,900	1.01968135	$ 2,323,800
	$56,180,100		$57,285,800
LIMESTONE			
CALCITE, MICHIGAN	$ 444,500	1.151219512	$ 511,700
MARBLEHEAD, OHIO	$ 258,700	1.151219512	$ 297,800
PORT INLAND, MICHIGAN	$ 790,000	1.151219512	$ 909,500
STONEPORT, MICHIGAN	$ 175,000	1.151219512	$ 201,500
	$ 1,668,200		$ 1,920,500
Total WP Transportation Costs	$76,637,500		$77,777,300

Table S1.31 - Update Of Rail/Truck Transportation Costs Associated With Using An Alternate Port From May 1996 To October 2000.

AVERAGE ORIGIN DESTINATION PAIR	May-96 AVERAGE ANNUAL RAIL COSTS	Rail/Truck Update Factor From May-96 To Oct-00	Oct-00 AVERAGE ANNUAL RAIL COSTS	Rounded Oct-00 ANNUAL RAIL COSTS
IRON ORE-Alternate Port=Cleveland Ohio				
DULUTH, MINNESOTA	$ 889,400	0.988383349	$ 879,068	$ 879,100
ESCANABA, MICHIGAN	$ 926,400	0.988383349	$ 915,638	$ 915,600
PRESQUE ISLE, MICHIGAN	$ 9,212,200	0.988383349	$ 9,105,185	$ 9,105,200
ST. LAWRENCE RIVER	$ 1,737,800	0.988383349	$ 1,717,613	$ 1,717,600
SILVER BAY, MINNESOTA	$ 1,017,200	0.988383349	$ 1,005,384	$ 1,005,400
SUPERIOR WISCONSIN	$ 6,207,000	0.988383349	$ 6,134,895	$ 6,134,900
TWO HARBORS MINNESOTA	$ 127,500	0.988383349	$ 126,019	$ 126,000
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	$20,117,500		$19,883,802	$19,883,800
COAL-Alternate Port=Conneaut Ohio				
ADVANCE, MICHIGAN	$ 962,000	1.01968135	$ 980,933	$ 980,900
BATH, ONTARIO	$ 655,700	1.01968135	$ 668,605	$ 668,600
CHARLEVOIX, MICHIGAN	$ 2,173,000	1.01968135	$ 2,215,768	$ 2,215,800
CLARKSON, ONTARIO	$ 1,415,700	1.01968135	$ 1,443,563	$ 1,443,600
COURTWRIGHT, ONTARIO	$ 5,158,200	1.01968135	$ 5,259,720	$ 5,259,700
DETROIT, MICHIGAN	$ 433,500	1.01968135	$ 442,032	$ 442,000
DUNKIRK, NEW YORK	$ 251,900	1.01968135	$ 256,858	$ 256,900
GLADSTONE, MICHIGAN	$ 216,300	1.01968135	$ 220,557	$ 220,600
GRAND HAVEN, MICHIGAN	$ 139,700	1.01968135	$ 142,449	$ 142,400
GREENBAY, WISCONSIN	$ 3,383,200	1.01968135	$ 3,449,786	$ 3,449,800
MANISTEE HARBOR, MICHIGAN	$ 947,900	1.01968135	$ 966,556	$ 966,600
MARINETTE, WISCONSIN	$ 173,800	1.01968135	$ 177,221	$ 177,200
MARYSVILLE, MICHIGAN	$ 170,300	1.01968135	$ 173,652	$ 173,700
MILWAUKEE, WISCONSIN	$ 5,950,300	1.01968135	$ 6,067,410	$ 6,067,400
NANTICOKE, ONTARIO	$11,323,300	1.01968135	$11,546,158	$11,546,200
NIAGARA RIVER, NEW YORK	$ 1,224,100	1.01968135	$ 1,248,192	$ 1,248,200
ONTONAGON HARBOR, MICHIGAN	$ 390,300	1.01968135	$ 397,982	$ 398,000
PICTON, ONTARIO	$ 1,844,600	1.01968135	$ 1,880,904	$ 1,880,900
PORT STANLEY, ONTARIO	$ 804,500	1.01968135	$ 820,334	$ 820,300
PORT WASHINGTON, WISCONSIN	$ 4,031,700	1.01968135	$ 4,111,049	$ 4,111,000
PRESQUE ISLE, MICHIGAN	$ 5,962,200	1.01968135	$ 6,079,544	$ 6,079,500
ST. CLAIR, MICHIGAN	$ 3,693,500	1.01968135	$ 3,766,193	$ 3,766,200
ST. LAWRENCE RIVER & ABOVE	$ 4,051,700	1.01968135	$ 4,131,443	$ 4,131,400
SUPERIOR WISCONSIN	$ 408,900	1.01968135	$ 416,948	$ 416,900
THUNDERBAY, ONTARIO	$ 2,357,700	1.01968135	$ 2,404,103	$ 2,404,100
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	$58,124,000		$59,267,959	$59,267,900
LIMESTONE-Alternate Port=Conneaut Ohio				
CALCITE, MICHIGAN	$ 586,800	1.151219512	$ 675,536	$ 675,500
MARBLEHEAD, OHIO	$ 341,500	1.151219512	$ 393,141	$ 393,100
PORT INLAND, MICHIGAN	$ 1,042,800	1.151219512	$ 1,200,492	$ 1,200,500
STONEPORT, MICHIGAN	$ 231,000	1.151219512	$ 265,932	$ 265,900
	---------------		---------------	---------------
	$ 2,202,100		$ 2,535,100	$ 2,535,000
	$80,443,600			$81,686,700

c. Update Of Total With Project Condition Average Annual Transportation Costs. Total With Project condition average annual transportation costs is a summary of With Project condition average annual water costs (Table S1.28) and With Project condition average annual rail costs (Table S1.30). Total With Project condition average annual total transportation costs in October 2000 prices and a 6 3/8% annual interest rate is provided in Table S1.32.

d. Update Of Without Project Condition Water Transportation Costs Updating Without Project condition water transportation costs is more involved since discounting takes place. The first step was updating water transportation costs by channel depth as provided in Table S1.6. This update is provided in Table S1.33. These water transportation costs in Table S1.33 could now be used to develop Without Project condition total transportation costs at Ashtabula Harbor and total transportation costs at the alternate ports.

Tables S1.30 and S1.31 provided updated rail/truck costs associated with using Ashtabula Harbor and alternate ports. These rail/truck costs can be used to develop total transportation costs associated with using Ashtabula Harbor at different channel depths and total transportation costs associated with using alternate ports (See Table S1.34).

These costs in Table S1.34 can be used to develop Without Project condition transportation cost time streams over the 50 year evaluation period, by origin destination pair. These Without Project condition transportation cost time streams can then be converted to average annual costs using the current Federal discount rate of 6 3/8%. This development of October 2000 price levels Without Project condition transportation cost time streams is presented for coal going to Advance, Michigan (Table S1.35). A similar process was followed to develop Without Project average annual rail cost for this origin/destination route (Table S1.36). This process was repeated for all of the remaining origin/destination routes. A summary of Without Project condition average annual water and rail/truck transportation costs is presented in Table S1.37.

e. Average Annual Benefits-October 2000 Prices and 6 3/8% Annual Interest Rate. Average annual benefits are the difference in total average annual costs between the Without Project (Table S1.37) and the With Project condition (Table S1.32). These calculations are summarized in Table S1.38. Total Average Annual Commercial Navigation transportation benefits came to $1,308,500. These benefits reflect October 2000 price levels and a 6 3/8% annual interest rate.

Table S1.32 Average Annual Total WP Condition Transportation Costs- October 2000 Prices And 6 3/8% Annual Interest Rate

ORIGIN DESTINATION PAIR	Oct-00 AVERAGE ANNUAL WATER COSTS	Oct-00 AVERAGE ANNUAL RAIL/TRUCK COSTS	Oct-00 TOTAL AVERAGE ANNUAL TRNSPRTATN COSTS
IRON ORE			
DULUTH, MINNESOTA	$ 1,733,800	$ 821,100	$ 2,554,900
ESCANABA, MICHIGAN	$ 1,101,800	$ 855,200	$ 1,957,000
PRESQUE ISLE, MICHIGAN	$13,581,400	$ 8,504,000	$ 22,085,400
ST. LAWRENCE RIVER	$ 3,914,500	$ 1,604,100	$ 5,518,600
SILVER BAY, MINNESOTA	$ 1,323,300	$ 939,000	$ 2,262,300
SUPERIOR WISCONSIN	$ 9,256,300	$ 5,729,900	$ 14,986,200
TWO HARBORS MINNESOTA	$ 297,800	$ 117,700	$ 415,500
	$31,208,900	$18,571,000	$ 49,779,900
COAL			
ADVANCE, MICHIGAN	$ 870,500	$ 948,100	$ 1,818,600
BATH, ONTARIO	$ 259,300	$ 646,300	$ 905,600
CHARLEVOIX, MICHIGAN	$ 1,298,900	$ 2,141,600	$ 3,440,500
CLARKSON, ONTARIO	$ 472,400	$ 1,395,200	$ 1,867,600
COURTWRIGHT, ONTARIO	$ 1,224,500	$ 5,083,800	$ 6,308,300
DETROIT, MICHIGAN	$ 124,000	$ 427,200	$ 551,200
DUNKIRK, NEW YORK	$ 53,500	$ 248,300	$ 301,800
GLADSTONE, MICHIGAN	$ 192,900	$ 213,200	$ 406,100
GRAND HAVEN, MICHIGAN	$ 164,000	$ 137,800	$ 301,800
GREENBAY, WISCONSIN	$ 3,632,000	$ 3,334,500	$ 6,966,500
MANISTEE HARBOR, MICHIGAN	$ 828,200	$ 934,200	$ 1,762,400
MARINETTE, WISCONSIN	$ 160,900	$ 171,300	$ 332,200
MARYSVILLE, MICHIGAN	$ 57,800	$ 167,800	$ 225,600
MILWAUKEE, WISCONSIN	$ 5,794,600	$ 5,864,400	$ 11,659,000
NANTICOKE, ONTARIO	$ 1,611,200	$11,159,900	$ 12,771,100
NIAGARA RIVER, NEW YORK	$ 314,800	$ 1,206,400	$ 1,521,200
ONTONAGON HARBOR, MICHIGAN	$ 450,400	$ 384,700	$ 835,100
PICTON, ONTARIO	$ 719,900	$ 1,818,000	$ 2,537,900
PORT STANLEY, ONTARIO	$ 105,000	$ 792,900	$ 897,900
PORT WASHINGTON, WISCONSIN	$ 3,513,900	$ 3,973,600	$ 7,487,500
PRESQUE ISLE, MICHIGAN	$ 2,862,900	$ 5,876,200	$ 8,739,100
ST. CLAIR, MICHIGAN	$ 974,700	$ 3,640,200	$ 4,614,900
ST. LAWRENCE RIVER & ABOVE	$ 2,752,100	$ 3,993,300	$ 6,745,400
SUPERIOR WISCONSIN	$ 505,300	$ 403,100	$ 908,400
THUNDERBAY, ONTARIO	$ 1,584,400	$ 2,323,800	$ 3,908,200
	$30,528,100	$57,285,800	$ 87,813,900
LIMESTONE			
CALCITE, MICHIGAN	$ 1,071,800	$ 511,700	$ 1,583,500
MARBLEHEAD, OHIO	$ 306,300	$ 297,800	$ 604,100
PORT INLAND, MICHIGAN	$ 1,995,600	$ 909,500	$ 2,905,100
STONEPORT, MICHIGAN	$ 603,900	$ 201,500	$ 805,400
	$ 3,977,600	$ 1,920,500	$ 5,898,100
Total WP Transportation Costs	$65,714,600	$77,777,300	$143,491,900

Table S1.33. Update Of Yearly Water Transportation Costs By Channel Depth-Ashtabula Harbor From May 1996 To October 2000

1. WATER TRANSPORTATION COSTS- IRON ORE

ASHTABULA HARBOR CHANNEL DEPTH	DULUTH MINNESOTA	ESCANABA MICHIGAN	PRESQUE ISLE MICHIGAN	SAINT LWRNCE RIVER	SILVER BAY MINNESOTA	SUPERIOR WISCONSIN	TWO HARBORS MINNESOTA	TOTAL IRON ORE WATER COSTS
UPD FCTR	103.08%	106.05%	103.34%	107.13%	97.16%	101.29%	105.99%	
TONS	193,190	201,222	2,000,902	377,445	220,928	1,348,175	27,690	4,369,552
28	$1,733,800	$1,101,800	$13,581,400	$3,914,500	$1,323,300	$9,256,300	$297,800	$31,208,900
27	$1,733,800	$1,101,800	$13,581,400	$3,914,500	$1,323,300	$9,256,300	$297,800	$31,208,900
26	$1,739,000	$1,114,500	$13,614,400	$3,925,200	$1,326,200	$9,276,600	$297,800	$31,293,700
25	$1,763,700	$1,151,700	$13,797,300	$3,989,500	$1,343,700	$9,394,100	$302,100	$31,742,100
24	$1,822,500	$1,202,600	$14,235,500	$4,140,500	$1,385,500	$9,668,600	$311,600	$32,766,800
23	$1,912,100	$1,260,900	$14,913,500	$4,362,300	$1,447,600	$10,086,900	$326,400	$34,309,700
22	$2,024,500	$1,328,800	$15,760,900	$4,627,900	$1,527,300	$10,600,500	$345,500	$36,215,400
21	$2,156,400	$1,404,000	$16,745,700	$4,931,100	$1,618,600	$11,194,100	$367,800	$38,417,700
20	$2,309,000	$1,491,000	$17,886,600	$5,279,300	$1,722,600	$11,876,800	$393,200	$40,958,500
19	$2,485,300	$1,590,700	$19,219,800	$5,684,200	$1,843,100	$12,757,000	$422,900	$44,003,000
18	$2,695,500	$1,706,300	$20,757,500	$6,162,000	$1,982,000	$13,562,300	$457,900	$47,323,500
17	$2,949,100	$1,842,000	$22,685,900	$6,727,700	$2,146,200	$14,619,900	$500,300	$51,471,100
16	$3,257,300	$2,003,200	$24,995,600	$7,415,400	$2,344,400	$15,877,900	$551,100	$56,444,900
15	$3,645,900	$2,200,500	$27,887,200	$8,267,100	$2,584,400	$17,401,400	$614,700	$62,601,200

2. WATER TRANSPORTATION COSTS- COAL

ASHTABULA HARBOR CHANNEL DEPTH	ADVANCE MICHIGAN	BATH ONTARIO	CHARLEVOIX MICHIGAN	CLARKSON ONTARIO	COURTWRIGHT ONTARIO	DETROIT MICHIGAN	DUNKIRK NEW YORK	GLADSTONE MICHIGAN
UPD FCTR	107.08%	107.13%	107.08%	107.13%	107.13%	105.99%	107.08%	105.99%
TONS	79,830	54,416	180,328	117,483	428,056	35,972	20,905	17,951
28	$870,500	$259,300	$1,298,900	$472,400	$1,224,500	$124,000	$53,500	$192,900
27	$870,500	$259,300	$1,298,900	$472,400	$1,224,500	$124,000	$53,500	$192,900
26	$870,500	$259,300	$1,298,900	$472,400	$1,225,500	$124,000	$53,500	$192,900
25	$870,500	$261,400	$1,298,900	$472,400	$1,230,900	$124,000	$53,500	$192,900
24	$870,500	$265,700	$1,298,900	$474,600	$1,252,300	$124,000	$53,500	$192,900
23	$870,500	$276,400	$1,298,900	$479,900	$1,294,100	$124,000	$53,500	$192,900
22	$870,500	$290,300	$1,301,100	$494,900	$1,353,000	$124,000	$53,500	$192,900
21	$870,500	$307,500	$1,308,600	$519,600	$1,422,700	$124,000	$53,500	$192,900
20	$875,900	$326,700	$1,336,400	$550,600	$1,504,100	$124,000	$53,500	$195,000
19	$897,300	$350,300	$1,398,500	$587,100	$1,598,400	$126,100	$53,500	$201,400
18	$947,600	$377,100	$1,493,800	$631,000	$1,708,700	$131,400	$53,500	$214,100
17	$1,024,700	$408,200	$1,613,800	$682,400	$1,840,500	$142,000	$53,500	$233,200
16	$1,126,400	$447,800	$1,760,500	$744,500	$2,000,100	$154,700	$54,600	$258,600
15	$1,256,000	$494,900	$1,938,200	$821,700	$2,197,200	$170,600	$55,700	$289,300

ASHTABULA HARBOR CHANNEL DEPTH	GRAND HAVEN MICHIGAN	GREEN BAY WISCONSIN	MANISTEE HARBOR MICHIGAN	MARINETTE WISCONSIN	MARYSVILLE MICHIGAN	MILWAUKEE WISCONSIN	NANTICOKE ONTARIO	NIAGARA RIVER NEW YORK	ONTONAGON HARBOR MICHIGAN
TONS	11,597	280,760	78,659	14,425	14,133	493,786	939,672	101,579	32,393
UPD FCTR	103.16%	107.08%	105.77%	103.16%	107.13%	106.93%	107.13%	107.08%	105.99%
28	$164,000	$3,632,000	$828,200	$160,900	$57,800	$5,794,600	$1,611,200	$314,800	$450,400
27	$164,000	$3,632,000	$828,200	$160,900	$57,800	$5,794,600	$1,611,200	$314,800	$450,400
26	$164,000	$3,632,000	$828,200	$160,900	$57,800	$5,794,600	$1,611,200	$314,800	$450,400
25	$164,000	$3,632,000	$828,200	$160,900	$57,800	$5,794,600	$1,615,500	$314,800	$450,400
24	$164,000	$3,632,000	$828,200	$160,900	$57,800	$5,794,600	$1,633,700	$314,800	$450,400
23	$164,000	$3,632,000	$828,200	$160,900	$57,800	$5,794,600	$1,677,600	$314,800	$450,400
22	$164,000	$3,632,000	$828,200	$160,900	$57,800	$5,795,600	$1,736,600	$314,800	$450,400
21	$164,000	$3,633,100	$828,200	$160,900	$58,900	$5,810,600	$1,805,100	$314,800	$450,400
20	$164,000	$3,652,400	$832,400	$162,000	$58,900	$5,892,900	$1,884,400	$318,000	$453,600
19	$164,000	$3,740,200	$849,400	$164,000	$62,100	$6,132,500	$1,977,600	$328,700	$464,200
18	$164,000	$3,952,200	$897,000	$173,300	$66,400	$6,570,900	$2,090,100	$348,000	$490,700
17	$166,100	$4,291,600	$974,200	$187,800	$79,300	$7,961,000	$2,377,200	$409,000	$589,300
15	$201,200	$5,289,600	$1,211,100	$235,200	$88,900	$8,951,100	$2,574,300	$451,900	$661,300

Table S1.33. Continued

ASHTABULA HARBOR CHANNEL DEPTH	PICTON ONTARIO	PORT STANLEY ONTARIO	PORT WASHINGTON WISCONSIN	PRESQUE ISLE MICHIGAN	ST. CLAIR MICHIGAN	ST. LAW RIVER & ABOVE	SUPERIOR WISCONSIN	THUNDER BAY ONTARIO	TOTAL COAL WATER COSTS
TONS	153,073	66,761	334,574	494,778	306,505	336,235	33,936	195,657	4,823,464
UPD FCTR	107.13%	107.13%	107.00%	103.24%	105.60%	107.13%	106.60%	107.13%	
28	$719,900	$105,000	$3,513,900	$2,862,900	$974,700	$2,752,100	$505,300	$1,584,400	$30,528,100
27	$719,900	$105,000	$3,513,900	$2,862,900	$974,700	$2,752,100	$505,300	$1,584,400	$30,528,100
26	$721,000	$105,000	$3,513,900	$2,867,000	$974,700	$2,753,200	$505,300	$1,584,400	$30,535,400
25	$724,200	$105,000	$3,513,900	$2,888,700	$974,700	$2,769,300	$505,300	$1,594,100	$30,597,900
24	$737,000	$105,000	$3,513,900	$2,939,300	$974,700	$2,825,000	$505,300	$1,626,200	$30,795,200
23	$764,900	$105,000	$3,513,900	$3,018,800	$974,700	$2,943,900	$505,300	$1,693,700	$31,190,700
22	$804,500	$106,100	$3,515,000	$3,123,000	$978,900	$3,108,900	$505,300	$1,788,000	$31,750,200
21	$851,700	$107,100	$3,527,800	$3,264,500	$992,600	$3,303,800	$506,300	$1,899,400	$32,478,500
20	$906,300	$110,300	$3,584,500	$3,452,400	$1,024,300	$3,529,900	$513,800	$2,030,100	$33,536,400
19	$970,600	$114,600	$3,735,400	$3,678,500	$1,070,800	$3,792,300	$535,100	$2,181,100	$35,173,700
18	$1,043,400	$118,900	$3,995,400	$3,942,800	$1,134,100	$4,098,700	$575,600	$2,357,900	$37,576,600
17	$1,132,300	$126,400	$4,350,600	$4,254,600	$1,216,500	$4,465,100	$632,100	$2,567,900	$40,742,200
16	$1,239,500	$133,900	$4,796,800	$4,626,200	$1,317,900	$4,908,600	$702,500	$2,823,900	$44,711,900
15	$1,371,200	$143,600	$5,356,500	$5,073,300	$1,442,500	$5,457,100	$792,000	$3,139,900	$49,664,300

3. WATER TRANSPORTATION COSTS- LIMESTONE

ASHTABULA HARBOR CHANNEL DEPTH	CALCITE MICHIGAN	MARBLEHEAD OHIO	PORT INLAND MICHIGAN	STONEPORT MICHIGAN	TOTAL LIMESTONE WATER COSTS
TONS	177,817	103,491	315,986	70,004	667,298
UPD FCTR	107.08%	104.55%	106.72%	107.08%	
28	$1,071,800	$306,300	$1,995,600	$518,300	$3,892,000
27	$1,071,800	$306,300	$1,995,600	$518,300	$3,892,000
26	$1,074,000	$306,300	$1,999,900	$518,300	$3,898,500
25	$1,089,000	$307,400	$2,018,000	$518,300	$3,932,700
24	$1,121,100	$307,400	$2,060,700	$518,300	$4,007,500
23	$1,172,500	$308,400	$2,132,200	$519,300	$4,132,400
22	$1,237,800	$311,500	$2,229,300	$520,400	$4,299,000
21	$1,318,100	$319,900	$2,347,700	$525,700	$4,511,400
20	$1,410,200	$331,400	$2,486,500	$537,500	$4,765,600
19	$1,519,400	$346,000	$2,647,600	$563,200	$5,076,200
18	$1,650,000	$363,800	$2,833,300	$603,900	$5,451,000
17	$1,806,400	$384,700	$3,054,200	$656,400	$5,901,700
16	$2,001,300	$410,900	$3,318,900	$720,600	$6,451,700
15	$2,248,600	$444,300	$3,642,200	$802,000	$7,137,100

Table S1.34- Total (Water & Rail/Truck) Annual Transportation Costs By Channel Depth Ashtabula Harbor- October 2000 Prices

1. TOTAL TRANSPORTATION COSTS (WATER AND RAIL)- IRON ORE

ASHTABULA HARBOR CHANNEL DEPTH	DULUTH MINNESOTA	ESCANABA MICHIGAN	PRESQUE ISLE MICHIGAN	SAINT LAWRENCE RIVER	SILVER BAY MINNESOTA	SUPERIOR WISCONSIN	TWO IRON HARBORS MINNESOTA	TOTAL WOP ORE TRANSPORTATION COSTS
TONS	193,190	201,222	2,000,902	377,445	220,928	1,348,175	27,690	4,369,552
28	$2,554,900	$1,957,000	$22,085,400	$5,518,600	$2,262,300	$14,986,200	$415,500	$49,779,900
27	$2,554,900	$1,957,000	$22,085,400	$5,518,600	$2,262,300	$14,986,200	$415,500	$49,779,900
26	$2,560,100	$1,969,700	$22,118,400	$5,529,300	$2,265,200	$15,006,500	$415,500	$49,864,700
25	$2,584,800	$2,006,900	$22,301,300	$5,593,600	$2,282,700	$15,124,000	$419,800	$50,313,100
24	$2,643,600	$2,057,800	$22,739,500	$5,744,600	$2,324,500	$15,398,500	$429,300	$51,337,800
23	$2,733,200	$2,116,100	$23,417,500	$5,966,400	$2,386,600	$15,816,800	$444,100	$52,880,700
22	$2,845,600	$2,184,000	$24,264,900	$6,232,000	$2,466,300	$16,330,400	$463,200	$54,786,400
21	$2,977,500	$2,259,200	$25,249,700	$6,535,200	$2,557,600	$16,924,000	$485,500	$56,988,700
20	$3,130,100	$2,346,200	$26,390,600	$6,883,400	$2,661,600	$17,606,700	$510,900	$59,529,500
19	$3,306,400	$2,445,900	$27,723,800	$7,288,300	$2,782,100	$18,486,900	$540,600	$62,574,000
18	$3,516,600	$2,561,500	$29,261,500	$7,766,100	$2,921,000	$19,292,200	$575,600	$65,894,500
17	$3,770,200	$2,697,200	$31,189,900	$8,331,800	$3,085,200	$20,349,800	$618,000	$70,042,100
16	$4,078,400	$2,858,400	$33,499,600	$9,019,500	$3,283,400	$21,607,800	$668,800	$75,015,900
15	$4,467,000	$3,055,700	$36,391,200	$9,871,200	$3,523,400	$23,131,300	$732,400	$81,172,200
CLEVELAND TRANSPORTATION COSTS								
WATER	$1,659,600	$1,032,900	$12,832,100	$4,104,100	$1,265,000	$8,881,500	$284,000	$30,059,200
RAIL	$ 879,100	$ 915,600	$ 9,105,200	$1,717,600	$1,005,400	$6,134,900	$126,000	$19,883,800
	$2,538,700	$1,948,500	$21,937,300	$5,821,700	$2,270,400	$15,016,400	$410,000	$49,943,000
ASHTABULA HARBOR CHANNEL DEPTH AT WHICH SWITCH IS MADE	28.00	28.00	28.00	23.65	25.70	25.92	28.00	
ASHTABULA HARBOR STARTING CHANNEL DEPTH	28.00	27.00	28.00	27.00	28.00	27.00	28.00	
CHANNEL SHOALING RATE- FEET PER YEAR	0.5	0.5	0.5	0.5	0.5	0.5	0.5	

2. TOTAL TRANSPORTATION COSTS (WATER AND RAIL)- COAL

ASHTABULA HARBOR CHANNEL DEPTH	ADVANCE MICHIGAN	BATH ONTARIO	CHARLEVOIX MICHIGAN	CLARKSON ONTARIO	COURTWRIGHT ONTARIO	DETROIT MICHIGAN	DUNKIRK NEW YORK	GLADSTONE MICHIGAN
TONS	79,830	54,416	180,328	117,483	428,056	35,972	20,905	17,951
28	$1,818,600	$ 905,600	$3,440,500	$1,867,600	$6,308,300	$551,200	$301,800	$406,100
27	$1,818,600	$ 905,600	$3,440,500	$1,867,600	$6,308,300	$551,200	$301,800	$406,100
26	$1,818,600	$ 905,600	$3,440,500	$1,867,600	$6,309,300	$551,200	$301,800	$406,100
25	$1,818,600	$ 907,700	$3,440,500	$1,867,600	$6,314,700	$551,200	$301,800	$406,100
24	$1,818,600	$ 912,000	$3,440,500	$1,869,800	$6,336,100	$551,200	$301,800	$406,100
23	$1,818,600	$ 922,700	$3,440,500	$1,875,100	$6,377,900	$551,200	$301,800	$406,100
22	$1,818,600	$ 936,600	$3,442,700	$1,890,100	$6,436,800	$551,200	$301,800	$406,100
21	$1,818,600	$ 953,800	$3,450,200	$1,914,800	$6,506,500	$551,200	$301,800	$406,100
20	$1,824,000	$ 973,000	$3,478,000	$1,945,800	$6,587,900	$551,200	$301,800	$408,200
19	$1,845,400	$ 996,600	$3,540,100	$1,982,300	$6,682,200	$553,300	$301,800	$414,600
18	$1,895,700	$1,023,400	$3,635,400	$2,026,200	$6,792,500	$558,600	$301,800	$427,300
17	$1,972,800	$1,054,500	$3,755,400	$2,077,600	$6,924,300	$569,200	$301,800	$446,400
16	$2,074,500	$1,094,100	$3,902,100	$2,139,700	$7,083,900	$581,900	$302,900	$471,800
15	$2,204,100	$1,141,200	$4,079,800	$2,216,900	$7,281,000	$597,800	$304,000	$502,500
CONNEAUT TRANSPORTATION COSTS								
WATER	$ 889,800	$ 252,800	$1,326,800	$ 458,500	$1,280,200	$134,600	$ 48,200	$196,100
RAIL	$ 980,900	$ 668,600	$2,215,800	$1,443,600	$5,259,700	$442,000	$256,900	$220,600
	$1,870,700	$ 921,400	$3,542,600	$1,902,100	$6,539,900	$576,600	$305,100	$416,700
ASHTABULA HARBOR CHANNEL DEPTH AT WHICH SWITCH IS MADE	18.50	23.12	18.97	21.51	20.59	16.42	15.00	18.83
ASHTABULA HARBOR STARTING CHANNEL DEPTH	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
CHANNEL SHOALING RATE- FEET PER YEAR	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33

Table S1.34- Continued

ASHTABULA HARBOR CHANNEL DEPTH	GRAND HAVEN MICHIGAN	GREEN BAY WISCONSIN	MANISTEE HARBOR MICHIGAN	MARINETTE WISCONSIN	MARYSVILLE MICHIGAN	MILWAUKEE WISCONSIN	NANTICOKE ONTARIO	NIAGARA RIVER NEW YORK	ONTONAGON HARBOR MICHIGAN
TONS	11,597	280,760	78,659	14,425	14,133	493,786	939,672	101,579	32,393
28	$301,800	$6,966,500	$1,762,400	$332,200	$225,600	$11,659,000	$12,771,100	$1,521,200	$ 835,100
27	$301,800	$6,966,500	$1,762,400	$332,200	$225,600	$11,659,000	$12,771,100	$1,521,200	$ 835,100
26	$301,800	$6,966,500	$1,762,400	$332,200	$225,600	$11,659,000	$12,771,100	$1,521,200	$ 835,100
25	$301,800	$6,966,500	$1,762,400	$332,200	$225,600	$11,659,000	$12,775,400	$1,521,200	$ 835,100
24	$301,800	$6,966,500	$1,762,400	$332,200	$225,600	$11,659,000	$12,793,600	$1,521,200	$ 835,100
23	$301,800	$6,966,500	$1,762,400	$332,200	$225,600	$11,659,000	$12,837,500	$1,521,200	$ 835,100
22	$301,800	$6,966,500	$1,762,400	$332,200	$225,600	$11,660,000	$12,896,500	$1,521,200	$ 835,100
21	$301,800	$6,967,600	$1,762,400	$332,200	$226,700	$11,675,000	$12,965,000	$1,521,200	$ 835,100
20	$301,800	$6,986,900	$1,766,600	$333,300	$226,700	$11,757,300	$13,044,300	$1,524,400	$ 838,300
19	$301,800	$7,074,700	$1,783,600	$335,300	$229,900	$11,996,900	$13,137,500	$1,535,100	$ 848,900
18	$301,800	$7,286,700	$1,831,200	$344,600	$234,200	$12,435,300	$13,250,000	$1,554,400	$ 875,400
17	$303,900	$7,626,100	$1,908,400	$359,100	$239,600	$13,045,800	$13,377,500	$1,581,200	$ 917,800
16	$317,300	$8,068,400	$2,012,000	$379,700	$247,100	$13,825,400	$13,537,100	$1,615,400	$ 974,000
15	$339,000	$8,624,100	$2,145,300	$406,500	$256,700	$14,815,500	$13,734,200	$1,658,300	$1,046,000
CONNEAUT TRANSPORTATION COSTS									
WATER	$167,100	$3,697,400	$ 844,100	$164,000	$ 61,100	$5,961,400	$1,510,500	$ 294,500	$ 478,000
RAIL	$142,400	$3,449,800	$ 966,600	$177,200	$173,700	$6,067,400	$11,546,200	$1,248,200	$ 398,000
	$309,500	$7,147,200	$1,810,700	$341,200	$234,800	$12,028,800	$13,056,700	$1,542,700	$ 876,000
ASHTABULA HARBOR CHANNEL DEPTH AT WHICH SWITCH IS MADE	16.58	18.66	18.43	18.37	17.89	18.93	19.87	18.61	17.99
ASHTABULA HARBOR STARTING CHANNEL DEPTH	7.00	27.00	27.00	27.00	28.00	27.00	27.00	27.00	27.00
CHANNEL SHOALING RATE- FEET PER YEAR	0.33	0.33	0.33	0.33	0.5	0.33	0.33	0.33	0.33

ASHTABULA HARBOR CHANNEL DEPTH	PICTON ONTARIO	PORT STANLEY ONTARIO	PORT WASHINGTON WISCONSIN	PRESQUE ISLE MICHIGAN	ST. CLAIR MICHIGAN	ST. LAW RIVER & ABOVE	SUPERIOR WISCONSIN	THUNDER BAY ONTARIO	TOTAL COAL TRANSPORTATION COSTS
TONS	153,073	66,761	334,574	494,778	306,505	336,235	33,936	195,657	4,823,464
28	$2,537,900	$897,900	$7,487,500	$ 8,739,100	$4,614,900	$6,745,400	$ 908,400	$3,908,200	$ 87,813,900
27	$2,537,900	$897,900	$7,487,500	$ 8,739,100	$4,614,900	$6,745,400	$ 908,400	$3,908,200	$ 87,813,900
26	$2,539,000	$897,900	$7,487,500	$ 8,743,200	$4,614,900	$6,746,500	$ 908,400	$3,908,200	$ 87,821,200
25	$2,542,200	$897,900	$7,487,500	$ 8,764,900	$4,614,900	$6,762,600	$ 908,400	$3,917,900	$ 87,883,700
24	$2,555,000	$897,900	$7,487,500	$ 8,815,500	$4,614,900	$6,818,300	$ 908,400	$3,950,000	$ 88,081,000
23	$2,582,900	$897,900	$7,487,500	$ 8,895,000	$4,614,900	$6,937,200	$ 908,400	$4,017,500	$ 88,476,500
22	$2,622,500	$899,000	$7,488,600	$ 8,999,200	$4,619,100	$7,102,200	$ 908,400	$4,111,800	$ 89,036,000
21	$2,669,700	$900,000	$7,501,400	$ 9,140,700	$4,632,800	$7,297,100	$ 909,400	$4,223,200	$ 89,764,300
20	$2,724,300	$903,200	$7,558,100	$ 9,328,600	$4,664,500	$7,523,200	$ 916,900	$4,353,900	$ 90,822,200
19	$2,788,600	$907,500	$7,709,000	$ 9,554,700	$4,711,000	$7,785,600	$ 938,200	$4,504,900	$ 92,459,500
18	$2,861,400	$911,800	$7,969,000	$ 9,819,000	$4,774,300	$8,092,000	$ 978,700	$4,681,700	$ 94,862,400
17	$2,950,300	$919,300	$8,324,200	$10,130,800	$4,856,700	$8,458,400	$1,035,200	$4,891,700	$ 98,028,000
16	$3,057,500	$926,800	$8,770,400	$10,502,400	$4,958,100	$8,901,900	$1,105,600	$5,147,700	$101,997,700
15	$3,189,200	$936,500	$9,330,100	$10,949,500	$5,082,700	$9,450,400	$1,195,100	$5,463,700	$106,950,100
CONNEAUT TRANSPORTATION COSTS									
WATER	$702,800	$115,700	$3,572,800	$2,913,500	$1,019,000	$2,712,500	$ 511,700	$1,606,900	$30,920,000
RAIL	$1,880,900	$820,300	$4,111,000	$6,079,500	$3,766,200	$4,131,400	$ 416,900	$2,404,100	$59,267,900
	$2,583,700	$936,000	$7,683,800	$8,993,000	$4,785,200	$6,843,900	$ 928,600	$4,011,000	$90,187,900
ASHTABULA HARBOR CHANNEL DEPTH AT WHICH SWITCH IS MADE	22.97	15.05	19.17	22.06	17.87	24.78	19.45	23.10	20.60
ASHTABULA HARBOR STARTING CHANNEL DEPTH	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00	
CHANNEL SHOALING RATE- FEET PER YEAR	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	

Table S1.34- Continued

3. TOTAL TRANSPORTATION COSTS (WATER AND RAIL)- LIMESTONE

TONS 177,817 103,491 315,986 70,004 667,298

ASHTABULA HARBOR CHANNEL DEPTH	CALCITE MICHIGAN	MARBLEHEAD OHIO	PORT INLAND MICHIGAN	STONEPORT MICHIGAN	TOTAL LIMESTONE TRANSPORTATION COSTS
28	$1,583,500	$604,100	$2,905,100	$ 719,800	$5,812,500
27	$1,583,500	$604,100	$2,905,100	$ 719,800	$5,812,500
26	$1,585,700	$604,100	$2,909,400	$ 719,800	$5,819,000
25	$1,600,700	$605,200	$2,927,500	$ 719,800	$5,853,200
24	$1,632,800	$605,200	$2,970,200	$ 719,800	$5,928,000
23	$1,684,200	$606,200	$3,041,700	$ 720,800	$6,052,900
22	$1,749,500	$609,300	$3,138,800	$ 721,900	$6,219,500
21	$1,829,800	$617,700	$3,257,200	$ 727,200	$6,431,900
20	$1,921,900	$629,200	$3,396,000	$ 739,000	$6,686,100
19	$2,031,100	$643,800	$3,557,100	$ 764,700	$6,996,700
18	$2,161,700	$661,600	$3,742,800	$ 805,400	$7,371,500
17	$2,318,100	$682,500	$3,963,700	$ 857,900	$7,822,200
16	$2,513,000	$708,700	$4,228,400	$ 922,100	$8,372,200
15	$2,760,300	$742,100	$4,551,700	$1,003,500	$9,057,600
CONNEAUT TRANSPORTATION COSTS					
WATER	$1,099,700	$324,100	$2,035,100	$ 532,200	$3,991,100
TRUCK	$675,500	$393,100	$1,200,500	$ 265,900	$2,535,000
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	$1,775,200	$717,200	$3,235,600	$ 798,100	$6,526,100
ASHTABULA HARBOR CHANNEL DEPTH AT WHICH SWITCH IS MADE					
	21.68	15.75	21.18 18.18	20.63	
ASHTABULA HARBOR STARTING CHANNEL DEPTH					
	28.00	28.00	28.00	18.00	
CHANNEL SHOALING RATE- FEET PER YEAR					
	0.5	0.5	0.5	0.33	

4. TOTAL TRANSPORTATION COSTS.

ASHTABULA HARBOR CHANNEL DEPTH	TOTAL IRON ORE TRANSPORT COSTS	TOTAL COAL TRANSPORT COSTS	TOTAL LIMESTONE TRANSPORT COSTS	TOTAL TRANSPORT COSTS
28	$49,779,900	$87,813,900	$5,812,500	$143,406,300
27	$49,779,900	$87,813,900	$5,812,500	$143,406,300
26	$49,864,700	$87,821,200	$5,819,000	$143,504,900
25	$50,313,100	$87,883,700	$5,853,200	$144,050,000
24	$51,337,800	$88,081,000	$5,928,000	$145,346,800
23	$52,880,700	$88,476,500	$6,052,900	$147,410,100
22	$54,786,400	$89,036,000	$6,219,500	$150,041,900
21	$56,988,700	$89,764,300	$6,431,900	$153,184,900
20	$59,529,500	$90,822,200	$6,686,100	$157,037,800
19	$62,574,000	$92,459,500	$6,996,700	$162,030,200
18	$65,894,500	$94,862,400	$7,371,500	$168,128,400
17	$70,042,100	$98,028,000	$7,822,200	$175,892,300
16	$75,015,900	$101,997,700	$8,372,200	$185,385,800
15	$81,172,200	$106,950,100	$9,057,600	$197,179,900

Table S1.35- Without Project Condition Average Annual Water Transportation Costs- Advance Michigan October 2000 Prices, 6 3/8% Annual Interest Rate

Oct-00 Prices

CHANNEL DEPTH	ASHTABULA WATER COSTS	CHANNEL DEPTH	ASHTABULA WATER COSTS
28	$870,500	21	$ 870,000
27	$870,500	20	$ 875,900
26	$870,500	19	$ 897,300
25	$870,500	18	$ 947,600
24	$870,500	17	$1,024,700
23	$870,500	16	$1,126,400
22	$870,500	15	$1,256,000

Time Stream Of Water Transportation Costs - Switch takes place at 18.51 ft channel depth

Project Year	Ashtabula Channel Starting Depth	Amount Shoaled Per Year	Ashtabula Channel Depth Beginning Of Year	Water Transport Costs	Present Worth Factor	Present Worth Value
1	27.00	0.33	27.00	$870,500	0.940070505	$818,331
2	27.00	0.33	26.66	$870,500	0.883732555	$723,186
4	27.00	0.33	26.00	$870,500	0.780983229	$679,846
5	27.00	0.33	25.66	$870,500	0.734179298	$639,103
6	27.00	0.33	25.33	$870,500	0.690180304	$600,802
7	27.00	0.33	25.00	$870,500	0.648818147	$564,796
8	27.00	0.33	24.66	$870,500	0.609934803	$530,948
9	27.00	0.33	24.33	$870,500	0.573381719	$499,129
10	27.00	0.33	24.00	$870,500	0.539019242	$469,216
11	27.00	0.33	23.66	$870,500	0.506716091	$441,096
12	27.00	0.33	23.33	$870,500	0.476348852	$414,662
13	27.00	0.33	23.00	$870,500	0.447801506	$389,811
14	27.00	0.33	22.66	$870,500	0.420964988	$366,450
15	27.00	0.33	22.33	$870,500	0.395736769	$344,489
16	27.00	0.33	22.00	$870,500	0.372020464	$323,844
17	27.00	0.33	21.66	$870,500	0.349725466	$304,436
18	27.00	0.33	21.33	$870,500	0.328766595	$286,191
19	27.00	0.33	21.00	$870,500	0.30906378	$269,040
20	27.00	0.33	20.66	$872,300	0.290541743	$253,440
21	27.00	0.33	20.33	$874,100	0.273129723	$238,743
22	27.00	0.33	20.00	$875,900	0.256761197	$224,897
23	27.00	0.33	19.66	$883,033	0.241373628	$213,141
24	27.00	0.33	19.33	$890,167	0.226908229	$201,986
25	27.00	0.33	19.00	$897,300	0.213309733	$191,403
26	27.00	0.33	18.66	$914,067	0.200526189	$183,294
27	27.00	0.33	18.33	$889,800	0.188508756	$167,735
28	27.00	0.33	18.00	$889,800	0.177211521	$157,683
29	27.00	0.33	17.66	$889,800	0.166591324	$148,233
30	27.00	0.33	17.33	$889,800	0.15660759	$139,349
31	27.00	0.33	17.00	$889,800	0.147222177	$130,998
32	27.00	0.33	16.66	$889,800	0.138399226	$123,148
33	27.00	0.33	16.33	$889,800	0.13010503	$115,767
34	27.00	0.33	16.00	$889,800	0.122307902	$108,830
35	27.00	0.33	15.66	$889,800	0.114978051	$102,307
36	27.00	0.33	15.33	$889,800	0.108087474	$96,176
37	27.00	0.33	15.00	$889,800	0.101609847	$90,412
38	27.00			$889,800	0.09552042	$84,994
39	27.00			$889,800	0.089795929	$79,900
40	27.00			$889,800	0.084414505	$75,112
41	27.00			$889,800	0.079355586	$70,611
42	27.00			$889,800	0.074599846	$66,379
43	27.00			$889,800	0.070129115	$62,401
44	27.00			$889,800	0.065926312	$58,661
45	27.00			$889,800	0.061975382	$55,146
46	27.00			$889,800	0.058261228	$51,841
47	27.00			$889,800	0.054769662	$48,734
48	27.00			$889,800	0.051487344	$45,813
49	27.00			$889,800	0.048401734	$43,068
50	27.00			$889,800	0.045501042	$40,487

						$13,105,356
					Partial Payment Factor	0.066788968

						$875,293
					Rounded	$875,300

Table S1.36- Without Project Condition Average Annual Rail Transportation Costs- Advance Michigan October 2000 Prices, 6 3/8% Annual Interest Rate

Time Stream Of Rail Transportation Costs- Switch takes place at 18.51 ft channel depth

Project Year	Ashtabula Channel Starting Depth	Amount Shoaled Per Year	Ashtabula Channel DepthRail Beginning Of Year	Transport Costs	Present Worth Factor	Present Worth Value
1	27.00	0.33	27.00	$948,100	0.940070505	$891,281
2	27.00	0.33	26.66	$948,100	0.883732555	$837,867
3	27.00	0.33	26.33	$948,100	0.830770909	$787,654
4	27.00	0.33	26.00	$948,100	0.780983229	$740,450
5	27.00	0.33	25.66	$948,100	0.734179298	$696,075
6	27.00	0.33	25.33	$948,100	0.690180304	$654,360
7	27.00	0.33	25.00	$948,100	0.648818147	$615,144
8	27.00	0.33	24.66	$948,100	0.609934803	$578,279
9	27.00	0.33	24.33	$948,100	0.573381719	$543,623
10	27.00	0.33	24.00	$948,100	0.539019242	$511,044
11	27.00	0.33	23.66	$948,100	0.506716091	$480,418
12	27.00	0.33	23.33	$948,100	0.476348852	$451,626
13	27.00	0.33	23.00	$948,100	0.447801506	$424,561
14	27.00	0.33	22.66	$948,100	0.420964988	$399,117
15	27.00	0.33	22.33	$948,100	0.395736769	$375,198
16	27.00	0.33	22.00	$948,100	0.372020464	$352,713
17	27.00	0.33	21.66	$948,100	0.349725466	$331,575
18	27.00	0.33	21.33	$948,100	0.328766595	$311,704
19	27.00	0.33	21.00	$948,100	0.30906378	$293,023
20	27.00	0.33	20.66	$948,100	0.290541743	$275,463
21	27.00	0.33	20.33	$948,100	0.273129723	$258,954
22	27.00	0.33	20.00	$948,100	0.256761197	$243,435
23	27.00	0.33	19.66	$948,100	0.241373628	$228,846
24	27.00	0.33	19.33	$948,100	0.226908229	$215,132
25	27.00	0.33	19.00	$948,100	0.213309733	$202,239
26	27.00	0.33	18.66	$948,100	0.200526189	$190,119
27	27.00	0.33	18.33	$980,900	0.188508756	$184,908
28	27.00		18.00	$980,900	0.177211521	$173,827
29	27.00		17.66	$980,900	0.166591324	$163,409
30	27.00		17.33	$980,900	0.15660759	$153,616
31	27.00		17.00	$980,900	0.147222177	$144,410
32	27.00		16.66	$980,900	0.138399226	$135,756
33	27.00		16.33	$980,900	0.13010503	$127,620
34	27.00		16.00	$980,900	0.122307902	$119,972
35	27.00		15.66	$980,900	0.114978051	$112,782
36	27.00		15.33	$980,900	0.108087474	$106,023
37	27.00		15.00	$980,900	0.101609847	$99,669
38	27.00			$980,900	0.09552042	$93,696
39	27.00			$980,900	0.089795929	$88,081
40	27.00			$980,900	0.084414505	$82,802
41	27.00			$980,900	0.079355586	$77,840
42	27.00			$980,900	0.074599846	$73,175
43	27.00			$980,900	0.070129115	$68,790
44	27.00			$980,900	0.065926312	$64,667
45	27.00			$980,900	0.061975382	$60,792
46	27.00			$980,900	0.058261228	$57,148
47	27.00			$980,900	0.054769662	$53,724
48	27.00			$980,900	0.051487344	$50,504
49	27.00			$980,900	0.048401734	$47,477
50	27.00			$980,900	0.045501042	$44,632
						$14,275,220
				Partial Payment Factor		0.066788968
						$953,427
				Rounded		$953,400

Table S1.37 Total Average Annual WOP Condition Transportation Costs- Iron Ore, Coal, Limestone

ORIGIN DESTINATION PAIR	Oct-00 WOP AVERAGE ANNUAL WATER COSTS	Oct-00 WOP AVERAGE ANNUAL RAIL COSTS	Oct-00 TOTAL WOP AVERAGE ANNUAL TRNSPRTATN COSTS
IRON ORE-Alternate Port= Cleveland, Ohio			
DULUTH, MINNESOTA	$ 1,733,800	$ 821,100	$ 2,554,900
ESCANABA, MICHIGAN	$ 1,101,800	$ 855,200	$ 1,957,000
PRESQUE ISLE, MICHIGAN	$13,581,400	$ 8,504,000	$ 22,085,400
ST. LAWRENCE RIVER	$ 4,057,900	$ 1,675,800	$ 5,733,700
SILVER BAY, MINNESOTA	$ 1,281,500	$ 986,900	$ 2,268,400
SUPERIOR WISCONSIN	$ 8,949,700	$ 6,063,100	$ 15,012,800
TWO HARBORS MINNESOTA	$ 297,800	$ 117,700	$ 415,500
	$31,003,900	$19,023,800	$ 50,027,700
COAL-Alternate Port= Conneaut			
ADVANCE, MICHIGAN	$ 875,300	$ 953,400	$ 1,828,700
BATH, ONTARIO	$ 257,900	$ 656,400	$ 914,300
CHARLEVOIX, MICHIGAN	$ 1,309,500	$ 2,154,600	$ 3,464,100
CLARKSON, ONTARIO	$ 470,800	$ 1,410,600	$ 1,881,400
COURTWRIGHT, ONTARIO	$ 1,271,600	$ 5,129,000	$ 6,400,600
DETROIT, MICHIGAN	$ 126,000	$ 428,600	$ 554,600
DUNKIRK, NEW YORK	$ 53,200	$ 248,800	$ 302,000
GLADSTONE, MICHIGAN	$ 194,000	$ 214,500	$ 408,500
GRAND HAVEN, MICHIGAN	$ 164,400	$ 138,200	$ 302,600
GREENBAY, WISCONSIN	$ 3,647,800	$ 3,354,800	$ 7,002,600
MANISTEE HARBOR, MICHIGAN	$ 832,100	$ 939,500	$ 1,771,600
MARINETTE, WISCONSIN	$ 161,600	$ 172,300	$ 333,900
MARYSVILLE, MICHIGAN	$ 59,100	$ 169,200	$ 228,300
MILWAUKEE, WISCONSIN	$ 5,840,100	$ 5,900,100	$ 11,740,200
NANTICOKE, ONTARIO	$ 1,629,100	$11,245,400	$ 12,874,500
NIAGARA RIVER, NEW YORK	$ 312,400	$ 1,213,200	$ 1,525,600
ONTONAGON HARBOR, MICHIGAN	$ 456,000	$ 386,500	$ 842,500
PICTON, ONTARIO	$ 716,200	$ 1,846,400	$ 2,562,600
PORT STANLEY, ONTARIO	$ 108,700	$ 794,700	$ 903,400
PORT WASHINGTON, WISCONSIN	$ 3,533,100	$ 3,999,700	$ 7,532,800
PRESQUE ISLE, MICHIGAN	$ 2,914,800	$ 5,950,800	$ 8,865,600
ST. CLAIR, MICHIGAN	$ 992,900	$ 3,657,600	$ 4,650,500
ST. LAWRENCE RIVER & ABOVE	$ 2,728,800	$ 4,080,600	$ 6,809,400
SUPERIOR WISCONSIN	$ 507,200	$ 405,900	$ 913,100
THUNDERBAY, ONTARIO	$ 1,603,900	$ 2,360,000	$ 3,963,900
	$30,766,500	$57,810,800	$ 88,577,300
LIMESTONE-Alternate Port=Conneaut			
CALCITE, MICHIGAN	$ 1,103,500	$ 580,700	$ 1,684,200
MARBLEHEAD, OHIO	$ 320,500	$ 314,600	$ 635,100
PORT INLAND, MICHIGAN	$ 2,046,700	$ 1,024,000	$ 3,070,700
STONEPORT, MICHIGAN	$ 603,900	$ 201,500	$ 805,400
	$ 4,074,600	$ 2,120,800	$ 6,195,400
Total WOP Avg Annual Transportation Costs	$65,845,000	$78,955,400	$144,800,400

**Table S1.38- Total Average Annual Commercial Navigation Benefits-
October 2000 Prices and 6/38% Annual Interest Rate**

ORIGIN DESTINATION PAIR	Oct-00 Average Annual WOP Trnsprtn Costs	Oct-00 Average Annual WP Trnsprtn Costs	Oct-00 Average Annual Transportation Benefits
IRON ORE			
DULUTH, MINNESOTA	$ 2,554,900	$ 2,554,900	$ 0
ESCANABA, MICHIGAN	$ 1,957,000	$ 1,957,000	$ 0
PRESQUE ISLE, MICHIGAN	$22,085,400	$22,085,400	$ 0
ST. LAWRENCE RIVER	$ 5,733,700	$ 5,518,600	$ 215,100
SILVER BAY, MINNESOTA	$ 2,268,400	$ 2,262,300	$ 6,100
SUPERIOR WISCONSIN	$15,012,800	$14,986,200	$ 26,600
TWO HARBORS MINNESOTA	$ 415,500	$ 415,500	$ 0
	$50,027,700	$49,779,900	$ 247,800
COAL			
ADVANCE, MICHIGAN	$ 1,828,700	$ 1,818,600	$ 10,100
BATH, ONTARIO	$ 914,300	$ 905,600	$ 8,700
CHARLEVOIX, MICHIGAN	$ 3,464,100	$ 3,440,500	$ 23,600
CLARKSON, ONTARIO	$ 1,881,400	$ 1,867,600	$ 13,800
COURTWRIGHT, ONTARIO	$ 6,400,600	$ 6,308,300	$ 92,300
DETROIT, MICHIGAN	$ 554,600	$ 551,200	$ 3,400
DUNKIRK, NEW YORK	$ 302,000	$ 301,800	$ 200
GLADSTONE, MICHIGAN	$ 408,500	$ 406,100	$ 2,400
GRAND HAVEN, MICHIGAN	$ 302,600	$ 301,800	$ 800
GREENBAY, WISCONSIN	$ 7,002,600	$ 6,966,500	$ 36,100
MANISTEE HARBOR, MICHIGAN	$ 1,771,600	$ 1,762,400	$ 9,200
MARINETTE, WISCONSIN	$ 333,900	$ 332,200	$ 1,700
MARYSVILLE, MICHIGAN	$ 228,300	$ 225,600	$ 2,700
MILWAUKEE, WISCONSIN	$11,740,200	$11,659,000	$ 81,200
NANTICOKE, ONTARIO	$12,874,500	$12,771,100	$ 103,400
NIAGARA RIVER, NEW YORK	$ 1,525,600	$ 1,521,200	$ 4,400
ONTONAGON HARBOR, MICHIGAN	$ 842,500	$ 835,100	$ 7,400
PICTON, ONTARIO	$ 2,562,600	$ 2,537,900	$ 24,700
PORT STANLEY, ONTARIO	$ 903,400	$ 897,900	$ 5,500
PORT WASHINGTON, WISCONSIN	$ 7,532,800	$ 7,487,500	$ 45,300
PRESQUE ISLE, MICHIGAN	$ 8,865,600	$ 8,739,100	$ 126,500
ST. CLAIR, MICHIGAN	$ 4,650,500	$ 4,614,900	$ 35,600
ST. LAWRENCE RIVER & ABOVE	$ 6,809,400	$ 6,745,400	$ 64,000
SUPERIOR WISCONSIN	$ 913,100	$ 908,400	$ 4,700
THUNDERBAY, ONTARIO	$ 3,963,900	$ 3,908,200	$ 55,700
	$88,577,300	$87,813,900	$ 763,400
LIMESTONE			
CALCITE, MICHIGAN	$ 1,684,200	$ 1,583,500	$ 100,700
MARBLEHEAD, OHIO	$ 635,100	$ 604,100	$ 31,000
PORT INLAND, MICHIGAN	$ 3,070,700	$ 2,905,100	$ 165,600
STONEPORT, MICHIGAN	$ 805,400	$ 805,400	$ 0
	$ 6,195,400	$ 5,898,100	$ 297,300
Total AA Transportation Costs/Benefits	$144,800,400	$143,491,900	$1,308,500

ASHTABULA HARBOR LONG TERM MANAGEMENT STUDY
ASHTABULA, OHIO
DRAFT LETTER REPORT

SUB APPENDIX S2

An Economic And Fiscal Impact Study Of The Ashtabula Harbor Dredging Project

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An Economic and Fiscal Impact Study of the Ashtabula Harbor Dredging Project

Final Report

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The Ohio State University
Columbus, Ohio

September 30, 1996

Table of Contents

An Economic and Fiscal Impact Study of the Ashtabula Harbor Dredging Project

Introduction

Water transportation has long been important in the economy of Ashtabula city and county. Since the late 18th century, the Ashtabula Port has been a conduit for natural resource commodities flowing in and out of the regional and national economy. Industrial and commercial uses of the harbor are now threatened by a halt in dredging operations due to the presence of contaminated sediment.

Dredging of the federal channel in the Ashtabula Harbor was carried out periodically by the Army Corps of Engineers until recently. Dredged materials were transported to an open lake dump site a few miles from the harbor. However, contaminated sediment from the river migrated gradually into the harbor and federal law now forbids open-lake dumping of sediment from the harbor. In order to resume dredging, a confined disposal facility (CDF) will have to be constructed for the deposit of the contaminated sediment.

Ships are currently being light loaded at one of the three industrial docks in Ashtabula because of harbor sedimentation, increasing the cost per ton of cargo. Without dredging, the Ashtabula Harbor will become less competitive as a Great Lakes port and may lose significant volumes of industrial shipping activity. In addition, jobs would be lost in closely-linked sectors, such as trucking and rail services, that support the port's activities, and firms within Ashtabula County that use the harbor facilities would have to ship raw materials by more costly modes of transportation. As port workers and workers in the closely-linked industries lose their jobs and income, additional losses would occur in other sectors, such as the retail and service industries.

With reduced economic activity in the directly and indirectly affected sectors, various changes are likely to occur in Ashtabula County. For example, government revenues and the supply of local public services are likely to decline.

Ashtabula Harbor accounts for 14 percent of the freight tonnage passing through the ten major Lake Erie ports (Figure 1). Freight traffic passing through the harbor consists of two major commodities (Table 1). Coal (an Ashtabula export) and iron ore (an Ashtabula import) account for the largest tonnages. A smaller amount of limestone is shipped, and an "other" category includes scrap, slag, fertilizer, non-metallic minerals, cement, and sand and gravel. Figure 2 shows Ashtabula Harbor freight shipments by commodity category over the period 1984-93. Total tonnage at the end of this period was three percent below the tonnage in 1983 with considerable fluctuation during the ten year period. Coal exports declined from 5.4 million tons in 1984 to 3.4 million tons in 1993 while iron ore imports increased from 3.1 million tons to 4.7 million tons. Coal moves by rail from mining regions of Ohio, West Virginia, and Pennsylvania to the Conrail dock in the Ashtabula Port and is then transported by water to domestic and foreign (primarily Canadian) markets. Iron ore arrives at Pinney Dock by ship from U.S. and Canadian locations and is transported by rail to steel plants on the Ohio River in Ohio and West Virginia.

There are three industrial docks in the Ashtabula Harbor. The owners are Pinney Dock and Transport Company, the Conrail Corporation, and R.W. Sidley, Incorporated. The Pinney dock imports limestone and building materials, including cement, stone, and potash. The Conrail dock exports coal and imports iron ore, while the Sidley dock imports limestone and stone. According to the Ashtabula Port Action Plan prepared by the Ashtabula Port Authority in 1994, ships bringing stone to the Sidley dock are able to fill to only two-thirds of capacity because of sedimentation in the inner harbor. Pinney and Conrail, which are located farther out in the harbor, reported no light-loading. The business establishments operating the three docks have a combined workforce of approximately 150 workers.

Recreational and commercial boating activity are not included in this study since these businesses are primarily located south of the harbor and the 6th Street bridge in the mouth of the river.

Objectives

The proposed solution for the Ashtabula Harbor is to build a confined disposal facility (CDF) for the dredged contaminated sediment from the outer harbor. A CDF built to federal standards would allow periodic maintenance dredging and continuation of industrial shipping in the port. The Army Corps of Engineers has evaluated at least three sites as potential locations for the CDF.

Since federal legislation at the time that the report was prepared calls for local cost sharing for the construction of CDFs, some portion of the facility's estimated $13 million cost may be borne by local governments. If cost-sharing were implemented, what would be the fiscal consequences for local governments in the county? In order to answer these questions and others, one must have some idea about (1) the potential benefits and costs of not building the CDF and (2) the potential benefits and costs of building the CDF.

We develop three different scenarios that represent alternative views of the future with regard to Ashtabula Harbor. These scenarios allow us to examine the consequences of differing assumptions about cost sharing arrangements. For each scenario, we estimate the economic impacts on the Ashtabula County economy and the fiscal impacts on local governments if the

CDF is built and dredging continues (the "with" case). We also estimate the economic and fiscal impacts if the CDF is not built and dredging does not occur (the "without" case). Economic impacts are measured in this study in terms of changes in (1) total county employment and (2) county gross product (i.e, net income accruing to households, firms, and local governments). Fiscal impacts are measured in terms of changes in (1) revenues and (2) expenditures of local governments in Ashtabula County.

Project Scenarios

Economic impact studies generally involve a comparison between a baseline case and a hypothetical, though plausible, counterfactual case (see Figure 3). In this study, the baseline case assumes that harbor dredging ceases permanently and that tonnage shipped through the harbor falls to 20 percent of its 1996 level by year 2017. While several counterfactual cases could be formulated, the case that appears most relevant is one in which a CDF is constructed in 1997 and 1998 and maintenance dredging of the harbor occurs annually, allowing shipping tonnage to continue into the future at the 1996 level.

Estimates of the cost of constructing the CDF and the costs of initial and annual maintenance dredging were developed through discussions with the Buffalo District office of the Army Corps of Engineers. The project has two major cost components: construction of a confined disposal facility (CDF) and annual maintenance dredging.

1. Construction of the CDF. Construction of this facility is estimated to take two years and to cost a total of $13 million. This is the amount of a bid that the Corps recently negotiated for construction of a 66 acre CDF along Land Erie in the Cleveland area.
2. Annual Maintenance Dredging. Dredging to maintain the target channel depth is

estimated to cost $650,000 annually. It is assumed that 130,000 cubic yards of sediment will be removed annually at $5 per cubic yard. In 1987, the last year that the Army Corps of engineers conducted maintenance dredging in the harbor, 84,000 cubic yards of material were removed at a unit cost of $4.

Cost Sharing. Until recently, the federal government bore all costs of CDF construction. For this reason, we consider zero local cost sharing as one of three funding options in our analysis. Current federal legislation requires that all costs of construction be borne locally. Therefore, 100 percent cost sharing is considered as a second option. Since the current legislation may change in the near future, we also consider a funding arrangement involving more than zero but less than 100 percent cost sharing. Therefore, the third funding option we consider involves 25 percent local cost sharing.

The federal government continues to bear all costs of maintenance dredging to support commercial shipping activity in federal waterways. Since this funding arrangement is likely to continue, we assume zero cost sharing for maintenance dredging in Ashtabula Harbor.

Description of Study Methods

Types of Impacts. The economic effects of outer harbor dredging on Ashtabula County can be divided into primary and secondary impacts. The three industrial shippers will be impacted directly by the existence or absence of outer harbor dredging. The primary economic impact, in this case the gain or loss of shipping activity in Ashtabula Harbor, can be thought of as a "shock" that sends ripples through the local economy, generating secondary economic impacts (see Figure 4). The secondary impacts consist of changes in the sales and purchases of firms that transact with the directly impacted shipping firms as well as the changes in consumption expenditures of workers employed in both the directly and indirectly affected industries.

Model. The economic and fiscal impacts on Ashtabula County were estimated using REGEM, a regional general equilibrium model developed by David Kraybill and Dee-Yu Pai at The Ohio State University for benefit-cost analysis of community projects. REGEM is a state-of-the-art regional model that projects changes in industry output, intermediate purchases, employment, migration, exports, imports, household consumption, and spending and revenue of governments. In the version used in this study, REGEM has ten industries: agriculture; construction; nondurable goods manufacturing; durable goods manufacturing; water transportation; retail; finance, insurance, and real estate; personal services; business services; and miscellaneous services. The model has three categories of government (local, state, and federal) and one representative household category.

Households in REGEM supply labor to businesses and receive wages in return, receive profits from businesses, pay taxes to governments, receive transfers from governments, and purchase goods and services both within and outside of Ashtabula County. If the cost of living in Ashtabula County rises relative to the rest of Ohio and the U.S., the labor market component of REGEM will predict out-migration of some Ashtabula County residents.

Baseline Projection. To estimate the extent to which shipping will decline in Ashtabula if dredging ceases permanently, we obtained cost data for the harbor from the Army Corps of Engineers. Table 2 shows Corps estimates of shipping costs per ton for coal, iron ore, and limestone for various harbor depths. Based on these shipping costs and on the assumption that harbor sedimentation occurs at the rate of 0.5 feet per year, we estimated changes in the demand for the three commodities shipped through Ashtabula Harbor using elasticities of demand estimated econometrically in several commodity market studies.[1] Since the water is not of uniform depth in the harbor but varies from dock to dock, we estimated changes in shipping tonnage for each of the three industrial shippers.

Tables 3, 4, and 5 show the annual tonnages of the three commodities projected for the three industrial shipping firms if no further dredging occurs in the harbor. Table 6 shows the projected reduction in annual tonnage for all three shippers combined. Assuming 1997 is the first year of the project, by the twentieth year (i.e., by year 2017) all industrial shipping in the harbor is projected to cease. Because the Sidely dock currently has the shallowest depth, shipping there is halted earliest (year 7), followed by the Conrail dock (year 11), ending last at the Pinney dock (year 19).

Baseline and Counterfactual Data. Table 7 shows the changes introduced into the REGEM model to estimate the baseline and counterfactual cases. The second column of the table shows the percentage by which 1996 shipping tonnage is projected to decline annually. The third column shows the amount that would be spent annually in years 1 and 2 to build the CDF and the fourth column shows annual spending on maintenance dredging. REGEM allocates a portion of the construction and dredging expenditures to parties (contractors) outside the county, though a portion is allocated to firms within the county to account for local subcontracting that is likely to occur.

Description of the Data

The starting point in the construction of the Ashtabula County dataset was a 189-industry

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[1] A survey of commodity price elasticity of demand studies is found in J.S. DeSalvo and D.L. Fuller, "The Role of Price Elasticities of Demand in the Economic Impact of a Port," The Review of Regional Studies, Vol. 25, No. 1, 1995, pp. 13-35.

social accounting matrix (SAM) of the Ashtabula economy for year 1992. A SAM is a complex set of accounts that tracks the circular flow of expenditure and income among industries, households, governments, and outside parties (e.g., industries located in other regions and the federal government). The data in the SAM consists of four major categories of economic transactions: (1) interindustry sales and purchases of intermediate inputs; (2) final payments by industries to in-state labor, in-state owners of capital, various levels of government, and out-of-state producers and owners of capital; (3) commodity purchases by households and governments plus inventory changes, investment, and exports, and (4) income transfers from governments to households and firms and transfers among different level of government. These four categories contain most of the data necessary to estimate multiplier effects in the economy.

The Ashtabula County SAM was prepared at Ohio State University using data assembled by Minnesota IMPLAN, Incorporated. The SAM accounts are based on numerous federal government data series including County Business Patterns, the Employment Security (ES202) series, the quinquennial national input-output accounts, the annual national input-output accounts, and the Regional Economic Information System (REIS). The REIS data are derived from economic censuses (Manufactures, Retail, Agriculture, Governments, etc.) conducted by the U.S. Bureau of the Census, the Gross State Product series, and various other statistical series.

The SAM accounts record Ashtabula County transactions with the rest of the state, the nation, and the rest of the world. This information is essential for accurately estimating economic multipliers since the size of the multiplier is determined by the pattern of trade. A region that imported most of the goods required by businesses, households, and governments would have a low multiplier, while a region that imported a small proportion of its requirements would have a high multiplier.

Results of the Analysis

When future benefits and costs are estimated, a project duration must be identified for accounting purposes. We adopt a project duration of 50 years, the length of time used by the Army Corps of Engineers in their calculation of national benefits of the project.

We estimate that 150 workers are employed currently by the three industrial shippers in the Ashtabula Harbor. The projected change in employment if dredging ceases permanently (the baseline case) is shown as a solid line in Figure 5. By year 20, shipping industry employment is projected to fall to 21 workers who would serve only a local demand for harbor activities. In contrast, if the CDF is built and dredging continues (the counterfactual case), employment in the harbor shipping industry is assumed to stay at its current level, as shown by the broken line in the graph.

Gross regional product (GRP) is a broad measure of income, including wages and benefits, returns to capital, and excise taxes. According to our regional economic accounts, the year 0 GRP in Ashtabula County is $1,432 million (i.e, $1.432 billion). Figure 6 shows that in the baseline case, GRP is estimated to drop to $1,422 million by year 20, a decline of $10 million. In the counterfactual case, GRP increases by $2 million annually during CDF construction and then returns to the initial level of $1,432 million.

There are 45,660 employed workers in Ashtabula County in 1996, according to our regional economic data. As shown in Figure 7, county employment is projected to decline to 45,605 by year 20 in the baseline case. Some, though not all, of the workers that become unemployed in the harbor shipping industry will take up employment elsewhere in the county. For this reason, the reduction in total county employment is smaller than the reduction in employment in the shipping industry. In the counterfactual case, employment in the county rises by around 40 workers during the construction of the CDF and then returns to a level slightly higher than the year 0 level due to a handful of workers employed in maintenance dredging of the harbor.

An alternative view of the labor market impact of reduced harbor shipping activity is shown in the migration chart in Figure 8. In the baseline case, out migration begins between years 8 and 10 as shipping operations are gradually curtailed. By year 20, 55 persons out migrate due to the loss of employment and income in the county. In the counterfactual case, there is a very small inflow of population due to the additional employment opportunities provided to a small number of workers involved in CDF construction and maintenance dredging.

The revenues of local governments in the county fall in the baseline case (Figure 9). From a level of $136.8 million in 1996, local government revenue falls slightly to $136.3 million by year 20, an annual revenue loss of $0.5 million. In the counterfactual case, revenue rises slightly during CDF construction and then continues at approximately the initial level.

Local government expenditures fall slightly between years 10 and 20 due to out migration in the baseline case. In the counterfactual case, expenditures vary depending upon cost sharing arrangements for the construction of the CDF. As shown in Figure 10, under zero cost sharing, local government expenditures stay at the year 0 level except for a slight increase due to the temporary influx of construction workers in years 1 and 2. Under 25 percent cost sharing, annual local government expenditures rise by nearly $2 million during years 1 and 2, primarily due to the outlays for CDF construction; under 100 percent cost sharing, annual expenditures rise by $6.5 million during the construction phase.

The net effect on local governments is shown in Figure 11. Under the baseline case, local governments experience a decline of $139,000 in annual revenue by year 20 if dredging ceases permanently. Under the counterfactual case with zero cost sharing, there is no net change in the fiscal position of local governments as compared to the current situation. Under 25 percent cost sharing, local governments experience a reduction in annual net revenues of $1.6 million in years 1 and 2. Under 100 cost sharing, the annual reduction is $6.5 million.

Present Value. Shipping operations in the Ashtabula Harbor generate a stream of income for county residents, both employees and business owners. While our results show that harbor activity is a relatively small percentage of total income and employment in the county economy, the impacts of harbor activity add up over time. In present value terms, we estimate that the present value of additional gross regional product (GRP) over the next 50 years would be $49.8 million. This calculation was carried out using a discount rate of 7.6 percent, the rate currently adopted by the Army Corps of Engineers.

The net present value of fiscal benefits to local governments over the next 50 years is estimated to be $270,000 under the zero percent cost share arrangement (Figure 12). Under a 25 percent cost share arrangement, the net present value of fiscal benefits to local governments would be -$2.65 million. In other words, project-related spending by local governments would exceed project-related revenue generated by direct and indirect effects of harbor shipping. Under 100 cost sharing, the net present value to local governments would be -$11.4 million. Thus, we estimate that local governments would experience net revenue losses under the 25 and 100 percent cost share arrangements.

While local governments would experience a net revenue loss under 25 and 100 percent cost sharing arrangements, the county economy (as measured by gross regional product) would benefit from the harbor dredging project under all three cost sharing scenarios. As in any benefit-costs analysis, the important question for Ashtabula County is whether the beneficiaries could afford to pay the costs of the project? The project benefits of $49.8 million in present value terms accrue to business owners, workers, and local governments in the county. The present value of the local share of CDF construction cost is $3.16 million under 25 percent cost sharing and $12.66 under 100 percent cost sharing (at a discount rate of 7.6 percent). Clearly, the local benefits of the project far exceed the local costs of the project under all potential cost share arrangements considered in this study. Exactly who will bear the costs of the project if cost sharing is mandated is an important question that county leaders will have to answer.

Conclusions

Permanent cessation of dredging in the Ashtabula Harbor would generate relatively small, yet important, impacts in Ashtabula County. According to our estimates, transhipment of commodities would likely cease by the year 20 (i.e, 2017). As cutbacks in the shipping industry ripple through the county economy, county gross product and employment would decrease slightly and a small number of current residents would migrate out to other areas. Construction of a CDF and continued dredging of the harbor would allow shipping activity to continue, providing benefits for the county economy as a whole even if local cost sharing is mandated. However, the way in which the project is funded is important since project-induced revenue flowing to local governments would be lower than project-related expenditures if a 25 or 100 percent cost sharing arrangement is entered into with the federal government. If the project is implemented, a net revenue loss for local governments can be avoided in two ways: (1) the project is funded with no local cost sharing or (2) or project beneficiaries or other private-sector entities in the country bear some of the project costs.

Table 1: Ashtabula Harbor Freight Traffic, 1993
(thousand tons)

Commodity	Grand Total	Inflows	Outflows
All	8974	5441	3533
Coal	3445	22	3423
Iron ore	4685	4575	110
Limestone	409	409	0
Other	435	435	0

Table 2: Yearly Unit Shipping Costs for Coal, Iron Ore, Limestone

	Shipping Cost Per Ton		
Depth (Feet)	Coal	Iron Ore	Limestone
28.0	$5.94	$6.93	$5.47
27.5	$5.94	$6.93	$5.47
27.0	$5.94	$6.93	$5.47
26.5	$5.94	$6.93	$5.47
26.0	$5.95	$7.00	$5.50
25.5	$5.96	$7.05	$5.52
25.0	$5.98	$7.17	$5.58
24.5	$5.99	$7.28	$5.63
24.0	$6.03	$7.45	$5.72
23.5	$6.07	$7.62	$5.80
23.0	$6.13	$7.83	$5.92
22.5	$6.18	$8.04	$6.04
22.0	$6.25	$8.29	$6.19
21.5	$6.32	$8.53	$6.34
21.0	$6.43	$8.82	$6.52
20.5	$6.53	$9.10	$6.69
20.0	$6.69	$9.44	$6.91
19.5	$6.85	$9.77	$7.13
19.0	$7.08	$10.14	$7.39
18.5	$7.31	$10.51	$7.65
18.0	$7.62	$10.97	$7.97
17.5	$7.93	$11.43	$8.29
17.0	$8.32	$11.98	$8.68
16.5	$8.70	$12.53	$9.06
16.0	$9.19	$13.22	$9.54
15.5	$9.67	$13.90	$10.02
15.0	$9.67	$13.90	$10.02

Table 3: Projected Tonnage Shipped by Conrail

Project Year	Water Depth	Cost/ton coal	Tonnage coal
1	24	5.99	3445
2	23.5	6.03	3444.6
3	23	6.07	3444.2
4	22.5	6.13	3443.6
5	22	6.18	3443.0
6	21.5	6.25	3442.3
7	21	6.32	3441.6
8	20.5	6.43	3440.5
9	20	6.53	3439.4
10	20	6.53	2292.9
11	20	6.53	1146.5
12	20	6.53	0.0
13	20	6.53	0.0
14	20	6.53	0.0
15	20	6.53	0.0
16	20	6.53	0.0
17	20	6.53	0.0
18	20	6.53	0.0
19	20	6.53	0.0
20	20	6.53	0.0
21	20	6.53	0.0
22	20	6.53	0.0
23	20	6.53	0.0
24	20	6.53	0.0
25	20	6.53	0.0
26	20	6.53	0.0
27	20	6.53	0.0
28	20	6.53	0.0
29	20	6.53	0.0
30	20	6.53	0.0
31	20	6.53	0.0
32	20	6.53	0.0
33	20	6.53	0.0
34	20	6.53	0.0
35	20	6.53	0.0
36	20	6.53	0.0
37	20	6.53	0.0
38	20	6.53	0.0
39	20	6.53	0.0
40	20	6.53	0.0
41	20	6.53	0.0
42	20	6.53	0.0
43	20	6.53	0.0
44	20	6.53	0.0
45	20	6.53	0.0
46	20	6.53	0.0
47	20	6.53	0.0
48	20	6.53	0.0
49	20	6.53	0.0
50	20	6.53	0.0

Table 4: Projected Tonnage Shipped by Pinney

Project Year	Water Depth	Cost/ton limestone	Tonnage limestone	Cost/ton iron ore	Tonnage ore
1	28.0	5.47	759.6	6.93	4685
2	27.5	5.47	759.6	6.93	4685.0
3	27.0	5.47	759.6	6.93	4685.0
4	26.5	5.48	759.6	6.94	4684.9
5	26.0	5.48	759.6	6.95	4684.7
6	25.5	5.50	759.5	7.00	4684.0
7	25.0	5.52	759.4	7.05	4683.3
8	24.5	5.58	759.1	7.17	4681.7
9	24.0	5.63	758.8	7.28	4680.1
10	23.5	5.72	758.4	7.45	4677.7
11	23.0	5.80	758.0	7.62	4675.4
12	22.5	5.92	757.4	7.83	4672.5
13	22.0	6.04	756.9	8.04	4669.5
14	21.5	6.19	756.2	8.29	4666.2
15	21.0	6.34	755.4	8.53	4662.8
16	20.5	6.52	754.6	8.82	4658.9
17	20.0	6.69	753.8	9.10	4655.0
18	20.0	6.69	502.5	9.10	3103.3
19	20.0	6.69	251.3	9.10	1551.7
20	20.0	6.69	0.0	9.10	0.0
21	20.0	6.69	0.0	9.10	0.0
22	20.0	6.69	0.0	9.10	0.0
23	20.0	6.69	0.0	9.10	0.0
24	20.0	6.69	0.0	9.10	0.0
25	20.0	6.69	0.0	9.10	0.0
26	20.0	6.69	0.0	9.10	0.0
27	20.0	6.69	0.0	9.10	0.0
28	20.0	6.69	0.0	9.10	0.0
29	20.0	6.69	0.0	9.10	0.0
30	20.0	6.69	0.0	9.10	0.0
31	20.0	6.69	0.0	9.10	0.0
32	20.0	6.69	0.0	9.10	0.0
33	20.0	6.69	0.0	9.10	0.0
34	20.0	6.69	0.0	9.10	0.0
35	20.0	6.69	0.0	9.10	0.0
36	20.0	6.69	0.0	9.10	0.0
37	20.0	6.69	0.0	9.10	0.0
38	20.0	6.69	0.0	9.10	0.0
39	20.0	6.69	0.0	9.10	0.0
40	20.0	6.69	0.0	9.10	0.0
41	20.0	6.69	0.0	9.10	0.0
42	20.0	6.69	0.0	9.10	0.0
43	20.0	6.69	0.0	9.10	0.0
44	20.0	6.69	0.0	9.10	0.0
45	20.0	6.69	0.0	9.10	0.0
46	20.0	6.69	0.0	9.10	0.0
47	20.0	6.69	0.0	9.10	0.0
48	20.0	6.69	0.0	9.10	0.0
49	20.0	6.69	0.0	9.10	0.0
50	20.0	6.69	0.0	9.10	0.0

Table 5: Projected Tonnage Shipped by Sidley

Project Year	Water Depth	Cost/ton limestone	Tonnage limestone
1	19.0	7.13	84.4
2	18.5	7.39	84.3
3	18.0	7.65	84.1
4	17.5	7.97	84.0
5	17.0	8.29	83.8
6	17.0	8.29	55.9
7	17.0	8.29	27.9
8	17.0	8.29	0.0
9	17.0	8.29	0.0
10	17.0	8.29	0.0
11	17.0	8.29	0.0
12	17.0	8.29	0.0
13	17.0	8.29	0.0
14	17.0	8.29	0.0
15	17.0	8.29	0.0
16	17.0	8.29	0.0
17	17.0	8.29	0.0
18	17.0	8.29	0.0
19	17.0	8.29	0.0
20	17.0	8.29	0.0
21	17.0	8.29	0.0
22	17.0	8.29	0.0
23	17.0	8.29	0.0
24	17.0	8.29	0.0
25	17.0	8.29	0.0
26	17.0	8.29	0.0
27	17.0	8.29	0.0
28	17.0	8.29	0.0
29	17.0	8.29	0.0
30	17.0	8.29	0.0
31	17.0	8.29	0.0
32	17.0	8.29	0.0
33	17.0	8.29	0.0
34	17.0	8.29	0.0
35	17.0	8.29	0.0
36	17.0	8.29	0.0
37	17.0	8.29	0.0
38	17.0	8.29	0.0
39	17.0	8.29	0.0
40	17.0	8.29	0.0
41	17.0	8.29	0.0
42	17.0	8.29	0.0
43	17.0	8.29	0.0
44	17.0	8.29	0.0
45	17.0	8.29	0.0
46	17.0	8.29	0.0
47	17.0	8.29	0.0
48	17.0	8.29	0.0
49	17.0	8.29	0.0
50	17.0	8.29	0.0

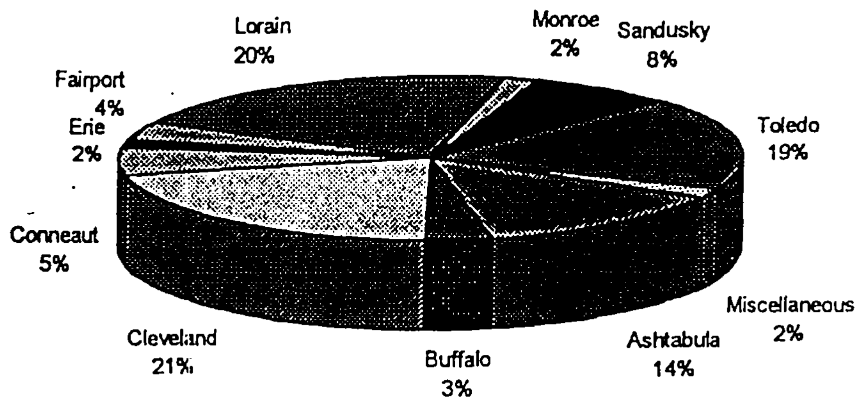
Table 6: Projected Tonnage Shipped Through Ashtabula Harbor

Project year	Tonnage All Commodies	Percent of initial
1	8974.0	100.0%
2	8973.4	100.0%
3	8972.9	100.0%
4	8972.0	100.0%
5	8971.1	100.0%
6	8941.6	99.6%
7	8912.2	99.3%
8	8881.3	99.0%
9	8878.3	98.9%
10	7729.1	86.1%
11	6579.9	73.3%
12	5429.9	60.5%
13	5426.4	60.5%
14	5422.3	60.4%
15	5418.2	60.4%
16	5413.5	60.3%
17	5408.8	60.3%
18	3605.8	40.2%
19	1802.9	20.1%
20	0.0	0.0%
21	0.0	0.0%
22	0.0	0.0%
23	0.0	0.0%
24	0.0	0.0%
25	0.0	0.0%
26	0.0	0.0%
27	0.0	0.0%
28	0.0	0.0%
29	0.0	0.0%
30	0.0	0.0%
31	0.0	0.0%
32	0.0	0.0%
33	0.0	0.0%
34	0.0	0.0%
35	0.0	0.0%
36	0.0	0.0%
37	0.0	0.0%
38	0.0	0.0%
39	0.0	0.0%
40	0.0	0.0%
41	0.0	0.0%
42	0.0	0.0%
43	0.0	0.0%
44	0.0	0.0%
45	0.0	0.0%
46	0.0	0.0%
47	0.0	0.0%
48	0.0	0.0%
49	0.0	0.0%
50	0.0	0.0%

Table 7: Annual Elements of Baseline and Counterfactual Cases

Year	Tonnage as Pct. of 1996 Level	Construction ($ Million)	Maint. Dredging ($ Million)
1	100.0	6.5	.65
2	100.0	6.5	.65
3	100.0		.65
4	100.0		.65
5	100.0		.65
6	99.6		.65
7	99.3		.65
8	99.0		.65
9	98.9		.65
10	86.1		.65
11	73.3		.65
12	60.5		.65
13	60.5		.65
14	60.4		.65
15	60.4		.65
16	60.3		.65
17	60.3		.65
18	40.2		.65
19	20.1		.65
20	0.0		.65
21	0.0		.65
22	0.0		.65
23	0.0		.65
24	0.0		.65
25	0.0		.65
26	0.0		.65
27	0.0		.65
28	0.0		.65
29	0.0		.65
30	0.0		.65
31	0.0		.65
32	0.0		.65
33	0.0		.65
34	0.0		.65
35	0.0		.65
36	0.0		.65
37	0.0		.65
38	0.0		.65
39	0.0		.65
40	0.0		.65
41	0.0		.65
42	0.0		.65
43	0.0		.65
44	0.0		.65
45	0.0		.65
46	0.0		.65
47	0.0		.65
48	0.0		.65
49	0.0		.65
50	0.0		.65

Figure 1: Lake Erie Port Tonnages, 1993



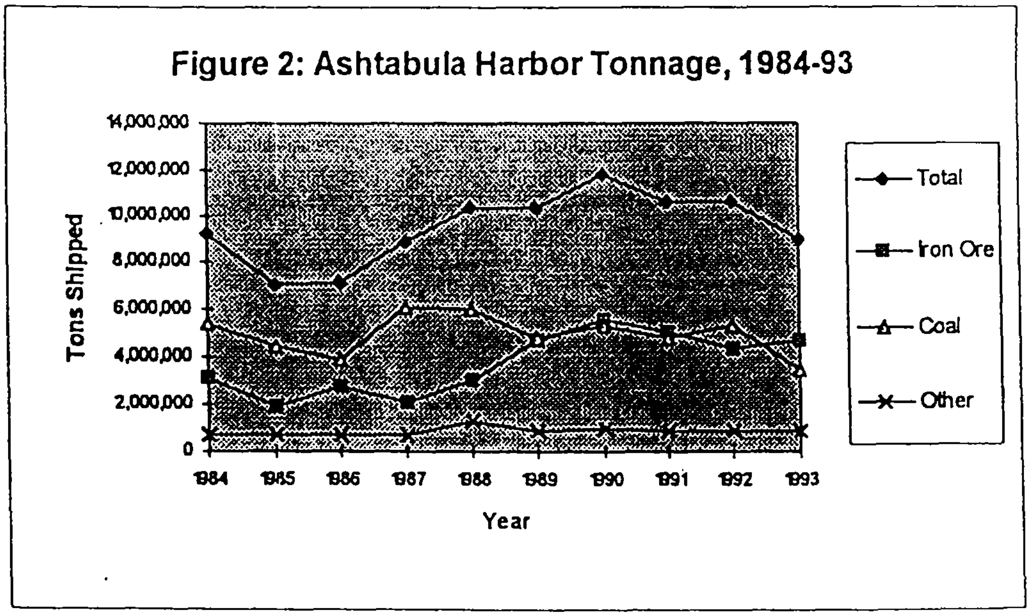


Fig. 3: Impact Scenario

Baseline case

* Harbor dredging ceases permanently
* Activity in the harbor shipping industry declines to 20 percent of 1996 level by year 2017

Counterfactual case

* Confined disposal facility (CDF) is constructed in 1997 and 1998
* Maintenance dredging of the harbor occurs annually
* Shipping activity continues at 1996 level

Fig. 4: Breakdown of Economic Impacts in Ashtabula County if Dredging Ceases Permanently

Primary economic impact
Sales, employment, and profits decline in harbor shipping industry

+

Secondary economic impact
* Output and employment decline in local businesses that supply materials and services to harbor shipping firms
* Workers in directly and indirectly affected industries have less household income to spend locally

=

Total economic impact

Fig. 5: Employment in Harbor Shipping Industry

Ashtabula Harbor

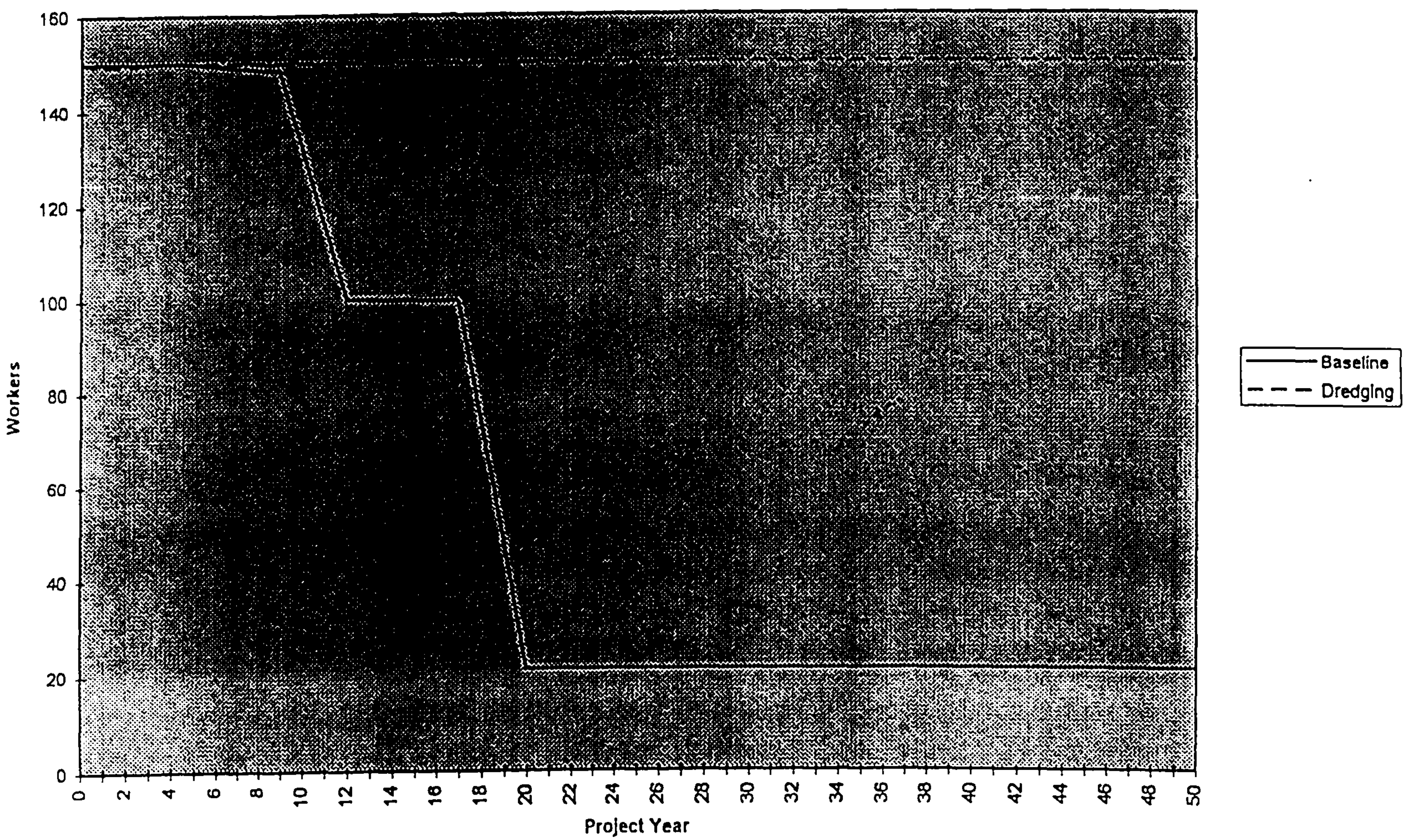


Fig. 6: Gross Regional Product
Ashtabula County

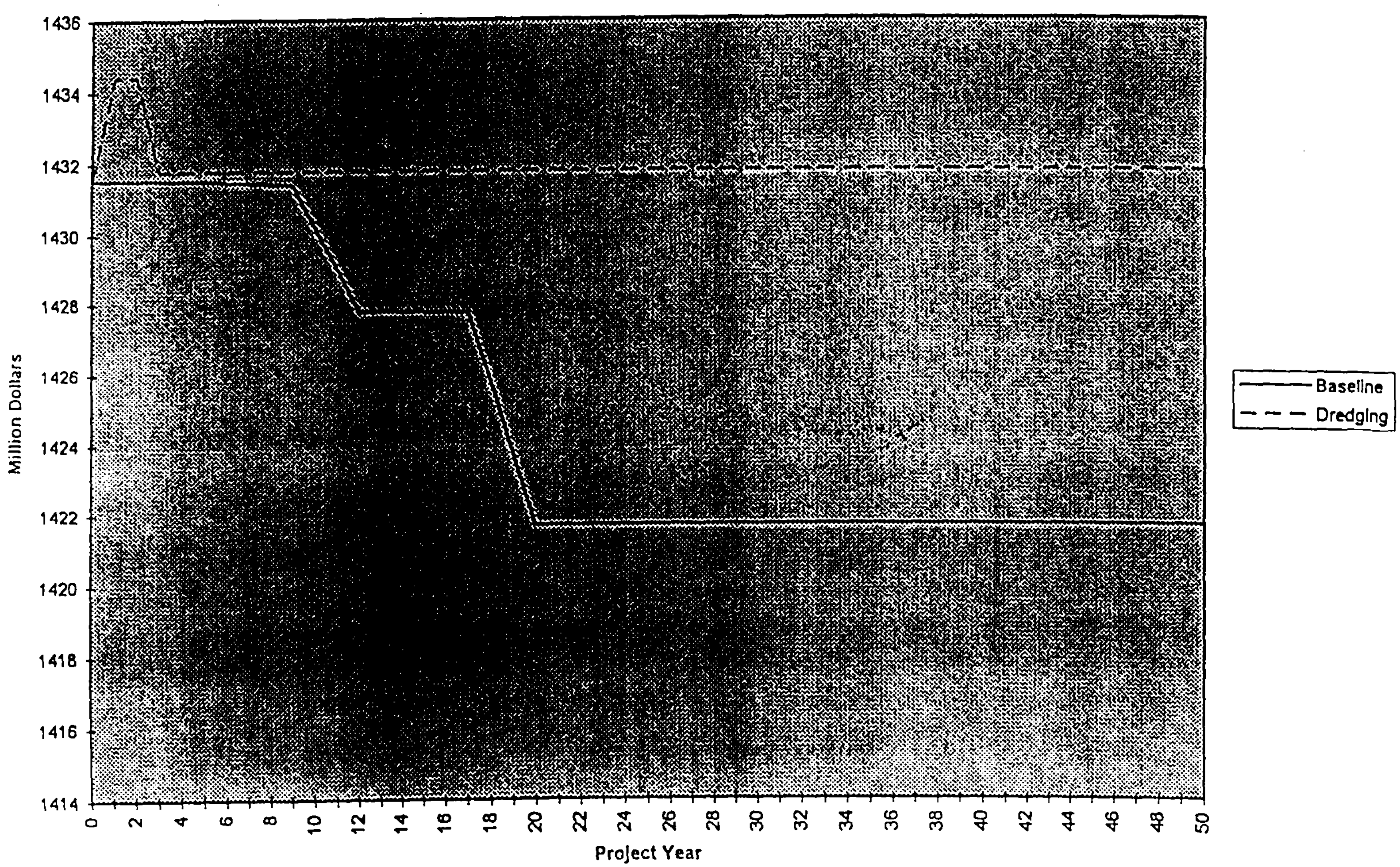


Fig. 7: Total Employment
Ashtabula County

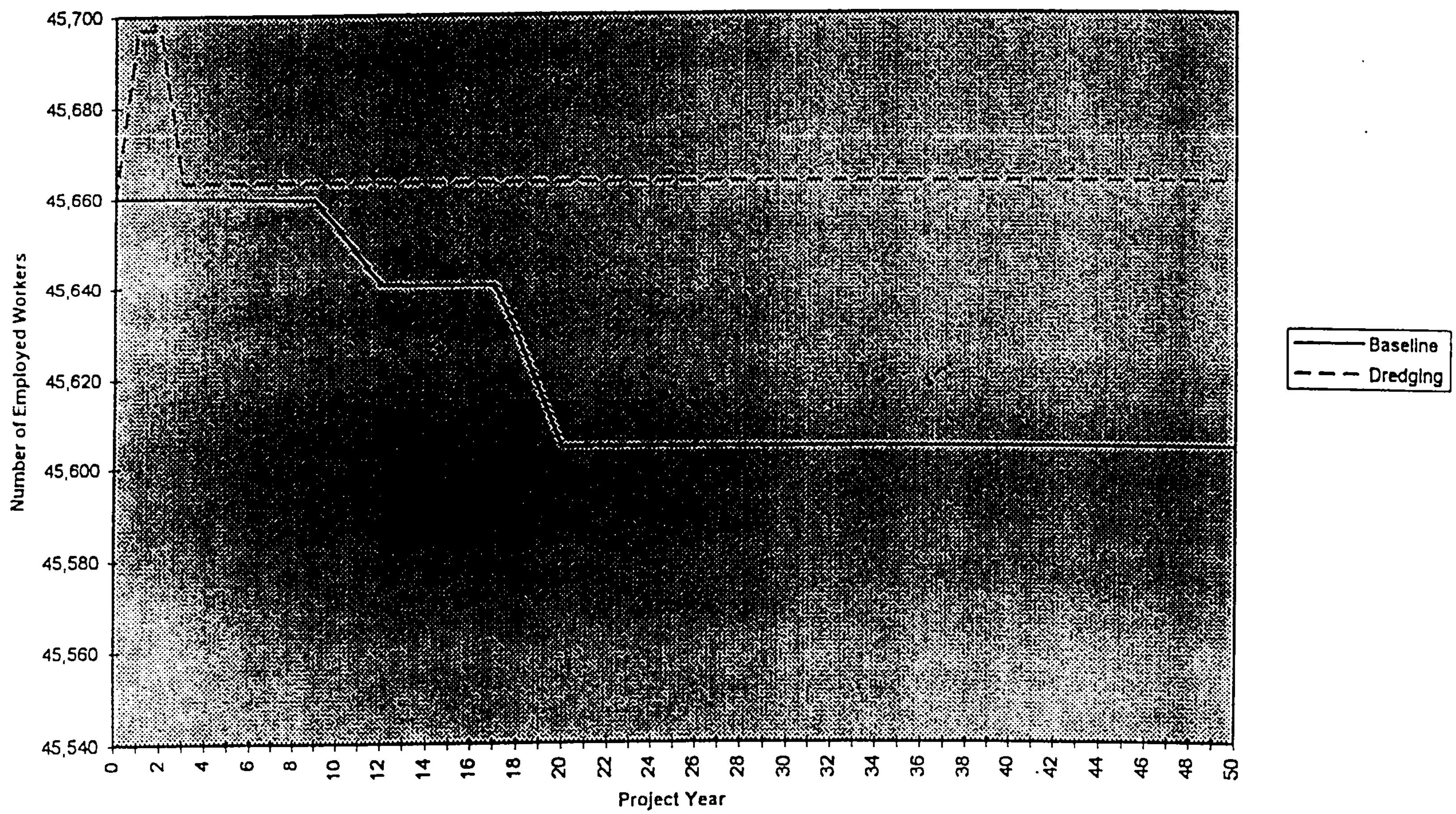


Fig. 8: Migration
Ashtabula County

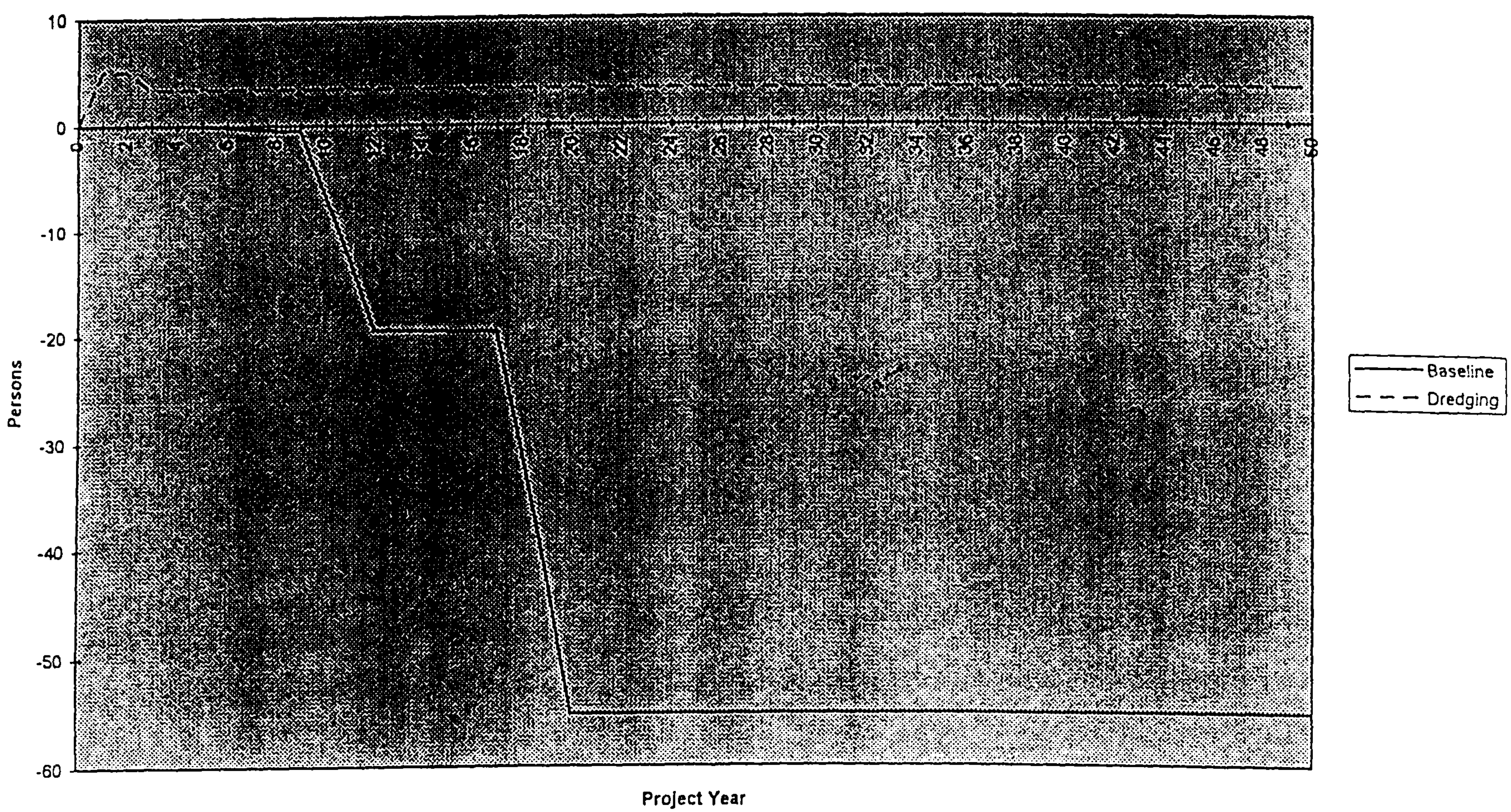


Fig. 9: Local Government Revenues

All Local Governments, Ashtabula County

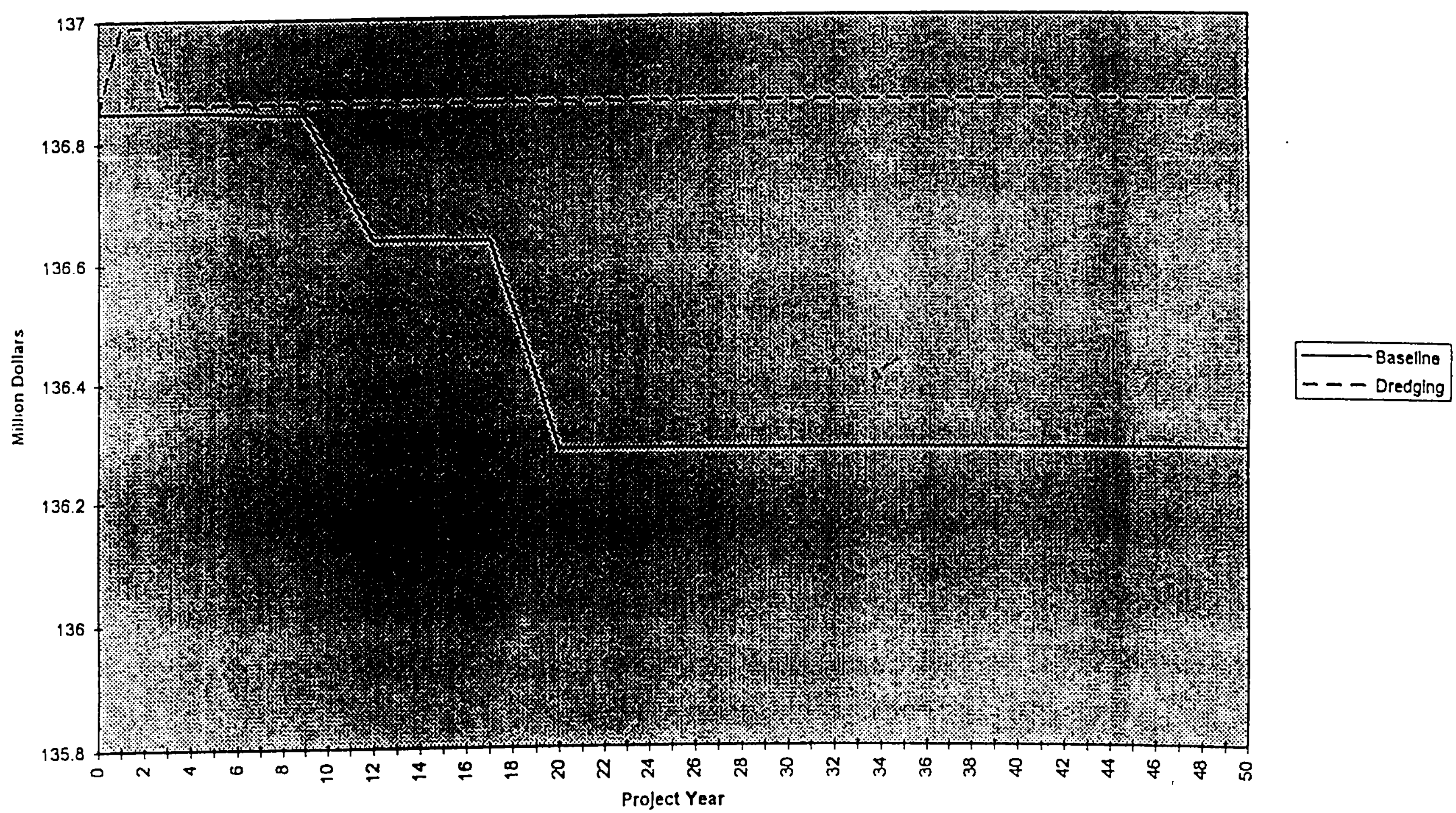


Fig. 10: Local Government Expenditures

All Local Governments, Ashtabula County

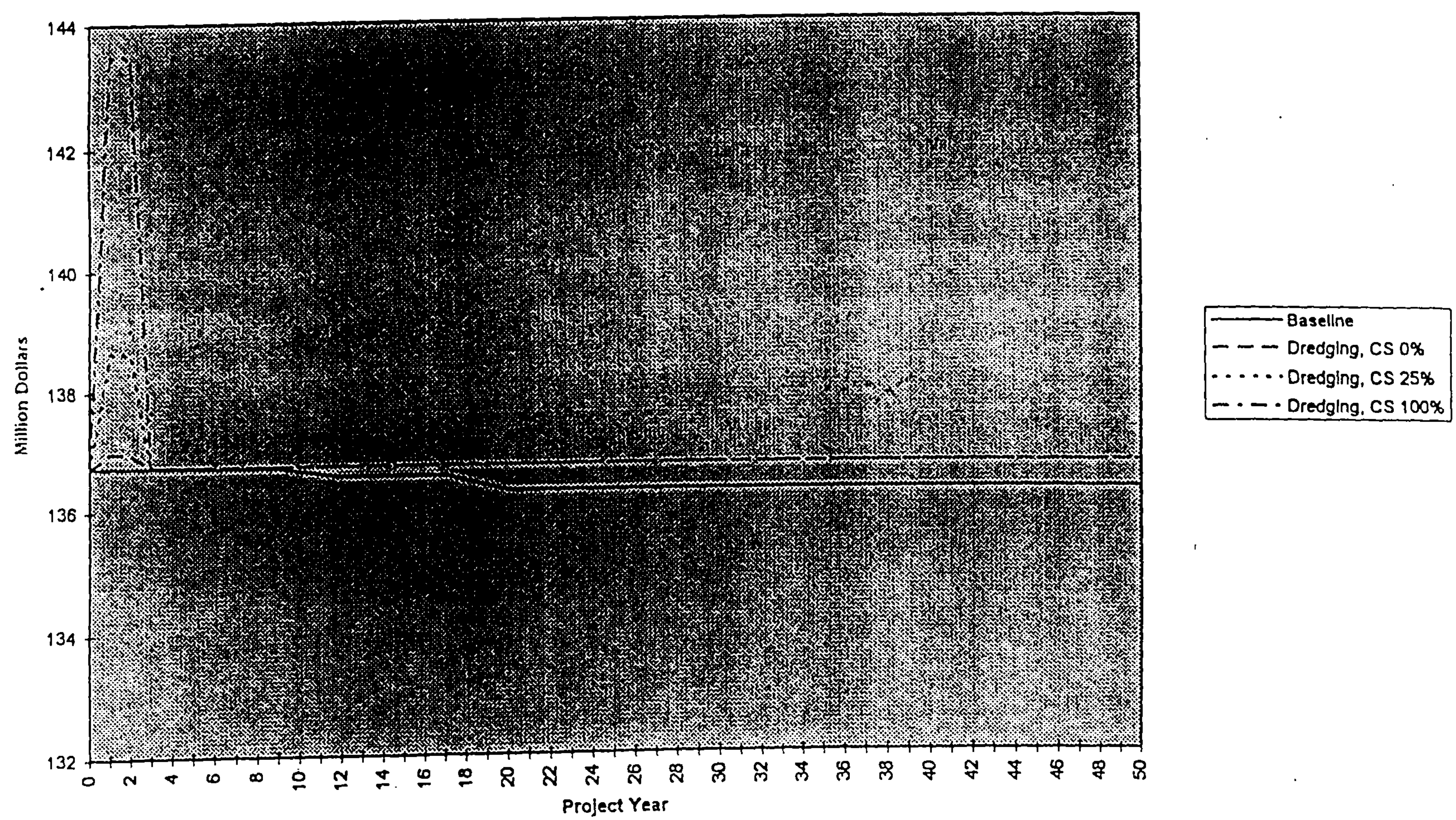


Fig. 11: Local Government Net Fiscal Benefits
Ashtabula County

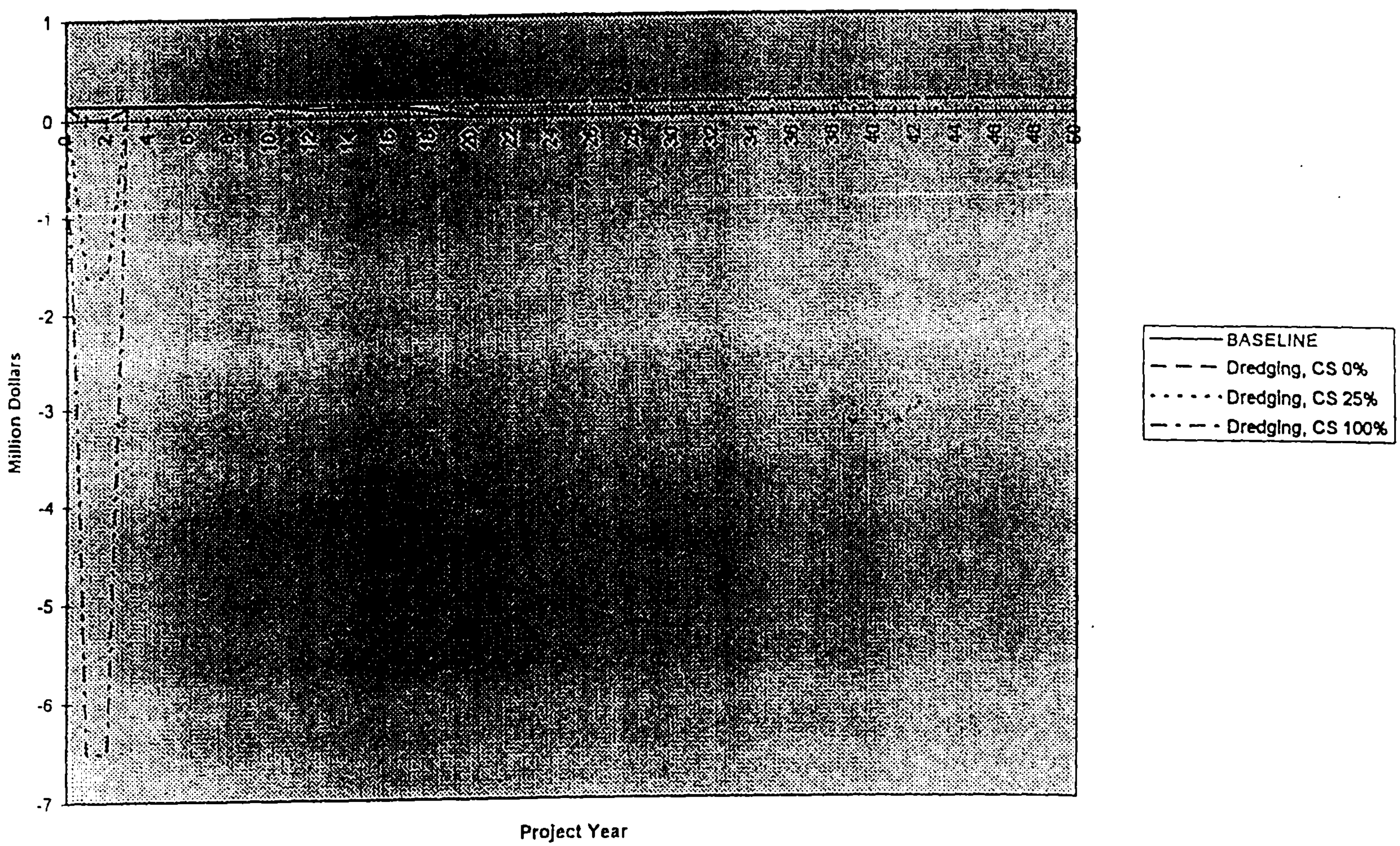
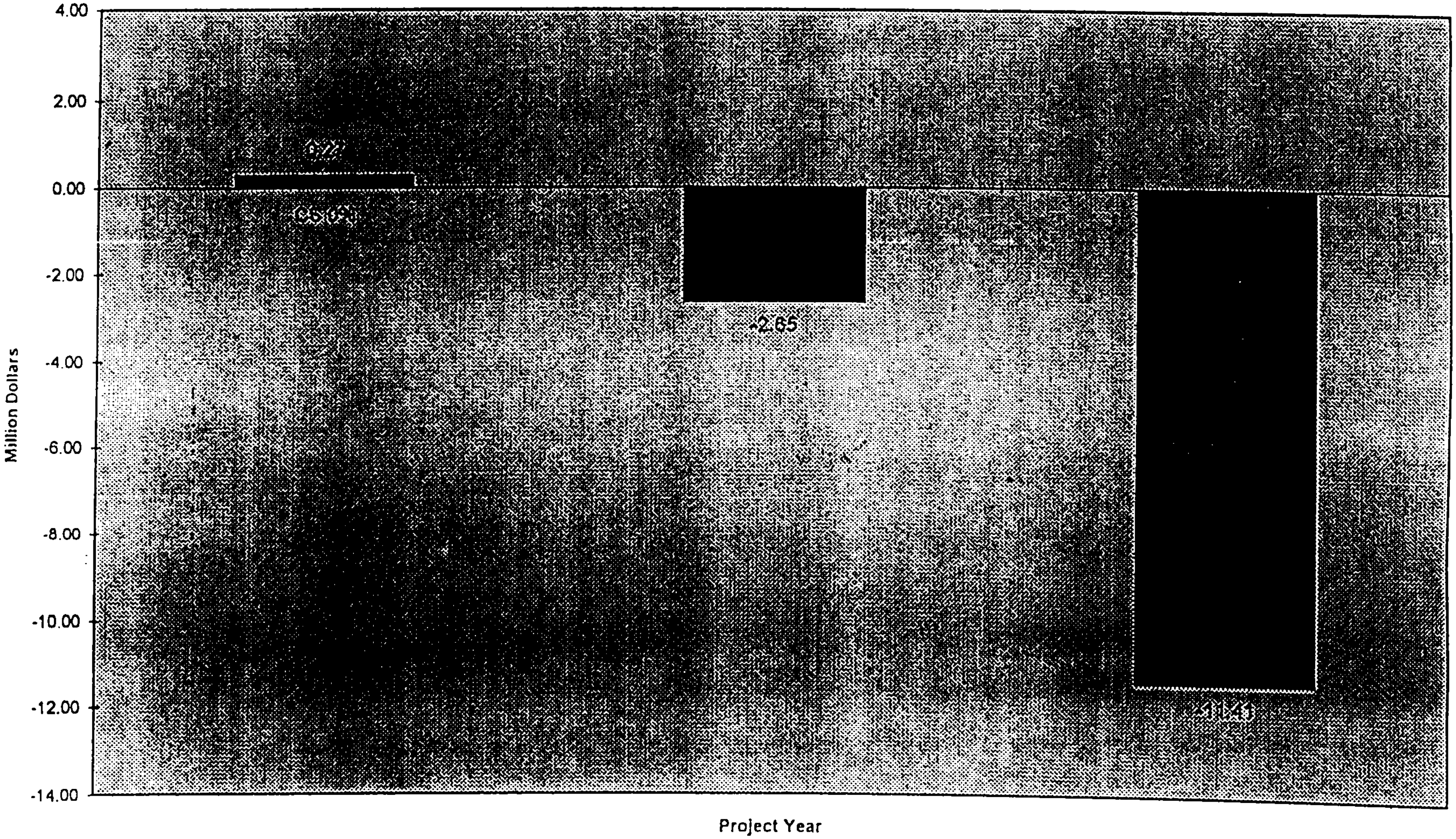


Fig. 12: Local Gov. Net Fiscal Benefits

Net Present Value Over 50 Years, Three Cost Share Options



ASHTABULA HARBOR LONG TERM MANAGEMENT STUDY
ASHTABULA, OHIO
DRAFT LETTER REPORT

SUB APPENDIX S3

REPRESENTATIVE BOAT USER BENEFITS

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo New York 14207

REPRESENTATIVE BOAT USER BENEFITS.

Currently, there are over 1,000 (1,058) slips and 11 launch ramps in eleven marinas and or yacht clubs located at Ashtabula Harbor upstream of the Fifth Street Bridge. These marinas and yacht clubs provide a variety of services to their clientele. These slip renters come from all over northeast Ohio, including Ashtabula, Geauga, Lake, Mahoning and Trumbull counties. In addition to slip renters, six marina/yacht clubs currently have charter fishing businesses renting slips at their facilities.

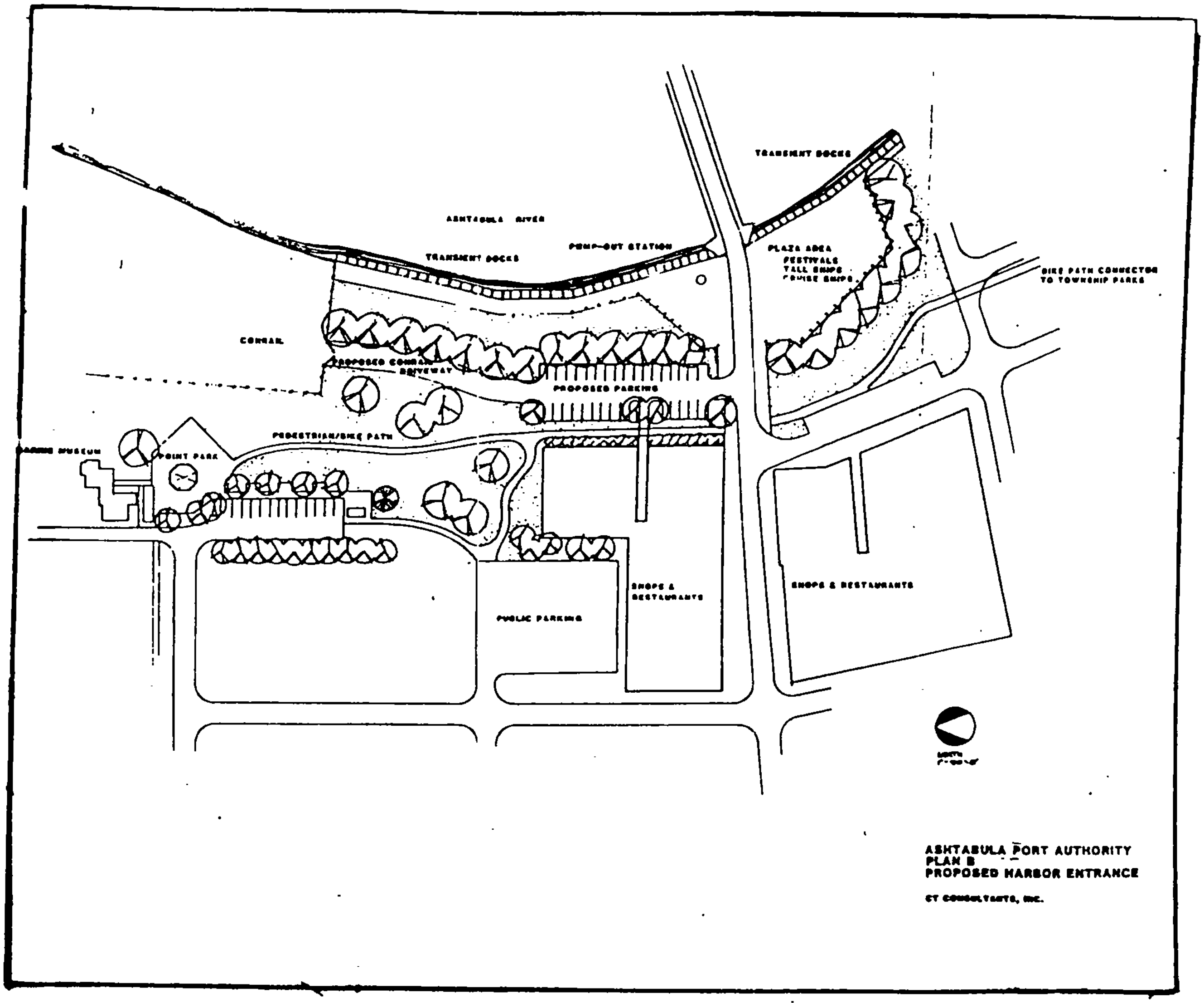
Point Park and Walnut Beach are within walking distance of the Harbor area. Point Park is currently undergoing improvements. The Park will have an observation deck providing views of the Harbor, the city and the lakefront. The park will have new walkways that will connect the cities historic commercial area, Point Park and the Great Lakes Marine Museum. Walnut Beach is located on the west side of the River, and is one of the few large sandy beaches along Lake Erie. Admission to the park is free, and has parking, swimming, fishing, tennis, basketball, playground equipment, and picnic shelters.

Future usage of the harbor area, and the upstream portion of the Ashtabula River in particular, will depend upon the perceived usability of these areas, as well as their official designation by EPA. Development of Ashtabula in the late 40s and early 50's resulted in a number of industrial companies locating in the Fields Brook area east of the City Of Ashtabula. Lack of regulation with respect to hazardous wastes resulted in Fields Brook becoming severely polluted and being named a superfund site. The discharge of Fields Brook into the Ashtabula River has made the upper portion of the Ashtabula River contaminated and in some sections, toxic. The first six feet of channel bottom sediments are considered contaminated and not suitable for open lake disposal. The larger problem, is the removal of sediments which have been polluted to a "toxic" or "hazardous" level. These sediments are below the contaminated level of sediments. Cleanup of the Fields Brook superfund site will have impacts on the future composition of channel sediments with respect to being classified as polluted or toxic.

Current Ashtabula Harbor improvement plans (Ashtabula Port action Plan, Feb 15,994) are considering building a bike path to connect Walnut beach Park and Point Park. Eventually the Bike path would connect to East Liverpool in southern Ohio. The Bike path would connect the marinas on the western bank to the Harbors entrance and historical/ commercial district. The path would allow boaters to walk to the business district and cyclists a method of traveling to/from Walnut Beach Park, Point Park and the historic/commercial district. Also considered is new transient docks located on the west bank above the Fifth Street Bridge, along with public parking adjacent to the transient docks. A schematic of proposed improvements is presented in Figure S 3.1.

Given the proposed onetime cleanup of the Ashtabula River bottom sediments, a number of harbor users would benefit: commercial marina operators, charterboat fishermen, recreational slip renters and launch ramp users, and beach and park users.

FIGURE S3.1-ARTIST CONCEPTION OF HARBOR IMPROVEMENTS



A preliminary evaluation of the impact on boaters currently using boat slips and launch ramp users, was developed using the Unit Day Method. The benefit to boat slip users and launch ramp users equals the net increase in Unit day Value per passenger, times the number of passengers per boat activity occasion, times the number of boat activity occasions per year.

Unit Day Values were developed for "With Project" and Without Project" conditions for slip users and launch ramp users. The recreational boating experience for these two user groups was rated using five criteria, to develop the "With Project" and "Without Project" condition User Day Values. The five criteria were: recreation experience, availability of opportunity, carrying capacity, accessability and environmental quality. The recreation category used was General Recreation. Guidelines for assigning points associated with the five criteria are presented in Table S 3.1. Table S 3.2 provides a summary of the point values attributed to each criteria for boaters using rented slips and launch ramp users under "With Project" and "Without Project" conditions. The difference in Unit Day Values, under "With Project" and "Without Project" conditions, for boat slip users and launch ramp users came to $.44 and $.35 respectively (See Table S 3.2). This is how much the value of the recreational boating experience would increase with the implementation of the proposed remediation plan. These net Unit Day Value benefits per person can now be used with data on the number of people on the boat for boat slip users and launch ramp users, and number of activity occasions per year, to develop total net recreational boater benefits. It was assumed that boat slip users used their boats 25 times during the boating season, and each launch ramp had 1,000 launches during the boating season. It was also assumed there were, on the average, 4.4 people per boating occasion for boat slip users and 3.8 people for launch ramp users. Recent data on boat usage at Ashtabula Harbor indicate that there are between 1,000 and 1,200 slips rented annually. This evaluation used 1,058 slips. These are the number of slip renters provided in the Ashtabula Port Action Plan, 15 February, 1994.

The above data can now be used to develop total fleet benefits for boat slip users and launch ramp users. Given this data, total recreational navigation fleet benefits can be calculated. Benefits for the boat slip user fleet is essentially number of slips rented annually (1,058) times the number of boat usages per season (say 25), times the number of people per boat usage (4.4), times the net User Day Benefit per boating activity occasion ($.44). Total recreational navigation boat slip user fleet benefits came to $51,700 (See Table S 3.2).

Benefits for the launch ramp fleet is essentially the number of launches made annually (11,000) times the number of people per boat (3.8) times the net Unit Day Value Benefit per boating activity occasion ($.35). Total recreational navigation launch ramp fleet benefits came to $14,600 (See Table S 3.2).

Total recreational navigation fleet benefits are the sum of slip renter fleet benefits and launch ramp user fleet benefits. Total recreational navigation fleet benefits came to $66,300 (See Table S 3.2). Since this net benefit accrues every year during the project evaluation period, this is also an average annual benefit value. These benefits reflect May 1996 price levels.

TABLE S 3.1. GUIDELINES FOR ASSIGNING POINTS FOR GENERAL RECREATION

Criteria	Judgement factors				
(a) Recreation experience[1] **Total** Points: 30 **Point** value:	Heavy use or frequent crowding or other interference with use 0-4	Moderate use, other users evident and likely to interfere with use 5-10	Moderate use, some evidence of other users and occasional interference with use due to crowding 11-16	Usually little evidence of other users, rarely if ever crowded 17-23	Very lo. dence of other users never crowded 24-30
(b) Availability of opportunity[2] **Total** points: 18 **Point** value:	Several within 1 hr. travel time; a few within 30 min. travel time 0-3	Several within 1 hr. travel time; none within 30 min. travel time 4-6	One or two within 1 hr. time; none within 45 min. travel time 7-10	None within 1 hr. travel time 11-14	None within 2 hr. travel time 15-18
(c) Carrying capacity[3] **Total** points: 14 **Point** value:	Minimum facility development for public health and safety 0-2	Basic facilities to conduct activity(ies) 3-5	Adequate facilities to conduct without deterioration of the resource or activity experience 6-8	Optimum facilities to conduct activity at site potential 9-11	Ultimate facilities to achieve intent of selected alternative 12-14
(d) Accessibility **Total** points: 18 **Point** value:	Limited access by any means to site or within site 0-3	Fair access, poor quality roads to site; limited access within site 4-6	Fair access, fair road to site; fair access; good roads within site 7-10	Good access, good roads to site; fair access, good roads within site 11-14	Good access, high standard road to site; good access within site 15-18
(e) Environmental **Total** points: 20 **Point** value:	Low esthetic factors[4] that significantly lower quality[5] 0-2	Average esthetic quality; factors exist that lower quality to minor degree 3-6	Above average esthetic quality; any limiting factors can be reasonably rectified 7-10	High esthetic quality; no factors exist that lower quality 11-15	Outstanding esthetic quality; no factors exist that lower quality 16-20

[1] **Value** for water-oriented activities should be adjusted if significant seasonal water level changes occur.
[2] **Likelihood** of success at fishing and hunting.
[3] **Value** should be adjusted for overuse.
[4] **Major** esthetic qualities to be considered include geology and topography, water, and vegetation.
[5] **Factors** to be considered to lowering quality include air and water pollution, pests, poor climate, and **unsightly adjacent areas.**

TABLE S 3.2. RECREATIONAL BOATING FLEET BENEFITS

1.1. UNIT DAY VALUE POINT ALLOCATIONS

	WITHOUT PROJECT BOAT SLIP USERS	WITHOUT PROJECT LAUNCH RAMP USERS	WITH PROJECT BOAT SLIP USERS	WITH PROJECT LAUNCH RAMP USERS
RECREATION EXPERIENCE	15	15	15	15
AVAILABILITY OF OPPORTUNITY	3	3	3	3
CARRYING CAPACITY	5	3	8	5
ACCESSABILITY	11	11	11	11
ENVIRONMENTAL	2	2	6	6
	37	34	43	40

2. DOLLAR VALUE PER POINTS-FISCAL YEAR 1996

POINT VALUES	GENERAL RECREATION VALUES
0	$2.50
10	$2.92
20	$3.37
30	$3.93
40	$4.52
50	$5.38
60	$5.80
70	$6.25
80	$6.67
90	$7.11
100	$7.53

	WITHOUT PROJECT BOAT SLIP USERS	WITHOUT PROJECT LAUNCH RAMP USERS	WITH PROJECT BOAT SLIP USERS	WITH PROJECT LAUNCH RAMP USERS
POINT VALUE	37	34	43	40
UNIT DAY VALUE	$4.34	$4.17	$4.78	$4.52

NET BENEFITS

	BOAT SLIP USERS	LAUNCH RAMP USERS
WITH PROJECT	$4.78	$4.52
WITHOUT PROJECT	$4.34	$4.17
NET BENEFITS	$0.44	$0.35

3. RECREATIONAL BOATER BENEFITS

A. BOAT SLIP USER BENEFITS

NUMBER OF SLIPS/BOATS	1,058
USAGES PER YEAR	25
BOAT USAGES PER YEAR	26,450
PEOPLE PER BOAT	4.44
ACTIVITY OCCASIONS PER YEAR	117,438
NET UDV PER ACTIVITY OCCASION	$0.44
BOAT SLIP USER NET BENEFITS	$51,673
ROUNDED	$51,700

B. LAUNCH RAMP USER BENEFITS

NUMBER OF LAUNCH RAMPS	11
LAUNCHES PER RAMP	1,000
LAUNCHES PER YEAR	11,000
PEOPLE PER BOAT	3.78
ACTIVITY OCCASIONS PER YEAR	41,580
NET UDV PER ACTIVITY OCCASION	$0.35
LAUNCH RAMP USER NET BENEFITS	$14,553
ROUNDED	$14,600

C. RECREATIONAL BOATER NET BENEFIT SUMMARY

BOAT SLIP USER NET BENEFITS	$51,700
LAUNCH RAMP USER NET BENEFITS	$14,600
RECREATIONAL BOAT USER NET BENEFITS	$66,300

Average annual recreational navigation fleet benefits of $66,300 were updated from May 1996 prices to September 1996 prices using the Recreation and Fish And Wildlife Index. This index uses as weights: Consumer Price Index-Urban-All Items (50%), Consumer Price Index-Urban-Entertainment Commodities (30%) and Producer Price Index-All commodities (20%). The update factor was 1.005877. Average Annual recreational navigation fleet benefits, at September 1996 price levels, came to $66,700.

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SUB APPENDIX S4

PLANS EVALUATED

Note:

1. A wide range of alternatives were evaluated during the planning process to address cleanup of polluted bottom sediments and restoration of disrupted habitats in the studies area of concern. Three dredging scenarios were developed: a "Shallow Dredge", a "Deep Dredge" and a "Bank To Bank Bedrock". The related cost estimates for these plans reflected a 7.625% annual interest rate, a 50 year project life and September 1996 prices. These plans included costs for performing ecological restoration/preservation measures.
2. The ARP's Recommended Plan has evolved over time from September 1996 to October 2000. The ARP developed a "Recommended Environmental Dredging Plan". As such this plan only included costs associated with the removal, treatment and disposal of polluted river sediments. All costs associated with aquatic ecosystem restoration measures were removed from the "Recommended Environmental Dredging Plan". The implementation of these restoration measures will be persued as a separate but related project. Consequently, whenever "Recommended Environmental Dredging Plan" costs are discussed, they do not include ecosystem restoration measure costs. All costs presented applying to the "Recommended Environmental Dredging Plan" reflect a 6.375% annual interest rate, a 50 year project life and October 2000 Prices.

U.S. Army Engineer District, Buffalo
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TABLES

SECTION 1

PRELIMINARY PLANS EVALUATED

A. INTRODUCTION

A wide range of alternatives were considered to address the cleanup of polluted bottom sediments and restoration of disrupted habitats in the studies area of concern. Alternatives ranged from no action, to an in-river shear cap to alternatives that included dredging, habitat restoration, transfer/de-watering/transfer, treatment technologies, transportation to a disposal site and eventual disposal of TSCA and non TSCA dredged material at the disposal site. Alternative components were assessed/evaluated for environmental and social acceptability, for engineering and economic feasibility, and/or for best meeting the project planning objectives. An array of alternative plan components pertaining to dredging methods, transfer facilities, treatment measures, disposal sites, and habitat restoration were progressively assessed and evaluated by various work groups within the Ashtabula River Partnership.

More than 20 dredge types, including mechanical, hydraulic and special purpose dredges were listed, categorized, and evaluated using the selection criteria. Initially four vicinity and 11 specific sites were assessed and evaluated as potential sites for development of dredged material transfer/dewater/transfer facilities. General assessment/evaluation parameters included costs, availability, capacity, ease of access/transport, and engineering, environmental, community and cultural resources considerations. Whether the sediments were dredged mechanically or hydraulically, they would require dewatering in order to accommodate transport and to meet the legal requirements of containment of no free liquid prior to being final land filled. Numerous dewatering technologies were reviewed including passive dewatering technologies (i.e. primary settling, solar evaporation, surface drainage, subsurface drainage, wick drains), mechanical dewatering (i.e. belt filter press, centrifugation, gravity thickeners, chamber filtration, vacuum filtration), and active evaporation technologies. They were assessed and evaluated in light of the scope of the project and economic, engineering and environmental efficiencies. A number of alternative PCB contaminated sediment treatment and disposal measures were assessed/evaluated (incineration, thermal desorption, and burial of untreated sediment in a TSCA landfill). Initially, some 36 sites were assessed/evaluated as potential sites for development of disposal facilities. Assessment/evaluation parameters were developed which included engineering, economic and environmental concerns. The 36 sites were narrowed down to five and then to two upland sites (Sites 5 and 7) and one potential inland in lake diked confined disposal facility site (Site P). Supplemental Dredging Ecological Restoration/Preservation Measures for Protected Aquatic/Fishery Shallows were developed to address the lack of protected aquatic/fishery shallows in the area of concern on the river. Two major problem areas were identified: from the mouth of the river to the 5th Street Bridge (Ecological Assessment Area 3) and from the 5th Street Bridge through the upper navigation channels (Ecological Assessment Area 2). Three habitat restoration plans were developed/assessed/evaluated for area 3 and four habitat restoration plans were developed/assessed/evaluated for area 2.

B. DEVELOPMENT OF THREE DREDGING SCENARIOS

One of the key insights that evolved during this evaluation procedure was that any estimate of project cost was tied directly to the number of cubic yards the plans proposed to remove. The Ashtabula River Partnership assessed/evaluated several dredging scenarios in order to determine the amount of material needed to be dredged, which would moderate project costs, while still meeting river cleanup goals. Basically three alternative scenarios were assessed/evaluated: a shallow dredge scenario, a deep dredge scenario and a bank to bank scenario. The River project area was broken down into reaches and assessed/evaluated for dredging. River reach dredging /assessment/evaluation criteria included items such as: contamination levels and location of contaminated sediments, shoreline structural stability, dredge idiosyncrasies, channel limits, future sedimentation and scour, etc. Cross sections identifying contamination levels and location of contaminated sediments were developed for every 100 feet of the river project area.

1. Shallow Dredge Scenario. The Shallow Dredge scenario would remove 592,000 cubic yards of sediment. This scenario would leave a small amount of TSCA PCB contaminated sediments and some lower level contaminated sediments which would be eventually covered by new clean sediments coming from the rivers future clean sediment load.

2. Deep Dredge Scenario The Deep Dredge scenario would remove 696,000 cubic yards. This scenario would involve more extensive dredging and would remove all of the TSCA PCB contaminated sediments, but leave some lower level contaminated sediments which would be eventually covered by new clean sediments coming from the rivers future clean sediment load.

3. Bank To Bank Bedrock Dredging. A Bank To Bank Bedrock Dredging would remove 1,140,000 cubic yards and would involve extensive dredging. The plan would remove all of the TSCA PCB contaminated sediments and all of the contaminated sediments. These sediments would in time be replaced by new clean sediments coming from the rivers future clean sediment load.

4. Scenario Options. These three cleanup scenarios were evaluated for a range of options with respect to location of the dewatering facility (three locations), the disposal location for TSCA material (two existing commercial facilities or a new disposal facility), and the disposal location for non-TSCA material (two new disposal facilities or an existing commercial facility). A description of the options evaluated for each of the three dredging scenarios follows.

a. Scenario 1 Options. The dewatering facility for Scenario 1 was located on Conrail property and consisted of construction of an impermeable earthen diked settling basin. Three options were developed for this dewatering location, based upon three different locations available for disposing TSCA classified sediment. Option 1 was to transport by truck TSCA material to the nearest existing regional TSCA permitted CDF disposal facility (Model City, New York). Option 2 looked at transporting by rail TSCA material to the nearest existing rail linked TSCA disposal facility (ECDC Landfill, Utah). Option 3 was to construct a new upland CDF TSCA disposal site in the area (Site 7.) As for non-TSCA classified sediments, Options 1 and 2 assumed usage of a local landfill (BFI), while Option 3 assumed the new upland CDF (Site 7) would be used.

b. Scenario 2 Options. The dewatering facility for Scenario 2 would involve dewatering at an offshore marine station use of watertight barges located in the vicinity of Sidley Dock. The barges would be used as settling basins for dredged materials. Sediments would be allowed to settle out from the dredged material. The remaining water/slurry would be pumped out into a series of watertight barge settling basins, filtered and eventually discharged into the river or lake after meeting water quality discharge standards. Consolidated sediments would be unloaded from the barge to land and transported by truck to an appropriate disposal facility. Two options were developed for this dewatering location, based upon two different locations available for disposing TSCA classified sediment. Option 1 was to transport by truck TSCA material to the nearest existing regional TSCA permitted CDF disposal facility (Model City, New York). Option 2 was to dispose of the TSCA classified sediments at a newly constructed local upland CDF TSCA disposal site (Site 7.). As for non-TSCA classified sediments, Option 1 assumed usage of a local landfill (BFI), while Option 2 assumed the new upland CDF (Site 7) would be used.

c. Scenario 3 Options. The location of the dewatering facility was the focus of options for Scenario 3. There were two options under Scenario 3. Option 1 was to locate the dewatering facility in the outer harbor on Conrail property. Option 2 was to locate the dewatering facility offshore, several miles east of the project. Option 2's dewatering facility consisted of construction of an off shore pump/pipe operation. The facility would include a wave protection breakwater, and/or platform to protect pumpout operations from wave action, a pumpout platform/facility, piping (2,000 feet long) from the pumpout platform/facility up the shoreline embankment to a developed upland dewatering and disposal facility (ie, site 7) and lift pumps to pump dredged material slurry up the embankment. Dredged material would be barged to the pumpout platform/facility, pumped out, and pumped/piped to the upland dewatering and disposal facility. Sediments would be allowed to settle out from the dredged material utilizing a dewatering facility. Decanted water would be treated to meet discharge standards and piped back into the lake. Under Option 1, TSCA material would go to the new upland site (Site 7) and non TSCA material would go in a new lakefront CDF: Site P. (Site P is located to the east of the harbor). Under Option 2, TSCA and non TSCA sediment would go to a new upland site (site 7).

C. PRELIMINARY CONSTRUCTION COSTS FOR THE THREE DREDGING SCENARIOS - SEPTEMBER 1996 PRICES

Preliminary project costs for the three cleanup scenarios were derived for a range of options with respect to location of the dewatering facility (three locations), the disposal location for TSCA material (two existing commercial facilities and one a new disposal facility), and the disposal location for non-TSCA material (two new disposal facilities or an existing commercial facility). These preliminary costs are presented in Table S 4.1. Preliminary construction costs for the above scenarios, with their options, ranged from $125m to $58m. These preliminary construction costs were used as a screening process to develop the Recommended Plan.

TABLE S4.1. PRELIMINARY SCENARIO CONSTRUCTION COSTS- SEPT 1996 PRICES

WORK ITEM	Qty	UOM	UNIT COST	ALTERNATE 1 OPTION 1	ALTERNATE 1 OPTION 2	ALTERNATE 1 OPTION 3	ALTERNATE 2 OPTION 1	ALTERNATE 2 OPTION 2	ALTERNATE 3	ALTERNATE 4
				[illegible]			[illegible]		[illegible]	[illegible] Marine Pump-out Upland Dewater
1 MOB/DEMOB (DREDGING ONLY)		LS		$580,000	$580,000	$580,000	$580,000	$580,000	$580,000	$580,000
2 CLAMSHELL DREDGING	592,000	CY	$16.00	$9,472,000	$9,472,000	$9,472,000	$9,472,000	$9,472,000	$9,472,000	$9,472,000
3 MARINE DEWATERING STATION										
- Mob. Equipment & Assemble Plant		LS					$423,000	$423,000		
- Operation	592,000	CY	$2.80				$1,839,200	$1,839,200		
4 TRANSFER FACILITY										
A. Dewatering/Transfer (Interim CDF)										
- Construction		LS		$2,180,000	$2,180,000	$2,180,000			$2,180,000	
- Operation	592,000	CY	$2.55	$1,509,600	$1,509,600	$1,509,600			$1,509,600	
B. Transfer Only (Sidley Dock)										
- Operation	592,000	CY	$2.30				$1,361,600	$1,361,600		
C. Off-Shore Pumpout/CDF Dewatering Facility										
- Construction										
a. Off-Shore Ifrastr/Pumpout Sta.		LS								$6,000,000
b. Dewatering Station @ CDF		LS								$2,180,000
- Operation (Pumpout & Dewater)	592,000	CY	$6.30							$3,729,600
5 SEDIMENT DISPOSAL OPTIONS - TSCA LEVELS (BASED ON 100,000 CY DEWATERED SEDIMENTS @ 1.5 T/CY)										
A. Commercial Options										
- Model City, NY (Common Carrier)	150,000	TON	$152.00	$22,800,000			$22,800,000			
- ECDC Landfill (Utah) by Rail	150,000	TON	$115.00		$17,250,000					
B. Upland CDF -8 to 7 (Quantity shown is dewatered volume)										
- Construction		LS				$3,300,000		$3,300,000	$3,300,000	$11,400,000
- Transport Sediments to CDF	100,000	CY	$2.65			$265,000		$265,000	$265,000	$1,192,800
- CDF Operation	100,000	CY	$1.60			$160,000		$160,000	$160,000	$720,000
6 SEDIMENT DISPOSAL OPTIONS - Non TSCA LEVELS (BASED ON 350,000 CY @ 1.6 T/CY)										
A. Upland CDF - Site 7 (Quantity shown is dewatered volume)										
- Construction		LS				$8,100,000		$8,100,000		
- Transport Sediments to CDF	350,000	CY	$2.65			$927,500		$927,500		
- CDF Operation	350,000	CY	$1.60			$560,000		$560,000		
B. Lakefront CDF										
- Construction		LS							$10,000,000	
- Transport Sediments to CDF	350,000	CY	$1.25						$437,500	
- CDF Operation	350,000	CY	$2.00						$700,000	
C. Commercial - BFI Landfill	525,000	TON	$30.00	$15,750,000	$15,750,000		$15,750,000			
7 SAMPLING & ANALYSIS										
A. Dredging		LS		$271,000	$271,000	$271,000	$271,000	$271,000	$271,000	$271,000
B. Transfer Facility		LS		$131,000	$131,000	$131,000			$131,000	$131,000
C. Disposal Facility (CDF)		LS				$2,278,500		$2,278,500	$2,278,500	$2,278,500
8 WETLANDS MITIGATION										
A. Transfer Site		LS		$50,000	$50,000	$50,000				
B. Upland TSCA Only Landfill		LS							$50,000	
C. Upland TSCA & Non-TSCA Landfill		LS				$400,000		$400,000		$400,000
9 LIABILITY										
A. Non-TSCA Landfill		LS				$2,700,000		$2,700,000		$2,700,000
B. TSCA Only Landfill		LS				$3,600,000		$3,800,000	$3,800,000	$3,800,000
Construction Cost ——				$52,443,600	$47,193,600	$36,382,800	$51,896,800	$36,836,800	$34,832,800	$44,882,600
25% Contingency ——				$13,056,400	$11,806,400	$9,117,400	$13,003,200	$8,964,200	$8,667,400	$11,147,400
Project Construction Cost Subtotal ——				$65,503,000	$59,000,000	$45,500,000	$64,900,000	$44,800,000	$43,500,000	$55,700,000
10 SMP STUDY COSTS										
A. CMP/EIS		LS		$1,800,000	$1,800,000	$1,800,000	$1,800,000	$1,800,000	$1,800,000	$1,800,000
B. Detailed Design		LS		$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
C. Plans & Specifications		LS		$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
Subtotal				$3,800,000	$3,800,000	$3,800,000	$3,800,000	$3,800,000	$3,800,000	$3,800,000
11 ENG. & DESIGN DURING CONSTRUCTION (1.5% Construction Cost)		LS		$800,000	$700,000	$500,000	$800,000	$500,000	$500,000	$635,000
12 SUPR. & ADMIN. DURING CONSTRUCTION (5% of Construction Cost)		LS		$2,544,000	$2,344,000	$1,779,000	$2,600,000	$1,735,000	$1,679,000	$2,200,000
13 REAL ESTATE										
A. Landfill Area				N/A	N/A	$65,000	$0	$65,000	$65,000	$65,000
B. Transfer Site/Dewatering Facility				$156,000	$156,000	$156,000	$0	N/A	$156,000	N/A
Subtotal				[illegible]	[illegible]	$221,000	$0	$65,000	$221,000	$65,000
Total Project Cost ——				$72,[illegible]	$66,800,000	$51,800,000	$72,100,000	$50,800,000	$49,700,800	$62,400,000

TABLE S4.1.- Continued

DEEP DREDGING PLAN

WORK ITEM	Qty	UOM	UNIT COST	ALTERNATE 1 OPTION 1	ALTERNATE 1 OPTION 2	ALTERNATE 1 OPTION 3	ALTERNATE 2 OPTION 1	ALTERNATE 2 OPTION 2	ALTERNATE 3	ALTERNATE 4
				DEWATERING FACILITY AT INTERIM CDF			DEWATERING AT OFF-SHORE MARINE STATION		UPLAND CDF & ISLAND CDF (INTERIM STA)	UPLAND CDF for TSCA Non-TSCA Marine Pump-out Upland Dewater
1 MOB/DEMOB (Dredging Only)		LS		$580,000	$580,000	$580,000	$580,000	$580,000	$580,000	$580,000
2 CLAMSHELL DREDGING	696,000	CY	$16.00	$11,136,000	$11,136,000	$11,136,000	$11,136,000	$11,136,000	$11,136,000	$11,136,000
3 MARINE DEWATERING STATION										
- Mob. Equipment & Assemble Plant		LS					$423,000	$423,000		
- Operation	696,000	CY	$2.60				$1,809,600	$1,809,600		
4 TRANSFER FACILITY										
A. Dewatering/Transfer (Interim CDF)										
- Construction		LS		$2,180,000	$2,180,000	$2,180,000			$2,180,000	
- Operation	696,000	CY	$2.55	$1,774,800	$1,774,800	$1,774,800			$1,774,800	
B. Transfer Only (Sidley Dock)										
- Operation	696,000	CY	$2.30				$1,600,800	$1,600,800		
C. Off-Shore Pumpout/CDF Dewatering Facility										
- Construction										
a. Off-Shore Bdwtr/Pumpout Sta.		LS								$8,000,000
b. Dewatering Station @ CDF		LS								$2,180,000
- Operation (Pumpout & Dewater)	696,000	CY	$6.30							$4,384,800
5 SEDIMENT DISPOSAL OPTIONS - TSCA LEVELS (Based on 100,000 CY Dewatered Sediments @ 1.5 T/CY)										
A. Commercial Options										
- Model City, NY (Common Carrier)	150,000	TON	$150.00	$22,500,000			$22,500,000			
- ECDC Landfill (Utah) by Rail	150,000	TON	$115.00		$17,250,000					
B. Upland CDF (Site 7)										
- Construction		LS				$3,600,000		$3,600,000	$3,600,000	$12,800,000
- Transport Sediments to CDF	100,000	CY	$2.65			$265,000		$265,000	$265,000	$1,325,000
- CDF Operation	100,000	CY	$1.60			$160,000		$160,000	$160,000	$800,000
6 SEDIMENT DISPOSAL OPTIONS - Non TSCA LEVELS (Based on 400,000 CY @ 1.5 T/CY)										
A. Upland CDF (Site 7)										
- Construction		LS				$9,200,000		$9,200,000		
- Transport Sediments to CDF	400,000	CY	$2.65			$1,060,000		$1,060,000		
- CDF Operation	400,000	CY	$1.60			$640,000		$640,000		
B. Lakefront CDF										
- Construction		LS							$10,000,000	
- Transport Sediments to CDF	400,000	CY	$1.25						$500,000	
- CDF Operation	400,000	CY	$2.00						$800,000	
C. Commercial - BFI Landfill	600,000	TON	$30.00	$18,000,000	$18,000,000		$18,000,000			
7 SAMPLING & ANALYSIS										
A. Dredging		LS		$271,000	$271,000	$271,000	$271,000	$271,000	$271,000	$271,000
B. Transfer Facility		LS		$131,000	$131,000	$131,000			$131,000	$131,000
C. Disposal Facility (CDFs)		LS				$2,278,800		$2,278,800	$2,278,800	$2,278,800
8 WETLANDS MITIGATION										
A. Transfer Site		LS		$50,000	$50,000	$50,000				
B. Upland TSCA Only Landfill		LS							$50,000	
C. Upland TSCA & Non-TSCA Landfill		LS				$400,000		$400,000		$400,000
9 LIABILITY										
A. Non-TSCA Landfill		LS				$2,700,000		$2,700,000		$2,700,000
B. TSCA Only Landfill		LS				$3,600,000		$3,600,000	$3,600,000	$3,600,000
Construction Cost ——				$56,622,800	$51,372,800	$39,924,300	$56,320,400	$39,621,800	$37,224,300	$48,484,300
25% Contingency ——				$14,177,200	$12,827,200	$9,975,700	$14,079,600	$9,878,100	$9,275,700	$12,115,700
Project Construction Cost Subtotal ——				$70,800,000	$64,200,000	$49,900,000	$70,400,000	$49,500,000	$46,500,000	$60,600,000
10 EMP STUDY COSTS										
A. CMP/EIS		LS		$1,800,000	$1,800,000	$1,800,000	$1,800,000	$1,800,000	$1,800,000	$1,800,000
B. Detailed Design		LS		$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
C. Plans & Specifications		LS		$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
Subtotal				$3,800,000	$3,800,000	$3,800,000	$3,800,000	$3,800,000	$3,800,000	$3,800,000
11 ENG. & DESIGN DURING CONSTRUCTION (1.5% Construction Cost)		LS		$900,000	$770,000	$600,000	$850,000	$555,000	$579,000	$710,000
12 SUPR. & ADMIN. DURING CONSTRUCTION (5% of Construction Cost)		LS		$2,844,000	$2,574,000	$1,979,000	$2,850,000	$1,980,000	$1,900,000	$2,425,000
13 REAL ESTATE										
A. Landfill Area				N/A	N/A	$65,000	$0	$65,000	$65,000	$65,000
B. Transfer Site/Dewatering Facility				$156,000	$156,000	$156,000	$0	N/A	$156,000	N/A
Subtotal				$156,000	$156,000	$221,000	$0	$65,000	$221,000	$65,000
Total Project Cost ——				$78,400,000	$71,800,000	$56,800,000	$77,900,000	$55,900,000	$53,000,000	$67,600,000

TABLE S4.1.- Continued

	WORK ITEM	Qty	UOM	UNIT COST	[illegible] DREDGING PLAN / DEWATERING FACILITY AT INTERIM CDF: ALTERNATE 1 OPTION 1	ALTERNATE 1 OPTION 2	ALTERNATE 1 OPTION 3	DEWATERING AT [illegible] MARINE STATION: ALTERNATE 2 OPTION 1	ALTERNATE 2 OPTION 2	UPLAND CDF A [illegible] (INTERIM STA): ALTERNATE 3	UPLAND CDF for TSCA/Non-TSCA Marine Pump-out Upland Dewater: ALTERNATE 4
1	MOB/DEMOB (DREDGING ONLY)		LS		$580,000	$580,000	$580,000	$580,000	$580,000	$580,000	$580,000
2	CLAMSHELL DREDGING	1,140,000	CY	$16.00	$18,240,000	$18,240,000	$18,240,000	$18,240,000	$18,240,000	$18,240,000	$18,240,000
3	MARINE DEWATERING STATION										
	- Mob. Equipment & Assemble Plant		LS					$423,000	$423,000		
	- Operation	1,140,000	CY	$2.60				$2,964,000	$2,964,000		
4	TRANSFER FACILITY										
	A. Dewatering/Transfer (Interim CDF)										
	- Construction		LS		$2,180,000	$2,180,000	$2,180,000			$2,180,000	
	- Operation	1,140,000	CY	$2.55	$2,907,000	$2,907,000	$2,907,000			$2,907,000	
	B. Transfer Only (Sibley Dock)										
	- Operation	1,140,000	CY	$2.30				$2,622,000	$2,6[illegible],000		
	C. Off-Shore Pumpout/CDF Dewatering Facility										
	- Construction										
	a. Off-Shore Brkwtr/Pumpout Sta.		LS								$8,000,000
	b. Dewatering Station @ CDF		LS								$2,180,000
	- Operation (Pumpout & Dewater)	1,140,000	CY	$6.30							$7,182,000
5	SEDIMENT DISPOSAL OPTIONS - TSCA LEVELS ([illegible] ON 100,000 CY DEWATERED SEDIMENTS @ 1.5 T/CY)										
	A. Commercial Options										
	- Model City, NY (Common Carrier)	150,000	TON	$150.00	$22,500,000			$22,500,000			
	- ECDC Landfill (Utah) by Rail	150,000	TON	$115.00		$17,250,000					
	B. Upland CDF (Site 7)										
	- Construction		LS				$4,900,000		$4,900,000	$4,900,000	$15,800,000
	- Transport Sediments to CDF	100,000	CY	$2.65			$265,000		$265,000	$265,000	$2,120,000
	- CDF Operation	100,000	CY	$1.60			$160,000		$160,000	$160,000	$1,280,000
6	SEDIMENT DISPOSAL OPTIONS - NON TSCA LEVELS ([illegible] ON 400,000 CY @ 1.5 T/CY)										
	A. Upland CDF (Site 7)										
	- Construction		LS				$10,900,000		$10,900,000		
	- Transport Sediments to CDF	700,000	CY	$2.65			$1,855,000		$1,855,000		
	- CDF Operation	700,000	CY	$1.60			$1,120,000		$1,120,000		
	B. [illegible] CDF										
	- Construction		LS							$10,000,000	
	- Transport Sediments to CDF	700,000	CY	$1.25						$875,000	
	- CDF Operation	700,000	CY	$2.00						$1,400,000	
	C. Commercial - BFI Landfill	1,050,000	TON	$30.00	$31,500,000	$31,500,000		$31,500,000			
7	SAMPLING & ANALYSIS										
	A. Dredging		LS		$271,000	$271,000	$271,000	$271,000	$271,000	$271,000	$271,000
	B. Transfer Facility		LS		$131,000	$131,000	$131,000			$131,000	$131,000
	C. Disposal Facility (CDFs)		LS				$2,278,500		$2,278,500	$2,278,500	$2,278,500
8	WETLANDS MITIGATION										
	A. Transfer Site		LS		$50,000	$50,000	$80,000				
	B. Upland TSCA Only Landfill		LS							$50,000	
	C. Upland TSCA & Non-TSCA Landfill		LS				$400,000		$400,000		$400,000
9	LIABILITY										
	A. Non-TSCA Landfill		LS				$2,700,000		$2,700,000		$2,700,000
	B. TSCA Only Landfill		LS				$3,600,000		$3,800,000	$3,500,000	$3,600,000
	Construction Cost —				$78,359,000	$73,109,000	$52,436,800	$79,100,000	$53,178,800	$47,736,800	$62,660,800
	25% Contingency —				$19,541,000	$18,291,000	$13,064,500	$19,800,000	$13,323,800	$11,964,500	$15,639,800
	Project Construction Cost Subtotal —				$97,900,000	$91,400,000	$65,600,000	$98,900,000	$66,800,000	$59,700,000	$78,300,000
10	[illegible] STUDY COSTS										
	A. EMP/EIS		LS		$1,800,000	$1,800,000	$1,800,000	$1,800,000	$1,800,000	$1,800,000	$1,800,000
	B. Detailed Design		LS		$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
	C. Plans & Specifications		LS		$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
	Subtotal				$3,800,000	$3,800,000	$3,800,000	$3,800,000	$3,800,000	$3,800,000	$3,800,000
11	ENG. & DESIGN DURING CONSTRUCTION (1.5% Construction Cost)		LS		$1,200,000	$1,100,000	$800,000	$1,200,000	$800,000	$700,000	$900,000
12	SUPR. & ADMIN. DURING CONSTRUCTION (5% of Construction Cost)		LS		$3,844,000	$3,544,000	$2,579,000	$3,900,000	$2,736,000	$2,379,000	$3,135,000
13	REAL ESTATE										
	A. Landfill Area				N/A	N/A	$65,000	$0	$65,000	$65,000	$65,000
	B. Transfer Site/Dewatering Facility				$156,000	$156,000	$156,000	$0	N/A	$156,000	N/A
	Subtotal				$188,800	$188,000	$221,000	$0	$65,000	$221,000	$65,000
	Total Project Cost —				$109,900,000	$100,000,000	$72,900,000	$107,800,000	$73,800,000	$66,800,000	$88,200,000

D. AVERAGE ANNUAL COSTS FOR SELECTED PRELIMINARY CONSTRUCTION COSTS - SEPTEMBER 1996 PRICES.

Average annual costs were computed for three preliminary construction costs. These 3 preliminary construction costs were for the shallow dredge, deep dredge and bank to bank options where the dewatering facility was at the interm CDF and the disposal site was site 7. Preliminary First Costs for the shallow dredge, deep dredge and bank to bank options came to $51,800,000; $56,500,000 and $72,900,000. These costs were the basis for determining average annual costs.

Table S 4-2 provides a summary of First Costs, Investment Costs and Average Annual Costs associated with these three options. First Costs are basically Construction Costs, Study Costs, Engineering and Design Costs, Construction Management Costs and Real Estate Costs associated with building these three options.

Total First Costs included some expenditures that would be made after the project was constructed. There were three categories of post construction expenditures: post construction sampling and analysis of the completed disposal facility, operations and maintenance expenditures associated with the non-TSCA portion of the CDF and operations and maintenance expenditures associated with the TSCA portion of the CDF. These expenditures were subtracted from total first costs to arrive at Project Costs that needed to be average annualized. Project Costs that needed to be average annualized for the shallow dredge, deep dredge and bank to bank options came to $48,623,500; $53,323,500 and $69,723,500.

Interest During Construction was computed on Total First Costs less Real Estate Costs, less Post Construction CDF Monitoring costs, less Post Construction Non- TSCA related O&M Costs and less Post Construction TSCA related O&M Costs. Interest During Construction assumed a 4 year construction period, starting in May of 2002 and ending in November of 2005. It was assumed no construction took place in January February or March. Expenditures were divided evenly over the 34 months of construction. Interest During Construction was computed using a 7.625 % annual interest rate and monthly compounding. Interest During Construction for the shallow dredge, deep dredge and bank to bank options came to $6,817,000; $7,478,900 and $9,788,900 respectively.

Investment costs were computed for the three plans. Investment costs equaled Project First Costs that needed to be average annualized and Interest During Construction costs. Investment Costs for the shallow dredge, deep dredge and bank to bank options came to $55,440,500; $60,802,400 and $79,512,200 respectively.

Total average annual project costs had three components: average annual costs associated with the construction of the project, post construction monitoring costs and annual CDF maintenance costs . The conversion of construction related project costs, post construction monitoring costs and annual CDF maintenance costs to average annual costs used a 7.625% annual interest rate and a 50 year project evaluation period. All costs reflect September 1996 price levels. Total average annual project costs for the shallow dredge, deep dredge and bank to bank options came to $4,434,000; $4,853,600 and $6,317,300 respectively.

Table S4-2. Derivation Of Average Annual Costs- Shallow Dredging Plan – September 1996 Prices

Total Project Costs	
Construction Costs	
Dredging Costs	$10,052,000
Dewatering Costs	$ 3,689,600
Landfill Costs-TSCA	$ 3,725,000
Landfill Costs- Non TSCA	$ 9,587,500
Sampling And Analysis	
During Dredging & At The Transfer Facility	$ 402,000
At The Disposal facility- After Construction	$ 2,276,500
Wetlands Mitigation	$ 450,000
Liability	
Non TSCA	$ 2,700,000
TSCA Liability	$ 3,500,000
Construction Contingencies	$ 9,117,400

Total Construction Costs	$45,500,000
Study Costs	$ 3,800,000
Engineering And Design During Construction	$ 500,000
Construction Management	$ 1,779,000
Real Estate	$ 221,000

First Costs	$51,800,000
Investment Costs	
Project First Costs To Be Average Annualized[1]	$48,623,500
Interest During Construction	$ 6,817,000

Investment Costs To Be Average Annualized	$55,440,500
Average Annual Costs	
Interest (7.625%)	$4,227,300
Amortization (.198%)	$ 110,000
Post Construction Monitoring [2]	$ 69,300
Annual Maintenance [3]	$ 27,400

Average Annual Costs [4]	$4,434,000
Present Worth Factor for 7.625%	12.78202
Present Worth Of Average Annual Costs	$56,675,461
Rounded PW of Average Annual Costs	$56,675,500

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(1) Costs equals total first costs ($51,800,000) less CDF Monitoring Costs ($2,276,500), less lump sum O&M costs for non TSCA portion of the landfill ($210,000) less lump sum O&M costs for TSCA portion of the landfill ($690,000).

(2) Post Construction Monitoring.-Based on expenditure of $2,276,000 over a 30 year period.

(3) Annual Maintenance- Based on annual expenditure of $30,000 over a 30 year period.

(4) Average annual costs reflect a 7.625 annual interest rate, a 50 year project life and September 1996 price levels.

Table S4-2. Derivation Of Average Annual Costs- Deep Dredging Plan - September 1996 Prices

Total Project Costs	
Construction Costs	
Dredging Costs	$11,716,000
Dewatering Costs	$ 3,954,800
Landfill Costs-TSCA	$ 4,025,000
Landfill Costs- Non TSCA	$10,900,000
Sampling And Analysis	
During Dredging & At The Transfer Facility	$ 402,000
At The Disposal facility- After Construction	$ 2,276,500
Wetlands Mitigation	$ 450,000
Liability	
Non TSCA	$ 2,700,000
TSCA Liability	$ 3,500,000
Construction Contingencies	$ 9,975,700

Total Construction Costs	$49,900,000
Study Costs	$ 3,800,000
Engineering And Design During Construction	$ 600,000
Construction Management	$ 1,979,000
Real Estate	$ 221,000

First Costs	$56,500,000
Investment Costs	
Project First Costs To Be Average Annualized[1]	$53,323,500
Interest During Construction	$ 7,478,900

Investment Costs To Be Average Annualized	$60,802,400
Average Annual Costs	
Interest (7.625%)	$ 4,636,200
Amortization (.198%)	$ 120,700
Post Construction Monitoring [2]	$ 69,300
Annual Maintenance [3]	$ 27,400

Average Annual Costs [4]	$ 4,853,600
Present Worth Factor for 7.625%	12.78202
Present Worth Of Average Annual Costs	$62,038,795
Rounded PW of Average Annual Costs	$62,038,800

(1) Costs equals total first costs ($56,500,000) less CDF Monitoring Costs ($2,276,500), less lump sum O&M costs for non TSCA portion of the landfill ($210,000) less lump sum O&M costs for TSCA portion of the landfill ($690,000).

(2) Post Construction Monitoring.-Based on expenditure of $2,276,000 over a 30 year period.

(3) Annual Maintenance- Based on annual expenditure of $30,000 over a 30 year period.

(4) Average annual costs reflect a 7.625 annual interest rate, a 50 year project life and September 1996 price levels.

Table S4-2. Derivation Of Average Annual Costs- Bank To Bank – September 1996 Prices

Total Project Costs	
Construction Costs	
Dredging Costs	$18,820,000
Dewatering Costs	$ 5,087,000
Landfill Costs-TSCA	$ 5,325,000
Landfill Costs- Non TSCA	$13,875,000
Sampling And Analysis	
During Dredging & At The Transfer Facility	$ 402,000
At The Disposal facility- After Construction	$ 2,276,500
Wetlands Mitigation	$ 450,000
Liability	
Non TSCA	$ 2,700,000
TSCA Liability	$ 3,500,000
Construction Contingencies	$ 13,064,500
Total Construction Costs	$65,500,000
Study Costs	$ 3,800,000
Engineering And Design During Construction	$ 800,000
Construction Management	$ 2,579,000
Real Estate	$ 221,000
First Costs	$72,900,000
Investment Costs	
Project First Costs To Be Average Annualized[1]	$69,723,500
Interest During Construction	$ 9,788,700
Investment Costs To Be Average Annualized	$79,512,200
Average Annual Costs	
Interest (7.625%)	$ 6,062,800
Amortization (.198%)	$ 157,800
Post Construction Monitoring [2]	$ 69,300
Annual Maintenance [3]	$ 27,400
Average Annual Costs [4]	$ 6,317,300
Present Worth Factor for 7.625%	12.78202
Present Worth Of Average Annual Costs	$80,747,833
Rounded PW of Average Annual Costs	$80,747,800

(1) Costs equals total first costs ($72,900,000) less CDF Monitoring Costs ($2,276,500), less lump sum O&M costs for non TSCA portion of the landfill ($210,000) less lump sum O&M costs for TSCA portion of the landfill ($690,000).

(2) Post Construction Monitoring.-Based on expenditure of $2,276,000 over a 30 year period.

(3) Annual Maintenance- Based on annual expenditure of $30,000 over a 30 year period.

(4) Average annual costs reflect a 7.625 annual interest rate, a 50 year project life and September 1996 price levels.

E. PRELIMINARY CONSTRUCTION COSTS FOR AQUATIC FISHERY SHALLOWS -SEPTEMBER 1996 PRICES

Seven aquatic fishery shallows plans were developed. Three of the plans were for Ecological Assessment Area 3 (mouth of the river to the 5th Street Bridge) and four for Area 2 (the area of concern upstream of the 5th Street Bridge).

Measures that could be applied to Area 3 are very limited since the area continues to be utilized for deep draft commercial vessels, docking of these vessels and transfer of bulk commodities. One measure that has been considered at other harbors for similar situations is the construction of a man made aquatic habitat shelf along the channel reach primarily to facilitate movement of fisheries through the reach. The three plans derived were variations of this aquatic shelf. Construction first costs, with contingencies, ranged from $352,300 to $885,700 (See Table S4.3).

Plans that would have a greater ecological impact could be developed for Ecological Assessment Area 2. Four plans were developed for this area. Subcomponents of these plans included acquisition of river shoreline property and construction of aquatic fishery shallows, as possible. These plans would include a mix of aquatic and shoreline plantings, stone/gravel bottom areas, and cover structures. The areas would be interfaced with the lake/river regime and would provide passage, cover, feeding and spawning habitats. Construction first costs, with contingencies, for Area 2 plans ranged from $450,700 to $1,729,300 (See Table S4.3).

The seven habitat restoration plans developed were assessed and evaluated given various evaluation parameters. Each plan was rated on how well it achieved ecological restoration/preservation goals/objectives. The plans were also assessed/evaluated with respect to a wide range of output measures. Output measures included items such as: costs, economic benefits, practicality, ecological improvement (rank), shoreline improvement (acres), shallows improvement (acres), fishery passage length, Ohio Habitat Assessment Procedures (HAP), biological indices (Qualitative Habitat Evaluation Index-QHEI, Fishery Index Of Biotic Integrity-IBI), Macroinvertibrate Invertebrate Community Index (ICI) Improvements and accomplishment of Supplemental Ecological Restoration Objective. This assessment/evaluation procedure was used to develop an Aquatic Fishery Shelf Plan for the Recommended Plan. A description of the Aquatic Fishery Shelf Plan for the Recommended Plan is presented in Section 2.

Table S4-3. Supplemental Dredging Ecological Restoration/Preservation Measures For Aquatic Fishery Shallows Assessment Evaluation-Ecological Assessment Areas 3 and 2 – September 1996 Prices.

Summary Assessment Items	(Ecological Assessment Area 3 Plans)			(Ecological Assessment Area 2 Plans)			
Item	Plan 1 Aquatic/Fishery Shelf Cut	Plan 2 Aquatic/Fishery Shelf Hung	Plan 3 Aquatic/Fishery By-Pass Cut	Plan 1 Conrail Slip & Aquatic/Fishery Shelf Cut	Plan 2 Conrail Slip & Aquatic/Fishery Shelf Extended	Plan 3 Aquatic/Fishery Shelf Cut	Plan 4 Conrail Slip Aquatic/Fishe Shelf Cu
Construction First Cost (+12.5%)	$ 400,662	$ 313,111	$ 787,313	$ 1,250,004	$ 1,537,136	$ 400,662	$ 447,237
Project Cost: (Present Worth)	$ 450,745	$ 352,250	$ 885,727	$ 1,406,255	$ 1,729,279	$ 450,745	$ 503,142
Project Economic Benefits (Present Worth) NED : Regional : Total :	(+/-)	302,508 280,962 $ 583,470	(+/-)	(+/-)	(+/-)	(+/-)	$ 817,892 $ 759,638 $1,577,530
Practicality*	Poor	Fair	Poor	Good	Good	Good	Good
Ecological Improvement Rank	1	3	2	2	1	4	3
Shoreline Improvement (Acres)	0.7	0.5	1.5	3.5	4.0	0.7	0.7+Acq.
Shallows Improvement (Acres)	0.7	0.1	1.5	2.5	3.0	0.7	0.7+Acq.
Fishery Passage Length	Good	Good	Good	Poor	Good	Good	Good
Physical Habitat Improvement (HAP QHEI up to)	Fair +5	Fair +4	Fair +5	Good +8	Good +9	Good +7	Good +8
Fishery Improvement (HAP IBI up to)	Fair +4	Fair +3	Fair +4	Good +11	Good+ +12	Good +10	Good +11
Macroin-vertebrate Improvement (HAP ICI up to)	Fair +4	Poor +2	Fair +4	Good +13	Good+ +14	Good +12	Good +13
Supplemental Accomplishment of Ecological Restoration Objective	Fair	Fair	Fair	Good	Good	Good	Good

Notes:

* Commercial shipping activities pertaining to coal transhipment and storage. Coal dust problem.
* Recreational boating channel area. Available shoreline area.

General Scale: (Good, Fair, Poor)(Aqu. = Acquisition)

(HAP QHEI) - Habitat Assessment Procedure Qualitative Habitat Evaluation Index
(HAP IBI) - Habitat Assessment Procedure Index of Biotic Integrity
(HAP ICI) - Habitat Assessment Procedure Invertebrate Community Index

SECTION 2

RECOMMENDED PLAN - SEPTEMBER 1996 PRICES

A. RECOMMENDED PLAN DESCRIPTION

In September 1996, plan components for the Recommended Plan were decided upon with respect to the three polluted sediment removal/dewatering/transport/disposal options and the seven habitat restoration alternatives. The Recommended Plan at this time was based upon the evaluation parameters developed by the partnership. The Recommended Plan for polluted sediment removal/dewatering/transport/disposal in September 1996 was the Deep Dredging Scenario-Dewatering Facility At Interm CDF-Option 3. The Recommended Plan for habitat restoration consisted of an aquatic/fishery shelf plan for Ecological Assessment Area 3 (Plan 2) and the acquire Conrail Slip and Aquatic/Fishery Shelf Cut Plan for Ecological Assessment Area 2 (Plan 4).

The Recommended Plan for polluted sediment removal/dewatering/ transport/disposal (Deep Dredge scenario) had moderate costs and met River ecological cleanup restoration/preservation goals/objectives. The Recommended Plan, at that time, called for disposal of approximately 696,000 cubic yards of sediments. Approximately 581,000 cubic yards of contaminated sediments were located upstream of the 5th Street Bridge, of which approximately 150,000 cubic yards were significantly PCB contaminated and would be handled and disposed of in accordance with Toxic Substance Control Act (TSCA) regulations. The remaining 115,000 cubic yards of contaminated sediments were located down stream of the 5th street Bridge, from the 5th Street Bridge downstream to station 120+00. PAH contamination was considered to be the primary contaminant of concern in this area.

The Recommended Plan polluted sediment removal/dewatering/ transport/disposal (deep dredge scenario) had the following components: dredging of the contaminated bottom sediments, movement of the sediments to a staging area, developing and utilizing a land based transfer/dewatering/transfer facility located along the river portion of the harbor area, dewatering of the sediments at the transfer/dewatering/ transfer facility, trucking of the dewatered dredged material from the staging area to a final disposal site, disposing of the material as appropriate and monitoring of the disposal site for 50 years after project construction.

The staging area would be located somewhere along the river. The final disposal site would be an upland disposal facility. A portion of the disposal facility would be built to TSCA disposal standards to receive the 150,000 cubic yards of TSCA material. The remainder of the disposal facility would be used to store the non TSCA material. The facilities would also address leachate collection, treatment and monitoring procedures, and closure and post closure monitoring measures. Design environmental protection measures have been incorporated into the project design, construction, operation, and maintenance. The Recommended Plan also included construction costs associated with the staging area as well as the final disposal site.

Dredging would start at the upper turning basin and proceed down stream to just past the U.S. Coast Guard Station. TSCA material was located primarily in the reach from the upper turning basin to just past Kister Marine. Construction of project facilities would take about two years. Dredging, transfer/dewatering/transfer, and disposal would take about 3 years. Construction would begin in 2001 and the project would be completed in 2005. Dredging, transfer/dewatering/transfer, and disposal of TSCA material would take place the first year. Dredging would likely occur from upstream to downstream, in order to try to recapture any re-suspended sediments and associated contaminants.

The habitat restoration components of the Recommended Plan, proposed in 1996, constituted ecological restoration, as possible, for loss of protected aquatic/fishery shallows due to facilitated structural (ie, bulkheading, channelization), and activities impacts. The plans for Ecological Assessment Area 3 and 2 were practical optimized plans of moderate cost providing problem area protected aquatic/fishery shallows of substantial length which accomplished, as possible, the Partnerships goals/objectives in this regard. The areas would be interfaced with the lake/river regime and would provide passage, cover, feeding and spawning habitat.

The Partnership recommended the implementation of Plan 2 for Ecological Assessment Area 3. With this plan a property easement would be acquired and an artificial aquatic/fishery shelf would be hung along the existing sheetpile bulkheading in unit sections of about 30 feet for about 2,500 feet. The unit sections would be constructed of standard or custom concrete units about 10 feet long, with a cover feature and stone placed along the lower shelf. The shelf could have a grate bottom to allow silt/coal dust to move through the stone and shelf. The estimated construction cost, with contingencies, for this measure was be about $313,000 in September 1996 prices.

The Partnership recommended the implementation of Plan 4 for Ecological Assessment Area 2. With this plan shoreline property would be acquired including the Conrail Slip and an aquatic/fishery shelf would be cut along the east embankment channel for about 2,500 feet. Some bulkheading would be left in place as a buffer between the recreational channel and the shelf. The cut would be about two feet below low water datum (LWD) and at a minimum 8 to 10 feet wide. Improvements would be made to the bottom of the cut to include: contouring, soil and aquatic planting areas, gravel areas, and some cover structures. The shoreline area would also be improved with cover/food plantings or artificial cover structures, as necessary.

The plan called for long term channel maintenance dredging upstream of the 5th Street Bridge to recreational navigation depths, as is being done at present. This would provide aquatic shallow areas along the lower River shoreline in the distant future at no cost.

The plan also called for an eight feet or more decrease in the width of the maintained recreational navigation channel to the west upstream of the 5th Street Bridge between the Conrail slip and the Upper Turning Basin. This would provide additional aquatic shallow area along the east embankment in the distant future at no cost and likely savings. The estimated construction cost for this measure, with contingencies, was about $447,200 in September 1996 prices.

B. RECOMMENDED PLAN COSTS - SEPTEMBER 1996 PRICES

Costs were developed for all components of the Recommended Plan: The Recommended Plan polluted sediment removal/dewatering/transport/disposal option (Deep Dredge Scenario-Dewatering Facility At Interm CDF-Option 3), Plan 2 costs for Ecological Assessment Area 3 and Plan 4 costs for Ecological Assessment Area 2. Average annual costs were computed for the Recommended Plan. Table S4-4 provides a summary of First Costs, Investment Costs and Average Annual Costs associated with the Recommended Plan. All costs reflect September 1996 price levels.

First Costs are basically Construction Costs, Habitat Restoration Costs, Study Costs, Engineering and Design Costs, Construction Management Costs and Real Estate Costs associated with building the components of the Recommended Plan. First Costs for the Recommended Plan came to $42,380,000.

Construction Costs associated with polluted sediment remediation came to $34,875,000. This $34,875,000 included: dredging costs ($11,716,000), construction of a dewatering facility and operation thereof ($2,912,400), TSCA related landfill construction costs ($3,091,700), non TSCA related landfill construction costs ($8,514,800), sampling and analysis costs for the construction period ($321,600), sampling and analysis at the disposal facility after construction ($437,000), wetlands mitigation costs ($167,000) and contingencies ($7,714,500).

Habitat restoration costs came to $860,000. These costs included construction costs ($662,000), contingencies on the habitat restoration construction costs ($103,000) and Engineering And Design and Supervision and Administration costs associated with habitat restoration ($95,000).

Study Costs were $3,800,000. Engineering And Design costs during construction were $530,000. Construction Management costs were $1,765,000. Real Estate costs were $550,000: $370,000 associated with Section 312 and O&M and $180,000 for Section 206. Total First Costs came to $42,380,000.

Interest During Construction assumed a 4 year construction period, starting in May of 2002 and ending in September 2005. It was assumed no construction took place in January February or March. Construction cost time streams were developed for 20 cost categories on a monthly expenditure basis. Interest During Construction was computed using a 7.625 % annual interest rate and monthly compounding. Interest During Construction came to $6,410,900.

Interest During Construction ($6,410,900) was added to Project First Costs ($42,380,000) to arrive at project Investment costs. Project Investment costs came to $48,790,900.

There were a number of expenditures that would be made after the project was constructed. There were three general categories of post construction expenditures: Disposal Site expenditures, Wetland Mitigation area expenditures and Section 206 related expenditures.

Table S4-4. Derivation Of Average Annual Costs-Recommended Plan-September 1996 Prices

Total Project Construction Costs And First Costs	
Construction Costs	
Dredging Costs	$11,716,000
Dewatering Costs	$ 2,912,400
Landfill Costs-TSCA	$ 3,091,700
Landfill Costs- Non TSCA	$ 8,514,800
Sampling And Analysis	
During Dredging & At The Transfer Facility	$ 321,600
At The Disposal facility- After Construction	$ 437,000
Wetlands Mitigation	$ 167,000
Construction Contingencies	$ 7,714,500

Total Construction Costs	$34,875,000
Aquatic Fishery Shelves Restoration (Habitat Restoration)	$ 860,000
Study Costs	$ 3,800,000
Engineering And Design During Construction	$ 530,000
Construction Management	$ 1,765,000
Real Estate	$ 550,000
Section 312, O&M	($ 370,000)
Section 206	($ 180,000)

First Costs	$42,380,000
Investment Costs	
Project First Costs To Be Average Annualized	$42,380,000
Interest During Construction [1]	$ 6,410,900

Investment Costs To Be Average Annualized	$48,790,900
Average Annual Costs	
Interest (7.625%)	$ 3,720,300
Amortization (.198%)	$ 96,800
Disposal Site	
Post Construction Monitoring [2]	$ 57,100
Annual Maintenance [3]	$ 44,900
Wetland Mitigation Area	
Post Construction Monitoring 4	$ 2,000
Annual Maintenance 5	$ 1,800
Section 206	
Post Construction Monitoring 6	$ 2,000
Annual Maintenance 7	$ 6,600

Average Annual Costs 8	$3,931,500
Present Worth Factor for 7.625%	12.78202
Present Worth Of Average Annual Costs	$50,252,498
Rounded PW of Average Annual Costs	$50,252,500

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(1) Interest During Construction Costs are based on total first costs ($42,380,000) less Real Estate costs of $550,000. IDC was based on a four year construction period and monthly compounding using a 7.625 percent annual interest rate.

(2) Disposal Site Post Construction Monitoring.-Based on an annual expenditure of $57,100 over a 50 year period.

(3) Disposal Site Annual Maintenance- Based on an annual expenditure of $44,900 over a 50 year period.

(4) Wetland Mitigation Area Post Construction Monitoring. Based on an annual expenditure of $2,000 over a 50 year period.

(5) Wetland Mitigation Area Annual Maintenance- Based on an expenditure of $10,400 once every five years, for ten cycles.

(6) Section 206 Post Construction Monitoring. Based on an annual expenditure of $2,000 over a 50 year period.

(7) Section 206 Annual Maintenance- Based on an expenditure of $38,300 once every five years, for ten cycles.

(8) Average Annual Costs reflect a 7.625 annual interest rate, a 50 year project life and September 1996 price levels.

Disposal Site expenditures included post construction monitoring (sampling and laboratory analysis) of the completed disposal facility and operations and maintenance expenditures associated with the TSCA and non-TSCA portion of the CDF. Each of these costs would be incurred every year over a 50 year period. Since these costs would be incurred every year, these are average annual costs. These average annual costs reflected a 7.625 percent annual interest rate and a 50 year evaluation period. These yearly expenditures are discussed below.

After the project is completed, post construction monitoring would take place at the disposal facility on a yearly basis. Test wells at the final disposal site would be inspected and monitored annually for the next 50 years. Annual Post Construction Monitoring Costs were placed at $57,100. Post Construction monitoring included groundwater sampling, groundwater laboratory analysis, groundwater statistical analysis and reporting, NPDES sampling, NPDES monthly analysis, NPDES semi-annual analysis, NPDES annual organic analysis, NPDES reporting and miscellaneous monitoring.

Another annual cost at the disposal site was associated with annual maintenance of the CDF after construction. After the project is completed, the final disposal site would incur some annual maintenance costs for the next 50 years. Annual Maintenance Costs were placed at $44,900. These annual costs included such items as: repair of the capping system, revegetation, sedimentation basin cleanout, mowing, fence repair, monitoring well repairs, quarterly inspections and reports, implementation of a leachate management system, leachate transportation and disposal from the TSCA and Non-TSCA cells of the disposal site, maintenance of facility roads, and other miscellaneous items.

Wetland mitigation area post construction expenditures included post construction inspections of the mitigation area and operations and maintenance expenditures associated with maintaining the mitigation areas over the 50 year project life. Post construction wetland mitigation inspections would take place yearly and would cost $2,000 annually. Once every five years, the wetlands would need some maintenance performed on them to insure their continued viability. This would continue over the 50 years of the project life, resulting in 10 cycles. The maintenance cost per event was placed at $10,400. This time stream of costs was converted to a present worth value and then an average annual cost using a 7.625 percent annual interest rate and a 50 year project life. Average annual wetland mitigation area operation and maintenance costs came to $1,800.

Section 206 post construction expenditures included post construction inspections of the Section 206 area and operations and maintenance expenditures associated with maintaining the Section 206 habitat areas over the 50 year project life. Post construction Section 206 habitat inspections would take place yearly and would cost $2,000 annually. Once every five years, the habitat areas created by Section 206 would need some maintenance performed on them to insure their continued viability. This would continue over the 50 years of the project life, resulting in 10 cycles. The maintenance cost per event was placed at $38,300. This time stream of costs was converted to a present worth value and then an average annual cost using a 7.625 percent annual interest rate and a 50 year project life. Average annual wetland mitigation area operation and maintenance costs came to $6,600.

Total average annual project costs for the Recommended Plan came to $3,931,500. These average annual costs had four components: average annual costs associated with sediment remediation and habitat restoration, annual post construction Disposal Site Costs, annual post construction Wetland Mitigation costs and annual post construction Section 206 costs.

The conversion of sediment remediation and habitat restoration related project costs, post construction Disposal Site costs, post construction Wetland Mitigation costs and post construction 206 costs to average annual costs, used a 7.625% annual interest rate and a 50 year project evaluation period. All costs reflected September 1996 price levels.

C. RECOMMENDED PLAN COSTS BY AUTHORITY- SEPTEMBER 1996 PRICES

Although the Partnership Plan is an overall plan to clean up the river, project costs were separated into costs by authority. There were basically five authorities used to implement the "Recommended Plan" in September 1996. Section 1 of the Rivers And Harbors Act of 1937 was used to remove all contaminated sediments located inside the Federal channel downstream of the 5^{th} Street Bridge. Section 101 of WRDA 1986 was used to dispose of all contaminated sediments located inside the Federal channel downstream of the 5^{th} Street Bridge. Section 312 (a) was used for the removal and disposal of all contaminated sediments located outside of the Federal channel downstream of the 5^{th} Street Bridge. Section 312 (b) was used to remove and dispose of all contaminated sediments located upstream of the 5^{th} Street Bridge, inside and outside the federal channel. Finally Section 206 was used to accomplish habitat restoration located upstream or downstream of the 5^{th} Street Bridge.

1. Recommended Plan First Costs By Authority Total Recommended Plan First Costs, in September 1996 prices, came to $42,380,000. Project First Costs associated with removing and disposing of sediments located within the Federal channel downstream of the 5th Street Bridge (Section 1 of the Rivers And Harbors Act of 1937 and Section 101 of WRDA 1986)) were $3,627,200. Project First costs associated with removing and disposal of sediments located outside of the Federal channel downstream of the 5th Street Bridge (Section 312 (a) authority), were $3, 079,000. Project First costs associated with removing and disposal of sediments located upstream of the 5th Street Bridge (Section 312 (b) authority), were $34,633,800. Finally, Project First costs associated with habitat restoration (Section 206) were $1,040,000. (See Table S4-5).

2.Recommended Plan Average Annual Costs By Authority. Table S4-5 presents Average Annual Costs by Authority for the Recommended Plan, as envisioned in September 1996. Total Average Annual costs for the Recommended Plan were $3,931,500.

Project First Costs associated with removal and disposal of polluted sediments located upstream of the 5th Street Bridge came to $34,633,800. These were essentially costs associated with Section 312 (b). Average Annual costs associated with Section 312 (b) were $3,208,100.

Table S4-5- Ashtabula River Partnership Recommended Plan Average Annual Project Costs- By Area By Authority-September 1996 Prices

	Sediment Removal And Disposal Downstream Of The 5th Street Bridge			Sediment Removal & Disposal Upstream Of The 5th Street Bridge	Restoration Upstream & Downstream Of The 5th Street Bridge	Total Project Costs
Authority	Section 1 of R&HA 1937 & Section101 WRDA 1986	Section 312 A	Total Downstream	Section 312 (b)	Section 206	All Authorities
Location	Within The Federal Channel	Adjacent To The Federal Channel	Total Downstream Of 5th St Brdge	Within & Adjacent To Fed Channel	Upstream & Downstream Of 5th St. Brdg	All Locations
Investment Costs						
Project First Costs	$3,627,200	$3,079,000	$6,706,200	$34,633,800	$1,040,000	$42,380,000
Interest During Construction [1]	$ 548,700	$ 465,800	$1,014,500	$ 5,239,100	$ 157,300	$ 6,410,900
Investment Costs To Be Average Annualized	$4,175,900	$3,544,800	$7,720,700	$39,872,900	$ 1,197,300	$48,790,900
Average Annual Costs						
Interest (7.625%)	$ 318,400	$ 270,300	$ 588,700	$ 3,040,300	$ 91,300	$ 3,720,300
Amortization (.198%)	$ 8,300	$ 7,000	$ 15,300	$ 79,100	$ 2,400	$ 96,800
Disposal Site						
Post Construction Monitoring [2]	$ 5,000	$ 4,200	$ 9,200	$ 47,900	N.A.	$ 57,100
Annual Maintenance [3]	$ 3,900	$ 3,300	$ 7,200	$ 37,700	N.A.	$ 44,900
Wetland Mitigation Area						
Post Construction Monitoring [4]	$ 200	$ 200	$ 400	$ 1,600	N.A.	$ 2,000
Annual Maintenance [5]	$ 200	$ 100	$ 300	$ 1,500	N.A.	$ 1,800
Section 206						
Post Construction Monitoring [6]	$ N.A.	$ N.A.	$ N.A.	$ N.A.	$ 2,000	$ 2,000
Annual Maintenance [7]	$ N.A.	$ N.A.	$ N.A.	$ N.A.	$ 6,600	$ 6,600
Average Annual Costs [8]	$ 336,000	$ 285,100	$ 621,100	$ 3,208,100	$ 102,300	$ 3,931,500

(1) Interest During Construction Costs are based on total first costs ($42,380,000) less Real Estate costs ($550,000). IDC was based on a four year construction period, a 7.625% annual interest rate and monthly compounding. IDC was allocated among the various authorities based on each authorities percentage of Project First costs.
(2) Disposal Site Post Construction Monitoring - Based on an annual expenditure of $57,100 over a 50 year period. This was ratioed among R&HA of 1937, Section 312 (a) and Section 312 (b) based on each authorities percent of total Project First Costs less Section 206 project First Costs.
(3) Disposal Site Annual Maintenance - Based on an annual expenditure of $44,900 over a 50 year period. Ratioing same as Disposal Site Post Construction Monitoring.
(4) Wetland Mitigation Area Post Construction Monitoring- Based on an annual expenditure of $2,000 over a 50 year period
(5) Wetland Mitigation Area Annual Maintenance - Based on an expenditure of $10,400 once every five years for 10 cycles
(6) Section 206 Post Construction Monitoring- Based on an annual expenditure of $2,000 over a 50 year period.
(7) Section 206 Area Annual Maintenance - Based on an expenditure of $38,300 once every five years for 10 cycles.
(8) Average Annual Costs reflect a 7.625 percent annual interest rate, a 50 year project life and September 1996 price levels

Project First Costs associated with habitat restoration taking place upstream and downstream of the 5th Street Bridge were $1,040,000. These are essentially costs associated with Section 206. Average Annual costs associated with Section 206 were $102,300.

Project First Costs associated with removal and disposal of polluted sediments located downstream of the 5th Street Bridge were $6,706,200. These project first costs were divided into two components: costs associated with removing sediments located within ($3,627,200) the Federal channel and costs associated with removing sediments located adjacent to ($3,079,000) the Federal channel. Average Annual costs associated with removing sediments located within the Federal channel were $336,000. Average Annual costs associated with removing sediments located adjacent to the Federal channel were $285,100.

SECTION 3

RECOMMENDED PLAN - OCTOBER 2000 PRICES

A. RECOMMENDED PLAN DESCRIPTION- OCTOBER 2000 PRICES

The Recommended Plan has evolved during the time period September 1996 to October 2000. Alternative Recommended Plan components were assessed/evaluated for environmental and social acceptability, for engineering and economic feasibility, and/or for best meeting the project planning objectives. An array of alternative plan components pertaining to dredging methods, transfer facilities, treatment measures and disposal sites were progressively assessed and evaluated by various work groups within the Ashtabula River Partnership. This process led to the development of a "Recommended Environmental Dredging Plan". See the Main Report for further information on the planning process.

The Partnerships "Recommended Environmental Dredging Plan" proposes the dredging, remediation and disposal of almost 696,000 cubic yards of sediments. The recommended plan is the Deep Dredging Scenario-Dewatering Facility At Interim CDF-Option 3.

The "Recommended Environmental Dredging Plan" calls for the disposal of 696,000 cubic yards of sediment. Approximately 150,000 cubic yards of sediment proposed for removal are significantly PCB contaminated and would be handled and disposed of in accordance with Toxic Substance Control Act (TSCA) regulations. The remaining 546,000 tons of sediment is non-TSCA.

The "Recommended Environmental Dredging Plan" calls for the dredging of the contaminated bottom sediments, movement of the sediments to a staging area, developing and utilizing a transfer/dewatering facility at the staging area located somewhere along the river, trucking the dewatered dredge material from the staging area to an upland landfill disposal facility (State Road site) and disposing of the material, as appropriate in TSCA and Non-TSCA disposal facilities. The facilities would also address leachate collection, treatment and monitoring procedures, and closure and post closure monitoring measures.

In addition to polluted sediment removal and disposal, the Partnership developed a recommendation for aquatic ecosystem restoration. Restoration would involve the development of aquatic fishery shelves which would restore several acres of aquatic/fishery shallows areas and associated shoreline. However, these measures would be implemented as a separate, but related project. Consequently the costs associated with these aquatic ecosystem measures were not included in the costs of the "Recommended Environmental Dredging Plan"

B. "RECOMMENDED ENVIRONMENTAL DREDGING PLAN" COSTS- OCTOBER 2000 PRICES

The ARP Plan is an overall plan to clean up the river. Project costs can be separated into costs by authority. There are basically four authorities that would be used to implement the "Recommended Environmental Dredging Plan". Section 1 of the Rivers and Harbors Act of 1937 would be used to remove all polluted sediments located inside the Federal channel downstream of the 5th Street Bridge. Section 101 of WRDA 1986 would be used to dispose of all polluted sediments located inside the Federal channel downstream of the 5th Street Bridge. Section 312(a) would be used for the removal and disposal of all polluted sediments located outside of the Federal channel downstream of the 5th Street Bridge. Section 312(b) would be used to remove and dispose of all polluted sediments located upstream of the 5th Street Bridge, inside and outside the Federal channel.

Section 206 is a fifth authority that could be used to implement the related aquatic ecosystem restoration measures in the ARP Project Area, as recommended. Costs associated with these measures were addressed in the plan formulation portion of this document. However, these measures would be implemented as a separate, but related project. Accordingly, aquatic ecosystem restoration measure costs are not part of the "Recommended Environmental Dredging Plan" costs. Consequently, whenever "Recommended Environmental Dredging Plan" costs are discussed, they do not include ecosystem restoration measure costs.

The cost estimate for the "Recommended Environmental Dredging Plan" was prepared using the Micro Computer-Aided Cost Estimating System (MCACES) software, which was developed by Building Systems Design Inc., of Atlanta, GA. The MCACES software system includes a project database and supporting databases including the unit price book, crews, labor rates, and equipment ownership schedule costs. All the databases work in conjunction with each other to produce a detail cost estimate.

The cost estimate is based upon all the construction features associated with the current FY00 level of design for the Recommended Environmental Dredging Plan, which includes changes to the disposal site and water treatment technologies at the dewatering facility. The cost estimate for the "Recommended Environmental Dredging Plan" is in accordance with the policy, guidance and procedures described in the Department of the Army's Engineering Regulation (ER) 1110-2-1302. All costs reflect October 2000 price levels, a 6.375% annual Federal Discount Rate and a 50 year project evaluation period.

The cost estimate provided by Cost Estimating was $47, 615,000. This included costs for construction of the project as well as monitoring and maintenance costs that would be incurred over the 50-year life of the project. The monitoring and maintenance costs included Disposal Site Post Construction Monitoring ($1,301,300) and Annual Maintenance Expenditures at the disposal site ($1,307,900). These types of costs are normally presented as average annual costs. Consequently, these expenditures were subtracted from the $47,615,000 to arrive at a construction cost of $45,005,800. These Post Construction Disposal Site Monitoring Costs ($1,301,300) and Post Construction Disposal Site Maintenance Costs ($1,307,900) were converted to average annual dollars and are reflected in Disposal Site Average Annual Costs.

The components of the construction cost estimate ($45,005,800) for this "Recommended Environmental Dredging Plan" is provided in Table S4-6. Average annual costs were computed for the Recommended Plan. Table S4-6 provides a summary of First Costs, Investment Costs and Average Annual Costs associated with the "Recommended Environmental Dredging Plan". First Costs are basically Construction Costs, Study Costs, Engineering and Design Costs, Construction Management Costs and Real Estate Costs associated with building the "Recommended Plan". All costs reflect October 2000 price levels.

Construction Costs associated with polluted sediment remediation came to $37,202,100 . This $37,202,100 included: dredging costs ($11,460,200), construction of a dewatering facility and operation thereof ($4,985,600), TSCA related landfill construction costs ($2,834,700 , non TSCA related landfill construction costs (($10,319,800), sampling and analysis costs for the construction period ($816,600), sampling and analysis at the disposal facility after construction ($173,100) and construction contingencies ($6,702,100).

Study Costs and Engineering And Design costs during construction were $4,876,200. Construction Management costs were $2,555,100 . Real Estate costs associated with Section 312 and O&M were $372,400. Total First Costs came to $45,005,800.

Interest During Construction assumed a 4 year construction period, starting in May of 2002 and ending in September 2005. It was assumed minimal construction took place in January February or March. Construction cost time streams were developed for 20 cost categories on a monthly expenditure basis. Interest During Construction was computed using a 6.375 % annual interest rate and monthly compounding. Interest During Construction came to $5,531,600.

Interest During Construction ($5,531,600) was added to Project First Costs ($ 45,005,800) to arrive at project Investment costs. Project Investment costs came to $50,537,400.

There were a number of Disposal Site expenditures that would be made after the project was constructed. Disposal Site expenditures included post construction monitoring (sampling and laboratory analysis) of the completed disposal facility and operations and maintenance expenditures associated with the TSCA and non-TSCA portion of the CDF. Each of these costs would be incurred every year over a 50-year period. Since these costs would be incurred every year, these are average annual costs. These average annual costs reflect a 6.375 percent annual interest rate, October 2000 price levels and a 50-year evaluation period. These yearly expenditures will now be discussed

After the project is completed, post construction monitoring will take place at the disposal facility on a yearly basis. Test wells at the final disposal site would be inspected and monitored annually for the next 50 years. Annual Post Construction Monitoring Costs were placed at $26,000. Post Construction monitoring includes groundwater sampling, groundwater laboratory analysis, groundwater statistical analysis and reporting, NPDES sampling, NPDES monthly analysis, NPDES semi-annual analysis, NPDES annual organic analysis, NPDES reporting and miscellaneous monitoring.

Table S4-6 -Derivation Of Average Annual Costs-"Recommended Environmental Dredging Plan"-October 2000 Prices

Total Project Construction Costs And First Costs	
Construction Costs	
Dredging Costs	$11,460,200
Dewatering Costs	$ 4,985,600
Landfill Costs-TSCA	$ 2,834,700
Landfill Costs- Non TSCA	$10,319,800
Sampling And Analysis	
During Dredging & At The Transfer Facility	$ 816,600
At The Disposal facility- After Construction	$ 173,100
Construction Contingencies	$ 6,702,100
Total Construction Costs	$37,202,100
Study Costs And Engineering And Design During Construction	$ 4,876,200
Construction Management	$ 2,555,100
Real Estate- Section 312, O&M	$ 372,400
First Costs [1]	$ 45,005,800
Investment Costs	
Project First Costs To Be Average Annualized	$ 45,005,800
Interest During Construction [2]	$ 5,531,600
Investment Costs To Be Average Annualized	$ 50,537,400
Average Annual Costs	
Interest And Amortization (.06678897)	$ 3,375,400
Disposal Site	
Post Construction Monitoring [3]	$ 26,000
Annual Maintenance [4]	$ 26,200
Average Annual Costs [5]	$ 3,427,600
Present Worth Factor for 6.375%	14.97253
Present Worth Of Average Annual Costs	$ 51,319,853
Rounded PW of Average Annual Costs	$ 51,319,900

(1)Project First Costs provided by Cost Estimating came to $47,615,000. Included in these costs were expenditures over the 50 year life of the project for: Disposal Site Post Construction Monitoring ($1,301,300) and Annual Maintenance Expenditures at The Disposal Site ($1,307,900). These types of costs are normally presented as average annual costs. Consequently, these expenditures were subtracted from the $47,615,000 to arrive at a construction cost of $45,005,800. These Post Construction Disposal Site Monitoring Costs ($1,301,300) and Post Construction Disposal Site Maintenance Costs ($1,307,900) were converted to average annual dollars and are reflected in Disposal Site Average Annual Costs.

(2)Construction Costs used to develop Interest During Construction ($44,633,400) were computed by subtracting from Total First Costs ($45,005,800), the projects Real Estate costs ($372,400). IDC was based on 16 different construction cost components, a four-year construction period and monthly compounding using a 6.375 percent annual interest rate.

(3) Average Annual Disposal Site Post Construction Monitoring.- Disposal Site Post Construction Monitoring costs for a 50 year evaluation period were $1,301,300. These costs did not represent any discounting. This was the total amount that would be spent over the 50-year evaluation period in October 2000 prices. These costs were converted to an average annual dollar value. This average annual value came to $26,000. This average annual value reflects a 6.375 percent annual interest rate, a 50-year project life and October 2000 price levels.

(4) Average Annual Disposal Site Maintenance- Disposal Site Maintenance costs for the 50 year evaluation period were $1,307,900. These costs did not represent any discounting. This was the total amount that would be spent over the 50-year evaluation period in October 2000 prices. These costs were converted to an average annual dollar value. This average annual value came to $26,200. This average annual value reflects a 6.375 percent annual interest rate, a 50-year project life and October 2000 price levels.

(5) Average Annual Costs reflect a 6.375 annual interest rate, a 50-year project life and October 2000 price levels.

Another annual cost at the disposal site was associated with annual maintenance of the CDF after construction. After the project is completed, the final disposal site would incur some annual maintenance costs for the next 50 years. Annual Maintenance Costs were placed at $26,200. These annual costs included such items as: repair of the capping system, revegetation, sedimentation basin cleanout, mowing, fence repair, monitoring well repairs, quarterly inspections and reports, implementation of a leachate management system, leachate transportation and disposal from the TSCA and Non-TSCA cells of the disposal site, maintenance of facility roads, and other miscellaneous items.

Total average annual project costs for the Recommended Plan came to $3,427,600. These average annual costs had two components: average annual costs associated with sediment remediation and annual post construction Disposal Site Costs.

The conversion of sediment remediation and post construction Disposal Site costs to average annual costs, used a 6.375% annual interest rate and a 50 year project evaluation period. All costs reflect October 2000 price levels.

C. "RECOMMENDED ENVIRONMENTAL DREDGING PLAN " COSTS BY AUTHORITY. -OCTOBER 2000 PRICES

Again, although the ARP Plan is an overall plan to clean up the river, project costs can be separated into costs by authority. There are basically four authorities that would be used to implement the "Recommended Environmental Dredging Plan". Section 1 of the Rivers and Harbors Act of 1937 would be used to remove all polluted sediments located inside the Federal channel downstream of the 5th Street Bridge. Section 101 of WRDA 1986 would be used to dispose of all polluted sediments located inside the Federal channel downstream of the 5th Street Bridge. Section 312(a) would be used for the removal and disposal of all polluted sediments located outside of the Federal channel downstream of the 5th Street Bridge. Section 312(b) would be used to remove and dispose of all polluted sediments located upstream of the 5th Street Bridge, inside and outside the Federal channel.

Section 206 is a fifth authority that could be used to implement the related aquatic ecosystem restoration measures in the ARP Project Area, as recommended. Costs associated with these measures were addressed in the plan formulation portion of this document. However, these measures would be implemented as a separate, but related project. Accordingly, aquatic ecosystem restoration measure costs are not part of the "Recommended Environmental Dredging Plan" costs. Consequently, whenever "Recommended Environmental Dredging Plan" costs are discussed, they do not include ecosystem restoration measure costs.

Total "Recommended Environmental Dredging Plan" First Costs come to $45,005,800 (See Table S4-7.). Project First Costs associated with removing and disposing of sediments located within the Federal channel downstream of the 5th Street Bridge (O&M Authority) were $4,021,200 . Project First Costs associated with removing and disposal of sediments located outside the Federal channel downstream of the 5th Street Bridge (Section 312(a) authority) were $3,414,400 Project First Costs associated with removing and disposal of sediments located upstream of the 5th Street Bridge (Section 312(b) authority) were $37,570,200 Project First Costs for the Recommended Plan are presented in Table S4-7.

Table S4-7. Ashtabula River Partnership "Recommended Environmental Dredging Plan" Average Annual Project Costs- By Area By Authority- October 2000 Prices

	Sediment Removal And Disposal Downstream Of The 5th Street Bridge			Sediment Removal & Disposal Upstream Of The 5th Street Bridge	Total Project Costs
Authority	Section 1 of R&HA 1937 & Section101 WRDA 1986	Section 312 A	Total Downstream	Section 312 (b)	All Authorities
Location	Within The Federal Channel	Adjacent To The Federal Channel	Total Downstream Of 5th St Brdge	Within & Adjacent To Fed Channel	Locations
Investment Costs					
Project First Costs	$4,021,200	$3,414,400	$7,435,600	$37,570,200	$45,005,800
Interest During Construction [1]	$ 494,200	$ 419,700	$ 913,900	$ 4,617,700	$ 5,531,600
Investment Costs To Be Average Annualized	$4,515,400	$3,834,100	$8,349,500	$42,187,900	$50,537,400
Average Annual Costs					
Interest And Amortization (.066789)	$ 301,600	$ 256,100	$ 557,700	$ 2,817,700	$ 3,375,400
Disposal Site					
Post Construction Monitoring [2]	$ 2,300	$ 2,000	$ 4,300	$ 21,700	$ 26,000
Annual Maintenance [3]	$ 2,300	$ 2,000	$ 4,300	$ 21,900	$ 26,200
Average Annual Costs [4]	$ 306,200	$ 260,100	$ 566,300	$ 2,861,300	$ 3,427,600

(1) Interest During Construction Costs are based on total first costs ($45,005,800) less Real Estate costs ($372,400). IDC was based on a four year construction period, a 6.375% annual interest rate and monthly compounding. IDC was allocated among the various authorities based on each authorities percentage of Project First costs.

(2) Disposal Site Post Construction Monitoring – Based on an annual expenditure of $26,000 over a 50 year period. This was ratioed among R&HA of 1937, Section 312 (a) and Section 312 (b) based on each authorities percent of total Project First Costs.

(3) Disposal Site Annual Maintenance -Based on an annual expenditure of $26,200 over a 50 year period. Ratioing same as Disposal Site Post Construction Monitoring.

(4) Average Annual Costs reflect a 6.375 percent annual interest rate, a 50 year project life and October 2000 price levels.

Average annual costs were calculated for the Recommended Plan. Average annual costs for the Recommended Plan total $3,427,600. Project average annual costs associated with Section 312(b) (upstream of the 5th Street Bridge) total $2,861,300. Project average annual costs associated with the Rivers and Harbors act of 1937 and Section 101 of WRDA 1986 (removal and disposal of polluted sediments located inside the federal channel downstream of the 5th Street Bridge) total $306,200. Project average annual costs associated with Section 312(a) (the removal and disposal of polluted sediments located outside the federal channel downstream of the 5th Street Bridge) total $260,100.

D. "RECOMMENDED ENVIRONMENTAL DREDGING PLAN " COSTS BY COST SHARE - OCTOBER 2000 PRICES

Table S4-8 presents the proposed project conceptual cost shares for the "Recommended Environmental Dredging Plan". The Federal/Non Federal cost shares are based upon the cost share percentages associated with the various Authorities used to implement the "Recommended Environmental Dredging Plan".

Table S4-8. "Recommended Environmental Dredging Plan": Proposed Project Conceptual Cost Shares- October 2000 Prices

Cost Item	Federal Cost Share		Non Federal Cost Share		Total Cost
Dredging Downstream Of The 5th Street Bridge					
Within The Federal Channel (Section 1 of R&HA of 1937)	$ 2,299,000	(100%)		(0%)	$ 2,299.000
Adjacent To The Federal Channel (Section 312 a)	$ 1,952,000	(100%)		(0%)	$ 1,952.000
Dredging Upstream Of The 5th Street Bridge					
Within And Adjacent To The Federal Channel (Section 312 (b)	$13,961,000	(65%)	$ 7,517,000	(35%)	$21,478,000
Disposal Downstream Of The 5th Street Bridge					
Within The Federal Channel (Section 101 Of WRDA 1986)	$ 1,351,500	(80%)	$ 337,400	(20%)	$ 1,688,900
Adjacent To The Federal Channel (Section 312 a)	$ 1,147,300	(80%)	$ 286,800	(20%)	$ 1,434,100
Disposal Upstream Of The 5th Street Bridge					
Within And Adjacent To The Federal Channel (Section 312 (b)	$10.257,200	(80%)	$ 5.523,600	(20%)	$15.783,800
LERRDS					
Administrative Costs	$ 0	(0%)	$ 261.000	(100%)	$ 261,000
Acquisition Costs	$ 43.000	(38%)	$ 69,000	(62%)	$ 112.000
First Cost Totals'	$31,011,000	(68.9%)	$13,994,800	(31.1%)	$45,005,800
Monitoring And Maintenance (Costs allocated on cubic yards removed by Authority)					
Below 5th St Bridge & Inside the Federal Channel (O&M . R&HA 37)	$ 186,500	(80%)	$ 46,600	(20%)	$ 233,100
Below 5th St Bridge & Outside the Federal Channel (Section 312 (a))	$ 158,300	(80%)	$ 39,600	(20%)	$ 197,900
Above the 5th St Bridge (Section 312 (b))					
Non TSCA	$ 1,050,200	(65%)	$ 565,500	(35%)	$ 1,615,700
TSCA	$ 365,600	(65%)	$ 196,900	(35%)	$ 562,500
	$ 1.760,600		$ 848.600		$,2.609,200
Cost Estimating Control Totals	$32,771,600	(68.8%)	$14,843,400	(31.2%)	$47,615,000

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX T

REAL ESTATE

<u>**PREPARED BY**</u>**:**

U.S. Army Corps of Engineers, Buffalo District
Updated December 2000

REAL ESTATE PLAN
FOR
ASHTABULA RIVER PARTNERSHIP PLAN
ASHTABULA, OHIO

1. GENERAL

This Real Estate Plan (REP) was prepared in support of the Ashtabula River Partnership Project. The authorities for the Project are Section 312 of Water Resources Development Act (WRDA) of 1990, as amended by Section 205 of the WRDA of 1996 and the River and Harbor Act of 1937. In 1994, the Ashtabula River Partnership was established to remediate the river and eliminate impairments to beneficial uses. The Ashtabula City Port Authority has been identified as the local sponsor for the Project, consisting of construction of the dredged material disposal facility and the environmental dredging under Section 312.

The REP identifies and describes the lands, easements, rights-of-way, relocations and disposal areas (LERRD) required for the construction, operation and maintenance of the Project. The REP also addresses the minimum real estate requirements and procedures for the implementation of the recommended plan.

2. PROJECT DESCRIPTION

Ashtabula Harbor is located in Ashtabula, Ohio on Lake Erie about 65 miles east of Cleveland, Ohio. The project consists of construction of a dredged material disposal facility required for the environment and operation and maintenance dredging under Section 312 and the River and Harbors Act of 1937. The facility is a general navigation feature for proposed operation and maintenance dredging. Approximately 696,000 cubic yards of material will be dredged from the Ashtabula River starting at its mouth and going to the upstream limit of the Federal Navigation Channel. The distance is about 9,000 linear feet. The contaminated material requires various levels of upland containment. The Non-Federal sponsor is required to provide all lands, easements, rights-of-way, relocations, and disposal areas (LERRD's). The project requires temporary transfer areas; permanent dredged material disposal areas; work and storage areas and access roads. Seven sites will have to be acquired and are individually addressed.

2.1.1. Site One is a 10.01-acre area to be used as a temporary work area. Of the 10.01-acre area 8.31-acres will be used primarily as a transfer/dewatering area and the remaining 1.70-acre area for access. The site is part of a 300+-acre parcel owned by Norfolk and Southern, which supports and is willing to provide the site for the Project. The required Project interest is a standard Temporary Work Area Easement for a five-year term. The Site is shown on Exhibit "A". As part of the LERRD acquisition, a site survey will be made to establish the exact boundary.

2.1.1.1. The transfer/dewatering area of Site One is needed to transfer dredged material from barges to trucks for transportation to a permanent disposal site. The transfer area is located at Ashtabula River station 170+00. The west boundary of the area where the transfer of material from barges to upland will take place is a common boundary with the dredged portion of the Project and transfer area. In the past the area was used for material handling and storage. The area is zoned Industrial-Heavy Manufacturing which is adequate for the intended Project. A Phase I and II HTRW investigation will be completed for the area before the Non-Federal sponsor is notified to proceed with acquisition. There are no active rail lines in the area. No facility and/or utility relocation and no relocation of persons or businesses are required for the Project. The Non-Federal sponsor has the right of eminent domain. There are no cemeteries located within the area. Ohio State Historical Preservation Office made a determination of no adverse effect and has indicted there will be no need for further studies or investigation.

2.1.1.2. The access area of Site One is a road used by Norfolk and Southern and a local marina. The road runs from Route 531 to the above referenced transfer area. In 1959 the marina entered into a 99-year non-exclusive lease to use the road. Trucks transferring sediment and marina customers will be using the road at the same time. It is anticipated on-site traffic control will be necessary. In addition the use of the road for Project purposes does not require any crossing of railroad tracks. The area is zoned Industrial-Heavy which is adequate for the intended Project. A Phase I and II HTRW investigation will be completed for the area before the Non-Federal sponsor is notified to proceed with site acquisition. No facility and/or utility relocation and no relocation of persons or businesses will be required. The Non-Federal sponsor has the right of eminent domain. There are no cemeteries located within the area. Ohio State Historical Preservation Office made a determination of no adverse effect and has indicated there will be no need for further studies or investigations.

2.1.2. Site Two is 18.16 acres to be used as the non-Toxic Substances Control Act (TSCA) dredged material disposal facility. It is part of a larger 31.147-acre parcel owned in fee simple by State Road Industrial Development, LLC who supports and is willing to provide the site for the Project. The required Project interest is Fee Simple.

2.1.2.1. In the past, the site was owned and used by RMI Titanium Company for processing sodium metal to be used for industrial purposes. The processing plant has been closed for years and a number of the buildings where processing occurred have been demolished. In 2000, the site was sold to State Road Industrial Development, LLC. The site currently is vacant. The site is located approximately three miles northeast of the transfer site on State Road; 1,000' south of Lake Road and 700' north of the Norfolk and Southern tracts. The site is fairly level and zoned Industrial-Heavy Manufacturing which is adequate for the intended Project. An environmental assessment revealed elevated levels of contamination in shallow ground water, however US EPA determined remediation is not necessary. The US EPA and Ohio EPA have monitoring wells at the site. A Phase I and II HTRW investigation has been performed on the site. Barium and cadmium were discovered in the soil and ground water. Before the site will be acquired contaminants will have to be removed to industrial standards. There is a further discussion of contaminants in Appendix N-1 no facility and/or utility relocations and no relocation of persons or businesses are required for the Project. The Non-Federal Sponsor does not have the right of eminent domain over the site, because in is not within its boundary. The Federal Government, if required, will have to do the eminent domain acquisition. There are no cemeteries located within the area. Ohio State Historical Preservation Office made a determination of no adverse effect and has indicated there will be no need for further studies or investigations. The site is shown on Exhibit "B". As part of the LERRD acquisition a site survey will be made to establish the exact boundary.

2.1.3. Site Three is a 1.1-acre site to be used for a temporary work area. The Site is adjacent to the Projects Non-TSCA disposal facility and land owned by Di Maximus Inc. The 1.1-acre site is part of the 31.147-acre parcel previously identified. The required Project interest is a standard Temporary Work Area Easement for a five-year term.

2.1.3.1. The temporary work area is located west of site two and east of State Road. The site is zoned Industrial-Heavy Manufacturing which is adequate for the intended Project. An environmental assessment revealed elevated levels of contamination in shallow ground water, however US EPA determined remediation is not necessary. The US EPA and Ohio EPA have monitoring wells at the site. A Phase I and II HTRW investigation has been performed at the site. Barium and cadmium were discovered in the soil and ground water. Before the site will be acquired contaminants will have to be removed to industrial standards. There is a further discussion of contaminants in Appendix N-1. No facility and/or utility relocations and no relocation of persons or businesses are required. The Non-Federal sponsor does not have the right of eminent domain over the site, because the site is not within its boundary. The Federal Government, if required, will have to do the eminent domain acquisition. There are no cemeteries within the area. Ohio State Historical Preservation Office made a determination of no adverse effect and has indicated there will be no need for further studies or investigations. The site is shown on Exhibit "B". As part of the LERRD acquisition a site survey will be made to establish the exact boundary.

2.1.4. Site Four is a 0.6-acre site to be used as a permanent access road to the dredged material disposal facility. The 0.6-acre site is part of the 31.147-acre parcel previously identified as owned by State Road Industrial Development, LLC. The required Project interest is a standard Perpetual Road Easement.

2.1.4.1. The access road is located east of and between State Road and the non-TSCA dredged material disposal facility. The 40' wide road runs 650' west from State Road to the non-TSCA dredge material disposal facility. The site is zoned Industrial-Heavy Manufacturing which is adequate for the intended Project. An environmental assessment revealed elevated levels of contamination in shallow ground water, however US EPA determined remediation is not necessary. US EPA and Ohio EPA have monitoring wells at the site. A Phase I and II HTRW investigation has been performed at the site. Barium and cadmium were discovered in the soil and ground water. Before the site will be acquired contaminants will have to be removed to industrial standards. There is a further discussion of contaminants in Appendix N-1. No facility and/or utility relocations and no relocation of persons or businesses are required. The Non-Federal sponsor does not have the right of eminent domain over the site, because the site is not within its boundary. The Federal Government, if required, will have to do the eminent domain acquisitions. There are no cemeteries located within the area. Ohio State Historical Preservation Office made a determination of no adverse effect and has indicated there will be no need of further studies or investigations. The site is shown in Exhibit "B". As part of the LERRD acquisition a site survey will be made to establish the exact boundary.

2.1.5. Site five is a 2.6 acres site to be used for the TSCA dredged material disposal facility. It is part of a larger 16.143-acre parcel owned in Fee Simple by Di Maximus Inc., which acquired the land from RMI Titanium. Di Maximus Inc. supports and is willing to provide the site for the Project. The required Project interest is Fee Simple.

2.1.5.1. The site is located directly south of the above mentioned 18.16-acre non-TSCA site, directly east of a Super Fund Site, approximately 700' east of State Road and approximately 500' north of a Norfolk and Southern line. The zoning is Industrial-Heavy Manufacturing, which is adequate for the intended Project. An environmental assessment revealed elevated levels of contamination in shallow ground water, however US EPA determined remediation is not necessary. US EPA and Ohio EPA have monitoring wells at the site. A Phase I and II HTRW investigation has been performed on the site. Barium and cadmium were discovered in the soil and ground water. Before the site can be acquired all contaminants will have to be removed to industrial standards. There is a further discussion of contaminants in Appendix N-1. No facility and/or utility relocations and no relocation of persons or businesses are required. The Non-Federal sponsor does not have the right of eminent domain over the land, because the site is not within its boundary. The Federal Government, if required, will have to do the eminent domain acquisition. There are no cemeteries located within the site. Ohio State Historical Preservation Office made a determination of no adverse effect and has indicated there will be no need for further studies or investigations. The site is shown in Exhibit "C". As part of the LERRD acquisition a site survey will be made to establish the exact boundary.

2.1.6. Site Six is a 10.39-acre area to be used as a Temporary Work Area. It is part of the 16.432-acre parcel previously discussed. The required Project estate is a standard Temporary Work Area Easement for a five-year term.

2.1.6.1. The site is located directly south of the non-TSCA site. The site goes three-fourths of the way around the TSCA site and is bordered on the south by a Norfolk and Southern main line, on the west by State Street, on the north by State Road Industrial Development LLC property, TSCA and Super fund site. The site is zoned Industrial-Heavy Manufacturing which is adequate for the intended Project. An environmental assessment revealed elevated levels of contamination in shallow ground water, however US EPA determined remediation is not necessary. US EPA and Ohio EPA have monitoring wells at the site. A Phase I and II HTRW investigation has been performed at the site. Barium and cadmium were discovered in the soil and ground water. Before the site will be acquired contaminants will have to be removed to industrial standards. There is a further discussion of contaminants in Appendix N-1. No facility and/or utility relocation and no relocation of persons or businesses are required. The Non-Federal sponsor does not have the right of eminent domain over the land, because the site is not within its boundary. The Federal Government, if required, will have to do the eminent domain acquisition. There are no cemeteries located within the site. Ohio State Historical Preservation Office made a determination of no adverse effect and has indicated there will be no need for further studies or investigations. The site is shown on Exhibit "C". As part of the LERRD acquisition a site survey will be made to establish the exact boundary.

2.1.7. Site Seven is a 0.90-acre site off State Road to be used as a permanent access road to Site Five, TSCA site. It is part of the larger 16.143-acre parcel previously discussed. The required Project interest is a Perpetual Road Easement.

2.1.7.1. The Site starts at Di Maximus north property line and State Road Industrial Development LLC south property line and runs parallel to State Road 460' and then east 1235' to Site Six. The north side site is first bounded by part of the Project's work area and next to a Super Fund Site. The south side is first bounded by part of the Project's work area and then a closed landfill. The Site is level and zoned Industrial-Heavy Manufacturing, which is adequate for the intended Project. An environmental assessment revealed elevated levels of contamination in shallow ground water, however US EPA determined remediation is not necessary. US EPA and Ohio EPA have monitoring wells at the site. A Phase I and II HTRW investigation has been performed on the site. Barium and cadmium were discovered in the soil and ground water. Before the site will be acquired contaminants will have to be removed to industrial standards. There is further discussion of contaminants in Appendix N-1. No facility and/or utility relocation and no relocation of persons or business are required. The non-Federal sponsor does not have the right of eminent domain over the site, because the site is not within its boundary. The Federal Government will have to do, if necessary, the eminent domain acquisition. There are no cemeteries located within the site. Ohio State Historical Preservation Office made a determination of no adverse effect and has indicated there will be no need for further studies or investigations. The site is shown on Exhibit "C". As part of the LERRD acquisition a site survey will be made to establish the exact boundary.

2.1.8. There is no mineral activity on lands to be acquired for the project. The mineral rights are, believed to be, owned by the surface owners. If it is determined that minerals are severed they will be acquired on sites where fee simple is required and subordinated on sites where a temporary interest is required.

2.1.9. Neither the Non-Federal sponsor nor the Federal Government owns the land required for the project.

2.1,10. None of the upland required for the project lies within a previous Federal project.

2.1.11. From the mouth of the Ashtabula River for a distance of 1.7 miles, navigational servitude applies on the river bottom from bank to bank. This is the area where for navigation purposes approximately 696,000 cubic yards of material will be dredged.

2.2. The authorities for the Project have different cost sharing requirements. Section 312 (a) and the Rivers and Harbor Act of 1937 provide that 100% of the dredging cost of the Federal channel and adjacent acreage is the responsibility of the federal Government. Section 312 (b) requires a 50/50 cost sharing between the Non-Federal sponsor and the Federal Government for environment dredging of contaminates from navigable waters. Section 312 requires the Non-Federal sponsor to pay 100% of the cost for construction; operation and maintenance of the facility including all cost associated with LERRD's. The cost sharing for construction of the disposal facilities for operation and maintenance has been modified by Section 101 (a) of WRDA of 1986, as amended by Section 201 of WRDA 1996. These facilities are considered general navigation features which, in the case of Ashtabula Harbor require the Non-Federal sponsor to make a contribution of 10% of the cost of the facility plus an additional 10% contribution which can be off set by the value of the LERRD's.

2.2.1. Gross Appraisals were performed to establish the fair market value of the Project easements. Total Real Estate cost including Federal associated cost, LERRD value, and Non-Federal sponsor associated cost is estimated at $350,000.00. The Project authority is Section 312 (a) and (b) of WRDA 1990, as amended and Section 101 Of WRDA 1986, as amended. The authority provides that Project cost can be offset by the LERRDs values and Non-Federal sponsors associated cost. Crediting procedures have been discussed with the Non-Federal sponsor.

2.2.2. The Ashtabula City Port Authority has full power, authority, and capability to operate and maintain part one of the project, and has the legal capability to provide its share of the total project cost necessary for construction, operation, and maintenance. The Non-Federal sponsor is willing to provide all required lands, easements, rights-of-way, and disposal sites necessary for construction, operation, and maintenance of the project. The Non-Federal sponsor is a legally constituted public body with the full power, authority and capability to perform the terms of the Project Cooperation Agreement. They have the right of eminent domain, excepted as noted above. Acquisition policies and procedures, LERRD crediting procedures and the requirements for land acquisition have been discussed with the Ashtabula City Port Authority.

2.3. The Non-Federal sponsor has a limited staff with minimal expertise in real estate acquisition. It recognizes this limitation and has committed to retaining the necessary outside expertise to acquire the LERRD's needed for the project. The sponsor does not expect to request real estate assistance from the Corps.

2.4. A detailed acquisition schedule will be prepared with the Ashtabula City Port Authority.

3. REAL ESTATE DUTIES, MANAGEMENT PLANS, AND RESPONSIBILITIES.

The Detroit District Real Estate Division will advise and monitor all real estate acquisition activities undertaken by the non-Federal sponsors and will assure that the acquisition process is conducted in compliance with Federal and state laws, specifically, the requirements under the Federal Uniform Relocation and Acquisition Act (P.L. 91-646)

December 21, 2000
Rev. March 21 2001

December 20, 2000

The minimum real estate interest, which the Non-Federal Sponsor must acquire to support the construction and maintenance of the Ashtabula River Partnership Project.

Standard Estate

FEE SIMPLE

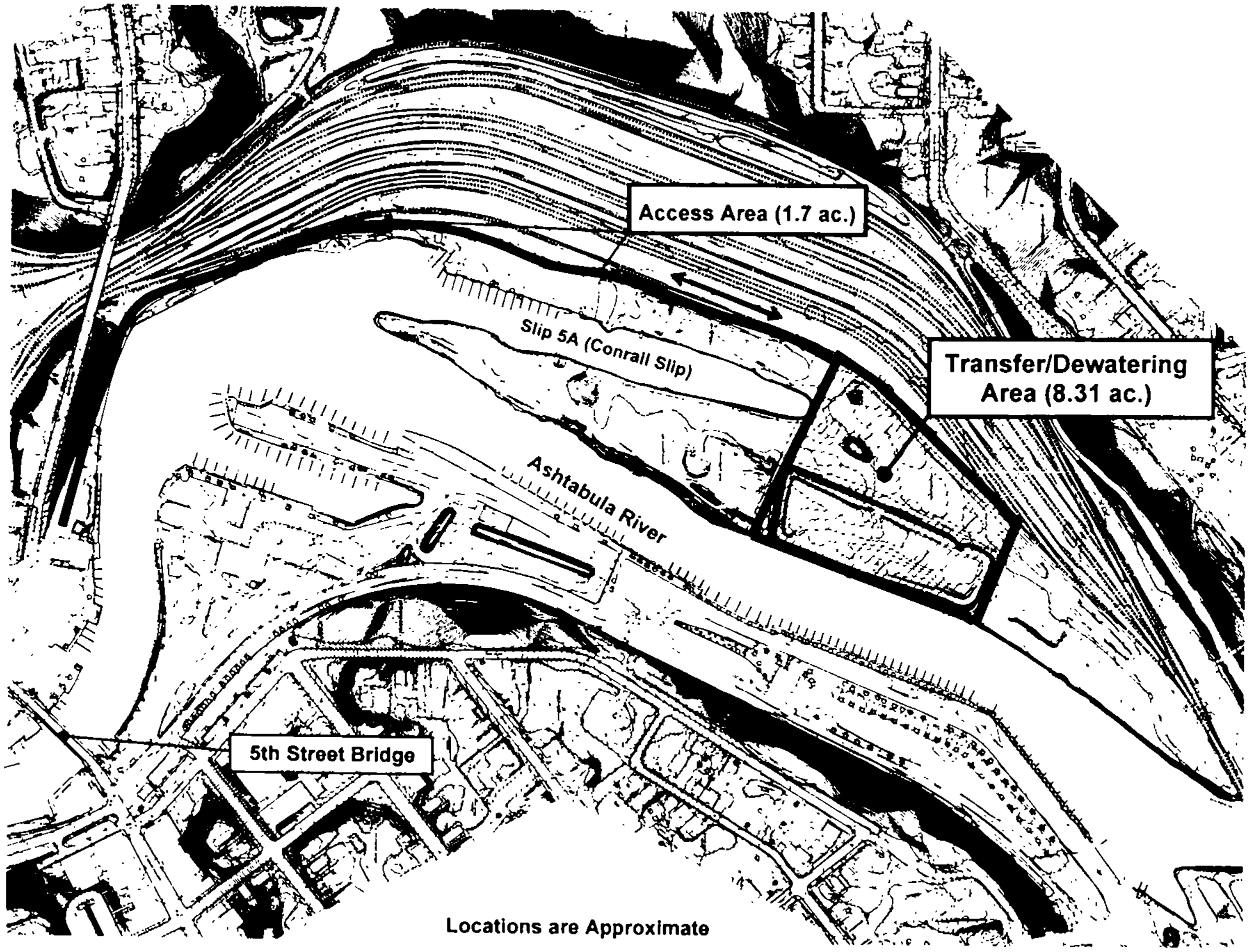
The fee simple title to Tracts Nos. ____, ____ and ____, subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

TEMPORARY WORK AREA EASEMENT

A temporary easement and right-of-way in, on, over and across Tracts Nos. ____, ____ and ____, for a period not to exceed five (5) years, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a work area, including the right to deposit fill, spoil and waste material thereon, move, store and remove equipment and supplies and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Ashtabula River Partnership Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easements hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

ROAD EASEMENT

A perpetual and assignable easement and right-of-way in, on, over and across Tracts Nos. ___, ___ and ___ for the location, construction, operation, maintenance, alteration replacement of a road and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B; and subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.



Locations are Approximate

Map Not To Scale

: Transfer/Dewatering Area

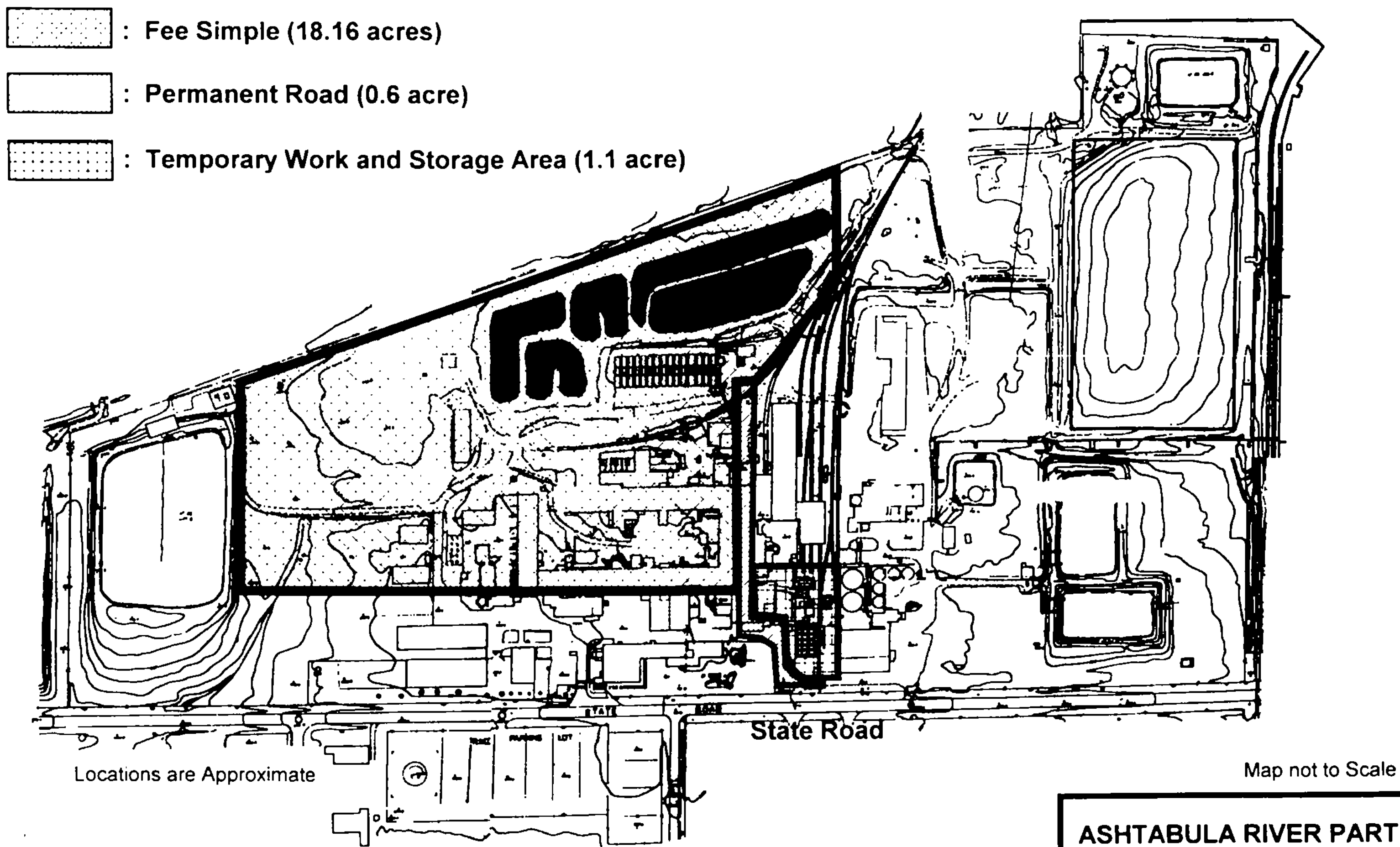
: Access Area

Temporary Work and Storage Area: 10.01 acres

ASHTABULA RIVER PARTNERSHIP
ASHTABULA, OHIO

EXHIBIT A

TRANSFER/DEWATERING COMPONENT



ASHTABULA RIVER PARTNERSHIP

ASHTABULA, OHIO

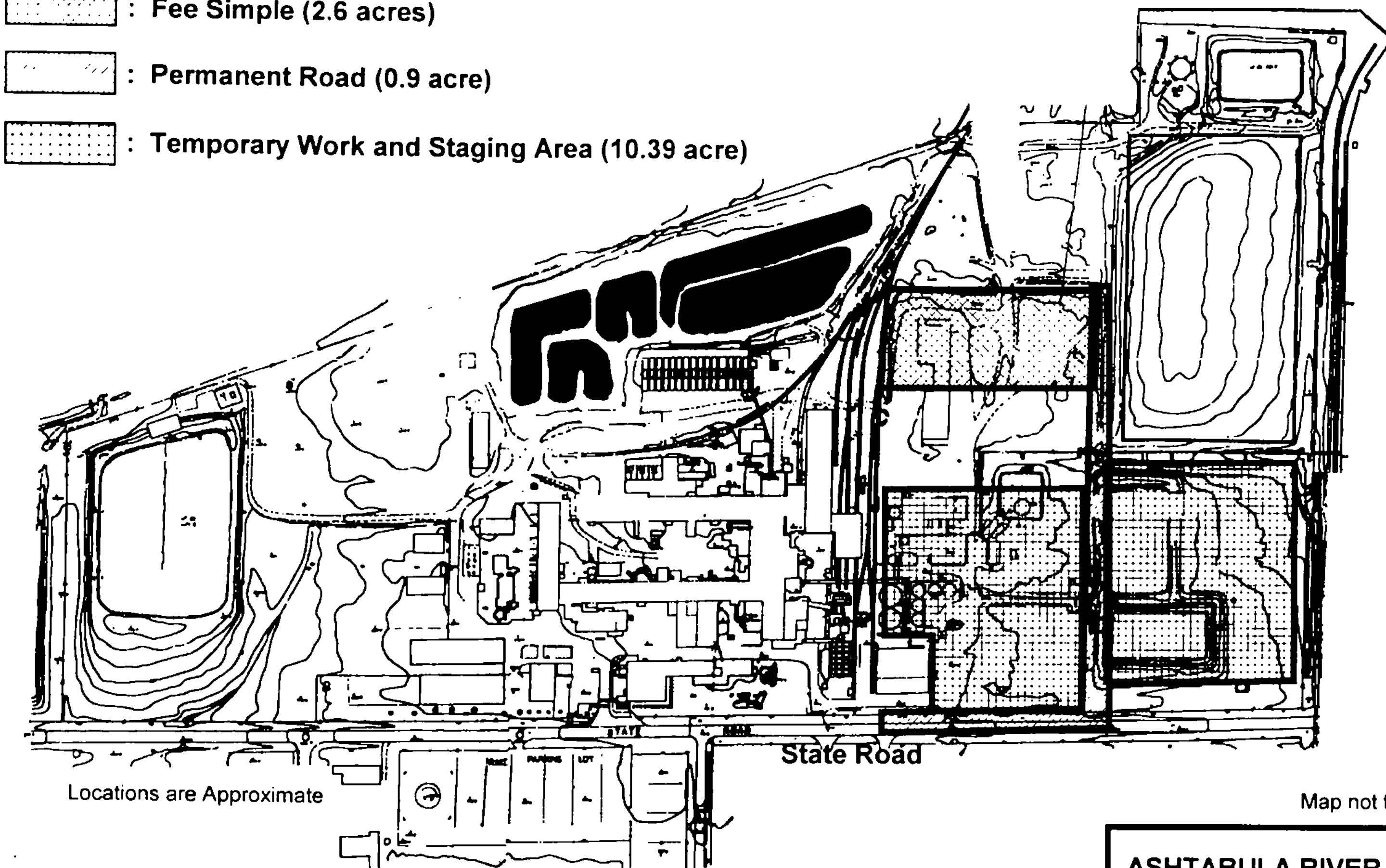
EXHIBIT B

Disposal Facility Component

: Fee Simple (2.6 acres)

: Permanent Road (0.9 acre)

: Temporary Work and Staging Area (10.39 acre)



Locations are Approximate

Map not to Scale

ASHTABULA RIVER PARTNERSHIP

ASHTABULA, OHIO

EXHIBIT C

Disposal Facility Component

ESTIMATED REAL ESTATE COST — DECEMBER 7, 2000
ASHTABULE RIVER PARTMERSHIP
ASHTABULA, OHIO

ESTIMATED COST

Non-Federal Sponsor		
LERRDs	$ 208,400.00	
LERRD Contingencies 25%	52,100.00	
Administration	55,000.00	
TOTAL		$ 315,500.00
Federal Government's Cost		
Administration	$ 24,500.00	
Reviewing	5,000.00	
Approving/Coordinating	5,000.00	
TOTAL		34,500.00
TOTAL ESTIMATED COST		$350,000.00

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX U

COST SHARING AND NON-FEDERAL RESPONSIBILITIES

PREPARED BY:

U.S. Army Corps of Engineers, Buffalo District
December 2000

1. Non-Federal Sponsor Requirements and Local Cooperation

1.1. Project Sponsor.

Section 221 of the River and Harbor and Flood Control Act of 1970 (P.L. 91-611), as amended by Section 912, Agreements, of the Water Resources Development Act 1986 (WRDA '86) requires that a written agreement be executed between the Secretary of the Army and local interests prior to commencement of construction. The project's local sponsor will be required to furnish the assurances required for projects of this nature including the non-Federal cash contribution and is also responsible for acquiring all lands, easements, rights-of-way, relocations and dike disposal areas (LERRD's), and for accomplishing non-Federal construction.

The Ashtabula River Partnership's Resources Committee was tasked with developing a methodology for project funding, identifying funding sources and mechanisms to obtain/generate funds, and to identify the non-Federal sponsor. The Partnership worked with Federal, State, and local agencies to assess cost-sharing responsibilities, for both project construction/implementation and for post-construction monitoring and operations and maintenance, and relate this information to potential non-Federal sponsors.

The Ashtabula City Port Authority (ACPA) unanimously endorsed their willingness to serve as the Non-Federal Sponsor on November 1, 2000. The Ashtabula City Port Authority provided a letter of intent, dated November 2, 2000, to serve as the Non-Federal Sponsor.

1.2. Real Estate.

Real Estate requirements for the Ashtabula River Remediation Plan will require both permanent and temporary construction easements and fee simple ownership of the landfill facility/area, by the local sponsor. A permanent easement will be required for access to the State Road landfill disposal areas. Temporary work and staging easements are required for the contractor's offices, land plant, storage of construction materials, and equipment operation. The Contractor will gain access/egress to the landfill areas from State Road.

Temporary easements will be required for construction/operation of the sediment dewatering/transfer facility and staging areas for the Contractor's offices, dockage for his marine plant, and storage of construction materials. Access and egress to the dewatering and transfer facility will be from State Route 531.

1.3. Responsibilities.

The non-Federal sponsor must be a public entity that has the financial and technical capabilities to coordinate local project activities. The Ashtabula City Port Authority letter states that they have the capabilities, under Ohio State statute, to fulfill the responsibilities of the Non-Federal Sponsor. The Port Authority will act as the single point of contact for the USACE and undertake the non-Federal responsibilities.

Prior to initiation of construction, the Ashtabula City Port Authority, which is legally empowered and financially capable under state law, would be required to enter into a Project Cooperation Agreement (PCA) with the Secretary of the Army, in accordance with the provisions of Section 221 of the River and Harbor and Flood Control Act of 1970, as amended, to provide the following items of local cooperation.

a. The Corps of Engineers is authorized to remove, as part of O&M of a navigation project, contaminated sediments outside of and adjacent to the boundaries of the navigation channel. The non-Federal Sponsor must provide the non-Federal share of total project costs, for navigation channel operations and maintenance, including disposal facilities, allocated to navigation under Section 312(a) of WRDA 1990, as amended, and Section 101, WRDA 1986, as amended, as part of the operation and maintenance of the project, as further provided below:

(1) Dredging and transportation costs allocated to these authorities are 100 percent Federal. Disposal facility costs allocated to these authorities shall be cost shared in accordance with Section 101, Title I - Cost Sharing, WRDA 1986, as amended;

(2) Provide, during the first year of construction, any additional funds needed to cover the non-Federal share of design costs;

(3) In accordance with Section 101(a) WRDA 1986, as amended, provide, during the period of construction, a cash contribution equal to 10 percent of the total cost of construction of the general navigation features (which include the construction of land-based and aquatic dredged material disposal facilities that are necessary for the disposal of dredged material required for project construction, operation, or maintenance and for which a contract for the federal facility's construction or improvement was not awarded on or before October 12, 1996);

(4) Pay with interest, over a period not to exceed 30 years following completion of the period of construction of the project, up to an additional 10 percent of the total cost of construction of general navigation features. The value of lands, easements, rights-of-way, and relocations provided by the non-Federal sponsor for the general navigation features, described below, may be credited toward this required payment. If the amount of credit exceeds 10 percent of the total cost of construction of the general navigation features, the non-Federal sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of lands, easements, rights-of-way, and relocations in excess of 10 percent of the total cost of construction of the general navigation features; and

(5) The Federal share of the costs of Federal navigation channel operation and maintenance, including operations and maintenance of the disposal facility shall be determined in accordance with Section 101(b), WRDA 1986, as amended. Under Section 101(b), the Federal share is 100 percent of the operation and maintenance costs for the disposal facility.

b. The Corps of Engineers is authorized to remove contaminated sediments from navigable waters for the purpose of environmental enhancement and water quality improvements. The non-Federal Sponsor must provide 35 percent of the separable project costs allocated to environmental dredging under Section 312(b), Environmental Dredging, Nonproject Specific, of WRDA 1990, as amended by Section 205 Environmental Dredging of WRDA 1996 and Section 224, Environmental Dredging, WRDA 1999, for the purpose of environmental enhancement and water quality, as further specified below:

(1) Enter into a Design Agreement (DA) providing 25 percent of design costs prior to execution of a project cooperation agreement (PCA) for the project;

(2) Provide, during construction, any additional funds needed to cover the non-Federal share of design costs;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, fish and wildlife mitigation associated with the disposal area, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;

(4) Provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, excavation of subaqueous pits, capping/liner requirements, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

(5) Provide, during construction, any additional costs as necessary to make its total contribution equal to 35 percent of the separable project costs allocated to environmental dredging under Section 312 (b) of WRDA 1990, as amended.

c. Provide all lands, easements, and rights-of-way, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features (including all lands, easements, and rights-of-way, and relocations necessary for dredged material disposal facilities and the transfer and dewatering facility).

d. Accomplish all removals determined necessary by the Federal Government other than those removals specifically assigned to the Federal Government.

e. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the general navigation features for the purpose of inspection, and, if necessary, for the purpose of operating, maintaining, repairing, replacing, and rehabilitating the general navigation features.

f. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project, any betterments, and the local service facilities, except for damages due to the fault or negligence of the United States or its contractors.

g. Keep, and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total cost of construction of the general navigation features, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and local governments at 32 CFR, Section 33.20.

h. Perform, or cause to be performed, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, maintenance, repair, replacement, or rehabilitation of the general navigation features. However, for lands that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigation unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction.

i. Assume complete financial responsibility, as between the Federal Government and the non-Federal sponsor, for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features.

j. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA.

k. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987, and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

l. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

m. Provide a cash contribution equal to the non-Federal cost share of the project's total historic preservation mitigation and data recovery costs attributable to commercial navigation that are in excess of 1 percent of the total amount authorized to be appropriated for commercial navigation.

n. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

1.4. Cost-Sharing Breakdown of Components.

Cost-sharing is dependent on guidance and cost-sharing policies developed based on WRDAs of 1986, 1990, 1996, and 1999. Cost-sharing is also impacted by the classification and volume of sediments regulated by the Toxic Substance Control Act (TSCA) and volumes associated with Environmental Dredging Section 312(a) - contaminated sediments outside of and adjacent to the Federal navigation channel; Section 312(b) - removal of contaminated sediments from navigable waters; and Section 101(b) - O&M dredging of Federal channels.

1.5. Financial Viability of the Non-Federal Sponsor

The Ashtabula River Partnership (ARP) successfully developed Federal, State, local, and private resources to fund ARP activities leading up to the design and construction phases of the project. This multi-party cooperative effort has laid a foundation upon which to structure and obtain the federal and non-federal cost shares. Because the project is designed to satisfy multiple goals, such as regulatory compliance, navigation, and environmental remediation, development of the non-federal cost share is unique and complex.

The Ashtabula City Port Authority identified itself as the non-Federal sponsor, in a letter dated November 2, 2000, for the environmental dredging project and Design Phase. Funding for the project construction phase will be obtained from multiple sources under an integrated financial package, pending the resolution of complex legal and financial issues during the design phase. The ARP emphasized that the full financial participation of the multi-party cooperative effort is expected at the time that the Project Cooperation Agreement (PCA) is executed.

1.5.1. Letters of Intent

The ARP organized an exchange of letters of intent among the parties of interest to demonstrate the financial viability of the non-Federal sponsor. Assumed liability under CERCLA and Natural Resource Damage Assessment (NRDA) authority binds the regulators and the regulated parties interest in moving towards successful implementation of the project.

The ARP requested that Federal and state regulators provide letters of intent confirming that the remedial dredging plan satisfies regulatory concerns and ultimately serves to resolve and limit liability for the Ashtabula River Cooperation Group (ARCG). This action is contingent upon private interests funding a significant portion of the non-federal cost share on a voluntary basis.

Resolving federal Superfund (CERCLA) and NRDA liability has a value to the regulated parties that is intended to motivate a financially significant voluntary contribution.

Letters of intent were obtained from the Ohio Environmental Protection Agency (OEPA), the United States Environmental Protection Agency (US EPA) and the United States Fish and Wildlife Service (USFWS). The OEPA and USFWS serve as Natural Resource Damage Assessment Trustees. The letters are included in this appendix.

An RMI Titanium Company letter, dated September 19, 1997, presenting the ARCG intent to fund a significant portion of the project. The ARCG consists of fifteen Potentially Responsible Parties (PRP). The letter is included in this appendix.

Additional financial support from the State of Ohio was committed in a letter from the Ohio EPA, dated September 16, 1997, confirming a contribution of $7 million in State funding to the non-federal sponsor. The State of Ohio has also provided financial expertise from the State Ohio Water Development Authority (OWDA) to assist, and serve on, the ARP Resource Committee which will lead to successful financing of the project.

1.6 ARP Role

The ARP actions over the past six years have demonstrated the viability of a cooperative approach that will result in the accomplishment of multiple Federal, state, and local environmental and navigation missions while reducing overall time and costs for all participants. Most significantly, the ARP coordinated all state and Federal regulators, and met project milestones on schedule, including river characterization, site selection for a disposal facility, and development of the Comprehensive Management Plan (CMP). ARP motivation is intense due to a potential for closure of the Port of Ashtabula and the dire economic consequences of such an action on the community and local region.

The driving principal of the ARP is the development of a citizen-driven cooperative and voluntary approach to accomplish timely remediation of contaminated sediments in the Ashtabula River and Harbor. Two potential Federal actions impacted upon the direction of the Partnership's actions:

(1) the potential extension of the Fields Brook Superfund Site to include a Superfund designation for the Federal Navigation Channel and Outer Harbor downstream of Fields Brook, creating additional financial liability and uncertainty; and

(2) the discontinuance of Operations and Maintenance (O&M) dredging by the U. S. Army Corps of Engineers (USACE) due to the presence of contaminated sediments unsuitable for open-lake disposal and the lack of a Confined Disposal Facility for sediment containment.

The ARP recognized the linkage and impacts of upstream sources of contamination (historically contaminated sediments) and the prohibition of open-lake disposal of navigation channel dredge sediments. In 1994, the ARP, working with USACE, identified the Federal navigation interest that could impact future O&M costs due to contaminated sediments upstream in the Federal navigation channel. The discussions pursuant to the Federal navigation channel resulted in budgeting Federal funds for the Ashtabula River Comprehensive Management Plan, which is a feasibility study of alternative remedial action plans under ARP guidance. Open-lake disposal of future dredged sediments from the Federal navigation channel is a primary goal of the ARP and is a critical project goal justifying Federal participation based on future O&M dredging cost savings.

Tasks leading to submittal of the CMP/EIS were funded by a unique mix of Federal and state authorities with other financial commitments, totaling over $2 million. Funds were made available for the development of the CMP/EIS, establishment of a Partnership Office and employment of a Project Coordinator, and local resources/personnel being committed to the development of the study. Development of the Partnership's Comprehensive Management Plan (CMP) identified and coordinated all tasks required prior to detailed design and construction of the disposal facilities. Critical tasks included additional river testing, site selection for the sediment disposal facility, preparation of the Environmental Impact Statement, ecological and human health risk assessments, ecological restoration justification, community outreach and determination of a cost-sharing formula among Federal and non-Federal parties for facility construction and sediment removal. The USACE participated in this effort by dedicating O&M funding and the first-time use of the WRDA '90 Section 401 authority, cost-shared by the State of Ohio and the Support for Others (SFO) program funding from USEPA.

To continue with the project and proceed with Phase II, i.e., Pre-construction, Engineering and Design (PED), the Ashtabula City Port Authority provided a Letter of Intent, dated November 2, 2000, to serve as the non-Federal Sponsor. The Port Authority is a quasi-City government entity with all of the authority, capability and responsibility to provide the required items of local cooperation, cost-sharing funds and to accept the non-Federal project liabilities.

1.7 Justification of Cost Share Formula

The basis for development of the cost-sharing formula is Federal law and associated Congressional guidance as reflected in the WRDAs of 1986, 1990, 1996 and 1999. The project was divided into two segments (upstream and downstream of the 5th Street Bridge) that are further characterized by applicable Federal authorities and sediment volume, yielding cost percentages assigned to the Federal and non-Federal project sponsor. Segment I is defined as downstream or north of the 5th Street Bridge to Station 120 + 00. Segment I, a portion of the Ashtabula River, has been regularly maintained as a Federal navigation channel. Segment II is defined as upstream or south of the 5th Street Bridge, past the Upper Turning Basin to the upper limit of the authorized Federal channel. The ARP's comprehensive plan's features address aquatic ecosystem restoration (fishery shelves and habitat restoration) that may addressed as an independent project under Section 206. Aquatic Ecosystem Restoration, WRDA 1996.

1.7.1 Ashtabula River - Segment I

a. Sediment within the Federal navigation channel in Segment 1 will be removed to project depth (-18' LWD) at 100 percent Federal cost under general navigation O&M authorities previously presented in Section 1.3. The disposal facility will be cost-shared pursuant to Section 101(a) WRDA 1986, as amended by Section 201, WRDA 1996: the non-Federal sponsor will, during construction, pay 10 percent of the cost of the disposal facility for this segment of the work. The non-Federal sponsor will also be required to pay an additional 10 percent of the cost of the disposal facility over a period not to exceed 30 years but with the value of LERRs credited against this additional 10 percent. The non-Federal sponsor will also provide the lands, easements, rights-of-way and relocations (LERRs) necessary for construction of the disposal facility and subsequent O&M.

b. Contaminated sediment outside the boundary of the navigation channel is considered to impact regular operation and maintenance of the Federal navigation channel and will be removed at 100 percent Federal cost, per Section 312(a) WRDA 1990, as amended by Section 205 WRDA1996 and Section 224, WRDA 1999. Disposal will be in accordance with Section 101(a) WRDA 1986, as amended by Section 201, Cost Sharing For Dredged Material Disposal Areas, WRDA 1996 as discussed above.

1.7.2 Ashtabula River - Segment II

a. All contaminated sediment upstream of the 5th Street Bridge will be removed under Section 312(b) WRDA'90, as amended by Section 205 WRDA'96 and Section 224, WRDA '99, at 65 percent Federal and 35 percent non-Federal share of the costs of removal and remediation. The Disposal facility will also be cost shared 65 percent Federal and 35 percent non-Federal. The non-Federal sponsor will provide all lands, easements, rights-of-way, and relocations (LERRs) necessary for construction of the disposal facility and subsequent O&M. The value of LERRs is credited towards the 35 percent non-Federal share.

b. All of the above environmental actions have been evaluated and are economically justified as a result of the ecological restoration justification, presented in the CMP/EIS, for the purpose of environmental enhancement and water quality improvement in accordance with Section 312(b) of WRDA '90.

c. Additionally, the Partnership notes that Section 205(3), Environmental Dredging, of WRDA'96 states that the Secretary of the Army shall give priority in carrying out Section 205 work to five localities, including the Ashtabula River, Ohio.

1.7.3 Aquatic Ecosystem Restoration

Based upon the legal sufficiency review of overall project features, scope and purpose, it was determined that the aquatic ecosystem features presented in the ecological restoration justification analysis are properly addressed as an independent project under Section 206, Aquatic Ecosystem Restoration, WRDA '96, authority. Section 312, WRDA 1990, as amended, and O&M General Authorities address dredging, dewatering, and disposal of contaminated sediments but not the implementation of ecosystem restoration features.

A non-Federal sponsor is required for the fish habitat improvements under Section 206, Aquatic Ecosystem Restoration, WRDA 1996. A Section 206 project will be developed separately under this authority, presuming a non-Federal Sponsor and Federal and non-Federal funding are in place, and will examine all aspects including all costs, outputs and justification. Study findings will be presented in a Section 206, Aquatic Ecosystem Restoration Report which will establish cost sharing, non-Federal responsibilities and all necessary LERRD's. The project would be implemented after completion of the environmental dredging project work.

The aquatic ecosystem restoration features, including LERRDs, will be cost shared 65 percent Federal and 35 percent non-Federal under Section 206(b), WRDA 1996. The fishery shelves and habitat restoration project features would be constructed following completion of the ARP's environmental dredging project and execution of an appropriate PCA with a non-Federal sponsor. Monitoring and project maintenance plans associated with aquatic ecosystem restoration are a non-Federal responsibility.

1.7.4 Environmental Dredging Project Cost Share Breakdown by Components

Cost-sharing, in accordance with the several authorities, is dependent on Corps of Engineers policy guidance. Cost sharing is allocated by classification and volume of sediments associated with environmental dredging of contaminated sediments outside of the Federal channel below the 5th Street Bridge or all dredging above the 5th Street Bridge, and volumes of sediments associated with commercial navigation. An assessment and breakdown of project features and the associated Federal and non-Federal share of project costs based on sediment classification and volumes is presented in Table U-1.

Segment I - O&M dredging costs, estimated as $2,299,000, downstream of the 5th Street Bridge are 100 percent Federal,. Disposal costs are 80 percent Federal $1,538,000 and 20 percent non-Federal (with credit for LERRs) $384,000. Dredging costs under Section 312(a) outside of, and adjacent to, the channel are100 percent Federal $1,952,000. Disposal costs for Section 312(a) are 80 percent Federal, $1,306,000, and 20 percent non-Federal $326,000.

Segment II - Environmental dredging upstream of the 5th Street Bridge is cost-shared 65 percent Federal, $13,961,000, and 35 percent non-Federal, $7,517,000. Disposal costs under Section 312(b) for both TSCA and non-TSCA sediments are 35 percent non-Federal, $1,623,000 and $4,663,000 respectively. Disposal costs under Section 312(b) for both TSCA and non-TSCA sediments are 65 percent Federal, $3,014,000 and $8,659,000, respectively. In addition and upon completion of the environmental dredging, the non-Federal Sponsor will be responsible for 91 percent and the Federal Government 9 percent of the OMRR&R, including monitoring for the disposal facility.

Table U -1 Breakdown of Federal and Non-Federal Cost Sharing of Project Features

PROJECT FEATURES	FEDERAL	NON-FEDERAL
DREDGING 1		
O&M Dredging downstream of the 5th Street Bridge; total of 62,200 CY Non-TSCA	$ 2.229,000	$ 0
312(a) Dredging downstream of the 5th Street Bridge; total of 52,800 CY Non-TSCA	$ 1,952,000	$ 0
312(b) Dredging upstream of the 5th Street Bridge; total of 581,000 CY of TSCA and Non-TSCA sediments	$ 13,961.000	$ 7,517,000
SUBTOTAL	$ 18,212.00	$ 7,517.000
DISPOSAL		
O&M disposal of 62,200 CY of Non-TSCA sediments (Section 101, WRDA 86)	$ 1,538,000	$ 384,000
312(a) disposal of 52,800 CY of Non-TSCA sediments	$ 1,306,000	$ 326,000
312(b) disposal of TSCA and Non-TSCA sediments -- TSCA (150,000 CY) Non-TSCA (431.000 CY)	$ 3,014,000 $ 8,659,000	$ 1,623,000 $ 4,663,000
SUBTOTAL	$ 14,517,000	$ 6,996,000
LERRDs		
Administrative Cost	$ 0	$ 261,000
Acquisition Costs	$ 43,000	$ 69,000
SUBTOTAL	$ 43,000	$ 330,000
TOTAL ENVIRONMENTAL DREDGING 2	$ 32,772,000	$ 14,843,000

1 For purposes of this feasibility CMP/EIS, the costs associated with the dredging, transport, and dewatering of TSCA and non-TSCA sediments are the same

2 The total project costs are estimated to be $47,615,000. However, annual monitoring costs ($1,301,300) and disposal facility maintenance costs ($1,307,900) are included in that total. The total construction costs are $45,005,800.

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX U

COST SHARING AND NON-FEDERAL RESPONSIBILITIES

SUB-APPENDIX U-1

LETTERS OF INTENT SUPPORT

PREPARED BY:

U.S. Army Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, New York 14207
December 2000

OhioEPA

State of Ohio Environmental Protection Agency

STREET ADDRESS:
1800 WaterMark Drive
Columbus, OH 43215-1099

TELE: (614) 644-3020 FAX: (614) 644-2329

MAILING ADDRESS:
P.O. Box 1049
Columbus, OH 43216-1049

September 16, 1997

Mr. Brett Kaull, Chair, Resources Committee
Ashtabula River Partnership
1123 Bridge Street
Ashtabula, Ohio 44004

Dear Mr. Kaull:

The Ashtabula River Partnership is well underway with the critical tasks of designing and financing remediation of the Ashtabula River Area Of Concern (AOC). I am pleased that through the Partnership we are making solid progress towards resolving complex issues related to project design and funding. Our work together over the next year will provide us with public review and comment on the draft Comprehensive Management Plan/Environmental Impact Statement (CMP/EIS). With that input we can then move swiftly forward to construction and cleanup.

In 1989, to demonstrate Ohio's support of AOC cleanup, the State committed $3.5 million per year over a two year period totaling $7 million. For the last nine years we have repeatedly reiterated our funding committment, both verbally and in writing to the USACE and RAP partners. This underscores the fact that Ohio has never wavered in its strong committment to accomplish removal of contaminated Ashtabula River sediment.

The Ohio EPA's participation in the work of the Partnership is directed toward providing technical assistance and coordination support. Each month in Ashtabula there are a minimum of four Agency staff who travel from our central and northeast district offices to attend RAP and Partnership meetings. Ohio EPA firmly supports continuing this level of assistance to the community. Although we have not tabulated the cumulative costs associated with this level of staff time and effort, it represents an additional major financial committment.

In terms of other roles for Ohio EPA to work with the Partnership, we have the capacity to help orchestrate the river cleanup financing plan. I firmly commit to continuing this work with you and the Ohio Water Development Authority (OWDA) who possess considerable experience with a 25 year track record financing water quality improvements around the state. After more than a decade of study in and around the Ashtabula River AOC, the technical criteria and financial tools for cleanup are at hand. I believe the Partnership's efforts to locate and direct resources for this project will result in definitive actions to remediate the contaminated sediments.

As a member of the Ashtabula River Partnership, Ohio EPA greatly appreciates the opportunity to work with the local community on building the necessary structure for financing Ashtabula River cleanup. If you have any questions, please feel free to contact me at (614) 644-2782.

Sincerely,

Donald R. Schregardus, Director

cc: Jenny Tiell, Deputy Director, Programs
Tom Behlen, Chief, DSW
Barb Brdicka, Chief, DSIWM
Bob Wysenski, NEDO
Steve Scoles, Deputy Director, Fiscal Adm.
Jan Carlson, Chief, DERR
William Skowronski, Chief, NEDO
Ava Hottman, DSW/CO

RMI TITANIUM Company

P.O. BOX 269
1000 WARREN AVENUE
NILES, OHIO 44446-0269

September 19, 1997

Ashtabula River Partnership
1123 Bridge Street
Ashtabula, OH 44004

Attn: Mr. Brett Kaull
Chairman, Resources Committee

Ladies and Gentlemen:

We the following companies, Cabot Corporation, Centerior Energy, Consolidated Rail Corporation, Detrex Corporation, Elkem Metals Company, GenCorp, Mallinckrodt Chemical, Millennium Inorganic Chemicals, Occidental Chemical, Ohio Power Company, Olin Corporation, RMI Titanium Company, The Sherwin-Williams Company, Union Carbide Corporation, and Viacom International Inc., hereby notify you of our intent to participate in the funding of the Ashtabula River Partnership remedial action subject to the following terms.

It is our understanding that the current cost estimate for the remediation is $55 million; that the potential exists to significantly reduce costs by various means; that a major portion will be funded under Federal authorities such as the Water Resources Development Act; that the State of Ohio will contribute $7 million; and that the Partnership will continue to pursue other public and private funding.

We propose to provide a meaningful contribution at a level to be determined after we receive more definitive cost estimates and evidence of commitment by other entities. In order to be organized to fulfill this commitment, we intend to enter into a binding agreement among ourselves, the basic terms of which have been agreed upon.

Participation by us is contingent upon entering into an agreement with USEPA, Ohio EPA, the natural resource trustees, and any other necessary parties, which recognizes our participation as fulfillment of any CERCLA obligations, including but not limited to natural resource damages, and which includes covenants not to sue and contribution protection. We expect that all work will be consistent with the National Contingency Plan and that the Partnership, USEPA, and/or we will retain the ability to recover costs from others, so that their non-cooperation is not rewarded, and that any cost recovery by USEPA will be applied toward the Ashtabula River remediation. This is a pledge to negotiate such an agreement in good faith and is not legally binding.

This group of companies has voluntarily agreed to participate in this cooperative effort and this letter is not an admission of liability for any purpose, waiver of any defenses, or acknowledgement that other parties with potential CERCLA liability can avoid appropriate participation.

We applaud the cooperative spirit of the Partners that has brought us this far, and are looking forward to being part of this important initiative which will have far-reaching benefits to the Ashtabula community and is likely to become important on a national scale as the country looks for affordable, practical, solutions to its polluted harbors.

RMI TITANIUM Company

I have been authorized by each of the listed companies to sign this letter on our mutual behalf.

Signed,

Richard L. Mason
Director - Environmental Affairs

c: Colonel Michael Conrad
Commander, Buffalo District Office
U.S. Army Corps of Engineers

Congressman Steven C. LaTourette
U.S. House of Representatives

Mr. Donald Schregardus
Director
Ohio EPA

Mr. David A. Ullrich
Acting Regional Administrator
USEPA Region 5

Natalie Farber - OEPA
Stephen Golyski - USACE
Rick Nagle - USEPA
Amy Pelka - USEPA
Brian Troyer - USACE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

SEP 15 1997

REPLY TO THE ATTENTION OF:

R-19J

Mr. Brett Kaull
Chair, Resources Committee
Ashtabula River Partnership
1123 Bridge Street
Ashtabula, Ohio 44004

Dear Mr. Kaull:

Thank you for your letter of June 19, 1997, regarding the Ashtabula River Partnership and its efforts to prepare for a Policy Conference in mid-November. The Ashtabula River Partnership is beginning one of the more difficult phases of any remediation: deciding on a response action and securing funding for that alternative. The participation of my staff in facilitating your work to date leads me to believe that you are making steady progress towards resolving a number of complex issues concerning the basic project design. As those issues are resolved, a picture of the scope of the Partnership solution and the associated costs will become clearer. The process of determining the appropriate role for the United States Environmental Protection Agency (U.S. EPA) in demonstrating the conceptual viability of the Partnership solution will be iterative and involve further discussions with the Partnership. At this time, the U.S. EPA is able to offer only general commitments as to the types of arrangements we can *consider*, depending on the scope of the response action, the limit of our authorities, and the participation of the other Partners. We hope that this initial written response will assist in assembling the level of financial commitments required by the United States Army Corps of Engineers (U.S. ACE) later this year.

As you are aware, U.S. EPA is fully supporting the Partnership in developing a solution to the contaminated sediments. The participation of the U.S. EPA in the Partnership work is directed toward facilitating a remedial solution to the numerous problems posed by the contaminated sediments. To that end, the U.S. EPA will firmly commit to providing an ongoing level of staff time to continue our facilitation of the Partnership work. While this cannot be counted as non-federal share, it should assist in giving the U.S. ACE the confidence to commit resources to the project.

In terms of the cost share arrangements under U.S. ACE authorities, it is obvious that the U.S. EPA cannot make a direct financial contribution to the non-federal share. The U.S. EPA can help facilitate the non-federal Partners' participation by addressing the non-federal Partners' potential Superfund liability. The U.S. EPA is willing to commit to *consider*, after consultation with the Department of Justice and the fulfillment of a number of conditions, the issuance of covenants not to sue and contribution protections as provided under CERCLA Sections 122 (f) and (h) to parties interested in resolving their potential liability under those Sections. The conditions include, but are not limited to, the following items: First, the proposed remediation and the documents generated by the Partnership must not be inconsistent with the National Contingency Plan (40 CFR Part 300 *et seq.*); Second, the parties interested in resolving their potential liability must be willing to enter into a standard CERCLA consent decree that would resolve any past costs owed the Agency and be would submitted to a Federal Court; Third, that the U.S. EPA will review the funding plan to ensure that the parties seeking relief are making an appropriate contribution to the project; and Fourth, that the Partnership continues to meet its significant milestones as communicated to the Partnership in my letter to the Coordinating Committee Co-Chairs. These conditions, and others that may be discussed in the course of developing the project, are necessary to provide the U.S. EPA with the basis for providing any covenants or protections that may be sought. The consideration of this approach is unique and will require a substantial effort from everyone involved.

I share your optimism that as the project is further refined a response action will be designed that is worthy of the U.S. EPA's consideration and resource commitment. I look forward to receiving more details on the Policy Conference tentatively scheduled for mid-November and the proposed financial structure. If you have any questions, please do not hesitate to contact me.

Sincerely yours,

David A. Ullrich

David A. Ullrich
Acting Regional Administrator

Ashtabula Port Authority
P O Box 768
Ashtabula, OH 44005
PHONE: 440-997-5676

November 2, 2000

LTC Glen R. DeWillie, Commander
U.S. Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, NY 14207-3199

Dear Colonel DeWillie:

At a special meeting on November 1, 2000, of the Ashtabula City Port Authority, we have unanimously endorsed the willingness of the City Port Authority to serve as the Non-Federal Sponsor for the Ashtabula River remediation project.

The Ashtabula City Port Authority has the capabilities, under Ohio State statute, to fulfill this responsibility.

Sincerely,

Ronald R. Kister, Chairman
Ashtabula City Port Authority

RRK:jkb

c. J. Mahan

CELRH-PM
MAILROOM

12 DEC 00 PM 12:01

DEC 1 2 2000

Business Development

SUBJECT: Ashtabula River Remediation Project

Mr. Ronald R. Kister, Chairman
Ashtabula City Port Authority
P.O. Box 768
Ashtabula, OH 44005

Dear Mr. Kister:

I received your letter, dated November 2, 2000, concerning the Ashtabula City Port Authority's decision to serve as the non-Federal sponsor for the Ashtabula River Remediation Project. Your agency's decision is a major step forward in cleaning up river sediments and providing environmental and economic benefits to your community. The Port Authority recognizes the requirements and obligations associated with being the non-Federal sponsor as discussed in numerous meetings over the past seven years. I look forward to working with you as the non-Federal sponsor on this important project.

I also received a letter, dated October 27, 2000, from Mr. Richard Rowley, President of the Ashtabula County Port Authority, concerning their interest in serving as the non-Federal sponsor for the river remediation project. Mr. Rowley's letter is included as an attachment, as well as a Resolution Supporting the Ashtabula River Remediation Project, No. 00-19A, indicating their intent to serve as the non-Federal sponsor, providing complete adoption and funding of the Ashtabula River Partnership Coalition as proposed in the draft Memorandum of Understanding. We understand that the County Port Authority is aware of, supports, and defers to the Ashtabula City Port Authority's commitment to be the project sponsor. The strong cooperation and support between the agencies has a very positive impact on the project moving forward through design and construction.

My staff is finalizing the Comprehensive Master Plan (CMP) and we anticipate forwarding the document to the Independent Technical Review Team in early January 2001. Since we are required to identify the non-Federal sponsor in the CMP in order to recommend continued U.S. Army Corps of Engineers participation in the Remediation Project design and construction, the Ashtabula City Port Authority will be cited as the non-Federal sponsor.

Business Development
SUBJECT: Ashtabula River Remediation Project

Should there be any remaining concern over acceptance of the Ashtabula City Port Authority as the non-Federal sponsor, please advise me immediately. A copy of this letter is being provided to Mr Rowley for his consideration and possible comment.

It is important that the Ashtabula County Port Authority remain a member of the Ashtabula River Partnership (ARP) and continue to have a strong role in the Remediation Project. Strong community support and agreement on project goals and objectives is vital to the long-term success of this project. I look forward to working with the Ashtabula City Port Authority and the Ashtabula County Port Authority on this critical project.

Sincerely,

SIGNED

Glen R. DeWillie
Lieutenant Colonel, U.S. Army
District Engineer

Attachment

A copy of this letter has been forwarded to the following:

Deborah Newcomb, President
Ashtabula County Commissioners
25 W. Jefferson Street
Jefferson, OH 44047

August Pugliese, Manager
City of Ashtabula
4400 Main Avenue
Ashtabula, OH 44004

Mary Ann Smith, President
Ashtabula Township Trustees
3408 Schenley Avenue
Ashtabula, OH 44004

Richard Rowley, President
Ashtabula County Port Authority
36 W. Walnut Street
Jefferson, OH 44047

John Mahan, Coordinator
Ashtabula River Partnership
1123 Bridge Street
Ashtabula, OH 44004

ASHTABULA COUNTY PORT AUTHORITY

36 WEST WALNUT STREET
JEFFERSON, OHIO 44047

PHONE: 440-576-6069
FAX: 440-576-9139

NANCY ZANGERLE
EXECUTIVE DIRECTOR
EMAIL: nzangerle@yahoo.com

December 13, 2000

Mr. Brian Troyer
Mr. Ronald Guido
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207-3199

Dear Messrs. Troyer and Guido:

The Ashtabula County Port Authority has observed the progress of the Ashtabula River Remediation project with the Ashtabula City Port Authority as the non-Federal Sponsor. We are happy that the project is moving forward in accordance with the desired timetables.

As you are aware, the Ashtabula County Port Authority passed Resolution 00-19A on October 26, 2000 agreeing to serve as the non-Federal Sponsor for the Ashtabula River Remediation project. As the Ashtabula City Port Authority recently signed the project's Design Agreement with the U.S. Army Corps of Engineers, it is clear that our standing resolution is not necessary and may create confusion or inhibit the project at some future date.

The Ashtabula County Port Authority has a strong desire to see the completion of the project and cheers the efforts of those involved. Therefore, during the December 12, 2000 regular meeting of the Ashtabula County Port Authority, the Board passed Resolution 00-22 which rescinds the action previously contemplated by Resolution 00-19A and withdraws its offer to serve as non-Federal Sponsor to the Ashtabula River Remediation project. A copy of Resolution 00-22 is enclosed.

We applaud your efforts and wish for successful project completion.

Respectfully,

Nancy Stark Zangerle

Nancy Stark Zangerle
Executive Director

cc: John Mahan, Ashtabula River Partnership
Fred Leitert, Ashtabula River Foundation
August Pugliese, Ashtabula City Manager
Ron Kister, Ashtabula City Port Authority
JoAnn Misiner, Ashtabula City Council
Mary Ann Smith, Ashtabula Township Trustees
Duane S. Feher, Ashtabula County Commissioners
Congressman Steven LaTourette, U.S. House of Representatives
Senator Randy Gardner, Ohio Senate
Representative L. George Distel, Ohio House of Representatives

COPY

ASHTABULA COUNTY PORT AUTHORITY

36 WEST WALNUT STREET
JEFFERSON, OHIO 44047

PHONE: 440-576-6069
440-576-9138
FAX: 440-576-9139

RESOLUTION

No:00-22

WHEREAS, the Ashtabula River is recognized as a critical natural resource in Ashtabula County, Ohio with economic and environmental values; and

WHEREAS, members of the Ashtabula River Partnership, of which this body is one, have made steadfast and demonstrable progress towards a comprehensive solution for the removal and disposal of contaminated sediments that impede the full potential of the Ashtabula River; and

WHEREAS, the Ashtabula River Partnership must identify a single non-Federal Sponsor to enter into Agreements with the Federal Government and execute all responsibilities of such Agreements;

WHEREAS, the Ashtabula City Port Authority as agreed to serve as the non-Federal Sponsor for the Ashtabula River Remediation project at the request of the Ashtabula River Partnership;

NOW, THEREFORE, BE IT RESOLVED BY THE ASHTABULA COUNTY PORT AUTHORITY OF THE STATE OF OHIO, THAT:

I. The Ashtabula County Port Authority reiterates its support of the Ashtabula River Remediation project; and

II. To provide clarification to the Ashtabula River Remediation project and to remove any potential conflict or confusion which may inhibit the progress of the project, the Ashtabula County Port Authority hereby withdraws and rescinds its offer to serve as the non-Federal Sponsor of the Ashtabula River Remediation Project and/or execute the Design Agreement or any other agreement for the project.

COPY

RESOLUTION
Page Two

On a call of the roll:

WHEREUPON, the resolution was declared adopted.

Signed this 12th day of December, 2000.

____
Richard Rowley, President

____
John Palo, Vice President

____
Joseph W. Mayernick, Secretary

Certification

This is to certify that I, Joseph W. Mayernick, as Secretary of the Ashtabula County Port Authority certify that this is a true and correct copy of resolution on file in the Port Authority Office at 36 West Walnut Street, Jefferson, Ohio.

IN WITNESS THEREOF, I have hereunto set my hand this _____ day of __________, 2000.

____
Joseph W. Mayernick, Secretary
Ashtabula County Port Authority

Ashtabula County Port Authority
36 West Walnut Street
PO Box 297
Jefferson, Ohio 44047

Mr. Brian Troyer
Mr. Ronald Guido
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207-3199

14207-3199 13

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX U

COST SHARING AND NON-FEDERAL RESPONSIBILITIES

SUB-APPENDIX U-2

FINANCIAL ANALYSIS

Non-Federal Sponsor's Financial Plan
Non-Federal Sponsor's Statement of Financial Capability
District's Assessment of Financial Capability

PREPARED BY:

U.S. Army Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, New York 14207
December 2000

ASHTABULA RIVER PARTNERSHIP
PROJECT

FINANCIAL ANALYSIS
Non-Federal Sponsor's Financing Plan
Non Federal Sponsor's Statement Of Financial Capability
District's Assessment Of Financial Capability

U.S. Army Corps Of Engineers
Buffalo District
1776 Niagara St. Buffalo N.Y. 14207

TABLE OF CONTENTS

ASHTABULA RIVER PARTNERSHIP PROJECT
ASHTABULA COUNTY, OHIO
FINANCIAL ANALYSIS

SECTION 1 PROJECT OVERVIEW

1.01 Introduction

The purpose of this report is to demonstrate Ashtabula City Port Authority's capability of meeting their financial responsibilities as the non-Federal sponsor for the Ashtabula River Remediation Project. Their financial responsibilities cover all non-Federal costs and a major portion of the annual Operation, Maintenance, Repair, Rehabilitation and Replacement (OMRR&R). This report includes the following sections:

- An overview of the project including the main purpose of the project and the principal parties involved in the project
- A summary of the cost-sharing requirements, responsibilities of the non-Federal sponsor, and evidence of the non-Federal sponsor's capability to fulfill all cost sharing aspects of the project
- The District's assessment of the sponsor's financial capability.

1.02 Project

The lower Ashtabula River and Harbor was designated a Great Lakes Area Of Concern (AOC) in 1985 by the International Joint Commission. The lower Ashtabula River is defined as the two-mile reach extending from the upper limit of the Federal Navigation Channel to the river mouth.

An Ashtabula River Partnership (ARP) was established in 1994 with the purpose of exploring how to effectively remediate the contaminated sediments in the Ashtabula River and Harbor. More than 50 official partners participated as members in the ARP. Membership included: the United States Environmental Protection Agency (USEPA), the U.S. Army Corps Of Engineers (USACE), the Ohio Environmental Protection Agency (OEPA), the U.S. Fish and Wildlife Service (USFWS), the Ashtabula City Port Authority and the Ashtabula River Cooperation Group (ARCG).

The Partnership's Recommended Environmental Dredging Plan calls for the dredging, remediation and disposal of 696,000 cubic yards of sediments. Approximately 150,000 of these cubic yards are significantly PCB contaminated and would be handled and disposed of in accordance with Toxic Substance Control Act (TSCA) regulations. The remaining 546,000 cubic yards of sediment are non-TSCA.

The Plan calls for: dredging of contaminated bottom sediments, movement of the sediments to a staging area, developing and utilizing a transfer/dewatering facility at the staging area located along the river, trucking the dewatered dredge material from the staging area to an upland landfill disposal facility, and placing the material into the landfill site as appropriate in TSCA and non-TSCA disposal facilities. The plan also includes leachate collection, treatment and monitoring procedures at the transfer site and the disposal site; as well as disposal facility closure and post closure monitoring measures.

The project will remove polluted and toxic bottom sediments and allow future dredge material to be open lake disposed or provide cleaner sediments for future beneficial uses. The Plan minimizes costs, while at the same time optimizing the environmental outputs of the project.

1.03 Cost-Sharing

A number of Authorities were utilized to analyze the cleanup plan for contaminated bottom sediments. All contaminated sediments located above the 5th Street Bridge would be removed under Section 312 (b) of the Water Resources Development Act (WRDA) of 1990, as amended. All contaminated sediments located downstream of the 5th Street Bridge, and outside the federal channel, would be removed under Section 312 (a) of the WRDA of 1990, as amended. All contaminated sediments located downstream of the 5th Street Bridge and inside the federal channel, would be removed under Section 1 of the Rivers And Harbors Act of 1937 and Section 101 of WRDA 1986.

Total Project First Costs are estimated to be $45,005,800 (See Table 1). Remediation costs upstream of the 5th Street Bridge are $37,570,200. Remediation costs downstream of the 5th Street Bridge are $7,435,600. Table 1 shows remediation costs by Authority.

Table 1. ARP "Recommended Environmental Dredging Plan Costs" By Authority

Authority	Section 1 of R&HA 1937 & Section 101 WRDA 1986	Section 312 (a) WRDA 1990	Total Downstream	Section 312 (b) WRDA 1990	All Authorities
Location	Within The Federal Channel	Adjacent To The Federal Channel	Total Downstream Of The 5th St. Brdge	Within & Adjcnt To Fed. Channel	All Locations
	$4,021,200	$3,414,400	$7,435,600	$37,570,200	$45,005,800

Cost sharing follows the various cost sharing formulas associated with the various authorities used to perform the cleanup. Table 2 shows how Project First Costs ($45,005,800) are broken down into Federal and non-Federal costs.

Project financing includes funding of the Federal portion of the project ($31,010,800) through the U.S. Army Corps of Engineers, and funding of the non-Federal portion ($13,995,000) via the Ashtabula City Port Authority, as further explained in Section 2.

Table 2- ARP "Recommended Environmental Dredging Plan Costs" By Federal, Non-Federal Responsibility

Phase/Task	Federal	Non Federal	Total Federal, non Federal
Feasibility	$ 2,175,000	$ 300,000	$ 2,475,000
Design/PED	$ 1,398,000	$ 300,000	$ 1,698,000
Subtotal (Plng/Design)	$ 3,573,000	$ 600,000	$ 4,173,000
Construction	$27,437,800	$13,395,000	$40,832,800
Subtotal (Plng & Cnstruct)	$31,010,800	$13,995,000	$45,005,800

1.04 Expenditures And Use Of Funds

Table 3 shows the estimated Federal and non-Federal sponsor's expenditures for the Partnership project. Table 4 documents the sources and uses of the non-Federal funds.

SECTION 2 – FINANCIAL COMMITMENT

2.01 The Non Federal Sponsor's Financing Plan

The Ashtabula City Port Authority provided a "Letter of Intent" (see Attachment 1) on 1 March, 2001, expressing support for the project and their agreement to serve as the projects non-Federal sponsor. The Port Authority has provided information to the U.S. Army Corps of Engineers detailing their financial capability to enter into a Project Cooperation Agreement (PCA) and establishing their ability to meet the requirements of being the non-Federal sponsor.

The Ashtabula City Port Authority received financial commitments from the State Of Ohio and the Ashtabula River Cooperation Group (ARCG) allowing the Port Authority to meet its financial obligations as the non-Federal sponsor for the project. The State Of Ohio Environmental Protection Agency (EPA) has committed $7,000,000 to the project. The ARCG has offered a total of $13,000,000 for project implementation, $6,995,000 to be used for Environmental dredging. Specifics on funding sources for these commitments follows.

Ohio EPA's funding for the Ashtabula River Cleanup was accomplished in Ohio's 2000 budget cycle. A fund, Fund 541, was established specifically for this purpose. The cash balance of the fund, as of 20 February, 2001, was $6,847,375.79. The funds authorizing statute allows the fund to retain all interest earnings. The fund receives quarterly interest payments of about $160,000. The last interest payment was received and reported on 15 April, 2001. At that time, Ohio EPA had a cash balance sufficient to meet its $7,000,000 commitment to the project. The State of Ohio has provided the following documentation (Attachment 2) to the City Of Ashtabula Port Authority; 1) a certification of the availability of the Ohio funds; 2) a summary sheet

Table 3.- Schedule Of Estimated Federal And Non-Federal Expenditures

---

Feasibility, Design/PED Costs

Fiscal Year	Federal cash	Non Federal Cash	Value Of Non Federal LERRDS	Sub Total Non Federal	Total Federal, Non Federal
Thru 2002	$3,573,000	$600,000	---	$600,000	$4,173,000

Construction Expenditures

Fiscal Year	Federal (Cash)	Non Federal Cash	Value Of Non Federal LERRDS	Sub Total Non Federal	Total Federal, Non Federal
2003	$ 8,943,000	$ 4,334,000	$261,000	$ 4,595,000	$13,538,000
2004	$ 8,150,000	$ 3,900,000		$ 3,900,000	$12,050,000
2005	$ 7,700,000	$ 3,700,000		$ 3,700,000	$11,400,000
2006	$ 2,644,800	$ 1,200,000		$ 1,200,000	$ 3,844,800
	---------------	--------------	----------	--------------	--------------
	$27,437,800	$13,134,000	$261,000	$13,395,000	$40,832,800

Total Feasibility And Construction Expenditures

Federal (Cash)	Non Federal Cash	Value Of Non Federal LERRDS	Sub Total Non Federal	Total Federal, Non Federal
$31,010,800	$13,734,000	$261,000	$13,995,000	$45,005,800

Annual Monitoring And Maintenance Costs

Fiscal Year	Federal Cash	Non Federal Cash	Sub Total Non Federal	Total Federal, Non Federal
2007-2056	$4,700	$47,500	$47,500	$52,200

Table 4.- Schedule Of Sources and Uses of Non-Federal Funds

Feasibility, Design/PED Costs

Fiscal Year	Beginning Balance	Required Contribution	Balance
Thru 2002 (Cash)	$600,000	$600,000	$0

Construction Expenditures

Fiscal Year	Beginning Balance	Required Contribution	Balance
2003 (Cash)	$4,595,000	$ 4,595,000	$ 0
2004 (Cash)	$3,900,000	$ 3,900,000	$ 0
2005 (Cash)	$3,700,000	$ 3,700,000	$ 0
2006 (Cash)	$1,200,000	$ 1,200,000	$ 0
	$13,395,000	$13,395,000	$ 0

Total Feasibility And Construction Expenditures

Beginning Balance	Required Contribution	Balance
$13,995,000	$13,995,000	$ 0

Annual Monitoring And Maintenance Costs

	Beginning Balance	Required Contribution	Balance
2007-2056	$47,500	$47,500	$ 0

describing Fund 541 as the separate account created for the Ashtabula River Cleanup project; and 3) Section 3734.281 of the Ohio Revised Code that specifies monies will be set aside for the project.

In addition to the funds set aside by Ohio EPA, the Ashtabula River Cooperation Group (ARCG) has made a commitment to the Ashtabula River Partnership of $13,000,000. Provision of this $13,000,000 would provide the ARCG with a complete settlement and release of all claims applicable to the Ashtabula River cleanup project. The $13,000,000 would first be used to fund the remaining portion of the non-Federal Sponsors financial responsibility ($6,995,000), after accounting for funds provided by Ohio EPA. This would leave a balance of $6,005,000. Also funded from the ARCG monies would be the non-Federal sponsor's yearly responsibility of $47,500 for Operation, Maintenance, Repair, Rehabilitation and Replacement (OMRR&R). Given a 6% per year interest bearing account, approximately $748,700 would be needed to fund annual OMRR&R expenditures. This results in a remaining ARCG balance of $5,256,300. These monies would be used to fund a global settlement for all Natural Resource Damages claims related to the Ashtabula River as well as aquatic restoration projects currently identified in the CMP.

The ARCG is a group of 15 companies, formed in 1997, to help fund and implement the ARP's CMP. The ARCG provided a "funding Commitment" (Attachment 3) to the Ashtabula River Partnership in the form of a letter to the ARP's Coordinating and Resource Committees Chairmen on 17 January, 2001. This commitment of funding ($13,000,000) had the full support of all members of the ARCG.

Given that the non-Federal sponsors financial responsibility is $13,995,000, and that Ohio EPA has $7,000,000 set aside in a separate fund, this leaves a remaining balance needed of $6,995,000. The ARCG's commitment ensures that there will be enough monies to fund the remaining portion of the non-Federal sponsor's financial responsibility ($6,995,000).

The Ashtabula City Port Authority also understands that it is responsible for Operation, Maintenance, Repair, Rehabilitation and Replacement (OMRR&R) costs upon completion of the Projects construction phase. The Port Authority accepts responsibility for their portion of the OMRR&R costs, which are estimated to be $47,500. The ARCG's financial commitment results in discretionary funds ($6,005,000). These discretionary funds would be used by the ARP to underwrite annual OMRR&R costs of $47,500.

<u>2.02 The Non-Federal Sponsors Financial Capability</u>

As noted, the Letter of Intent (Attachment 1) is primary and direct evidence of the Ashtabula City Port Authority's intent to participate in the project as the Non-Federal Sponsor. The funding of the non-Federal share of the project ($13,995,000) will come from two sources: Ohio EPA's special 541 Fund ($7,000,000) and the commitment of funds to the ARP from the ARCG ($13,000,000). Part of the ARCG funds will be used to provide the remaining non-Federal construction cost obligation ($6,995,000). The remaining balance of the ARCG funds ($6,005,000) can be used at the discretion of the ARP.

SECTION 3 FINANCIAL CAPABILITY ASSESSMENT

3.01 Introduction

The Buffalo District must determine whether the Ashtabula City Port Authority has the financial capability to meet its obligations and responsibilities as the Non-Federal sponsor for the Ashtabula River Partnership project. The non-Federal sponsor's financial obligations include Construction and Design costs of $13,995,000. It is also responsible for annual OMRR&R costs of $47,500.

3.02 Assessment Of The Sponsors Financial Position

The Ashtabula City Port Authority is the sole non-Federal Sponsor for the project and has the responsibility of providing the non-Federal funds. The Port Authority has signed a Letter Of Intent (See Attachment 1) expressing support for the Ashtabula River Remediation Project. Funding of the non-Federal share of the project will come from two dedicated sources: Ohio EPA's special 541 Fund ($7,000,000) and the commitment of funds to the Ashtabula River Partnership from the Ashtabula River Cooperation Group ($13,000,000).

The language used to establish EPA's 541 Fund resulted in the creation of a separate account whose sole purpose was to fund the Ashtabula River Remediation Project. The fund currently has $7,000,000 in it. As for the Ashtabula River Cooperation Groups (ARCG) commitment of $13,000,000, the ARCG has already provided $2,800,000 in funding since 1989 (see Attachment 3) to assist the Ashtabula River Partnership in meeting study costs, design costs and administrative expenses. The ARCG includes 15 companies committed to funding and implementing the Comprehensive Management Plan. The $13,000,000 funding level had the full support of all members.

Annual requirements for Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) are $47,500. The Port Authority has acknowledged its responsibility for these expenditures and has discretionary funds from the ARCG of $6,005,000 available to satisfy this obligation.

3.03 Districts Recommendation

In summary, a review of the latest available information indicates that Ashtabula City Port Authority is a willing non-Federal sponsor with all the necessary assets and requirements to meet its financial obligations.

The Buffalo District, U.S. Army Corps of Engineers has determined that the Ashtabula City Port Authority is capable of providing the funds necessary to contribute the local share of total project costs under the construction PCA. These capabilities will allow the Ashtabula City Port Authority to serve in the role of sponsor and satisfy all financial obligations required by a Non-Federal sponsor in support of the Ashtabula River Remediation Project.

Based on this review of the sponsor's financial position and evidence of their ability to meet the non-Federal sponsor's financial obligations, Buffalo District approves the non-Federal sponsor's Financing Plan. I am convinced that the Ashtabula City Port Authority fully supports project implementation and is financially capable of meeting its obligations under the Project Cooperation Agreement.

APPROVED BY [signature] DATE 20 JUN 01

Glen R. DeWillie
Lieutenant Colonel, U.S. Army
District Engineer

ATTACHMENTS

1. Letter of Intent from the Ashtabula City Port Authority – 01 March 2001
2. Letter from Ohio EPA to the City of Ashtabula Port Authority – 02 March 2001
3. Letter from the Ashtabula River Cooperation Group to the Ashtabula River Partnership – 17 January 2001
4. Letter from Walter & Haverfield, LLP dated 20 July 2001 SUBJECT: Ashtabula River Cooperation Group Financial Reports.
5. Memorandum for the Files: dated 31 July 2001, SUBJECT: Non-Federal cost share funding obtained from a third party sponsor for the Ashtabula River Partnership Project. Financial Analysis – Ashtabula River Cooperation Group (ARCG).

ASHTABULA CITY PORT AUTHORITY
P O Box 768
Ashtabula, OH 44005

March 1, 2001

LTC Glen R. DeWillie
Commander, Buffalo District
Army Corps of Engineers
1776 Niagara St.
Buffalo, New York 14207-3199

Dear Col. DeWillie:

As the non-Federal sponsor of the Ashtabula River Remediation Project, the Ashtabula City Port Authority is providing you information to demonstrate our financial capability to enter into a Project Cooperation Agreement with the Corps of Engineers and meet the requirements of the non-federal sponsor.

The Port Authority has reviewed financial commitments from the State of Ohio and the Ashtabula River Cooperation Group and determined that the Port Authority has the commitments to proceed. Therefore, the Port Authority has the financial capability to meet non-federal sponsor financial responsibilities.

Attached please find a statement of financial capability, financial plan and letters of financial commitment to demonstrate the ability of the Port Authority to satisfy the non-Federal obligation for this important project.

Sincerely,

Ronald Kister
Chairman, Ashtabula City Port Authority

ATTACHMENT 1

ASHTABULA CITY PORT AUTHORITY
P O Box 768
Ashtabula, OH 44005

NON-FEDRAL SPONSORS STATEMENT OF FINANCIAL CAPABILITY

The Ashtabula City Port Authority as the designated non-Federal sponsor for the Ashtabula River Partnership's (ARP) Comprehensive Management Plan (CMP) has the capability to meet its financial obligations for the environmental dredging and remediation project. The non-Federal share of the of the ARP environmental dredging plan is estimated to be $13,995,000 including LERRDs, but does not include previous payments under Feasibility Cost Share Agreement (FCSA) or Design Agreements (DA). The Ashtabula City Port Authority also has the capability to meet the non-Federal share of OMRR&R costs estimated at $51,800 annually.

In assisting the Ashtabula City Port Authority in meeting its financial obligation the State of Ohio has committed $7,000,000 for implementation of the ARP project. This money has been earmarked and dedicated for usage in the Ashtabula River environmental dredging and remediation project as evidenced by Attachment 1.

The Ashtabula River Cooperation Group (ARCG) has made a commitment to the Ashtabula River Partnership of $13,000,000 for implementation of their Comprehensive Management Plan. The ARCG is a group of 15 companies, formed in 1997, to help fund and implement the ARP's CMP. The ARCG provided a "Funding Commitment" of $13,000,000 to the Ashtabula River Partnership on January 17, 2001, in a formal letter to the ARPs Coordinating and Resource Committees Chairmen. This formal letter signed by the Chairman of the ARCG, Attachment 2, is evidence of the Ashtabula City Port Authority's capability to provide its remaining financial obligation of the non-Federal share of ARP project costs. The letter stated: "The ARCG's commitment will ensure that the ARP has sufficient monies ($7,843,400) to fund the remaining non-Federal share of the projected CMP costs. This commitment also provides an additional $5,156,600 that could be used at the ARP' discretion,"

Therefore, the Ashtabula City Port Authority has received financial commitments from the State of Ohio and the ARCG that fully meet the non-Federal sponsor's financial obligations subject to the terms and conditions contained in each for the Ashtabula River environmental dredging and remediation project. The Ashtabula City Port Authority has the financial capability to implement the ARP project.

ASHTABULA CITY PORT AUTHORITY
P O Box 768
Ashtabula, OH 44005

FINANCIAL PLAN

The Table entitled "Schedule of Estimated Federal and Non-Federal Expenditures", by Federal Fiscal Year, is provided herein. This schedule includes Federal expenditures, non-Federal contributions, non-Federal lands, easements, rights-of-way, relocations and disposal areas (LERR&D); there are no known utility relocations required on this project. The total Federal and non-Federal shares displayed in the Table reflect current cost sharing policies of the different authorities making up this project.

SCHEDULE OF ESTIMATED FEDERAL AND NON-FEDERAL EXPENDITURES

Fiscal Year ($000)	Federal cash ($000)	Non - Federal Cash ($000)	LERR&D	Other ($000)	Total ($000)
2003	8,943.0	4,334.0	261.0	0.0	13,538.0
2004	8,150.0	3,900.0	0.0	0.0	12,050.0
2005	7,700.0	3,700.0	0.0	0.0	11,400.0
2006	2,645.0	1,200.0	0.0	0.0	3,845.0
	27,438.0	13,134.0	261.0	0.0	40,833.0

The Table entitled "Schedule of Sources and Uses of Non-Federal Funds" demonstrates how the non-Federal funding accumulates by Federal fiscal year. Since the Ashtabula River Cooperating Group has committed non-Federal funding for the project these monies will be placed in an escrow account prior to the initiation of construction and are shown as the initial balance on hand. The State of Ohio's commitment is expected on an annual basis and, therefore, is shown as a contribution based on anticipated non-Federal expenditures. Following construction anticipated monitoring and maintenance are shown as annual OMRR&R costs. The schedule of the sources and uses of funds is consistent with the schedule of estimated Federal and non-Federal expenditures.

SCHEDULE OF SOURCES AND USES OF NON-FEDERAL FUNDS

	FUNDS AVAILABLE FROM LOCAL SPONSOR		
	Beginning Balance & Annual Income ($000)	**Required Annual Contribution** ($000)	**Fund Balance** ($000)
Balance on Hand @ Construction Initiation ARCG	6,395.0		6,395.0
1st Year Revenues State of Ohio	6,395.0	2,300.0	8,695.0
2nd Year Revenues State of Ohio	8,695.0	2,100.0	10,795.0
3rd Year Revenues State of Ohio	10,795.0	2,000.0	12,795.0
4th Year Revenues State of Ohio	12,795.0	600.0	13,395.0
Project Completion	13,395.0		

Required Annual Non-Federal OMRR&R is estimated at $51,800 expected over 50 years. Source of Funds for OMRR&R is the ARCG commitment as presented in the non-Federal Sponsors Statement of Financial Capability.

OhioEPA
State of Ohio Environmental Protection Agency

STREET ADDRESS:
Lazarus Government Center
122 S. Front Street
Columbus, Ohio 43215

TELE: (614) 644-3020 FAX: (614) 644-2329

MAILING ADDRESS:
P.O. Box 1049
Columbus, OH 43216-1049

March 2, 2001

Mr. Ron Kister
City of Ashtabula Port Authority
P.O. Box 768
Ashtabula, Ohio 44005-0768

Re: Availability of State Funds

Dear Mr. Kister:

I applaud the community of Ashtabula for its role in achievement of a *draft* recommended plan and environmental impact statement (CMP/EIS) for comprehensive cleanup of the Ashtabula River and commend your tenacity in tackling the cleanup project. For the last 11 years, the State of Ohio has held constant to our funding commitment of $7 million, both verbally and in writing to the U.S. Army Corps of Engineers and Remedial Action Plan partners toward the one-time river cleanup. This underscores the fact that Ohio has never wavered in its strong commitment to accomplish removal of contaminated sediment in the Ashtabula River. I understand that the Ashtabula City Port Authority, as local sponsor for the project, is required to include a financing plan in the revised final CMP/EIS which will be available for public comment and review during Spring 2001.

To support this significant step, we are providing you the following documentation of Ohio's financial capability to partially fund the nonfederal project cost share for the cleanup and remediation of the Ashtabula River: 1) a certification of the availability of Ohio funds; 2) a summary sheet describing Fund 541 as the separate account created for Ashtabula; and 3) Section 3734.281 of the Ohio Revised Code that specifies monies will be set aside for the project. Presently Fund 541, an interest-bearing fund, totals $6,847,375.79 which is expected to grow to $7 million by the end of the next quarter, allowing these funds to be transferred, as necessary, for timely project implementation.

Please contact John Childs at (614) 644-2782 if you have any questions.

Sincerely,

Christopher Jones
Director

CJ:nf

Enclosures

State of Ohio Environmental Protection Agency

STREET ADDRESS:
Lazarus Government Center
122 S. Front Street
Columbus, Ohio 43215

TELE: (614) 644-3020 FAX: (614) 644-2329

MAILING ADDRESS:
P.O. Box 1049
Columbus, OH 43216-1049

MEMORANDUM

TO: Christopher Jones, Director

FROM: John Childs, Deputy Director

DATE: February 22, 2001

SUBJECT: Certification of Funds for the Ashtabula River Cleanup

As you are aware, the State committed $7 million towards the cleanup of the Ashtabula River. The Ashtabula City Port Authority, the local sponsor of the project, has requested that Ohio EPA submit a letter certifying the availability of the funds committed by the State. The letter will be included as part of its Statement of Financial Capability and Financial Plan.

Funding for the Ashtabula River cleanup is held in Fund 541, Environmental Protection Remediation Fund. This fund was created during the last budget cycle, and the authorizing statute allows the fund to retain all interest earnings. As of February 20, 2001, the cash balance available for the Ashtabula River cleanup is $6,847,375.79. The fund receives quarterly interest payments of approximately $160,000. The next interest payment will be received and reported by April 15, 2001. At that time, Ohio EPA will have a cash balance sufficient to meet its $7 million commitment for the project.

Summary of the Environmental Protection Remediation Fund	
Fund 541 created by HB 283	
	Fund 541
Beginning Balance SFY 2000	$0.00
Transfer from the Hazardous Waste Clean-Up Account Fund 505	$8,316,984.75
Less cash contribution for other sites not apart of the Ashtabula Project	$4,316,984.75
Cash contribution for the Ashtabula project	$4,000,000.00
Interest received for the period of 9-1-99 thru 6-30-00	$492,006.13
Ending Cash Balacne 6-30-00	$4,492,006.13
Beginning Balance SFY 2001	$4,492,006.13
Transfer from the Hazardous Waste Clean-Up Account Fund 505	$2,000,000.00
Interest received for the period of 7-1-00 thru 12-31-00	$355,369.66
Total to Date for the Ashtabula project	$6,847,375.79

BROUGHT UNDER SECTION 3734.14, 3734.20, 3734.22, 6111.03, OR 6111.04 OF THE REVISED CODE; AND ANY MONEYS RECEIVED UNDER THE "COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980," 94 STAT. 2767, 42 U.S.C. 9602, AS AMENDED, MAY BE PAID INTO THE STATE TREASURY TO THE CREDIT OF THE ENVIRONMENTAL PROTECTION REMEDIATION FUND, WHICH IS HEREBY CREATED. THE ENVIRONMENTAL PROTECTION AGENCY SHALL USE THE MONEYS IN THE FUND ONLY FOR THE PURPOSE OF REMEDIATING CONDITIONS AT A HAZARDOUS WASTE FACILITY, SOLID WASTE FACILITY, OR OTHER LOCATION AT WHICH THE DIRECTOR HAS REASON TO BELIEVE THERE IS A SUBSTANTIAL THREAT TO PUBLIC HEALTH OR SAFETY OR THE ENVIRONMENT. REMEDIATION MAY INCLUDE THE DIRECT AND INDIRECT COSTS ASSOCIATED WITH THE OVERSEEING, SUPERVISING, PERFORMING, VERIFYING, OR REVIEWING OF REMEDIATION ACTIVITIES BY AGENCY EMPLOYEES. ALL INVESTMENT EARNINGS OF THE FUND SHALL BE CREDITED TO THE FUND.

Sec. 3734.57. (A) For the purposes of paying the state's long-term operation costs or matching share for actions taken under the "Comprehensive Environmental Response, Compensation, and Liability Act of 1980," 94 Stat. 2767, 42 U.S.C.A. 9601, as amended; paying the costs of measures for proper clean-up of sites where polychlorinated biphenyls and substances, equipment, and devices containing or contaminated with polychlorinated biphenyls have been stored or disposed of; paying the costs of conducting surveys or investigations of solid waste facilities or other locations where it is believed that significant quantities of hazardous waste were disposed of and for conducting enforcement actions arising from the findings of such surveys or investigations; and paying the costs of acquiring and cleaning up, or providing financial assistance for cleaning up, any hazardous waste facility or solid waste facility containing significant quantities of hazardous waste, that constitutes an imminent and substantial threat to public health or safety or the environment; and, from July 1, ~~1997~~ 1999, through June 30, ~~1999~~ 2001, for the purposes of paying the costs of administering and

Tire Management Fund and transferred to the Department of Development. In fiscal years 2000 and 2001, the Director of Environmental Protection shall request that the Director of Budget and Management transfer $1,000,000, prescribed in division (G)(3) of section 3734.82 of the Revised Code, less one-half of the amount of the certified overpayment from the Scrap Tire Management Fund (Fund 4R5) to the Scrap Tire Loans and Grants Fund (Fund 586).

<u>Ashtabula River Project</u>

The Director of Environmental Protection, with the approval of the Director of Budget and Management, shall transfer cash in an amount not to exceed $4,000,000 in fiscal year 2000 and an amount not to exceed $3,000,000 in fiscal year 2001 from the Hazardous Waste Cleanup Fund (Fund 505) to the Environmental Protection Remediation Fund (Fund 541). The amounts of the cash transferred is hereby appropriated.

<u>Toussaint River Project</u>

Of the foregoing appropriation item 717-321, Water Quality Planning and Assessment, $100,000 in fiscal year 2000 shall be used for the Toussaint River Ordinance Clean-Up Project.

<u>Areawide Planning Agencies</u>

Of the foregoing appropriation item, 717-321, Water Quality Planning and Assessment, $450,000 in fiscal year 2000 and $450,000 in fiscal year 2001 shall be divided evenly between the following six areawide planning agencies: Eastgate Development and Transportation Agency, Toledo Metropolitan Area Council of Governments, Northeast Ohio Four County Regional Planning and Development Organization, Northeast Ohio Areawide Coordinating Agency, Ohio-Kentucky-Indiana Regional Council of Governments, and Miami Valley Regional Planning Commission.

<u>Study of Division of Surface Water and Division of Air Pollution Control</u>

Ashtabula River Cooperation Group

January 17, 2001

Nathan F. Brewer
Frederick Leitert
Co-Chairmen, Ashtabula River
Partnership Coordinating Committee
1123 Bridge Street
Ashtabula, Ohio 44004

Brett Kaull
Chairman, Ashtabula River
Partnership Resource Committee
1123 Bridge Street
Ashtabula, Ohio 44004

Re: Ashtabula River Cooperation Group Funding Commitment

Dear Messrs. Brewer, Leitert and Kaull:

On behalf of the fifteen companies that compose the Ashtabula River Cooperation Group ("ARCG"), I want to thank you for providing us with the opportunity to submit this funding commitment and appear before the Ashtabula River Partnership ("ARP") today to explain its terms.

The ARCG commends the substantial collaborative efforts undertaken by the members of the ARP over the past six years. The ARP has provided a unique forum for creative cooperation among parties with diverse interests. Those efforts have now coalesced and are represented in the form of a newly revised Comprehensive Management Plan ("CMP"). As a result, the entire Ashtabula River restoration project as envisioned by the ARP is at a critical juncture.

If the CMP is to be implemented within the available, but limited, window of opportunity and significant Federal funding preserved for this important project, a consensus must be reached among all interested parties concerning the content of the CMP and funding of the restoration work for the Ashtabula River. To this end, the ARCG has taken the initiative to formally state the basis for its participation so that the positive forward momentum generated by the ARP is preserved and our mutual objectives accomplished.

As you know, the ARCG has provided approximately $2,800,000 in funding since 1989 for the original Ashtabula River study, and to assist the ARP is meeting administrative expenses and the local share of costs for study and design work undertaken by the Army Corps of Engineers ("ACOE"). Based in part on these contributions, the ACOE has just completed the revised CMP that reflects updated cost estimates and the results of the Value Engineering Review conducted by the ACOE and ARP over the past year.

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Attachment 3

Although the ARCG does not agree with all aspects of the dredging and construction activities incorporated in the CMP, as more fully explained in our prior submissions, we are prepared in the spirit of cooperation and compromise to accept the present proposal and the projected costs encompassed by the CMP. The CMP provides for comprehensive navigational dredging and a significantly expedited timetable for implementation of restoration work in the River – none of which would result if the Ashtabula River were designated as a Superfund site. The ARCG believes that the CMP is a far better solution for all affected constituencies than a Superfund designation. **Therefore, the ARCG intends to facilitate the CMP approval process and ensure a timely restoration of the Ashtabula River for the community by submitting this commitment, irrespective of our previously specified concerns.**

The January, 2001 version of the CMP envisions Total Project Costs of $47,615,000 for the recommended environmental dredging plan and related construction work, with $32,771,600 allocated as the federal cost share and $14,843,400 allocated as the non-federal cost share. The $47,615,000 Total Project Costs estimate anticipates $30,500,000 will be needed for dredging and construction activities, and allocates $6,702,100 or 22% of construction costs for contingencies associated with construction and restoration activities. The $10,413,000 balance of the Total Project Costs estimate is proposed to cover study, design, management, acquisition and monitoring expenses of the CMP, although all of these costs may not require a matching non-federal cost share. These costs can be summarized as follows:

CMP FUNDING BY SOURCE

Federal Cost Share	$32,771,600
Non-Federal Cost Share	$14,843,400
Total Project Costs	**$47,615,000**

CMP FUNDING BY USE

Dredging and Construction Activities	$30,500,000
Construction Contingency	$ 6,702,000
Study, Design, Management, O&M, Acquisition and Related Expenses	$10,413,000
Total Project Costs	**$47,615,000**

These costs do not include the asserted demands from the NRD Trustees for Natural Resource Damages ("NRD") claims related to the Ashtabula River. Although the ARCG has attempted in good faith to separately negotiate a settlement with the NRD Trustees of any NRD claims related to the Ashtabula River over the past 15 months, those efforts have proven unsuccessful. Despite several meetings with the Trustees and submission of lengthy, scientifically-based technical memoranda providing a site-specific assessment of NRD claims potentially attributable to the ARCG companies (as opposed to the generic calculations and unsupported demands advanced by the NRD Trustees), the ARCG and the NRD Trustees are orders of magnitude apart.

We have regretfully concluded that our further negotiations with the Trustees will be unproductive and hold no hope of resulting in an agreement. The ARCG is gravely concerned that this impasse and resultant delay threatens implementation of the CMP, jeopardizes federal funding for the project and may ultimately cause the Ashtabula River to default to Superfund status; all of which are antithetical to the interests of the ARP, the ARCG and most importantly the Ashtabula community. Accordingly, as part of the ARCG proposal, we ask the ARP to undertake responsibility for negotiating a resolution of the NRD claims with the NRD Trustees within the overall ARCG funding commitment described below.

In reliance upon the updated cost estimates in the CMP, and in an effort to fully settle this matter in a timely manner, the ARCG is prepared to commit $7,843,400 for payment of the presently unfunded balance of the non-federal cost share ($14,843,400 less the $7,000,000 State of Ohio commitment) – **plus** an additional $5,156,600 (equal to approximately 66% of our $7,843,400 non-federal share commitment) to cover construction cost overruns and/or supplemental natural resource restoration projects beyond those currently incorporated in the CMP. **In total, the ARCG is committing to pay $13,000,000 (in addition to the $2,800,000 paid to date) for the implementation of the CMP and related natural resource restoration activities to be allocated by the ARP in the manner it deems most appropriate and consistent with the needs of the Ashtabula community. This proposal, which is being made after thorough discussions within the ARCG, has the full support of all members at this level of funding.**

The ARCG's commitment will ensure that the ARP has sufficient monies ($7,843,400) to fund the remaining non-federal share of the projected CMP costs. This commitment also provides an additional $5,156,600 that could be used at the ARP's discretion, for example, to double the overall construction cost contingency from $6,702,000 to $13,404,000 (44% of the $30,500,000 dredging and construction cost estimate) by using $2,145,000 as additional non-federal share matching funds. This scenario would leave approximately $3,011,600 in funding available for supplemental NRD restoration activities beyond the $1,000,000 for supplemental aquatic restoration projects currently budgeted in the CMP. Based upon this scenario, the ARCG funding commitment would be allocated by the ARP as follows:

ARCG FUNDING ALLOCATION – Scenario One

Non-Federal Share of CMP	$ 7,843,400
Non-Federal Share of Matching Funds for Construction Contingency	$ 2,145,000
Supplemental NRD Restoration Work	$ 3,011,600
Total	**$13,000,000**

Alternatively, the ARP could determine to allocate all monies beyond the $7,843,000 needed to fund the uncommited portion of the non-federal matching share for the CMP to supplemental natural resource restoration projects. Using this alternative scenario, the ARCG funding commitment would be allocated by the ARP as follows:

ARCG FUNDING ALLOCATION – Scenario Two

Non-Federal Share of CMP	$ 7,843,400
Supplemental NRD Restoration Work	$ 5,156,600
Total	**$13,000,000**

Our proposal anticipates the ARP taking responsibility for resolving funding allocation issues with interested parties from the ARP or concerned governmental representatives, and provides the ARP with the flexibility to determine the use of these funds in any manner consistent with the overall objectives of the project and this funding commitment.

The ARCG proposal requires that upon payment of these monies its comprehensive financial commitment result in a full and final release and resolution of all demands and claims (CERCLA, NRD or otherwise) related to the Ashtabula River by the concerned governmental agencies and representatives – many of which are participants in the ARP. This position is consistent with the conditions articulated by the ARCG in its prior submissions to the ARP over the past several years wherein we favorably responded to and paid funding requests for various design, study and administrative expenses.

A complete settlement and release of all claims applicable to the Ashtabula River is an indispensable component of this proposal. To obtain approval of this level of funding, the members of the ARCG require a definitive statement of their total financial commitment in accordance with this proposal, avoidance of substantial transaction and litigation costs and a single forum for compromise by each participant. As we have consistently stated for many months, we cannot envision a cooperative relationship which would leave unresolved in an adversarial context a major component of site costs while attempting to implement work at the site. By contrast, resolving all site issues as part of a comprehensive agreement permits all aspects of the project to be integrated into a coordinated plan, led by the ARP, that will be consistent, cost-effective and, potentially, funded in part with matching WRDA monies. Moreover, in response to Congressional guidelines and applicable regulations, government agencies and private parties have traditionally negotiated a single agreement for all site-related claims. A cooperative undertaking such as the ARP should accept nothing less.

It is our hope that with the willingness of the ARCG to accept the scope of the Ashtabula River work as defined by the CMP, to fund the uncommitted portion of the non-federal local share and to provide additional monies for a significantly larger construction contingency and/or supplemental NRD restoration projects, all impediments to the implementation of the CMP have now been addressed. The ARCG stands ready to act in a prompt manner to finalize the necessary documentation confirming the terms of its financial commitment so that the restoration of the Ashtabula River can proceed without delay. We are prepared to answer any questions you may have with respect to this proposal. We will await your response.

Very truly yours,

Stuart G. Breslow

Stuart G. Breslow
Chairman
Ashtabula River Cooperation Group

cc: All Members of the ARCG

264344-2

WALTER & HAVERFIELD LLP

RALPH E. CASCARILLA
Direct Dial Number:
(216) 928-2908

E-mail Address:
RCascarilla@walterhav.com

July 20, 2001

BY FEDERAL EXPRESS

Brian Troyer
US Army Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207

Re: Ashtabula River Cooperation Group Financial Reports

Dear Mr. Troyer:

Pursuant to your recent request to Mr. Richard Mason, enclosed please find financial documentation from each of the following member companies of the Ashtabula River Cooperation Group:

Cabot Corporation
First Energy Corporation
Norfolk Southern Corporation/Conrail, Inc.
Detrex Corporation
GenCorp, Inc.
Viacom International, Inc.
Occidental Chemical Corporation
Ohio Power Company/American Electric Power
Olin Corporation
RMI Titanium Company
Millennium Inorganic Chemicals, Inc.
The Sherwin-Williams Company
Union Carbide Corporation/DOW Chemical Companh

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I trust this information will be satisfactory to meet your needs. If you have any need for further information concerning these documents or the ARCG member companies, please do not hesitate to contact me.

Very truly yours,

Ralph E. Cascarilla
On behalf of the
Ashtabula River Cooperation Group

REC/rsd
Enclosures
cc: Joseph Heimbuch
Joseph Lonardo
Richard Mason

MEMORANDUM FOR THE FILES 31 July 2001

SUBJECT: Buffalo District determination of availability/source of non-Federal cost share/funding obtained from a third party sponsor for the Ashtabula River Partnership Project. Financial Analysis - Ashtabula River Cooperation Group (ARCG)

1. BACKGROUND:

As part of the proposed Ashtabula River Partnership Project a consortium of public companies, referred to as the Ashtabula River Cooperation Group (ARCG) will contribute approximately $7 million as a non-federal share of a defined project. The project is currently in the feasibility stages. The ER 1105-2-100 requires a feasibility report, accompanied by a financial analysis and financial capability review on the proposed project.

ER 1105-2-100 provides guidance and procedures for the preparation of financial analysis related to proposed projects. The current Ashtabula River Partnership Project is currently in the Feasibility Phase. Section D-5 d (2)(b) of ER 1105-2-100 regarding Feasibility Phase states:

"The feasibility report should be accompanied by supporting financial information consisting of a preliminary financing plan and a statement of financial capability as described in this section of this appendix".

Section D-5 e (2)(c) defines the requirements for a Statement of Financial Capability as follows:

"The non-Federal sponsor's statement of financial capability should provide evidence of the non-Federal sponsor's authority to utilize the identified source or sources of funds; and each statement of financial capability should provide information on the non-Federal sponsor's capability to obtain remaining funds, if any. This information will be at a level of detail necessary to demonstrate such capability for the particular project and the particular non-Federal sponsor".

In addition ER 1105-2-100 section D-5 b (5) defines Assessment of Financial Capability as:

"The district's assessment of the non-Federal sponsor's financial capability is to determine if it is reasonable to expect that ample funds will be available to satisfy the non-Federal sponsor's financial obligations for the project. Districts are expected to present rationale supporting the conclusion of the assessment. Appropriate rationale would include discussion of prior performance of the non-Federal sponsor on similar projects, certainty of revenue sources and method of payment, the overall financial position of the non-Federal sponsor and or credit worthiness of sponsor's debt obligations as reported by independent credit rating service such as Moody's or Standard and Poor's".

2. REVIEW:

A general review of overall financial capability was performed on the ARCG members FY 2000 financial information, as provided by letter dated July 20, 2001 from Walter & Haverfield, LLP, SUBJECT: ***Ashtabula River Cooperation Group Financial Reports***, in order to satisfy the requirements of ER 1105-2-100. Financial ratio analysis was prepared resulting in calculation of financial solvency indicators which where compared to industry financial models. Based on this review it was determined that the ARCG companies in aggregate have a fair financial position and are not in danger of financial distress that would affect their status as a going concern. Additional analysis was performed on the financial statements of the individual ARCG companies. Based on that review it is concluded that the companies currently maintain sufficient earnings and cash flow to support planned contributions to the proposed project. Also, it should be noted that each of these companies has participated and is currently participating in other projects in conjunction with the Ashtabula program. The companies have met their financial obligations as defined under those projects.

In addition to review of financial information the reviewer and the project manager held a teleconference with representatives of the ARCG to discuss the source of financing for the group's share of the project. The ARCG representatives stated that the member shares would be paid for either out of company earnings or available lines of credits of the individual companies. Based on the financial analysis discussed above, it is the conclusion of the reviewer that the companies have sufficient financial resources to support their part of the project costs.

3. CONCLUSION:

It is the opinion of the review that based on review of the financial information provided on the ARCG member companies and discussions with the company representatives that the ARCG, as a group, maintains sufficient financial capability to meet it the proposed non-federal cost share requirements of the proposed project. However, it is recommended that prior to execution of any definitive cooperation agreements that the ARCG provided verifiable documentation as to the existence of required funding.

ASHTABULA RIVER PARTNERSHIP
COMPREHENSIVE MANAGEMENT PLAN AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX V

ENVIRONMENTAL JUSTICE

PREPARED BY:

U.S. Environmental Protection Agency, Region 5
General Counsel Office
Updated December 2000

ENVIRONMENTAL JUSTICE ASSESSMENT

Summary of Analysis:

The Comprehensive Management Plan for the Ashtabula River Dredging Project and Confined Disposal Facility (Ashtabula River Proposal) conforms to the U.S. government's policy of insuring that federal projects do not disproportionately impact a community's right to a safe and clean environment. The project poses no significant risks to the health of nearby residents or the surrounding environment. Rather, the project is expected to improve long-term environmental conditions in the area benefiting up and downstream habitats, and recreational activities that depend on their quality.

Section I: Executive Directive and Agency Guidance

This appendix addresses environmental justice concerns raised by the Ashtabula River Proposal. In general, environmental justice refers to fair treatment of all races, cultures, and income levels with respect to development, implementation and enforcement of environmental laws, policies, and actions.

At the federal level, the obligation of government agencies to take environmental justice into account is outlined in Executive Order 12898. The Order signed by President Clinton on February 11, 1994, calls for federal agencies to incorporate environmental justice considerations in decision-making activities. Significantly, Section 1-101 of the Order states:

> "... each Federal Agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and environmental activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands."

In a memorandum accompanying Executive Order 12898, President Clinton also directed agencies to analyze "the environmental effects, including human health, economic and social effects, of federal actions, including effects on minority communities and low-income communities, when such analysis is required by the National Environmental Policy Act of 1969." To carry out this objective, on July 19, 1995, EPA issued "Draft Guidance for Consideration of Environ-mental Justice in Clean Air Act Section 309 Reviews." This document lists factors and conditions that may be considered in preparing environmental justice evaluations in environmental impact statements.

This appendix addresses environmental justice issues in terms of area demographics, ecological, environmental and health impacts, and the proposed site's logistical impacts on nearby residents as specified in Executive Order 12898. To provide context, a number of subjects addressed at length elsewhere in this EIS are briefly summarized.

Section II: Project Description

A. Background.

The Ashtabula River and Harbor project (Project), located in Ashtabula County, Ohio, has filled, over time, with an accumulation of sediment, some of which is contaminated with hazardous and other industrial materials. This accumulation restricts commercial navigation, inhibits economic growth, impairs up- and downstream aquatic habitats, and potentially threatens public water supplies.

The project consists of two main components: (1) Dredging of the River *(including transfer/dewatering/transfer)*, and (2) Disposal of the sediment at the proposed CDF site.

The proposed dredging plan calls for the removal of approximately 700,000 cubic yards of sediment from the River. The extent of the dredging stretches from the upper turning basin near the mouth of Field's Brook to the lower turning basin. The sediments will be removed over the course of five years using a closed clam-shell dredge that will lift the sediments into a barge. The barge will float to a specially constructed transfer dock constructed at the ConRail facility. At the transfer facility the sediments will be dried out and then placed into trucks and shipped to a confined disposal facility (CDF). *Reference Figures 1 and 2.*

The proposed CDF Site is a *32* acre parcel that is generally east of the Harbor near *State* Road and just south of Lake Road. The parcel is within an area owned *by State Road Development Corp.* The property is a *former industrial (demolished/remediated brownfield) site.*

Section III: Description of Area Near Site

The Ashtabula Harbor is located at the mouth of the Ashtabula River on the south shore of Lake Erie in eastern Ohio. The Harbor and lower Ashtabula River contain both commercial and recreational development, but little residential development along the waterfront. There are over 6000 residents within a one-mile radius of the dredging project, but most of those are west of the harbor extending into the historic harbor district. Other residential development has occurred in East Ashtabula, south, and east of the ConRail Bridge Yard. The preferred disposal site is located in an industrial setting east of the Harbor. The area is dominated by industrial facilities and *(further east)* abandon farmland. This disposal site is a considerable distance from *any residences.*

Section IV: Demographic Factors

Demographic data from 1990 indicates that Ashtabula County had a total population of 99,821. The City of Ashtabula had a 1990 Census-based population of 2 1,633. Based on a projected 1994 population of 101,939, the 4,065 members of the minority population comprise just under 4% of the total population. The County population is also 52% female and 48% male. (1990 Census data). Thus, a more extensive environmental justice analysis within this draft EIS is not merited based on the County race or sex demographics.

[NOTE: See Table 9 Appendix T, p.30, "Demographic Profile of Ashtabula County"]

In 1991, the civilian work force in Ashtabula County was 41,452 with an unemployment rate of approximately 10%. The unemployment rate has declined, dropping to below 8% by 1995. Major employment sectors include: Manufacturing (29%), Wholesale/Retail (20%), Health Service (10%), Agriculture (4%), Finance (3%), Insurance (3%), Real Estate (3%), and Public Administration (2%). In 1990, the personal income (per capita) in Ashtabula County was $13,499. Median family income was $28,610 in 1989 ranking Ashtabula County 65th out of 88 counties. The Poverty Rate, which is the percentage of the population living at or below the federally defined poverty level, was 17.1% in 1995 (Council for Economic Opportunities Report). This Poverty Rate is down from a high of 18.7% in 1993. Thus, based on the Poverty Rate, it is appropriate to consider the impacts on low income residents in more detail at this point.

There are over approximately 6,460 residents within a one-mile radius of the dredging project based on the 1990 STF3A Census data summarized in block groups. Approximately 41% of those people live in households with income levels less than twice the amount set for poverty level income. Approximately half of those people have incomes at or below the poverty income level. The two largest residential areas potentially affected by the dredging are the historic Harbor District and East Ashtabula. See *(Figure 3)* Map 1, "Census Blocks Within One Miles of Fields Brook" attached.

Section V: Impacts on Community

A. Logistics and Social Impacts.

Dredging activities associated with the proposed CDF will have an impact on the immediate area. As with any construction project, vehicle and equipment traffic will be ongoing, especially during the construction stage of the project. During dredging operations, traffic within the River will also increase with barges delivering material to the site.

Traffic delays and rerouting due to the influx of vehicles and drawbridge use on Highway 41 are also a probability. However, virtually all of the motorists affected will be workers at the site or one of the immediately adjacent facilities, or possibly truck operators making deliveries to these locations. Nearby residents can be expected to continue to use other routes to come and go. At present, there is modest pedestrian traffic through the project area. Additional traffic planning will be incorporated into the detailed design to avoid traffic congestion problems. The roads proposed for use are not residential in nature and should pose no greater burden on the residents than on the general population using these commercial thoroughfares. No significant impact on low-income community activities appears imminent.

Social impacts on the community will not be significant. The proposed CDF site will not require displacement of businesses or private residences. Nor will access to critical local institutions such as churches, community centers, or government offices be impacted. The CDF site has historically been used for industrial purposes only, and the proposed dredging project is not expected to have any sort of negative impact on nearby facilities.

B. Local Ecosystem.

A short-term ecological impact on the River is expected. Dredging will result in increased turbidity and decreases in dissolved oxygen levels. However, long-term improvements in water quality and benthic communities will almost certainly result from the removal of the contaminated sediment. The improved aquatic environment should, in turn, improve the size, diversity and health of fish communities in the Ashtabula River.

The present CDF site is of nominal ecological value. Its history of past agricultural or heavy industrial use has resulted in unexceptional plant habitat and limited use by animal life. Herbaceous plants, small trees, and some shrubs are present, though regarded as ecologically insignificant. There is minimal evidence of bird or small mammal *use or* nesting activity at the site.

Somewhat more common--and unlikely to be significantly affected by the CDF--are waterfowl migrating along the shore of Lake Erie and the Northeastern Ohio's inland ponds and river network. However, the lack of suitable habitat has, to this point, not attracted much waterfowl interest.

Dredged sediments deposited at the CDF pose extremely little risk to either surface water or drinking water used by area residents. Disposal plans for waters used in pretreatment and treatment are outlined at length elsewhere in this EIS.

At present, the River offers plentiful recreational use. There is some swimming and considerable recreational boating. Subsistence fishing is discouraged, with warning signs posted in the Harbor area. Once the dredging is complete, improved water *and sediment* quality and a deeper channel will enhance the potential use of the area for recreational activities.

C. Public Health Factors.

The project will not significantly increase environmental health risks faced by local residents. Some volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) will be released to the air during sediment dredging and disposal. However, these represent a small increase in current releases in the area and will not significantly increase background levels. As mentioned previously, a low level of volatilized PCBs and PAHs will also be released into the air during disposal operations. Analysis done for this and other dredging projects indicates that the contaminants of concern, PCBs and volatile organics, will not present a significant risk within 1000 feet of the CDF or point of dredging in the River before being dispersed into the atmosphere. Odors from organic decomposition should not reach more than several hundred feet onto the shore even under the worst case circumstances.

With simple standard and proper protection measures/precautions, handling of material with low level radionuclides will not present a substantial risk to workers or the public. Material will be safely and properly disposed of. A health and safety plan is developed for and included in project design and plans and specifications.

The disposal site is situated in the middle of a heavy industry zone. The risk evaluation indicates that the proposed CDF site is not likely to add to the current pollutant load in a significant way. When the project is complete, it is expected that ecological conditions at the disposal site should be similar *or better* to those disrupted. The public is also not likely to be at risk of dermal contact. A seven foot cyclone fence currently encloses the CDF site to deter trespassers. Once the CDF begins operation, security guards will be posted. As sediment is placed in the CDF, a berm will be constructed around its perimeter, further preventing migration of contaminants. Some of the adjacent industrial properties are similarly fenced and monitored with apparently no problems reported by local residents.

D. Additional Exposures.

Based on past Agency experience, three additional exposure issues have been considered: noise, odors, and visual obstructions.

Concerns about noise stem from the expected influx of construction and material handling equipment at the CDF property. A scientific analysis of noise impacts on nearby communities has not been conducted. However, due to the distance from residential areas and the use of conventional construction equipment, the CDF is not likely to result in significant noise impacts.

Landfill sitings in other communities have raised questions about odors. In the case of the proposed CDF, this is not likely to be a nuisance problem. The likely pathways of odors from the CDF are projected to disperse within one mile of the site. Because the principle odor-causing agent contained in the channel sediment is PAHs, the actual odors, if any, will be similar to the scent of motor oil exposed on a beach.

On an exceptionally hot and windy day, it is conceivable that odors from the site could drift into surrounding communities. However, on those occasions, the perceptible differences in odor conditions are expected to be insignificant in all but the most exceptional circumstances. Significantly, a recent Army Corps dredging project in Michigan City, Indiana raised similar questions. To date, the project has not had a noticeable impact on area residents.

When complete, the CDF will reach a height of about 30 feet. Without a doubt, the CDF will be more visible than the current flat, overgrown site. However, in contrast with the adjacent highway, industrial, the site will not be inordinately tall. At a height of no more than three stories, the CDF will not have much visual impact on residential areas at least one-half to one mile away.

E. Economic Impacts.

Currently, the lack of dredging in the river has resulted in transportation difficulties for some of the commercial and recreational concerns. Economic development in the Harbor area has been slowed to some degree because of concerns over the loss of beneficial uses caused by the contaminated sediments.

In contrast, the proposed CDF (and dredging activity) aims to enhance economic development opportunities by increasing marine transportation and recreation capability in the area.

F. Public Outreach.

Public participation in the project design and siting process has been exceptional. Meetings discussing design of the project and siting of a the disposal facility have been held at least once a month and are open to the public. The disposal site candidates were announced to the public in 1996 through a press conference and those candidate sites received widespread press coverage. Public outreach will continue through the NEPA process, which includes: release of the plan to the community, several public meetings, and the response to comments received on the Environmental Impact Statement.

Section VI: Conclusions

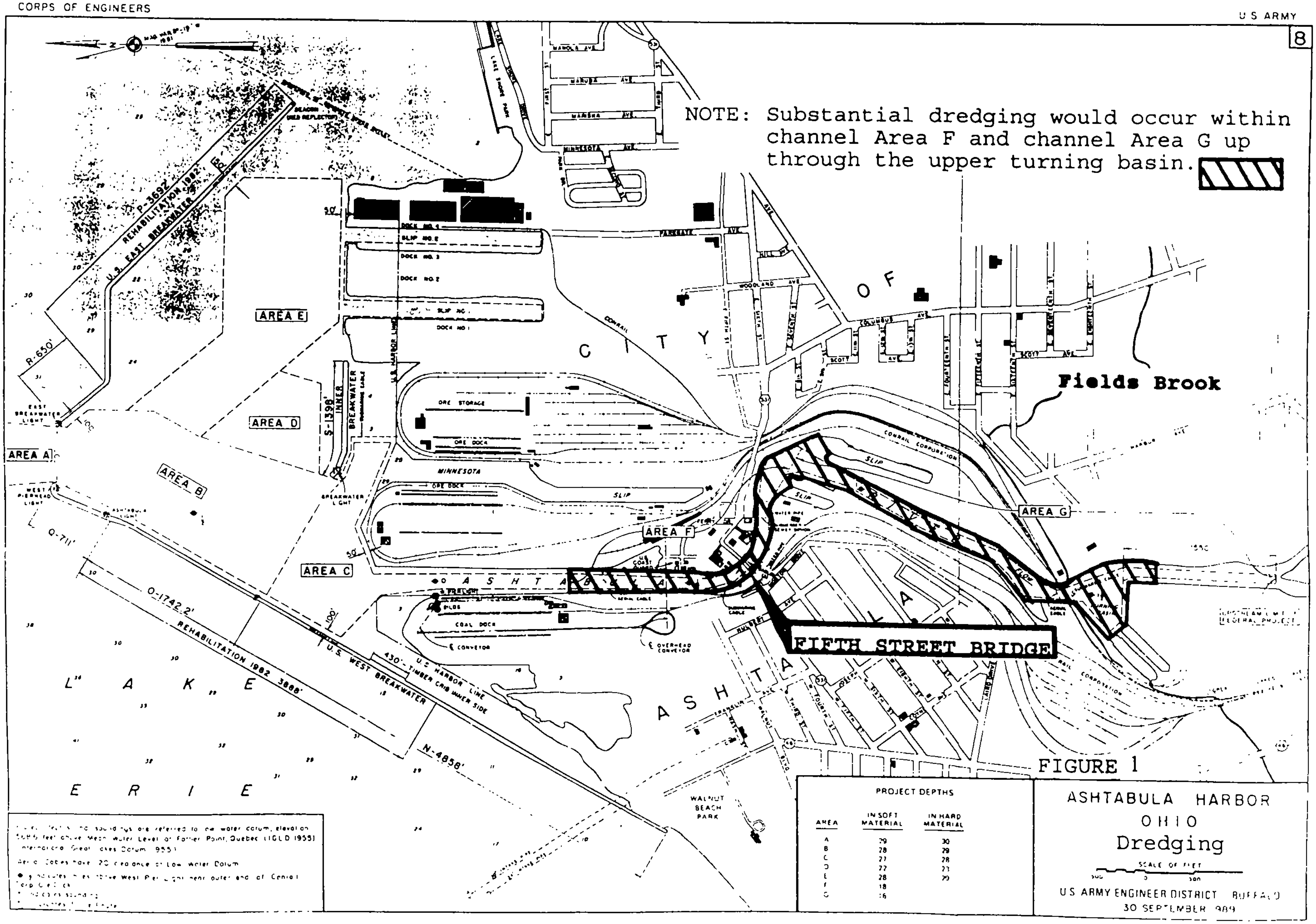
Taking all of the above factors into consideration, the Comprehensive Management Plan for the proposed Ashtabula River dredging project and proposed CDF does not conflict with the federal government's policy on environmental justice.

Overall, and relying on extremely conservative calculations of environmental risk factors, the CDF appears unlikely to pose significant increased hazards. In fact, the CDF should improve environmental conditions in the area. Dredging will remove contaminants from the Canal and reduce the risk of contaminants in public drinking water intakes. Stormwater runoff will be monitored and controlled. Opportunities for new economic activity will be enhanced. Residential areas are situated far enough away to be out of recognized pollutant pathways and will not be adversely affected.

Therefore, it is U.S. EPA's view that the inhabitants of Ashtabula--encompassing a wide spectrum of income levels and socio-economic backgrounds will realize cumulative environmental and economic benefits from the dredging of contaminated sediment from the River and the siting of the proposed CDF.

CORPS OF ENGINEERS

U S ARMY



PROJECT DEPTHS

AREA	IN SOFT MATERIAL	IN HARD MATERIAL
A	29	30
B	28	29
C	27	28
D	27	[illegible]
E	28	29
F	18	
G	16	

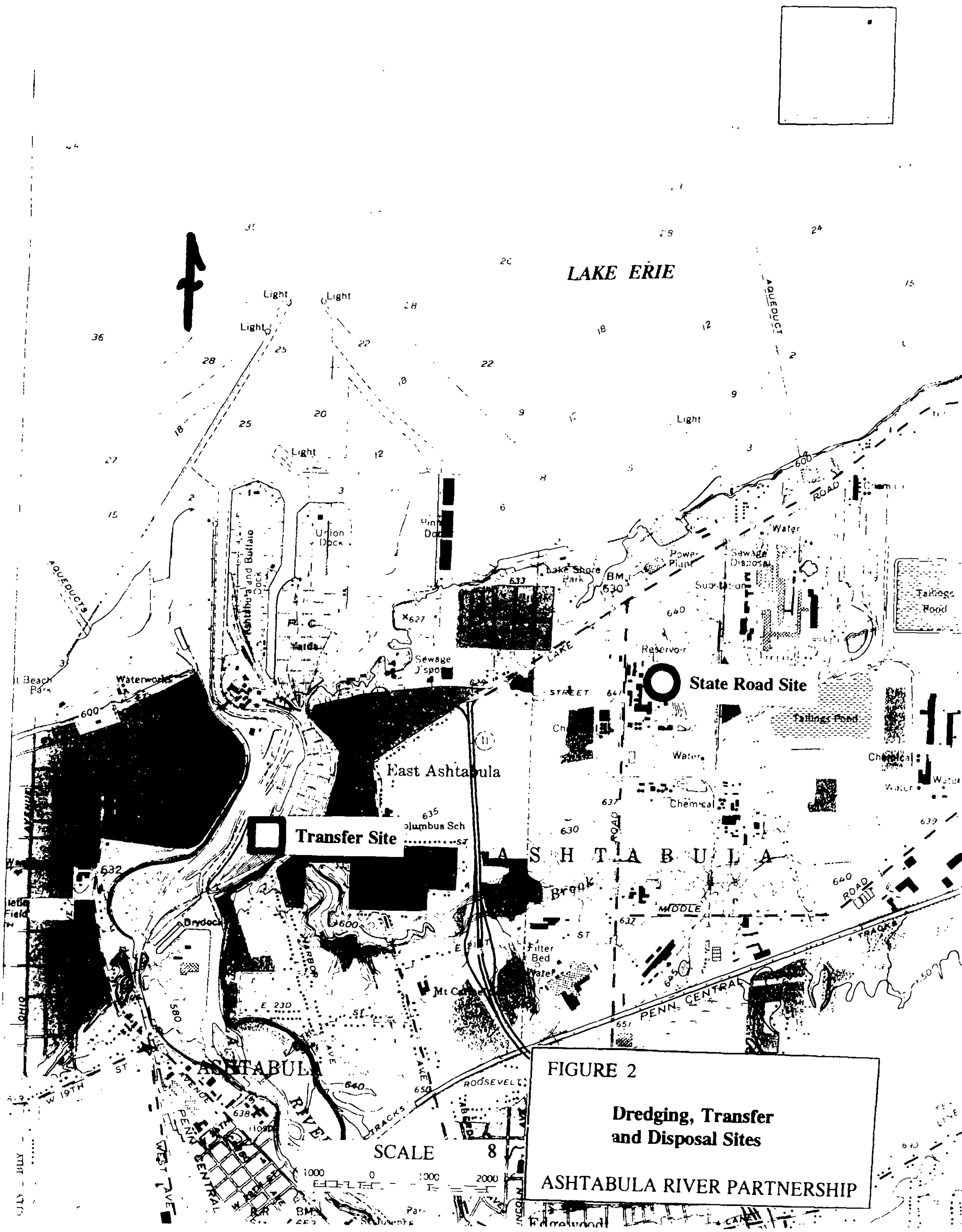


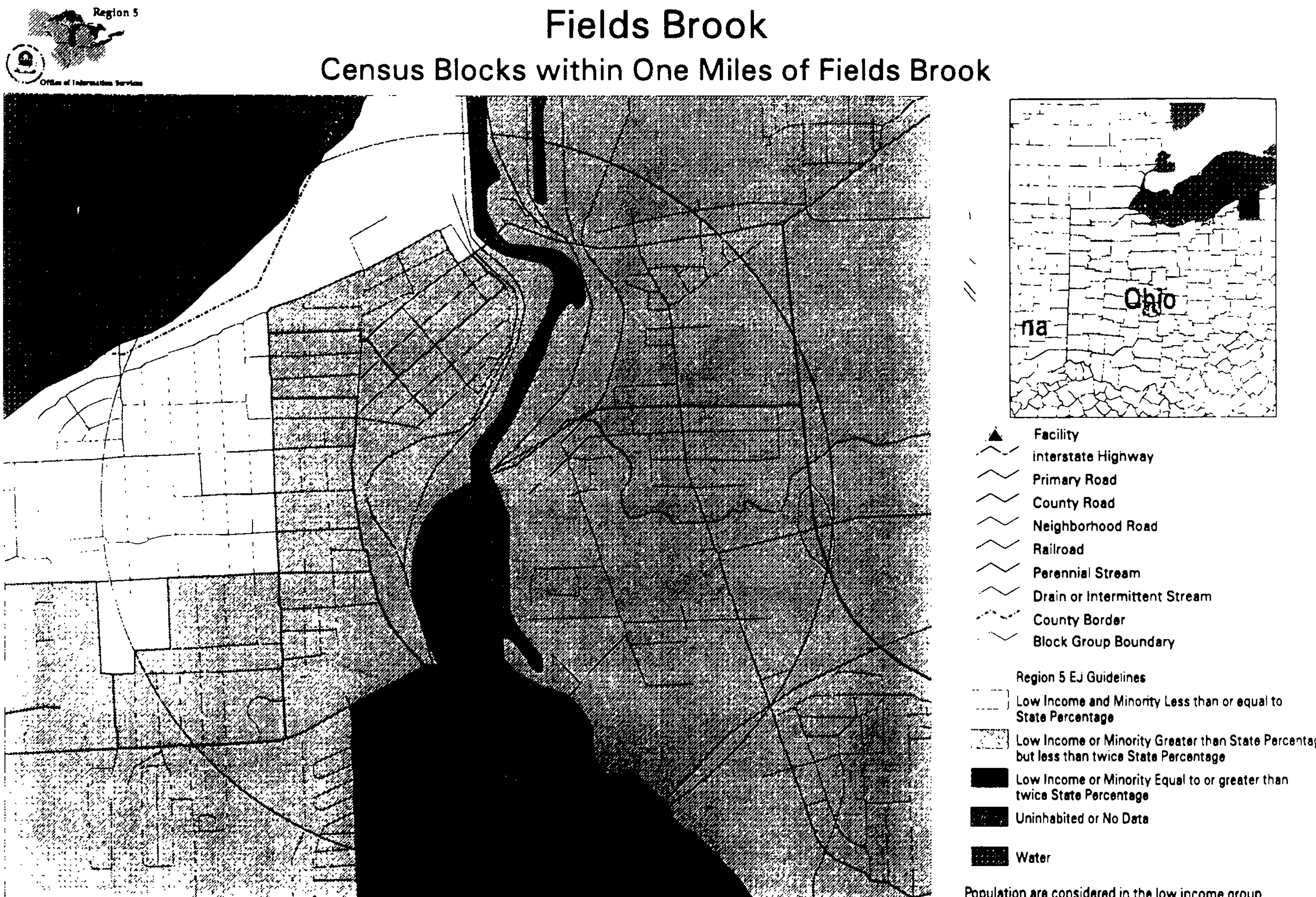
FIGURE 2

Dredging, Transfer and Disposal Sites

ASHTABULA RIVER PARTNERSHIP

Fields Brook

Census Blocks within One Miles of Fields Brook



TOTAL POPULATION 6,460	PERCENT MINORITIES 7.8	PERCENT POVERTY 21.0	PERCENT NATIVE POPULATION 0.2
PERCENT LOW INCOME 41.2	PERCENT CHILDREN 8.2	PERCENT NO ENGLISH 1.8	PERCENT HOUSING PRE 1980 98.9

State Low Income Population Percentage: 29   State Minority Population Percentage: 13

Population are considered in the low income group when the household income is less than double the poverty level. Minorities are considered everyone but white non-hispanic.

The data are summarized at the block group level, from 1990 STF3A data.

FIGURE 3 (MAP 1)