Final Report

File

Feasibility Study
Ley Creek Dredged Material Area Site

General Motors Corporation
Syracuse, New York

March 1996

O'BRIEN & GERE ENGINEERS, INC.

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5000 Brittonfield Parkway
Syracuse, New York 13221

Contents

Tables

Figures

Appendices

A. Leachability Study Data - First Study
B. Leachability Study Protocol - Second Study
C. Leachability Study Data Validation Report - Second Study
D. Hazard Quotient Evaluation - Great Blue Heron
E. Low Temperature Thermal Desorption Cost Estimate Documentation

Exhibits

A. Topographic and Property Boundary Survey (under separate cover)
B. Zoning Map of the Town of Salina
C. Flood Boundary and Floodway Map
D. Ley Creek Interceptor Sewer Installation Data
E. NYSDEC Comments - Hazard Quotient Evaluation
F. Biodegradation Pilot Study Progress Report

Executive Summary

The Ley Creek Dredged Material Area (site) is located along the south bank of Ley Creek between Townline Road and the Town of Salina Highway Garage in Onondaga County, New York. Materials dredged from Ley Creek were placed at the site during channel improvement programs conducted by Onondaga County. The New York State Department of Environmental Conservation (NYSDEC) classified the approximately 1,000 feet length of dredged materials on the south bank of Ley Creek, beginning at the General Motors Corporation (GM) Outfall 003 and extending west, as a Class 2 site in the NYS Registry of Inactive Hazardous Waste Disposal Sites. A property boundary survey, performed at the study area in 1995 as part of the FS, indicated that the following four parties own portions of the study area: County of Onondaga, Niagara Mohawk Power Corporation, The Pfaltzgraff Co., and the New York State Thruway Authority. Property boundaries are outlined in the topographic and property boundary survey map, presented in Exhibit A. It should be noted that reference to the State of New York on the survey map is to the Thruway Authority; it should also be noted that Ryacuss, referenced on the survey map, later changed its name to Syracuse China Corporation, which later merged with The Pfaltzgraff Co.

A Remedial Investigation/Feasibility Study (RI/FS) was conducted by O'Brien & Gere Engineers, Inc. on behalf of GM, in accordance with an Administrative Order on Consent (#A7-0239-90-07) between GM and NYSDEC and the RI/FS Work Plan (O'Brien & Gere Engineers, 1992), which was approved by NYSDEC on June 3, 1992 (Schick, 1992). Investigations have addressed the site and the area between Factory Avenue and Ley Creek extending approximately 4,000 feet west of the western site boundary (study area). The results of the RI were documented in the September 1993 revised RI Report (O'Brien & Gere Engineers, 1993[a]) which incorporated revisions approved by NYSDEC on August 25, 1993 (Schick, 1993) to the February 1993 initial RI Report.

The FS was conducted to formulate and evaluate remedial alternatives for the site. The objective of this FS was to develop, screen and evaluate remedial alternatives for the site in order to present sufficient information for decision makers to compare alternatives and select a remedy. Remedial action objectives were developed for the site based on risk considerations and applicable or relevant and appropriate requirements (ARARs). A FS Report was submitted to NYSDEC on November 24, 1993 (O'Brien & Gere Engineers, 1993[b]). Responses to NYSDEC comments were provided in an Addendum to the FS Report, and submitted as the Revised FS Report on May 20, 1994 (O'Brien & Gere Engineers, 1994). Following disagreement over responses in the Revised FS Report, and receipt of comments from one of the property owners, Onondaga County, a meeting was held between GM and NYSDEC on July 20, 1994. A redline/strikeout draft final FS Report was submitted to the NYSDEC on October 7, 1994 which incorporated the agreements reached during the July 20, 1994 meeting with NYSDEC; the agreements reached were summarized in GM's August 17, 1994 letter to NYSDEC (Kochem, 1994[b]). NYSDEC provided comments on the redline/strikeout draft final FS Report in a letter dated February 22, 1995. A topographic and property boundary survey was performed in the summer of 1995 for the FS. This document presents the final FS Report, which reflects the resolution of the issues raised in the course of discussions between GM and NYSDEC, including those technical comments made by NYSDEC in its letters of February 22, 1995 and December 13, 1995.

1.1 Dredged material/soil

The baseline human health risk assessment (RA) and Step I Fish and Wildlife Impact Analysis (FWIA) identified dermal contact and incidental ingestion of Ley Creek dredged material/soil as complete exposure pathways with no unacceptable human health risks and insignificant terrestrial wildlife risks based on current site conditions. A remedial action objective for dredged material/soil based on risk reduction was therefore not developed. The PCB Spill Cleanup Policy under the Toxic Substances Control Act (TSCA) establishes a cleanup level for soil in restricted access areas at 25 mg/kg polychlorinated biphenyls (PCBs) by weight and was identified as "To Be Considered" material (TBC). The 25 mg/kg cleanup level for PCBs is relevant for surface dredged material/soil at the study area, which constitutes a complete human health and environmental exposure pathway. Minimizing contact with surface dredged material/soil containing greater than 25 mg/kg PCBs was therefore developed as a remedial action objective.

In addition, although it was concluded that current study area conditions likely meet the three criteria used to develop cleanup objectives outlined in NYSDEC's Division Technical and Administrative Guidance Memorandum

(TAGM), *Determination of Soil Cleanup Objectives and Cleanup Levels* (NYSDEC, 1994), alternate cleanup levels of 1 mg/kg in surface soils (top 1 ft) and 10 mg/kg in subsurface soils (depths greater than 1 ft) were also evaluated to address NYSDEC's TAGM. Also, one of the study area property owners, Onondaga County, has identified concerns related to its need to conduct future activities on the property (Pirro, 1994). Onondaga County uses the property as part of the Ley Creek Flood Control Project Area and as a utility corridor. These concerns were evaluated during the development of alternatives.

1.2. Sediment

The RA identified no unacceptable human health risks for the sediment exposure pathway (human dermal contact and incidental ingestion) based on current site conditions. In the FWIA, the sediment exposure pathway was identified as complete for aquatic organisms in Ley Creek, and the food chain exposure pathway was identified as complete for piscivorous wildlife. PCB concentrations measured in sediments at the study area during the RI do not exceed acute aquatic toxicity NYSDEC sediment criteria for PCBs; detectable PCB concentrations measured in sediments at the study area do exceed wildlife residue NYSDEC sediment criteria for PCBs. Evaluation of the hazard of PCB levels in study area surface water, sediments, and fish to the great blue heron, however, indicated no unacceptable risks to piscivorous wildlife inhabiting or consuming biota in the study area. However, because of the continuing permitted SPDES discharge of PCBs from the GM Outfall 003 to Ley Creek and the association of these discharged PCBs with the GM main plant site, NYSDEC has decided that its decisions relative to remediation of sediments will be made as part of the GM main plant site RI/FS (Schick, 1994[a] and [b]). Resolution of NYSDEC comments on the hazard quotient evaluation will also be addressed during the main plant site RI/FS.

1.3. Ground water

Ground water does not constitute a complete exposure pathway for human or ecological receptors. Although ground water at the study area discharges to Ley Creek, the baseline RA concluded that the surface water exposure pathway was negligible compared to sediment/surface soil exposures, and that sediment/surface soil and fish ingestion exposure pathways did not present an unacceptable risk to human health or ecological receptors at the study area.

Detectable PCB concentrations in shallow unfiltered ground water at the study area exceeded the NYS Class GA ground water standard for PCBs. Because of the hydraulic connection of the shallow aquifer at the study area with impacted upgradient water at the GM main plant site, NYSDEC has decided that its decisions relative to remediation of ground water in the study area will be made as part of the GM main plant site RI/FS (Schick, 1994[a] and [b]). In the meantime a remedial action objective was developed to monitor PCB concentrations in shallow ground water.

1.4. Surface water

It was concluded in the baseline RA that surface water exposures were negligible compared to sediment/surface soil exposures, and that sediment/surface soil exposure pathways did not present an unacceptable risk to human health. The surface water exposure pathway was also identified as complete for ecological receptors. Based on NYSDEC's assessment of poor overall Ley Creek water quality, low detected PCB concentrations in surface water, and the great blue heron risk evaluation, it was concluded that surface water does not present an unacceptable risk to piscivorous wildlife inhabiting or consuming biota in the study area. Although the NYS Class B surface water standard for PCBs was exceeded in Ley Creek in the vicinity of GM Outfall 003, the main contributor to the exceedence of the Class B standard was likely the GM Outfall 003 discharge, which was demonstrated to be a compliant SPDES discharge during RI storm sampling and routine SPDES monitoring. Furthermore, future decreases in PCBs discharged through GM Outfall 003 are anticipated with future upgradient remediation on the GM property.

Fish ingestion was identified as a complete human health exposure pathway in the RA. Risks associated with this pathway, however, were concluded to be acceptable. In addition, it was concluded from evaluation of risk to the great blue heron that PCB concentrations present in study area fish do not present an unacceptable risk to piscivorous wildlife inhabiting or consuming biota in the study area.

Because of the continuing permitted SPDES discharge of PCBs from the GM Outfall 003 to Ley Creek and the association of these discharged PCBs with the GM main plant site, NYSDEC has decided that its decisions relative to remediation of surface water will be made as part of the GM main plant site RI/FS (Schick, 1994[a] and [b]).

1.5. Air

PCBs were not detected in air samples collected during earlier investigation, and air was subsequently concluded to be an incomplete exposure pathway for human and ecological receptors at the study area. A remedial objective to address air at the study area was accordingly not justified.

1.6. Summary

In summary, the following remedial action objectives were developed for the study area:

- Minimize direct contact with dredged material/soil containing PCBs at concentrations greater than 25 mg/kg.
- Monitor PCB concentrations in shallow ground water.

Additionally, alternate soil cleanup objectives for PCBs of 1 mg/kg (surface) and 10 mg/kg (subsurface) were evaluated to address NYSDEC's TAGM, together with Onondaga County concerns as a property owner.

Thirteen remedial alternatives, consisting of seven main alternatives with variations, were developed. The screening of alternatives step was not performed because seven main alternatives with variations was a manageable number for detailed analysis. These alternatives were evaluated in detail relative to the following criteria: overall protection of human health and the environment; compliance with applicable or relevant and appropriate requirements (ARARs); long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; cost; state acceptance; and community acceptance. The remedial alternatives evaluated in detail in this FS included the following:

- No Action (Alternative 1),
- Containment (Alternatives 2A, 2B, 2C),
- Excavation and Disposal (Alternatives 3A, 3B),
- Treatment - On-Site Incineration (Alternative 4),
- Treatment - Thermal Desorption (Alternatives 5A, 5B),
- Treatment - *In Situ* Biological (Alternative 6), and
- Excavation, Disposal, and Containment (Alternatives 7A, 7B, 7C).

It was concluded that Alternative 2A was the appropriate alternative to be recommended for implementation at the study area; Alternative 2A meets remedial action objectives and provides the best balance of performance with respect to the evaluation criteria.

Remedial Alternative 2A, a containment alternative, is the recommended alternative which attains remedial action objectives and provides the best balance of performance with respect to the evaluation criteria. Based on remedial action objectives, study area conditions, NYSDEC's hazardous waste landfill closure performance requirements, and USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990), it was concluded a 12 inch vegetated soil cover was the appropriate cover design for the study area. Alternative 2A includes covering the dredged material/soil containing greater than 25 mg/kg PCBs on the surface with a 12 inch vegetated soil cover, monitoring PCB concentrations in shallow ground water, and implementation of deed restrictions and fencing to restrict access to remaining dredged material/soil at the study area with PCB concentrations less than 25 mg/kg. Alternative 2A also includes the following activities proposed to address Onondaga County concerns related to future property use:

- lining of cross culverts and construction of pathways to access cross culverts;

- modification of sanitary sewer manholes to match final study area grades, installation of asphalt pads around each manhole for access, and modification of fencing to allow manhole access without access to the remainder of the study area; and

- construction of an access road on the south bank of Ley Creek to provide a working area for future creek maintenance activities.

Alternative 2A would result in 11 acres of clean surface soils at the study area and would involve only minor disturbance of PCB-contaminated dredged material/soil during regrading activities; remedial worker contact with PCBs would therefore be minimal. Alternative 2A would provide for approximately the same level of overall protection of human health and the environment as Alternatives 2B and 2C, through use of different equally protective controls. Further, Alternative 2A would not require disturbance of dredged material/soil, as would Alternatives 3A, 3B, 4, 5A, 5B, 7A, 7B, and 7C, and would consequently not result in risks associated with material excavation and transport. Alternative 2A would attain ARARs, and would be the most cost-effective alternative of the range considered. The preliminary estimated 30-year total present worth cost for implementation of Alternative 2A is approximately $1.7 million. These costs include an estimated total capital cost of approximately $1.2 million and an estimated annual operation and maintenance cost of approximately $35,000.

GM believes Alternative 2A is the appropriate remedial alternative for selection in accordance with the remedy selection criteria set forth in the NCP and NYSDEC's "TAGM on Selection of Remedial Actions at Inactive Hazardous Waste Sites" (NYSDEC, 1990). However, NYSDEC expressed a preference for a remedial alternative which reflected the PCB cleanup objectives of 1 ppm (surface) and 10 ppm (subsurface) set forth in NYSDEC TAGM 4046, entitled "Determination of Soil Cleanup Objectives and Cleanup Levels." In light of this preference, GM, without admitting the appropriateness of use of this TAGM's PCB standards under applicable legal or technical requirements, has developed a new remedial alternative, Alternative 8, which incorporates the use of the requested PCB standards. The new alternative, Alternative 8, involves the following:

- excavation and off-site disposal of dredged material/soil containing PCBs at concentrations greater than 50 parts per million (ppm);

- regrading of dredged material/soil in the floodway;

- construction of an access road along the south bank of Ley Creek to facilitate potential future dredging operations;

- grading and installation of a vegetated soil cover over approximately 17 acres of dredged material/soil containing PCBs at concentrations greater than 10 ppm in subsurface soils and 1 ppm in surface soils to minimize erosion and direct contact.

- installation of fence gates and gravel paths to provide access to Onondaga County sewer manholes;

- grading and piping of drainage swales crossing the site;

- fencing;

- land use restrictions precluding disturbance of soil cover;

- routine ground water monitoring;

- routine inspection and maintenance; and

- five-year reviews.

The preliminary estimated 30-year present worth cost for implementation of Alternative 8 is approximately $6.7 million. Estimated direct and indirect capital costs total approximately $3.6 million and $1.6 million, respectively. The estimated annual operation and maintenance cost is approximately $100,000.

1. Introduction

1.1. Objectives and overview

A Remedial Investigation/Feasibility Study (RI/FS) has been conducted for the Ley Creek Dredged Material Area in the Town of Salina, New York. The New York State Department of Environmental Conservation (NYSDEC) has classified the approximately 1,000 feet length of dredged materials on the south bank of Ley Creek, beginning at the GM Outfall 003 and extending west (site), as a Class 2 Site in the New York State (NYS) Registry of Inactive Hazardous Waste Disposal Sites. Investigations have addressed the site and the area between Factory Avenue and Ley Creek extending approximately 4,000 feet west of the western site boundary (study area).

The RI/FS was conducted by O'Brien & Gere Engineers, Inc. on behalf of the General Motors Corporation (GM) in accordance with an Administrative Order on Consent (#A7-0239-90-07; Order) between GM and NYSDEC. The RI/FS was conducted in accordance with the RI/FS Work Plan (O'Brien & Gere Engineers, 1992) approved by NYSDEC on June 3, 1992 (Schick, 1992). The results of the RI were documented in the September 1993 revised RI Report (O'Brien & Gere Engineers, 1993[a]) which incorporated revisions approved by NYSDEC on August 25, 1993 (Schick, 1993) to the February 1993 initial RI Report.

This document presents the FS Report, which sets forth the formulation and evaluation of remedial alternatives for the site. The objective of this FS was to develop, screen and evaluate remedial alternatives for the site in order to present sufficient information for decision makers to compare alternatives and select a remedy. Consistent with the approved RI/FS Work Plan, the FS was conducted in accordance with the Order, the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA), the United States Environmental Protection Agency's (USEPA) *Guidance for Conducting Remedial*

Investigations and Feasibility Studies under CERCLA (USEPA, 1988[b]), the *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP, 1990), USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990), and NYSDEC's revised *Technical and Administrative Guidance Memorandum on Selection of Remedial Actions at Inactive Hazardous Waste Sites* (NYSDEC, 1990).

The FS Report is organized into five sections, with accompanying tables, figures, and appendices. A brief overview of these sections follows:

Section 1 summarizes the information contained in the September 1993 revised RI Report. It presents information about the site such as its history and environmental conditions. Section 1 includes a description of the extent of contamination at the site.

Section 2 presents the development of remedial alternatives. Included in this section is the presentation of remedial action objectives, general response actions, and identification of volumes or areas of media. The identification and screening of remedial technologies which address the remedial action objectives are also discussed. Finally, Section 2 presents the evaluation of process options, the selection of representative process options and the assembly of those process options into remedial alternatives.

Section 3 presents the detailed analysis of remedial alternatives. Each alternative was evaluated with respect to the following criteria:

- overall protection of human health and the environment;
- compliance with applicable or relevant and appropriate requirements (ARARs);
- long-term effectiveness and permanence;
- reduction of toxicity, mobility, and volume through treatment;
- short-term effectiveness;
- implementability;
- cost;

- state acceptance; and
- community acceptance.

Relative comparisons of the alternatives based on the above criteria were also documented in Section 3.

Section 4 presents the conclusions and recommendations of the FS.

Section 5 presents a conceptual design of the alternative identified for implementation.

Tables were prepared to summarize information generated as part of this study. Figures prepared to help summarize and present key issues are included in the Report. Appendices include raw data, calculations, or other materials prepared by O'Brien & Gere Engineers which support information presented in the report.

1.2. Site description

The Ley Creek Dredged Material Area is located along the south bank of Ley Creek in the Town of Salina, Onondaga County, New York. A site location map and study area map are presented as Figures 1 and 2, respectively. In the vicinity of the site, Ley Creek is generally less than 15 feet wide and less than 2 feet deep. Dredged material generated during a channel improvement program conducted by the Onondaga County Department of Drainage and Sanitation lines the south bank of Ley Creek in the area of the site. A fence extends along the south side of the study area approximately 10 ft north of Factory Avenue. A 4-ft diameter sanitary sewer runs through the southern portion of the site, close to Factory Avenue.

A property boundary survey, performed at the study area in 1995 as part of the FS, indicated that the following four parties own portions of the study area: County of Onondaga, Niagara Mohawk Power Corporation, The Pfaltzgraff Co., and the New York State Thruway Authority. Property boundaries are outlined in the topographic and property boundary survey map, presented in Exhibit A. It should be noted that reference to the State of New York on the survey map is to the Thruway Authority; it should also be noted that Ryacuss, referenced on the survey map, later changed its name to Syracuse China Corporation, which later merged with The Pfaltzgraff

Co. The site is located within an area which is zoned industrial; a portion of the Town of Salina zoning map is presented as Exhibit B with cross-hatch marking to show the approximate area of the study area. The site is also located within a NYS Class II wetland (SYE 6) and within a 100-year floodplain. The 1982 Federal Emergency Management Agency Flood Boundary and Floodway Map is presented as Exhibit C.

Ley Creek drains an area of approximately 30 square miles. With the exception of the northeast portion, the Ley Creek drainage basin can generally be described as a highly urbanized area. Portions of the cities and towns of Syracuse, North Syracuse, East Syracuse, Cicero, Clay, Dewitt, Manlius, and Salina are located in the Ley Creek drainage basin. Numerous industries and businesses are also located in the Ley Creek drainage basin, including GM, Bristol-Myers Squibb Company, Carrier Corporation, Syracuse China Corporation, New Process Gear, and General Electric Company. Also located in the Ley Creek watershed are 14 miles of highway, eight interchanges, a service facility for the New York State Thruway, a Niagara-Mohawk Power Corporation electrical transfer station, Syracuse International Airport, and the Air National Guard's Hancock Field. Streets, shopping areas, parking lots, and buildings cover other areas of this watershed. The northeast portion of the watershed is relatively undeveloped. The large areas of impermeable surfaces in the Ley Creek watershed cause rapid runoff during storms, resulting in rapid water level changes in the creek.

Industrial effluent streams and urban storm water runoff discharge into Ley Creek. Eight discharges into Ley Creek are permitted which originate from Sunnyside Nursing Home, Oberdorfer Foundries, and Roth Brothers Smelting Corporation, all upstream of GM; Ley Creek Pump Station, Lyncourt Sewer District, and Syracuse China Corporation, downstream of GM; and GM. Potential upstream sources of polychlorinated biphenyls (PCBs) to Ley Creek include Roth Brothers Smelting Corporation, whose NYSDEC State Pollutant Discharge Elimination System (SPDES) permit includes PCB discharge limits (NYSDEC, 1989); Carrier Corporation, which discharges to Ley Creek's upstream tributary, Sanders Creek, and has been documented to use PCBs (NYPIRG, 1983); and Hancock Field, where PCB-contaminated soils were stored uncontained and used for fill material in a hole approximately 30 ft from Ley Creek (Post Standard, 1992).

Ley Creek flows to the west and discharges to Onondaga Lake; the average Ley Creek flow rate at the USGS gauging station near Park

Street for 11 years of record (1980 to 1990) is 32.9 ft^3/second (Colbert, 1992). The Onondaga County Department of Drainage and Sanitation monitors various water quality parameters and metals at the USGS gauging station near Onondaga Lake. In 1983, Ley Creek discharged less than 10% of the total estimated annual loading of all monitored pollutants to Onondaga Lake except biochemical oxygen demand (BOD), silica, and lead (10.5%, 10.5%, and 12.2%, respectively) (Calocerinos & Spina, 1984).

1.3. Site history

Prior to the early 1970's, the combination of poor channel conditions and large impermeable areas in the Ley Creek watershed caused extensive flooding, some of the worst of which was near the GM facility in 1969 (Calocerinos and Spina, 1969). The formation of the Ley Creek Drainage District and clearing and dredging of the channel occurred after the 1969 flooding event. Dredging of Ley Creek was performed by the Onondaga County Department of Drainage and Sanitation. In 1970, the section of the creek between Seventh North Street and Route 11 was dredged. Portions of the creek between Seventh North Street and Onondaga Lake were dredged in 1971. Ley Creek was dredged from Townline Road to Onondaga Lake in 1975. In 1983, the section of the creek between Townline Road and Route 11 was dredged (EDI, 1985[b]). Dredged material generated during these activities was placed along the south bank of the creek or used for land restoration projects.

A hydrogeologic investigation performed by EDI Engineering and Science (EDI) pursuant to a SPDES Consent Order indicated the presence of PCBs in the dredged material at the site. One source of the PCBs is believed to have originated from materials previously used in hydraulic equipment for die casting operations at the GM facility (EDI, 1985[a]).

In 1985, EDI also completed a program to evaluate the occurrence and concentration of PCBs in the sediments and water of Ley Creek. Sediment and water samples were collected at 500 foot intervals along a 4,000 foot length of Ley Creek, which included a 1,000 foot length upstream of GM Outfall 003 and a 3,000 foot length downstream of GM Outfall 003. During this study, fourteen fish inhabiting Ley Creek were caught and analyzed for PCBs. The pattern of PCB occurrence observed in sediments was irregular; the irregularity was attributed to the Ley Creek dredging program completed in 1983. The report cited background information indicating that Aroclors 1242 and 1248, which occurred in GM effluent, were not identified in Onondaga Lake fish, which contained PCB Aroclors 1016, 1254, and 1260 (EDI, 1985[b]).

Subsequent to the completion of the EDI study, NYSDEC requested that GM perform a more detailed study of the area between Factory Avenue and Ley Creek. Pursuant to NYSDEC's request, GM completed an investigation in 1987 of dredged material/soil and ground water in the area between Factory Avenue and Ley Creek beginning at Townline Road and continuing for 1,600 feet downstream. Ground water flow was determined to be north towards Ley Creek. PCBs were detected in dredged material/soil and ground water samples (O'Brien & Gere Engineers, 1987[a]).

As a result of the 1987 investigation, NYSDEC decided that a more comprehensive evaluation of the Ley Creek dredged material/soil would be necessary to define the extent of PCBs along the north and south banks of Ley Creek and evaluate the impacts to public health and the environment. GM completed a field investigation of the site in 1989 which included ground water, dredged material/soil, sediment, and surface water sampling (O'Brien & Gere Engineers, 1989).

In its comments on the Field Investigation Report, NYSDEC requested: (i) additional investigatory work be performed at the site to complete the characterization of the areal and vertical extent of contamination present and (ii) the performance of a habitat based assessment (Kelly, 1989). GM and NYSDEC signed an Administrative Order on Consent for performance of an RI/FS at the site, effective May 23, 1991. Based on NYSDEC's Field Investigation Report comments and on several meetings between GM and NYSDEC, a Work Plan was developed for an RI/FS for the site (O'Brien & Gere Engineers, 1992) and approved by NYSDEC on June 3, 1992 (Schick, 1992). RI sampling activities commenced in July 1992, and the RI was completed in accordance with the RI/FS Work Plan (O'Brien & Gere Engineers, 1992). The September 1993 revised RI Report (O'Brien & Gere Engineers, 1993[a]) incorporated revisions approved by NYSDEC on August 25, 1993 (Schick, 1993) to the February 1993 initial RI Report.

A FS Report was submitted to NYSDEC on November 24, 1993. NYSDEC provided comments on the FS Report in letters dated January 14, 1994 (Schick, 1994[a]) and April 21, 1994 (Schick, 1994[b]). Responses were prepared and provided in an Addendum to the FS report and submitted to NYSDEC as the revised FS Report on May 20, 1994 (Kochem, 1994[a], and O'Brien & Gere Engineers, 1994). In a June 9, 1994 letter, NYSDEC expressed disagreement with the responses in the revised FS report. Also, in a letter dated June 28, 1994, one of the property owners, Onondaga County, expressed concerns related to future uses of the property and possible site remedial alternatives (Pirro, 1994). Following these developments, GM and NYSDEC held a meeting on July 20, 1994 for the purpose of reaching a resolution on outstanding issues regarding the FS Report. A redline/strikeout draft final FS Report was submitted to the NYSDEC on October 7, 1994 which incorporated the agreements reached during the July 20, 1994 meeting with NYSDEC; the agreements reached were summarized in GM's August 17, 1994 letter to NYSDEC (Kochem, 1994[b]). NYSDEC provided comments on the redline/strikeout draft final FS Report in a letter dated February 22, 1995. A topographic and property boundary survey was performed in the summer of 1995 for the FS.

GM submitted a proposed conceptual remedial design to NYSDEC on August 30, 1995 which represented a remedial program which GM was willing to implement as a matter of compromise and which GM and NYSDEC would likely be able to accept. NYSDEC provided comments on the proposed conceptual remedial design and the FS on December 13, 1995. This document presents the final FS Report, which reflects the resolution of the issues raised in the course of discussions between GM and NYSDEC, including those technical comments made by NYSDEC in its letters of February 22, 1995 and December 13, 1995.

1.4. Site conditions

The September 1993 revised RI Report (O'Brien & Gere Engineers, 1993[a]) contains a detailed summary of investigatory activities performed and data generated at the study area. A concise summary of study area conditions is presented in this section.

1.4.1. Geology and hydrogeology

A geologic cross section of the study area has been constructed from test boring logs and is shown in Figure 3. A review of the data indicates that the study area geology is characterized by the dredged material at the surface, and native soils consisting of silts, clays and fine-grained sand deposits. These fine-grained fluvial and lacustrine sediments overlie dense glacial till. The dredged materials deposited along the creek banks are comprised of these fluvial and lacustrine sediments. The depths of fluvial and lacustrine sediments range from 4 feet to 12 feet below grade with a thickness ranging from 5 feet to 25 feet. The hydraulic conductivity in the fluvial and lacustrine sediments range from 2.65 x 10^{-6} to 2.63 x 10^{-3} cm/sec.

The glacial till unit underlying the fluvial and lacustrine deposits consists of dense reddish brown clayey silt with sand and imbedded gravel fragments. On-site, the till layer ranges in depth from approximately 11 feet to approximately 30 feet below grade (Figure 3). Shale bedrock was encountered at between approximately 30 and 35 feet below grade.

Ground water elevation data were used to conclude that, in general, the direction of shallow ground water flow is to the north toward Ley Creek. Ground water elevations indicate an upward flow potential exists between the upper fluvial and lacustrine deposits and the underlying till. An average ground water flow velocity in the shallow zone was calculated to be 0.08 ft/day (29 ft/yr) assuming an average study area-wide hydraulic conductivity for materials in the shallow aquifer of 9.5 gpd/ft^2, an average hydraulic gradient of 0.022 ft/ft, and an estimated porosity of 0.35.

1.4.2. Investigatory data summary

Dredged material/soil. Historical dredged material/soil data compiled from the 1986/87 Hydrogeologic Investigation, 1988/89 Field Investigation, and 1993 RI are presented two-dimensionally on Figure 4. Dredged material/soil samples were obtained from the 55 borings that were completed between November 10, 1986 and December 4, 1992; surface dredged material/soil samples were also obtained from five locations during the RI. The compiled historical data indicate that PCBs are dispersed in dredged material/soil across the study area. As discussed here, surface soil data represent 0 to 3 inch surface soil samples and the uppermost composite soil samples from soil borings, with 0 to 2 feet or 0 to 4 feet intervals. Subsurface soil data represent composite soil samples collected from soil borings other than the uppermost samples. PCB concentrations in dredged material/soil samples historically ranged from less than detectable to 470 mg/kg dry weight. PCBs in surface dredged material/soil extend to the vicinity of the study area directly north of Factory Avenue; surface dredged material/soil PCB concentrations historically ranged from less than detectable to 100 mg/kg. The overall arithmetic and geometric means for PCB surface and subsurface dredged material/soil concentrations are 16 mg/kg and 1.4 mg/kg, respectively.

During the RI, dredged material/soil data indicate that Aroclor 1248 is predominant at the study area. Aroclor 1260 was detected in three dredged material/soil samples; however, Aroclor 1260 is not historically associated with GM process operations. Historical elevated subsurface PCB concentrations appear to be localized; RI borings placed adjacent to borings with historical elevated PCB detections (470 mg/kg and 180 mg/kg) contained an order of magnitude lower PCB concentrations (40 mg/kg and 18 mg/kg). The 23 soil borings installed during the RI, to evaluate whether the former drainage ditch and elevated PCB concentrations found south of Factory Avenue extend to the north side, did not indicate the presence of the former drainage ditch on the north side of Factory Avenue.

Sediment. As presented in Figure 2, sediment samples were collected one-half mile downstream of GM Outfall 003, one-half mile upstream of GM Outfall 003, and in the vicinity of GM Outfall 003 during the RI. PCBs were not detected in upstream sediment samples; Aroclor 1248 was detected in the vicinity of GM Outfall 003 (approximately 100 feet downstream of the outfall) and in three samples one-half mile downstream of the outfall at concentrations ranging from 0.19 mg/kg to 0.81 mg/kg dry weight. The range of detected PCB concentrations in sediment in 1992 were approximately one order of magnitude lower than the range of PCB concentrations detected in the 1988/89 Field Investigation (1.9 mg/kg to 8.6 mg/kg).

Ground water. PCB concentrations in filtered and unfiltered deep RI ground water samples were less than detectable, indicating that PCBs do not extend to the glacial till zone. In filtered shallow ground water samples collected during the RI, PCB concentrations were less than detectable. Unfiltered shallow RI ground water samples contained PCBs at concentrations ranging from less than detectable to 4.2 µg/l (Aroclor 1248).

The 1993 RI data provide the most current information regarding study area ground water conditions. The 1993 RI unfiltered shallow sample data indicate generally lower PCB concentrations than detected at the study area in previous investigations. Furthermore, 1993 RI data indicate a smaller area of ground water with detectable PCB concentrations than indicated in previous investigations. Historical ground water data compiled from the 1986/87 Hydrogeologic Investigation, 1988/89 Field Investigation, and 1993 RI are presented on Figure 5.

PCBs were not detected in filtered ground water samples collected during the RI. Further, PCB concentrations during the RI were higher in older monitoring wells with a larger screen slot size (20 slot) than PCB concentrations in the newer monitoring wells with a smaller screen slot size (10 slot). PCBs exhibit a low solubility in water and subsequently have a high propensity to be adsorbed to organic-rich media. Therefore, the 1993 RI data indicate a potential association of detected PCBs with particulates in the samples.

Surface water. As presented in Figure 2, surface water sampling activities were conducted in 1988 and 1989 at the study area. Samples were collected upstream, downstream, and in the vicinity of GM Outfall 003. In 1988, PCB concentrations were less than detectable at each location. In 1989, PCBs were detected at one of three sample locations; the one detected concentration was 1.4 µg/l in the vicinity of GM Outfall 003.

Fish. Fish from Ley Creek were collected during the RI and analyzed for PCBs. There were a total of 130 fish sampled; the length of 80% of the fish ranged from 17 to 96 mm. The fish were collected from locations one-half mile upstream of, one-half mile downstream of, and in the vicinity of GM Outfall 003. Aroclor 1248 concentrations in whole fish ranged from less than detectable to 1.1 mg/kg; Aroclor 1260 concentrations in whole fish ranged from less than detectable to 0.7 mg/kg. Aroclor 1248 concentrations in fish fillets and edible portions ranged from 0.11 mg/kg to 2.4 mg/kg; Aroclor 1260 was not detected in fish filets or edible portion samples. Aroclor 1260 is not historically associated with GM process operations. The fish species collected from Ley Creek are stream dwellers which tend to migrate for several miles in response to water level fluctuations, habitat quality, and food availability (Creech, 1992).

GM Outfall 003. Samples of outfall discharge water were collected from GM Outfall 003 during the RI over a two-hour period during a storm event. One sample of sediment was also collected from the outfall pipe. Detected PCB concentrations were less than GM's 4 µg/l Aroclor 1248 effluent limit established pursuant to a 1985 SPDES discharge Consent Order. Aroclor 1248 was detected in the first discharge water sample and duplicate sample collected during the storm at concentrations of 1.2 µg/l and 1.8 µg/l, respectively. Aroclor 1248 was detected in a discharge sample collected one-half hour later at 1.8 µg/l. PCBs were not detected in samples collected one hour and two hours after the first sample time. PCBs were not detected in the last two discharge water samples collected.

Aroclor 1248 was detected at 0.18 mg/kg in the sediment sample collected from the outfall pipe.

Air. Six air samples were collected in the 1988/89 Field Investigation for the purpose of evaluation of ambient air conditions around the perimeter of the study area. PCB concentrations were less than detectable in each sample.

1.5. Risk assessment conclusions

A baseline human health risk assessment (RA) was performed as part of the RI using analytical data generated during the 1988/89 Field Investigation and 1993 RI in accordance with USEPA guidelines and procedures. The following complete exposure pathways were identified in the RA:

- incidental ingestion and dermal adsorption of dredged material/soil,
- incidental ingestion and dermal adsorption of sediment,
- incidental ingestion and dermal adsorption of surface water, and
- ingestion of fish.

Risk associated with the surface water pathway was not quantified in the RA due to the limited PCB detections and consequent negligible exposures as compared to sediment and surface dredged material/soil exposures. Upper bound and average excess cancer risks and hazard indices (HIs) associated with the remaining complete exposure pathways were quantified as follows:

Table 1.5-1. *Risk assessment conclusions.*

Exposure pathway	Receptor	Average excess cancer risk	Average HI	Upper bound excess cancer risk	Upper bound HI
Direct Contact with Study Area Dredged Material/Soil	Adults	7.5×10^{-8}	2.4×10^{-3}	5.0×10^{-7}	3.4×10^{-3}
	Children	2.3×10^{-7}	5.1×10^{-3}	3.3×10^{-7}	7.2×10^{-3}

Table 1.5-1. *Risk assessment conclusions (Continued).*

Exposure pathway	Receptor	Average excess cancer risk	Average HI	Upper bound excess cancer risk	Upper bound HI
Direct Contact with Study Area Sediments	Adults	2.3×10^{-9}	7.3×10^{-5}	7.0×10^{-8}	4.8×10^{-4}
	Children	2.8×10^{-8}	6.1×10^{-4}	1.8×10^{-7}	4.0×10^{-3}
Ingestion of PCB Residues in Fish	Adults	6.0×10^{-6}	8.6×10^{-2}	6.0×10^{-5}	2.6×10^{-1}
	Children	5.2×10^{-6}	1.1×10^{-1}	1.6×10^{-5}	3.4×10^{-1}

Cancer risks and hazard indices were within the Superfund site remediation goal [10^{-4} to 10^{-6} for excess cancer risks (NCP; 40 CFR300.430) and less than 1 for HIs (USEPA, 1989)] These risks calculated during the RA are not a numerical presentation of actual study area risks to human health; they likely overestimate actual human health risks due to utilization of conservative exposure assumptions and dose response models as recommended by USEPA's standardized risk assessment methodology. Calculated risks for the fish ingestion pathway are especially conservative because of the undesirability of Ley Creek as a fishing location due to the nature, size, and quantity of fish present in the study area and aesthetic problems resulting from raw discharges and combined sewer overflows (NYSDEC, 1992).

1.6. Fish and wildlife impact analysis conclusions

A Step I Fish and Wildlife Impact Analysis (FWIA) was completed in accordance with NYSDEC guidelines as part of the RI to identify potential ecological receptors that inhabit the study area and vicinity and to evaluate the potential for impact on these receptors based on study area conditions and exposure pathways.

FWIA findings included:

- Three natural and three cultural covertypes exist in the study area, of which two natural covertypes (Floodplain Forest and Successional Southern Hardwoods) provide quality habitat for a variety of wildlife species.

- The study area is a portion of a New York State regulated wetland.

- Dredged material/soil, surface water, sediment, and food chain pathways are complete.

The overall "very poor" water quality of Ley Creek as defined by NYSDEC in the Rotating Intensive Basins Studies (RIBS) Water Quality Assessment Program (NYSDEC, 1992) was also emphasized in the FWIA. Due to industrial discharges, combined sewer overflows, and other urban impacts, Ley Creek habitat and water quality are not likely to improve sufficiently with study area remediation to promote vegetative, macroinvertebrate, and fish populations typical of a main channel stream habitat.

2. Development of alternatives

2.1. Introduction

The objective of this first phase of the FS was to develop a range of remedial alternatives for the site. The development of alternatives process included the development of remedial action objectives; development of general response actions; identification of volumes or areas of media; identification and screening of remedial technologies and process options; evaluation of process options; and the assembly of remedial alternatives.

2.2. Remedial action objectives

Remedial action objectives are medium-specific goals for protecting human health and the environment which specify the contaminant(s) of concern, exposure route(s) and receptor(s), and acceptable contaminant range of levels for each exposure route. USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988[b]) specifies that preliminary remediation goals be based on readily available risk information and applicable or relevant and appropriate requirements (ARARs), but that final acceptable concentrations be based on baseline risk assessment results and the exposure and risk evaluations for remedial alternatives. As discussed in Section 3.2.2, ARARs and To Be Considered Material (TBCs) were evaluated instead of New York State Standards, Criteria, and Guidelines (SCGs) in accordance with the Order and the RI/FS Work Plan (O'Brien & Gere Engineers, 1992).

Applicable requirements are defined in the *CERCLA Compliance With Other Laws Manual* (USEPA, 1988[a]) as those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or circumstance at a site. Accordingly, relevant and appropriate requirements are defined as those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site, address problems or situations sufficiently similar to those encountered at a site that their use is well suited to that site.

Documentation of rationale employed in the development of remedial action objectives for study area media is presented as follows.

Dredged material/soil. As discussed in Section 1.5, dermal contact and incidental ingestion of study area dredged material/soil was identified as a complete exposure pathway in the baseline human health RA performed during the RI. Risk calculations for this pathway indicated no unacceptable human health risks based on current site conditions. Dermal contact and ingestion of surface dredged material/soil was also identified as a complete exposure pathway for terrestrial wildlife in the FWIA, as discussed in Section 1.6. It was concluded in the FWIA, however, that based on the PCB dredged material/soil concentrations present and the infrequent study area use by terrestrial wildlife, that the exposure to PCBs was insignificant by the dredged material/soil exposure pathway. Based on the results of the RA and the FWIA, a remedial action objective for dredged material/soil based on risk reduction is not warranted.

As previously mentioned, ARARs are also considered during the development of preliminary remediation goals. Regulations for remediation of dredged material/soil containing PCBs have not been promulgated by USEPA or New York State. Chemical-specific ARARs related to soil were therefore not identified for the study area. TBCs were identified for the study area. As described in the *CERCLA Compliance With Other Laws Manual* (USEPA, 1988[a]), TBCs are non-promulgated advisories or guidance issued by the federal or state governments that are not legally binding but which are relevant for consideration.

NYSDEC has developed a Division Technical and Administrative Guidance Memorandum (TAGM), *Determination of Soil Cleanup Objectives and Cleanup Levels* (NYSDEC, 1994), which provides a basis and procedure to determine soil cleanup levels at State Superfund sites. NYSDEC's TAGM was initially considered a TBC for the study area.

NYSDEC's TAGM represents guidance which, under NYS regulations in 6 NYCRR 375-1.10(c)(1)(ii), must be considered under the following conditions:

> A site's program should be determined with consideration being given to guidance determined, after the exercise of engineering judgment, to be applicable on a case-specific basis.

The TAGM establishes that soil cleanup levels for organic chemicals should be based on one criterion of the following three which produces the most stringent cleanup objective:

- human health based levels corresponding to excess lifetime cancer risks of one in one million for Class B carcinogens,
- human health based levels for systemic toxicants calculated from Reference Doses (RfDs), and
- concentrations which are protective of ground water/drinking water quality based on promulgated or proposed New York State standards.

It was concluded in the baseline RA performed during the RI, as discussed in Section 1.5, that the upper bound excess carcinogenic risks associated with study area dredged material/soil were 5.0×10^{-7} and 3.3×10^{-7} for adults and children, respectively. Because these risks were less than one in one million, current study area conditions meet the first soil cleanup criterion. It was also concluded in the baseline RA that the upper bound hazard indices for non-carcinogenic risks associated with study area dredged material/soil were 3.4×10^{-3} and 7.2×10^{-3}, respectively. As these hazard indices are less than one, current study area conditions also meet the second soil cleanup criterion.

In an effort to evaluate the leachability of PCBs from study area dredged material/soil and the applicability of the third TAGM criterion, two leachability studies were performed. The first leachability study was performed during development of the November 1993 FS Report without NYSDEC oversight or generation of quality assurance and quality control (QA/QC) data. The second leachability study was performed in accordance with a protocol approved by NYSDEC on August 18, 1994 (Scharf, 1994) and the RI/FS Work Plan (O'Brien & Gere Engineers, 1992).

During the first leachability study, two study area dredged material/soil samples were submitted to H2M Laboratories, Inc. in July 1993 for analysis for total PCBs using NYSDEC Analytical Services Protocol (ASP) Method

91-3 and leachable PCBs using the Toxicity Characteristic Leaching Procedure (TCLP) extraction method and NYSDEC ASP Method 91-3 for leachate analysis. Dredged material/soil samples were collected from study area dredged material/soil which had been homogenized for the biodegradation pilot study GM is conducting. Analytical data generated from this exercise are presented in Appendix A. Total PCB concentrations in the two soil samples were 61 mg/kg and 56 mg/kg dry weight. It is noteworthy that these concentrations are in excess of the arithmetic and geometric mean concentrations for the dredged material/soil. Leachate generated using the TCLP procedure contained less than detectable PCB concentrations at a detection limit of 0.5 μg/l.

During the second leachability study, five soil samples (four environmental samples and one duplicate QA/QC sample) were collected from the study area at the approximate location from which dredged material/soil was collected for the above mentioned biodegradation study. The protocol followed for the leachability study sampling effort is included in Appendix B. The samples were collected from a depth of approximately 3 ft, and split samples were provided to Steven Scharf of NYSDEC, who was present for the sampling event. The samples were chosen based on field immunoassay screening results taken from two samples at the same location, indicating that PCB concentrations in one of the samples exceeded 50 mg/kg. In addition to the four environmental samples, a duplicate sample and two QA/QC samples were collected. The samples were chilled in ice and shipped to H2M Laboratories for analysis for total PCBs using USEPA Method 8080 and leachable PCBs using the TCLP extraction method and USEPA Method 8080 for leachate analysis. The analytical data summary and the data validation summary are included in Appendix C.

PCB concentrations in the soil samples were 82 mg/kg Aroclor 1242 (L-1), 32 mg/kg (estimated) Aroclor 1248 (L-2), 9.2 mg/kg (estimated) Aroclor 1248 (L-3), 54 mg/kg (estimated) Aroclor 1248 (L-4), and 67 mg/kg Aroclor 1248 (estimated) (L-5 (L-4 duplicate)). It should be noted that these concentrations are in excess of the estimated arithmetic and geometric mean concentrations for the dredged material/soil. PCB concentrations in the TCLP extracts prepared from the five soil samples were 5.4 ug/l (estimated) Aroclor 1242 (TL-1; leachate of L-1), 0.27 u/gl Aroclor 1248 (TL-2; leachate of L-2), 0.18 ug/l (estimated) Aroclor 1248 (TL-3; leachate of L-3), 0.18 ug/l (estimated) Aroclor 1248 (TL-4; leachate of L-4), and 0.19 ug/l Aroclor 1248 (TL-5; leachate of L-5).

With the exception of one leachate sample, PCB concentrations in the leachate samples from the second leachability study were within a normal range of laboratory analytical variation of the NYS Class GA ground water standard. Leachate PCB concentrations from the first leachability study, which were less than detectable at a higher detection limit (0.5 ug/l) than the second leachability study (0.1 ug/l), are consistent with the results of the second study. The 0.5 ug/l detection limit was consistent with the detection limit for ground water analyses during the RI using NYSDEC ASP Method 91-1. Further, an estimated detection of Aroclor 1242 at 5.4 ug/l in one leachate sample in the second leachability study does not indicate that PCBs are leaching from the dredged material/soil at levels which will result in exceedence of NYS Class GA ground water standards. The soil sample from which the leachate was generated contained PCBs at a higher concentration than the estimated arithmetic or geometric mean PCB soil concentration at the study area. Additionally, performance of the TCLP extraction procedure under controlled laboratory conditions is a more aggressive leaching procedure than that which occurs under natural conditions at the study area.

Although the results of the leachability study were inconclusive, it is unlikely that PCBs are leaching from study area dredged material/soil to ground water at levels representing a regulatory or migratory concern in view of the following ground water conditions observed at the study area:

- correlation doesn't exist between maximum PCB detections in dredged material/soil at the study area and PCB concentrations detected in study area ground water during the RI. For example, two of the highest PCB concentrations detected in subsurface soil at the study area, 470 mg/kg and 190 mg/kg, were in the soil boring for monitoring well OBG-6; PCB concentrations were less than detectable in unfiltered and filtered ground water samples collected from well OBG-6 during the RI.

- RI data indicate a potential association of PCBs detected in ground water samples with particulates in the samples, as discussed in Section 1.4.2.

- PCBs were detected in ground water south of Factory Avenue upgradient of the study area during the Ley Creek Interceptor Sewer installation (Exhibit D) at concentrations in the approximate range and higher than those detected in unfiltered shallow ground water at the study area, indicating potential upgradient contributions.

Therefore, current study area conditions likely meet the third soil cleanup criterion in the NYSDEC TAGM. Remedial action objectives were consequently not developed based on the NYSDEC TAGM. However, remedial alternatives were developed to address both the remedial action objectives and the NYSDEC TAGM.

The PCB Spill Cleanup Policy, a federal codified policy under the Toxic substances Control Act (TSCA) in 40 CFR Part 761 Subpart G, addresses cleanup of PCB-contaminated soil. The PCB Spill Cleanup Policy is not an ARAR for the study area because it is not a regulation and because it applies to spills occurring after May 4, 1987. As a codified federal policy representing scientific and technical evaluation, however, the PCB Spill Cleanup Policy is potentially pertinent and was regarded as a TBC for the study area. The PCB Spill Cleanup Policy establishes cleanup levels for PCB spills involving 1 lb or more of PCBs by weight for outdoor electrical substations, other restricted access areas, and non-restricted access areas. Restricted access areas include sites that are more than 0.1 km from residential/commercial areas or where access is limited by man-made or natural barriers (USEPA, 1990). As access to the study area is restricted, the cleanup level for restricted access areas is most appropriate for consideration for the study area; the policy specifies cleanup of soil to 25 mg/kg PCBs by weight in restricted access areas. The 25 mg/kg cleanup level for PCBs is relevant for surface dredged material/soil at the study area, which constitute a complete human health and environmental exposure pathway (although the quantified human health risk associated with this pathway is less than 1×10^{-6}).

Remediation of subsurface dredged material/soil to 25 mg/kg PCBs, however, is not warranted. Subsurface dredged material/soil at the study area does not constitute a complete exposure pathway, and leaching of PCBs from dredged material/soil to ground water is likely not an operative mechanism, as previously discussed. Furthermore, the arithmetic mean and geometric mean PCB concentrations in study area surface and subsurface dredged material/soil, 16 mg/kg and 1.5 mg/kg, respectively, are lower than 25 mg/kg.

Based on these considerations, the following remedial action objective was developed for dredged material/soil at the study area:

> Minimize contact with dredged material/soil containing greater than 25 mg/kg PCBs.

Alternate cleanup levels of 1 mg/kg in surface soils (top 1 ft) and 10 mg/kg in subsurface soils (depths greater than 1 ft) were also evaluated to address NYSDEC's TAGM, as discussed previously in this section. These cleanup levels are reflective of the cleanup standards used under the TSCA Spill Cleanup Policy for non-restricted access areas. For these areas, the Policy specifies soil cleanup to 10 mg/kg if excavated to a minimum of 10 inches and covered with clean soil containing less than 1 mg/kg PCBs.

Further, one of the study area property owners, Onondaga County, has identified concerns related to its need to conduct future activities on the property (Pirro, 1994). Onondaga County uses the property as part of the Ley Creek Flood Control Project Area and as a utility corridor. The Onondaga County Department of Drainage and Sanitation needs to maintain sanitary and drainage facilities in the study area, which is a part of the Bear Trap Ley Creek Drainage District and the County Consolidated Sanitary District. An underground trunk sewer runs through the study area parallel to Factory Avenue that must be maintained and repaired as necessary. Further, creek channel maintenance and repair must be performed as necessary, although little sediment buildup was observed in the creek during RI field activities. The Onondaga County Department of Transportation is responsible for maintaining cross culverts which run under Factory Avenue, through the study area, and drain to Ley Creek. In addition, the County cited possible widening of Factory Avenue as a future use for the property. Onondaga County's concerns were considered and evaluated during the development and analysis of alternatives.

Sediment. As discussed in Section 1.5, dermal contact and incidental ingestion of Ley Creek sediment was identified as a complete exposure pathway in the baseline human health RA performed during the RI. Risk calculations for this pathway indicated no unacceptable human health risks based on current site conditions. The sediment exposure pathway was also identified as complete for aquatic organisms in Ley Creek in the FWIA, as discussed in Section 1.6.

There currently are no promulgated federal or state regulations for remediation of sediment containing PCBs. NYSDEC has specified, however, that *Cleanup Criteria for Aquatic Sediments* (NYSDEC, 1993; NYSDEC's sediment criteria), an internal NYSDEC policy, be considered during the development of remedial action objectives for the study area, not as cleanup levels but as points of reference for further evaluation (NYSDEC, 1993 and Cooper, 1993). Sediment criteria are calculated for constituents based on the fraction organic carbon in the sediment, the surface water quality standard, and the octanol/water partition coefficient. PCB concentrations measured in sediments at the study area during the RI do not exceed acute aquatic toxicity sediment criteria for PCBs, calculated based on total organic carbon measurements at each sample location (O'Brien & Gere, 1993). Acute aquatic toxicity criteria represent concentrations which would be predicted to cause acute toxicity to benthic or epibenthic life. Detectable PCB concentrations measured in sediments at the study area during the RI do exceed wildlife residue criteria for PCBs, calculated to range from 0.0195 to 0.0295 mg/kg (O'Brien & Gere, 1993). Wildlife residue criteria represent concentrations which would be predicted to cause contaminant accumulation in aquatic animals to levels which would be harmful to wildlife consuming biota in that location. Detectable PCB concentrations measured in sediment at the study area during the RI also exceed human health bioaccumulation criteria for PCBs. Human health bioaccumulation criteria represent concentrations which would be predicted to cause toxic effects to humans from bioaccumulation resulting from ingestion of 0.33 kg/day of fish, which is not consistent with site conditions.

Because detectable PCB concentrations in sediments exceeded NYSDEC wildlife residue criteria, further evaluation was required to assess whether study area sediments present an unacceptable risk to wildlife inhabiting or consuming biota in the study area. Consequently, the hazard of PCB levels in Ley Creek surface water, sediments, and fish to the great blue heron (*Ardea herodias*) was estimated. The great blue heron was selected as the indicator species for risk assessment because it was identified in the FWIA as a sensitive species of concern that would be representative of risk to piscivorous inhabitants of the surrounding environs. The results of the hazard evaluation are presented in Appendix D. Utilizing conservative assumptions described in Appendix D, hazard quotients were calculated for two scenarios:

- Using mean detected PCB concentrations in fish, sediment, and surface water at the study area, hazard quotient = 0.275, and

- Using mean plus one standard deviation detected PCB concentrations in fish and sediment and mean PCB concentration in surface water (standard deviation not available), hazard quotient = 0.55.

Hazard quotients less than 1 indicate a low risk potential. Neither scenario indicated that exposure to PCBs in the study area would cause deleterious effects to the great blue heron. It is therefore concluded that PCB concentrations at the levels found to be present in study area sediments do not represent an unacceptable risk to piscivorous wildlife inhabiting or consuming biota in the study area.

Because of the continuing permitted SPDES discharge of PCBs from the GM Outfall 003 to Ley Creek and the association of these discharged PCBs with the GM main plant site, NYSDEC has decided that its decisions relative to remediation of sediments will be made as part of the GM main plant site RI/FS (Schick, 1994[a] and [b]). NYSDEC provided comments on the hazard quotient evaluation (Cooper, 1994), presented in Exhibit E. Resolution of these comments will be addressed in the GM main plant site RI/FS. It should be noted that USEPA guidelines were followed for the hazard quotient evaluation, in accordance with the Order, which requires the RI/FS to be conducted in accordance with federal guidance documents.

Ground water. As discussed in the RI Report (O'Brien & Gere, 1993), ground water does not constitute a complete exposure pathway for human or ecological receptors. Shallow ground water at the study area does discharge to Ley Creek, where surface water, sediment, and fish ingestion constitute complete exposure pathways for human and ecological receptors. It was concluded, however, during the baseline RA conducted during the RI, that the surface water exposure pathway was negligible compared to sediment/surface soil exposures, and that sediment/surface soil and fish ingestion exposure pathways did not present an unacceptable risk to human health. Further, as previously discussed, it was concluded that surface water, sediment, and food chain ecological exposure pathways do not currently present an unacceptable risk to ecological receptors at the study area.

The New York State Class GA ground water standard for PCBs, 0.1 μg/l, in 6 NYCRR Part 703 is a chemical-specific ARAR for the study area. Class GA ground water standards are applicable to all ground waters of the state. Detectable PCB concentrations in shallow unfiltered ground water at the study area exceeded the Class GA standard. However, this finding must be evaluated in the context of the following observations:

- The Class GA standard, 0.1 μg/l, is lower than the analytical detection limit, 0.5 μg/l, attained through reasonable means using NYSDEC ASP Method 91-3. NYSDEC indicated that a 0.5 μg/l detection limit was appropriate for evaluation of the presence of PCBs in ground water at the study area (Scharf, 1992). The arithmetic mean and geometric mean PCB concentrations in unfiltered shallow ground water samples collected during the 1993 RI were 1.0 μg/l and 0.68 μg/l, respectively, conservatively calculated by assuming less than detectable concentrations were one-half the detection limits. Study area ground water, on the average, is therefore nearly attaining the ARAR.

- The likely association of measured PCB concentrations in unfiltered shallow ground water samples with sample particulate content indicates that actual dissolved PCB concentrations in shallow ground water are probably in compliance with the ARAR, and consequently, it would be difficult to effectively perform or gauge the progress of any ground water remediation effort.

- The Class GA standard would likely be impossible to achieve with an active ground water remediation system given the adsorptive characteristics of PCBs. PCBs are relatively immobile in ground water, exhibiting very low solubility and the tendency to strongly adsorb to organic particulate matter. USEPA recognized the difficulty associated with active remediation of PCBs in ground water and the technical impracticability of achieving health-based levels in *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990; page 34). USEPA acknowledged that residual PCB oils lodge in pore spaces and are "very difficult to remove through traditional pump and treat methods," and for PCBs sorbed on particulates, "the rate of removal through ground water extraction may be very limited and substantial amounts of clean water will be affected as it is pulled into the contaminated zone."

- In *Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites* (USEPA, 1988[c]; page 5-17), USEPA maintains that the use of natural attenuation is potentially favorable under the following conditions which are present at the study area: low mobility contaminants, low concentrations of contaminants, low exposure potentials, and low projected demand for future ground water use.

- In *CERCLA Compliance With Other Laws Manual* (USEPA, 1988[a]; page 1-8), USEPA maintains that ARARs must be achieved at the completion of remedial action. In the case of ground water, remedial action can not be considered complete until future remediation of upgradient sources is complete due to the hydraulic connection of the shallow aquifer at the study area with impacted upgradient ground water. Active aquifer remediation in the study area would not affect ARAR attainment in the study area until such time as potential upgradient impacts are addressed.

Because of the hydraulic connection of the shallow aquifer at the study area with impacted upgradient ground water at the GM main plant site, NYSDEC has decided that its decisions relative to remediation of ground water will be made as part of the GM main plant site RI/FS (Schick, 1994[a] and [b]).

Although remedial objectives for ground water will be reevaluated during the GM main plant site RI/FS, tracking of ground water conditions in the interim is prudent. Routine observation of ground water PCB concentrations will provide a means to track natural attenuation progress or to detect concentration increases and subsequently evaluate risks associated with Ley Creek exposure pathways following ground water discharge.

Accordingly, the following remedial action objective was developed for ground water at the study area:

Monitor PCB concentrations in shallow ground water at the study area.

Surface water. Dermal contact and incidental ingestion of Ley Creek surface water was identified as a complete exposure pathway in the baseline human health RA performed during the RI. As previously mentioned, however, it was concluded in the RA that, based on the data presented in the RI, surface water exposures were negligible compared to sediment/surface soil exposures, and that sediment/surface soil exposure pathways did not present an unacceptable risk to human health. The surface water exposure pathway was also identified as complete for ecological receptors in the FWIA documented in the RI Report (O'Brien & Gere, 1993). It was concluded, however, in the FWIA that ecological impacts related to surface water PCB exposures were likely to be low due to low detected PCB concentrations and NYSDEC's assessment of overall Ley Creek water quality as poor (NYSDEC, 1992). Further, as previously discussed, it was concluded from evaluation of risk to the great blue heron that PCB concentrations present in study area surface water (as well as sediment and fish) do not present an unacceptable risk to piscivorous wildlife inhabiting or consuming biota in the study area.

The New York State Class B surface water standard for PCBs, 0.001 $\mu g/l$, in 6 NYCRR Part 703 is a chemical-specific ARAR for the study area. As documented in 6 NYCRR Part 895, the stretch of Ley Creek within the study area is a Class B surface water. Class B waters are suitable for primary contact recreation and any other uses except as a supply for drinking, culinary, or food processing purposes. Surface water sampling and analyses conducted during the 1988/89 Field Investigation, as discussed in Section 1.4.2, indicated that the Class B standard was exceeded in the vicinity of GM Outfall 003 on one of two sampling occasions. However, this finding must be evaluated in the context of the following observations:

- The main contributor to the exceedence of the Class B standard in 1989 in the vicinity of the GM Outfall 003 was likely the outfall discharge, which was demonstrated to be a compliant SPDES discharge during RI storm sampling and routine SPDES monitoring. Future decreases in PCBs discharged through GM Outfall 003 are anticipated with future upgradient remediation on the GM main plant site.

- The Class B standard, 0.001 $\mu g/l$, is two orders of magnitude lower than the analytical detection limit, 0.5 $\mu g/l$, attainable through reasonable means using NYSDEC ASP Method 91-3.

Based on these considerations, the New York State Class B surface water standard was not further considered as an ARAR in this FS.

As discussed in Section 1.5, fish ingestion was also identified as a complete human health exposure pathway in the RA. Risks associated with this pathway, however, were concluded to be acceptable. Further, mean PCB concentrations in whole fish and edible portions, 0.6 mg/kg and 0.8 mg/kg, respectively, are less than the Food and Drug Administration (FDA) Tolerance Limit for PCBs in fish, 2 mg/kg. The food chain bioaccumulation exposure pathway was also identified as complete in the FWIA. As previously discussed, it was concluded from evaluation of risk to the great blue heron that PCB concentrations present in study area fish (as well as surface water and sediments) do not present an unacceptable risk to piscivorous wildlife inhabiting or consuming biota in the study area.

Because of the continuing permitted SPDES discharge of PCBs from the GM Outfall 003 to Ley Creek and the association of these discharged PCBs with the GM main plant site, NYSDEC has decided that its decisions relative to remediation of surface water will be made as part of the GM main plant site RI/FS (Schick, 1994[a] and [b]).

Air. PCBs were not detected in air samples collected during the 1988/89 Field Investigation, and air was subsequently concluded to be an incomplete exposure pathway for human and ecological receptors at the study area. A remedial objective to address air at the study area is accordingly not justified.

Summary. In summary, the following remedial action objectives were developed for the study area:

- Minimize direct contact with dredged material/soil containing PCBs at concentrations greater than 25 mg/kg.
- Monitor PCB concentrations in shallow ground water at the study area.

Alternate cleanup levels of 1 mg/kg in surface soils (top 1 ft) and 10 mg/kg in subsurface soils (depths greater than 1 ft) were also evaluated to address NYSDEC's TAGM, as discussed previously in this section.

2.3. General response actions

General response actions are medium-specific actions which may be combined into alternatives to satisfy the remedial action objectives. General response actions which address the remedial action objective related to dredged material/soil include: institutional actions, containment actions, removal actions, treatment actions, and disposal actions. General response actions which address the ground water remedial objective include institutional actions.

2.4. Identification of volumes or areas of media

Site conditions, the nature and extent of contamination, and preliminary remediation goals were taken into consideration to define the volumes or areas of media to be addressed by the general response actions. A plan view of PCB concentrations in surface dredged material/soil at the study area is presented as Figure 6. A cross section displaying PCB concentrations detected in surface and subsurface dredged material/soil at the study area is presented as Figure 4. Soil on the north side of Ley Creek was not considered during the identification of areas and volumes of dredged material/soil to be addressed by general response actions. PCBs were detected in soil on the north side of Ley Creek in only three out of fifteen samples, two of which were at concentrations slightly above 1 mg/kg (3.5 mg/kg and 2 mg/kg) and the other at 27 mg/kg, only slightly above 25 mg/kg.

Data indicate PCBs are randomly dispersed in dredged material/soil across the study area; there is no pattern of distribution of PCB concentrations. PCB detections do not appear to be limited to specific depths or specific pile locations at the study area. Current study area topography is not useful in predicting the exact locations and depths of dredged materials. Historical drawings (Calocerinos & Spina, 1975) indicate that topography of study area native soils was not level prior to placement of dredged materials; existing topographic elevations do not therefore indicate physical boundaries of PCB-containing dredged materials. Accurate estimation of volumes of dredged material/soil to be addressed by removal actions is consequently not straightforward and must be based on assumptions.

Existing dredged material/soil PCB data was used to estimate average depths and areal percentages of the study area which would potentially be associated with soil cleanup objectives. Surface dredged material/soil at the study area containing PCBs at concentrations greater than 25 mg/kg are addressed by the remedial action objective for dredged material/soil. The estimated area of dredged material/soil in the study area with PCB concentrations greater than 25 mg/kg detected in surface dredged material/soil which would be addressed by a containment action is approximately 11 acres. To estimate the potential volume of dredged material/soil which would be addressed by a removal action, it was assumed that 1/16 of the total area (11 acres) would be excavated at an average depth of 6 ft to leave PCB concentrations at the new surface which would be less than 25 mg/kg. Based on these assumptions, the estimated volume of dredged material/soil with surface PCB concentrations greater than 25 mg/kg is 6,600 cubic yards. To estimate this volume, surface dredged material/soil data presented in Figure 6 and subsurface dredged material/soil data presented in Figure 4 were used.

Surface dredged material/soil at the study area (depths less than 1 ft) containing PCBs at concentrations greater than 1 mg/kg and subsurface dredged material/soil (depths greater than 1 ft) containing PCBs at concentrations greater than 10 mg/kg are addressed by NYSDEC's TAGM. The estimated area of dredged material/soil at the study area with PCB concentrations in surface soils greater than 1 mg/kg or in subsurface soils greater than 10 mg/kg, which would be addressed by a containment action, is approximately 17 acres. To estimate the potential volume of dredged material/soil which would be addressed by a removal action, it was assumed that 1/2 of the total area (17 acres) would be excavated at an average depth of 7 ft to address PCB concentrations greater than 10 mg/kg in subsurface soils. It was further assumed that the remaining 1/2 of the total area would be excavated to a depth of 1 ft to address remaining PCB concentrations greater than 1 mg/kg in surface soils. Based on these assumptions, the estimated volume of dredged material/soil with surface PCB concentrations greater than 1 mg/kg or subsurface soils greater than 10 mg/kg is 110,000 cubic yards. To estimate this volume, surface dredged material/soil data presented in Figure 6 and subsurface dredged material/soil data presented in Figure 4 were used.

Additionally, estimations were made of the area of dredged material/soil with PCB concentrations exceeding 10 mg/kg and the volume of dredged material/soil with surface or subsurface concentrations greater than 50 mg/kg to address specific remedial alternatives presented later in this report. The estimated area of dredged material/soil at the study area with PCB concentrations in surface or subsurface soils greater than 10 mg/kg which would be addressed by a cover action is approximately 15 acres. To estimate the potential volume of dredged material/soil with PCB concentrations greater than 50 mg/kg which would be addressed by an excavation action, it was assumed that dredged material/soil would be excavated from a circular area of 10 ft radius at sample locations which indicated concentrations greater than 50 mg/kg in past analyses. Assumed depths corresponded with sample depths as shown on Figure 4. Based on these assumptions, the estimated volume of dredged material/soil with PCB concentrations greater than 50 mg/kg to be addressed by an excavation action is 480 cubic yards.

2.5. Identification and screening of remedial technologies and process options

This step required identification of potentially applicable remedial technology types and process options for each general response action. Process options were screened on the basis of technical implementability. The technical implementability of each identified process option was evaluated with respect to site contaminant information, site physical characteristics, and areas and volumes of affected media. Technologies and process options identified for the dredged material/soil and ground water were described and screened for technical implementability as presented in Tables 1 and 2, respectively. Descriptions of process options which remained after the screening follows.

2.5.1. Dredged material/soil

A summary of the screening of technologies and process options relative to the dredged material is presented in Table 1. Each of the process options identified were considered potentially applicable. A discussion of the remedial technology process options for the dredged material which passed the technology screening phase follows.

Deed restrictions. With respect to the dredged material/soil, land use restrictions would be reflected in the property deed. The deed restrictions would preclude the conduct of activities which would potentially expose contaminated materials or impair the integrity of a soil cover without prior review and approval by NYSDEC. The scope of these land use restrictions would be reviewed with the property owners, Onondaga County, Niagara Mohawk Power Corporation, The Pfaltzgraff Co., and the New York State Thruway Authority.

Fencing. Fencing would consist of the placement and maintenance of a fence around the dredged material/soil to limit access to the area and thereby minimize contact and protect against activities which might adversely affect the integrity of a cover system. The study area is currently fenced along Factory Ave. Installation of locks on the gates and inspection and maintenance could be implemented during remediation.

Soil cover. A soil cover is one technology which would address the objective of minimizing contact with surface dredged material/soil. Based on study area conditions, a 12 inch vegetated soil cover is an appropriate cover design to serve this function. Potential ARARs and TBCs related to a soil cover at the study area include NYS hazardous waste secure land burial facility closure requirements in 6 NYCRR Part 373-2.14(g) and USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990).

NYS regulations specify that hazardous waste landfills be covered with a final cover designed and constructed to:

- provide long-term minimization of migration of liquid through the closed landfill,
- function with minimum maintenance,
- promote drainage and minimize cover erosion or abrasion,
- accommodate settling and subsidence to maintain cover integrity, and
- have a permeability less than or equal to natural subsoil permeability.

For study area conditions, a 12 inch vegetated soil cover is consistent with these performance requirements. As discussed in Section 2.2, migration of PCBs from dredged material to ground water appears to be minimal under current study area conditions. Grading and cover installation would be performed such that drainage is promoted, erosion is minimized, and cover integrity is protected. Finally, installation of a 12 inch vegetated soil cover would not facilitate ground water mounding.

USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990) further supports installation of a 12 inch vegetated soil cover at the study area. The guidance provides for implementation of minimal long-term management controls when low PCB concentrations remain on-site and direct contact risks are sufficiently reduced. An example analysis of long-term management controls is presented in Section 4.3.1 of this guidance which provides for installation of a 12 inch vegetated soil cover over PCB soil concentrations of 20 mg/kg and below. Arithmetic and geometric mean PCB concentrations in surface and subsurface soil at the study area are 16 mg/kg and 1.5 mg/kg, respectively.

Excavation. Excavation would involve the removal of dredged material/soil using construction equipment such as backhoes and front-end loaders. Excavated material with PCB concentrations greater than 50 mg/kg destined for off-site treatment or disposal would be managed in accordance with the TSCA PCB disposal regulations promulgated in 40 CFR Part 761 Subpart D and New York State hazardous waste regulations in 6 NYCRR Part 373. Applicable regulations are discussed in Section 3.2.2, Compliance with Applicable or Relevant and Appropriate Requirements (ARARs).

Commercial chemical landfill. Excavated dredged material/soil could be transported to a permitted commercial landfill for disposal.

Soil washing. Soil washing is a physical treatment process which involves the separation/segregation and volumetric reduction of contaminants in soils. The process involves high energy contacting and mixing of excavated soil with an aqueous-based washing solution in a series of mobile washing units. The soil washing process separates fine-grained soils from coarser-grained soils. PCBs would be expected to be adsorbed to the finer-grained particles. Management of PCB-containing fine-grained dredged material/ soil and wash water would subsequently be required.

Solidification/stabilization. Solidification/stabilization is a process which involves the addition of cement or pozzolanic materials to soil to produce a stable and inert mass. This process renders constituents in the soil less leachable, but does not destroy or reduce the toxicity of contaminants. Encapsulation of PCBs via solidification could be accomplished through the addition of cement or lime and mixing with dredged material/soil. Bonding of PCBs via stabilization could be accomplished through the addition of a modified clay or other binder and mixing with dredged material/soil. The solidified/stabilized matrix could be either placed on-site or transported for off-site disposal.

Chemical dechlorination. Chemical reagents prepared from polyethylene glycol and potassium hydroxide have been demonstrated to dechlorinate PCBs through a nucleophilic substitution process. The products of the reaction have been proven to be non-toxic, non-mutagenic, and non-bioaccumulative. In this process, reagents are mixed with soil and heated in a reactor. Wash water management is required. This treatment must be monitored carefully such that sufficient reaction time is allowed. The treated residuals could then be either placed on-site or transported for off-site disposal.

Solvent washing/extraction. Solvent washing/extraction involves removing PCBs from excavated contaminated soil and concentrating them in a residual solvent stream that requires subsequent management. Often the solvent can be recovered by taking advantage of certain properties of the solvent being used. Typically, solvent extraction treatment involves soil screening to remove large particles, potential addition of water to render the soil pumpable, mixture of soil and solvent in an extractor, routing of extracted PCB/solvent mixture to a separator, separation of solvent with temperature or pressure change, solvent recycling, concentrated PCB disposal, and treated soil disposal/replacement. Treated dredged material/ soil may require dewatering prior to management; water would subsequently require management.

Ex situ biological treatment. Ex situ biological treatment is a process in which excavated contaminated material is treated biologically in a reactor, composting system, or landfarming process. In this process, naturally occurring microorganisms are stimulated to degrade PCBs. Nutrients, oxygen, and co-metabolites are injected to enhance the process. This innovative technology allows the microorganisms to reduce the PCB into a less toxic compound.

Biological treatment for PCBs is a relatively innovative application. GM is concluding a pilot study for biodegradation of PCB-contaminated dredged material/soil from the study area. Attached as Exhibit F is a copy of the May 1994 progress report from GM's pilot biodegradation study.

In situ biological treatment. In situ biological treatment involves the degradation of soil contaminants in place by naturally occurring microorganisms. *In situ* biological treatment of surface dredged material/ oil at the study area could consist of a modified landfarming process in which nutrients and/or enhanced naturally occurring microbial populations are applied to surface dredged material/soil to enhance biodegradation. Tilling of surface dredged material/soil could also be performed to enhance oxygen availability to microbes. As noted above, the May 1994 progress report from GM's pilot biodegradation study is attached as Exhibit F.

Thermal desorption. Thermal desorption is an *ex situ* process that uses either direct or indirect heat exchange to volatilize organic contaminants from dredged material/soil. Thermal desorption is a physical separation (volume reduction) process and not an organic decomposition (incineration) process. Operating temperatures are in the 200 to 1000 degrees fahrenheit range. The relatively low operating temperatures tend to make thermal desorption less energy intensive and thus, less costly, than incineration. The primary technical factors affecting thermal desorption performance are the contaminant concentration, the maximum dredged material/soil temperature achieved, total soil residence time, and soil moisture content. The volatilized contaminants from the thermal desorption process are typically directed to a secondary system for incineration (i.e. an afterburner), adsorption on activated carbon, or recovery by condensation. If the volatilized contaminants are incinerated, an air emissions control system is employed to remove acid gases and particulates in the exhaust gas.

Thermal gas-phase reduction. Thermal gas-phase reduction involves a process that converts PCB contaminated material into gas, which is injected into a chamber with a heated hydrogen atmosphere. The PCBs are converted to methane gas and hydrochloric acid. The methane is used to heat the reactor that achieves conversion. The hydrochloric acid is moved into a scrubber chamber and converted into a solution of sodium chloride and water.

This process is an alternative to incineration; with the absence of free oxygen, the reaction can prevent the formation of dioxin compounds.

Incineration. Incineration is a thermal destruction treatment method which uses high temperature oxidation under controlled conditions to combust organic substances into products that generally include CO_2, H_2O vapor, SO_2, NO_x, HCL gases and ash. Products of thermal destruction/incineration such as particulates, SO_2, NO_x, HCl and products of incomplete combustion require air pollution control equipment to prevent release of undesirable species into the atmosphere. Ash disposal is also required. Incineration methods can be used to effectively destroy PCBs in dredged material/soil.

In situ vitrification. In situ vitrification (ISV) is a thermal process which transforms the chemical and physical characteristics of waste materials in place such that it becomes a glassy solid matrix which is resistant to leaching. Soil transformation occurs through a pyrolysis process using electrodes to apply a high power electrical current. PCBs are destroyed in the process. Off gases are collected in a hood and treated as necessary.

2.5.2 Ground water

A summary of the screening of technologies and process options relative to ground water is presented in Table 2. The remedial technology associated with the institutional general response action was monitoring, considered to be potentially applicable. A brief description of ground water monitoring follows.

Ground water monitoring. Ground water monitoring would involve periodic sampling and analysis of ground water at the study area. Ground water monitoring would provide a means to detect changes in PCB concentrations in the ground water.

2.6. Evaluation of process options

The process options remaining after the initial screening were evaluated further according to the criteria of effectiveness, implementability, and cost. The effectiveness criterion includes the evaluation of:

- potential effectiveness of the process options in meeting remediation goals and handling the estimated volumes or areas of media;
- potential effects on human health and the environment during construction and implementation; and
- experience and reliability of the process options for dredged material/ soil and conditions.

The technical and institutional aspects of implementing the process options were assessed for the implementability criterion. The capital and operation and maintenance (O&M) costs of each process option were evaluated as to whether they were high, medium, or low relative to the other process options of the same technology type.

Based on the evaluation, the most favorable process option of each technology type was chosen as a representative process option. Selecting representative process options simplifies the assembly of alternatives, but does not eliminate other process options. The process option actually used to implement remedial action may not be selected until the remedial design phase. Summaries of the evaluation of process options and selected representative process options for both dredged material and ground water are presented as Tables 3 and 4, respectively.

Representative process options selected for the dredged material/soil were: deed restrictions, fencing, vegetated soil cover, excavation, commercial chemical landfill, *in situ* biological treatment, incineration, and thermal desorption. The representative process option selected for ground water was ground water monitoring.

2.7. Assembly of remedial alternatives

General response actions and representative process options were combined to form alternatives that address the remedial objectives. Thirteen alternatives, consisting of seven main alternatives with variations, were developed for the study area; they include the following general alternative types:

- no action (Alternative 1),
- containment (Alternatives 2A, 2B, 2C),
- removal/disposal (Alternatives 3A, 3B),
- removal/on-site treatment (Alternative 4),
- removal/on-site treatment/replacement (Alternatives 5A, 5B),
- *in situ* treatment (Alternative 6), and
- removal/disposal/containment (Alternatives 7A, 7B, 7C).

The no action alternative was included in the range of alternatives in accordance with USEPA guidelines (USEPA, 1988[b]) and the NCP (Federal Register, March 8, 1990). A summary of the remedial alternatives and their elements is presented in Table 5. A description of each alternative follows:

2.7.1. Common components of alternatives

Ground water monitoring is a common component of each remedial alternative for the study area. Fencing, deed restrictions, and five-year reviews are common components of each alternative except Alternatives 3B and 5B. Ground water monitoring will be implemented to track PCB concentrations in ground water at the study area and will be instrumental in detecting any decreases and increases in PCB ground water concentrations.

There is currently a fence along the study area on the north side of Factory Avenue east of Townline Road which effectively restricts human contact with the dredged material/soil. As part of the institutional actions locks would be added to the fence gates for security, and the fence would be inspected and maintained on a routine basis. Access to the northern boundary of the study area is naturally restricted by the NYS Thruway and Ley Creek.

Deed restrictions would consist of land use restrictions which would preclude the conduct of activities which would potentially disturb or expose PCB-contaminated materials.

Five-year reviews would be conducted as required by the NCP (Federal Register, 1990) due to the fact that PCB-containing dredged material/soil would remain on-site. The purpose of the five-year review is to evaluate the study area in regard to the continuing protection of human health and the environment.

In order to address Onondaga County's concerns related to future property use, additional actions were identified as common components of each remedial alternative, except Alternatives 1, 3B, and 5B. Onondaga County's concerns were summarized in Section 2.2. For future Onondaga County maintenance activities for which concerns associated with the presence of PCBs could be reasonably addressed during study area remediation, actions were identified and are described in this section. Actions have been identified to address maintenance of cross culverts, the sanitary trunk sewer, and the creek channel. It is proposed that potential future activities, which are less predictable at the study area, such as sewer repair, sewer installation, widening of Factory Avenue, and replacement of utility poles, be dealt with on a case-by-case basis to address increased costs due to the presence of PCBs. Case-by-case handling of incremental costs incurred on account of the presence of PCBs is a reasonable approach due to the presence of PCBs in site ground water. Due to potential upgradient sources, the presence of PCBs in ground water would continue regardless of the remedial action selected for the dredged material/soil.

Proposed actions for each remedial alternative except for Alternatives 1, 3B and 5B are described as follows:

Cross culverts. The Onondaga County Department of Transportation (DOT) is responsible for maintenance of several cross culverts at the study area. These cross culverts originate on the south side of Factory Avenue and run to the north underneath Factory Avenue, through the study area and to Ley Creek. The purpose of the cross culverts is to direct surface drainage for the areas around Factory Avenue to Ley Creek. At this time, four cross culverts are known to be present within the study area; two associated with the GM permitted SPDES outfalls (Outfalls 003 and 004), one directly north of the GM western property boundary and one north of the Pfaltzgraff Co. property. The cross culverts appear to be grass or stone lined depressions to convey drainage to Ley Creek.

The DOT has indicated that there is a periodic need to remove silt and debris from these cross culverts. To address concerns related to worker exposure to PCBs, it is proposed that the culverts located within the study area be lined to minimize the potential for PCB exposure during cleaning activities. The culverts would be lined with either cast in place concrete or corrugated galvanized steel conduit. A small access pathway of compacted granular materials would be constructed in the north-south direction on one side of each culvert to facilitate access for heavy equipment without disturbing dredged material/soil or causing damage to a soil cover. This would permit the periodic silt and debris removal activities to proceed while minimizing potential exposure to PCBs which may be present in dredged material/soil.

Existing sanitary sewer. An existing 48 inch diameter sanitary sewer runs through portions of the study area parallel to Factory Avenue. Generally, this sewer runs through the southern portion of the site, close to Factory Avenue. Portions of this sewer formerly existed on the south side of Factory Avenue; however, these portions were plugged when the new interceptor sewer was installed at that location in 1991.

The Onondaga County Department of Drainage and Sanitation has indicated that periodic inspection, cleaning, maintenance and repair of this sewer line may be required in the future. At a minimum, access to each manhole at the study area will be required for these activities. A review of existing drawings of the sewer system indicate that 11 manholes may be located within the area of PCB detections in the study area. These manholes were not located at the surface during the 1995 survey. To address the concerns related to manhole access and potential worker exposure to PCBs, it is proposed that each manhole located in the study area be modified to match the final study area grades and elevations and that an asphalt pad or apron be installed around each. The asphalt aprons would serve as working surfaces for Onondaga County personnel to access the manholes with trucks or heavy equipment and not disturb dredged material/soil or a soil cover. The existing study area fence at each manhole location would be modified such that access from Factory Avenue to the manhole is possible, but access to the remainder of the study area is not.

Creek channel maintenance/reconstruction. Dredging of Ley Creek has been performed by Onondaga County in past years to control flooding within the Ley Creek watershed. Onondaga County has indicated that there may be a future need for a channel maintenance/reconstruction program at the study area. This will likely necessitate heavy equipment (*e.g.* dredges, backhoes, and dump trucks) access to Ley Creek to perform a dredging or channel maintenance program. To provide Onondaga County with access to Ley Creek while minimizing the potential for disturbance of dredged material/soil or a soil cover, construction of an access road on the south bank of the creek is proposed.

The proposed access road would run along Ley Creek, from Townline Road to the Town of Salina highway garage. The area along the creek would be graded, and facilities for existing drainage ditches to Ley Creek would be provided. The access road would be approximately 15 feet wide and constructed of a layer of soil stabilization fabric followed by crushed stone. The approximate length of the road would be 5,000 feet. A locking truck gate would be provided at the Townline Road end of the road to prevent unauthorized vehicular traffic on the road.

2.7.2. Alternative 1

Alternative 1 is the no action alternative. The no action alternative is required by the NCP and serves as a benchmark for the evaluation of action alternatives. This alternative provides for an assessment of the environmental conditions if no active remedial actions are implemented.

The no action alternative does include passive remedial actions including deed restrictions, fencing, and ground water monitoring. Five-year reviews would also be conducted for the study area. Each of these components was described in Section 2.7.1.

2.7.3. Alternatives 2A, 2B, and 2C

Alternatives 2A, 2B, and 2C are containment alternatives. Alternatives 2A, 2B, and 2C include deed restrictions, fencing, ground water monitoring, a soil cover, and five-year reviews. Alternatives 2A, 2B, and 2C also include components to address Onondaga County concerns. Dredged material/soil with surface concentrations of PCBs exceeding 25 mg/kg (2A) or 10 mg/kg (2B) would be covered with a minimum of 12 inches of topsoil. In Alternative 2C, dredged material/soil with PCBs in surface soils (top 1 ft) exceeding 1 mg/kg or subsurface soils (depths more than 1 ft) exceeding 10 mg/kg would be covered with a minimum of 12 inches of topsoil. The specific cover material to be utilized in the floodway area would be evaluated during remedial design to minimize the potential for erosion. Cost estimates include costs for the minimum 12 inch vegetated soil cover. The estimated areas to be covered for each alternative would be approximately 11 acres (2A), 15 acres (2B), and 17 acres (2C). Prior to placement of the soil cover, the dredged material/soil would be graded using construction equipment (e.g., backhoes or front end loaders) to distribute more evenly the material in the area such that piles are not present immediately adjacent to the creek and encourage runoff from the area with slopes no less than 4%. The soil cover would then be placed and vegetated to limit erosion of the cover and minimize direct contact. The vegetation would be maintained to maximize evapotranspiration. Rip rap or sheeting may be placed on the banks of the creek to further minimize erosion of the soil cover. Deed restrictions, fencing, ground water monitoring, five-year reviews, and activities to address Onondaga County concerns were described in Section 2.7.1.

2.7.4. Alternatives 3A and 3B

Alternatives 3A and 3B are removal/disposal alternatives. Alternatives 3A and 3B include deed restrictions (3A only), fencing (3A only), ground water monitoring, dredged material/soil excavation and off-site landfill disposal of dredged material/soil, and five-year reviews (3A only). Alternative 3A also includes components to address Onondaga County concerns. Dredged material/soil with concentrations of PCBs greater than 25 mg/kg in surface soils (3A) or greater than 1 mg/kg in surface soils or 10 mg/kg in subsurface soils (3B) would be excavated using construction equipment (e.g. backhoes or front end loaders). Based on approximate estimations, excavation of up to 6,600 cubic yards (3A) or 110,000 cubic yards (3B) may be required. Excavated material would be transported from the site to a permitted commercial landfill. The excavated areas would be regraded and backfilled, if necessary, with clean soil. Deed restrictions, fencing, ground water monitoring, five-year reviews, and activities to address Onondaga County concerns were described in Section 2.7.1.

2.7.5. Alternative 4

Alternative 4 is a removal/treatment alternative. Alternative 4 includes deed restrictions, fencing, ground water monitoring, excavation and on-site incineration of dredged material/soil, and five-year reviews. Alternative 4 also includes components to address Onondaga County concerns. Dredged material/soil with surface PCB concentrations greater than 25 mg/kg would be excavated using construction equipment. Based on estimates, excavation of approximately 6,600 cubic yards of material would be required. Excavated contaminated material would then be incinerated on-site in a permitted commercial incinerator. The excavated areas would be regraded and backfilled, if necessary, with clean soil. Deed restrictions, fencing, ground water monitoring, five-year reviews, and activities to address Onondaga County concerns were described in Section 2.7.1.

2.7.6. Alternatives 5A and 5B

Alternatives 5A and 5B are removal/treatment/replacement alternatives. Alternatives 5A and 5B includes deed restrictions (5A only), fencing (5A only), ground water monitoring, excavation, thermal desorption treatment, replacement of dredged material/soil, and five-year reviews (5A only). Alternative 5A also includes components to address Onondaga County concerns. Dredged material/soil with PCB concentrations greater than 25 mg/kg in surface soils (5A) or greater than 1 mg/kg in surface soils or 10 mg/kg in subsurface soils (5B) would be excavated using construction equipment. Based on estimates, excavation of approximately 6,600 cubic yards of material (5A) or 110,000 cubic yards of material (5B) would be required. Excavated material would be treated on-site utilizing either a direct or indirect thermal desorption technology. Screening of dredged material prior to treatment might be necessary to remove large particles. Although full-scale commercial thermal desorption units have been constructed, a treatability study would likely be necessary to establish design parameters for and establish the efficacy of the treatment process. Treated dredged material/soil would be used at the study area to backfill the excavated areas; clean soil would also be used for backfill, if necessary. Deed restrictions, fencing, ground water monitoring, five-year reviews, and activities to address Onondaga County concerns were described in Section 2.7.1.

2.7.7. Alternative 6
Alternative 6 is an *in situ* treatment alternative. Alternative 6 includes deed restrictions, fencing, ground water monitoring, *in situ* biological treatment of dredged material/soil, and five-year reviews. Alternative 6 also includes components to address Onondaga County concerns. Dredged material/soil with surface PCB concentrations exceeding 25 mg/kg would be treated with an *in situ* biological treatment technique. GM is concluding a pilot biodegradation study for PCB-containing dredged material/soil from the study area. Attached as Exhibit F is the May 1994 progress report on the PCB biodegradation study. Although the study involves the use of an *ex situ* reactor technique, data generated from the study would be useful for design of an *in situ* technique. Treatment would likely involve periodic applications of nutrients and possibly an enhanced naturally occurring microbial community to surface dredged material/soil. Periodic tilling of surface dredged material/soil would enhance oxygen availability for the microbes. Surface dredged material/soil sampling and analysis for PCBs would be performed regularly to assess treatment progress. Deed restrictions, fencing, ground water monitoring, five-year reviews, and activities to address Onondaga County concerns were described in Section 2.7.1.

2.7.8. Alternatives 7A, 7B, and 7C
Alternatives 7A, 7B, and 7C are excavation/disposal/containment alternatives. Alternative 7A, 7B, and 7C include deed restrictions, fencing, ground water monitoring, limited dredged material/soil excavation and off-site landfill disposal, a soil cover, and five-year reviews. Alternatives 7A, 7B, and 7C also include components to address Onondaga County concerns. Dredged material/soil with surface or subsurface soil PCB concentrations in excess of 50 mg/kg would be excavated using construction equipment (e.g. backhoes or front end loaders). Based on estimations, excavation of approximately 480 cubic yards would be required for Alternatives 7A, 7B, and 7C. Excavated material would be transported from the site to a permitted commercial landfill. The excavated areas would be regraded and backfilled, if necessary, with clean soil.

Dredged material/soil with concentrations of PCBs exceeding 25 mg/kg in surface soils (7A), exceeding 10 mg/kg in surface or subsurface soils (7B), or exceeding 1 mg/kg in surface soils or 10 mg/kg in subsurface soils (7C) would be covered with a minimum of 12 inches of topsoil. The specific cover material to be utilized in the floodway would be evaluated during remedial design to minimize the potential for erosion. Cost estimates include costs for the minimum 12 inch vegetated soil cover. The areas to be covered are estimated at approximately 11 acres (7A), 15 acres (7B), and 17 acres (7C). Prior to placement of the soil cover, dredged material/soil would be graded using construction equipment (e.g., backhoes or front end loaders) to distribute more evenly the material in the area such that piles are not present immediately adjacent to the creek and encourage runoff from the area with slopes no less than 4%. The soil cover would then be placed and vegetated to limit erosion of the cover and minimize direct contact. The vegetation would be maintained to maximize evapotranspiration. Rip rap or sheeting may be placed on the banks of the creek to further minimize erosion of the soil cover. Deed restrictions, fencing, ground water monitoring, five-year reviews, and activities to address Onondaga County concerns were described in Section 2.7.1.

3. Detailed analysis of alternatives

3.1. Introduction

Typically, the second phase of a FS is the screening of alternatives. In this phase of the FS, the alternatives are screened based on effectiveness, implementability, and cost to limit the number of alternatives that will undergo detailed analysis. Because six alternatives, which is a manageable number of alternatives for detailed analysis, were developed for this FS, there was no screening of alternatives performed in this FS.

The objective of the detailed analysis of alternatives was to analyze and present sufficient information to allow the alternatives to be compared and a remedy selected. The analysis consisted of an individual assessment of each alternative with respect to nine evaluation criteria that encompass statutory requirements and overall feasibility and acceptability. The detailed analysis of alternatives also included a comparative evaluation designed to consider the relative performance of the alternatives and identify major trade-offs among them. The nine evaluation criteria are:

- Overall protection of human heath and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance, and
- Community acceptance.

The preamble to the final NCP (*Federal Register, 1990)* indicates that, during remedy selection, these nine criteria should be categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. The two threshold criteria, overall protection of human health and the environment and compliance with ARARs, must be satisfied in order for an alternative to be eligible for selection. Long-term effectiveness and permanence; reduction of toxicity, mobility or volume through treatment; short-term effectiveness; implementability; and cost are primary balancing criteria which are used to balance the trade-offs between alternatives. The modifying criteria are state and community acceptance, which are formally considered after public comment is received on the Proposed Remedial Action Plan.

The results of the detailed analysis of alternatives are discussed in this section.

3.2. Individual analysis of alternatives

In the individual analysis of alternatives, each of the thirteen remedial alternatives was evaluated with respect to the nine evaluation criteria. A summary of the individual analysis of alternatives is presented in Table 6.

3.2.1. Overall protection of human health and the environment

The analysis of each alternative with respect to overall protection of human health and the environment provide an evaluation of whether the alternative would achieve and maintain adequate protection and a description of how protection would be achieved through treatment, engineering, and institutional controls. The individual analysis of each remedial alternative with respect to this criterion is presented in Table 6.

3.2.2. Compliance with applicable or relevant and appropriate requirements (ARARs)

A definition of ARARs was provided in Section 2.2 of this report. Section 121(d) of CERCLA, as amended by SARA, requires that remedial actions comply with ARARs under federal or state environmental law at the completion of remedial action. USEPA also requires evaluation of TBCs, as discussed in Section 2.2 (USEPA, 1988[b]). NYSDEC evaluates compliance with applicable or relevant and appropriate standards, criteria, and guidelines (SCGs). In accordance with the Order, which directs that the FS for the study area be conducted in accordance with CERCLA, the NCP, and USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, and the RI/FS Work Plan (O'Brien &

Gere, 1992), compliance with ARARs and TBCs was evaluated for the study area.

Three categories of ARARs must be considered: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs are health-based or risk-based numerical values which, when applied to site-specific conditions, result in the establishment of numerical values. These numerical values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. Location-specific ARARs set restrictions on activities based on the characteristics of the site or immediate environs. Action-specific ARARs set controls or restrictions on particular types of remedial actions once the remedial actions have been identified as part of a remedial alternative.

A remedial alternative, which does not attain all ARARs may be selected under CERCLA, provided that one or more of six waiver conditions are met and the alternative remains protective of human health and the environment. The six waiver conditions are:

- interim measures,
- greater risk to health and the environment,
- technical impracticability,
- equivalent standard of performance,
- inconsistent application of state requirements, and
- fund balancing.

Potential ARARs and TBCs for the study area are identified and described in Tables 7 and 8. Evaluation of compliance with ARARs for each remedial alternative is documented as follows and summarized in Table 6.

Alternative 1. Potential ARARS for Alternative 1 include the chemical-specific ARARs presented in Table 7. As discussed in Section 2.2, attainment of the Class GA standard will be evaluated during the GM main plant site RI/FS.

Potential TBCs for Alternative 1 include the chemical-specific TBCs presented in Table 8. Through no action, Alternative 1 would not meet the cleanup levels in the PCB Spill Cleanup Policy or meet the recommendations in USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990).

Alternatives 2A, 2B, and 2C. Potential ARARs for Alternatives 2A, 2B, and 2C include the chemical-specific and location-specific ARARs presented in Table 7, as well as action-specific ARARs related to soil cover, grading, and construction. As discussed for Alternative 1, attainment of the Class GA ground water standard will be evaluated as part of the GM main plant RI/FS. Soil cover design would be consistent with the potential location-specific ARARs for wetlands and floodplains discussed in Table 7. For study area conditions, the proposed soil cover is consistent with the NYS hazardous waste landfill capping performance requirements based on the following considerations:

- PCB migration to ground water is likely not a pathway of concern;
- grading would promote runoff and minimize erosion;
- cover maintenance would promote continued integrity; and
- soil cover installation would not facilitate ground water mounding.

USEPA approval would potentially be required to perform grading activities if grading at the study area is viewed under TSCA as placement of PCB material. Dust control measures would be implemented during earth moving activities to provide for attainment of the particulate air quality standard. Construction activities would be conducted in accordance with Occupational Safety and Health Administration (OSHA) requirements.

Each of the potential TBCs presented in Table 8 are pertinent to Alternatives 2A, 2B, and 2C. Alternative 2A is consistent with the PCB Spill Cleanup Policy for surface soils. Alternatives 2B and 2C meet more stringent cleanup levels than those in the PCB Spill Cleanup Policy for restricted access areas. Alternatives 2A, 2B, and 2C are consistent with the recommendations in USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990).

Alternatives 3A and 3B. Potential ARARs for Alternatives 3A and 3B include the chemical-specific ARARs presented in Table 7, the location-specific ARAR related to wetlands, as well as action-specific ARARs related to excavation, grading, landfill disposal, transportation, construction, storage, marking, and decontamination. As discussed for Alternative 1, attainment of the Class GA ground water standard will be evaluated as part of the GM main plant site RI/FS. Excavation of PCB-contaminated material would be conducted in a manner consistent with the wetland requirements. Dust control measures would be implemented during earth moving activities to provide for attainment of the particulate air quality standard. Excavated dredged material/soil containing PCBs at concentrations greater than 50 mg/kg would be disposed of at a TSCA-approved and Resource Conservation and Recovery Act (RCRA)-permitted hazardous waste landfill. Marking and decontamination would be performed in accordance with TSCA requirements. Dredged material/soil would be transported by permitted waste haulers in accordance with DOT requirements. Hazardous waste and PCB waste generator requirements would also be followed. Construction activities would be conducted in accordance with OSHA requirements.

Potential TBCs for Alternatives 3A and 3B include the chemical-specific TBCs presented in Table 8. Alternative 3A is consistent with the PCB Spill Cleanup Policy for surface soils. Alternative 3B meets more stringent cleanup levels than those in the PCB Spill Cleanup Policy for restricted access areas. With excavation and off-site disposal, both Alternatives 3A and 3B would meet or exceed the recommendation in USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990) for containment of low-threat material on-site.

Alternative 4. Potential ARARs for Alternative 4 include the chemical-specific and location-specific ARARs presented in Table 7, as well as action-specific ARARs related to excavation, grading, on-site treatment, incineration, residual management, storage, marking, decontamination, and construction. As discussed for Alternative 1, attainment of the Class GA ground water standard will be evaluated as part of the GM main plant site RI/FS. Excavation and incineration of PCB-contaminated material would be conducted in a manner consistent with the wetland requirements. The incinerator would be operated in accordance with the floodplain requirements. Dust control measures would be implemented during earth moving activities to provide for attainment of the particulate air quality standard. Excavated dredged material/soil containing PCBs at concentrations greater than 50 mg/kg would be incinerated in a TSCA-approved mobile incinerator which also meets substantive NYS RCRA requirements. The incinerator would be operated in accordance with substantive NYS air pollution control requirements. Incineration residuals would be disposed of in accordance with appropriate TSCA and NYS RCRA disposal requirements. Marking and decontamination would be performed in accordance with TSCA requirements. Construction activities would be conducted in accordance with OSHA requirements.

Potential TBCs for Alternative 4 include the chemical-specific TBCs presented in Table 8. Alternative 4 is consistent with the PCB Spill Cleanup Policy for surface soils. With excavation and incineration, Alternative 4 would meet or exceed the recommendation in USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990) for containment of low-threat material on-site.

Alternatives 5A and 5B. Potential ARARs for Alternatives 5A and 5B include the chemical-specific and location-specific ARARs presented in Table 7, as well as action-specific ARARs related to excavation, grading, on-site treatment, thermal desorption, residual management, storage, marking, decontamination, and construction. As discussed for Alternative 1, attainment of the Class GA ground water standard will be evaluated as part of the GM main plant site RI/FS. Excavation and thermal desorption of PCB-contaminated material would be conducted in a manner consistent with the wetland requirements. The treatment unit would be designed, constructed, and operated in accordance with the floodplain requirements. Dust control measures would be implemented during earth moving activities to provide for attainment of the particulate air quality standard. USEPA TSCA approval would be requested to use thermal desorption as an alternate disposal method to incineration or chemical waste landfill. Thermal desorption would be performed in accordance with NYS hazardous waste treatment facility substantive requirements. Thermal desorption residuals would be disposed of in accordance with appropriate TSCA and NYS RCRA disposal requirements. Marking and decontamination would be performed in accordance with TSCA requirements. Construction activities would be conducted in accordance with OSHA requirements.

Potential TBCs for Alternatives 5A and 5B include the chemical-specific TBCs presented in Table 8. Alternatives 5A is consistent with the PCB Spill Cleanup Policy for surface soils. Alternative 5B meets more stringent cleanup levels than those in the PCB Spill Cleanup Policy for restricted access areas. With excavation and treatment, Alternatives 5A and 5B would meet or exceed the recommendation in USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990) for containment of low-threat material on-site.

Alternative 6. Potential ARARs for Alternative 6 include the chemical-specific and location-specific ARARs presented in Table 7, as well as action-specific ARARs related to on-site treatment, *in situ* bioremediation, decontamination, and construction. As discussed for Alternative 1, attainment of the Class GA ground water standard would be evaluated as part of the GM main plant RI/FS. *In situ* bioremediation of PCB-contaminated material would be conducted in a manner consistent with the wetland requirements. Treatment would also be performed in a manner consistent with the floodplain requirements. Dust control measures would be implemented during tilling activities to provide for attainment of the particulate air quality standard. *In situ* bioremediation would be performed in accordance with NYS hazardous waste treatment facility substantive requirements. Decontamination would be performed in accordance with

TSCA requirements. Construction activities would be conducted in accordance with OSHA requirements.

Potential TBCs for Alternative 6 include the chemical-specific TBCs presented in Table 8. Alternative 6 is consistent with the PCB Spill Cleanup Policy for surface soils. With treatment, Alternative 6 would meet or exceed the recommendation in USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990) for containment of low-threat material on-site.

Alternatives 7A, 7B, and 7C. Potential ARARs for Alternatives 7A, 7B, and 7C include the chemical-specific and location-specific ARARs presented in Table 7, as well as the location-specific ARAR related to wetlands. Additionally, action-specific ARARs related to soil cover, grading, construction, excavation, landfill disposal, transportation, storage, marking, and decontamination are also ARARs for these alternatives. As discussed for Alternative 1, attainment of the Class GA ground water standard will be evaluated as part of the GM main plant site RI/FS. Soil cover design would be consistent with the potential location-specific ARARs for wetlands and floodplains discussed in Table 7. For study area conditions, the proposed soil cover is consistent with the NYS hazardous waste landfill capping performance requirements based on the following considerations:

- PCB migration to ground water is likely not a pathway of concern;
- grading would promote runoff and minimize erosion;
- cover maintenance would promote continued integrity; and
- soil cover installation would not facilitate ground water mounding.

Excavation of PCB-contaminated material related to hot-spot removal would be conducted in a manner consistent with the wetland requirements.

Dust control measures would be implemented during earth moving activities to provide for attainment of the particulate air quality standard. Excavated dredged material/soil containing PCBs at concentrations greater than 50 mg/kg would be disposed of at a TSCA-approved and RCRA-permitted hazardous waste landfill. Marking and decontamination would be performed in accordance with TSCA requirements. Dredged material/soil would be transported by permitted waste haulers in accordance with DOT requirements. Hazardous waste and PCB waste generator requirements would also be followed. Construction activities would be conducted in accordance with OSHA requirements.

Each of the potential TBCs presented in Table 8 are pertinent to Alternatives 7A, 7B, and 7C. Alternative 7A is consistent with the PCB Spill Cleanup Policy for surface soils. Alternatives 7B and 7C meet more stringent cleanup levels than those in the PCB Spill Cleanup Policy for restricted access areas. With excavation and off-site disposal, Alternatives 7A, 7B, and 7C would meet or exceed the recommendations in USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990) for containment of low-threat material on-site.

3.2.3. Long-term effectiveness and permanence

For the evaluation of long-term effectiveness and permanence, the magnitude of residual risk remaining from untreated material remaining at the site and the adequacy and reliability of controls used to manage untreated materials were assessed for each alternative. The individual analysis of each remedial alternative with respect to this criterion is presented in Table 6.

3.2.4. Reduction of toxicity, mobility, or volume through treatment

The evaluation of reduction of toxicity, mobility, or volume through treatment addressed the expected performance of treatment technologies employed in each alternative. The individual analysis of each remedial alternative with respect to this criterion is presented in Table 6.

3.2.5. Short-term effectiveness

The short-term effectiveness criterion addressed the protection of workers and the community during construction and implementation of each alternative, environmental effects resulting from implementation of each alternative, and the time required to achieve remedial objectives. The individual analysis of each remedial alternative with respect to this criterion is presented in Table 6.

3.2.6. Implementability

The analysis of implementability involved the assessment of the following: the ability to construct and operate technologies, the reliability of technologies, the ease of undertaking additional remedial action, the ability to monitor the effectiveness of each remedy, the ability to obtain necessary approvals from other agencies, and the availability of services, capacities, equipment, materials and specialists. Results of evaluation of implementability for each alternative are presented in Table 6.

3.2.7. Cost

The objective of evaluating costs during the detailed analysis of alternatives was to make comparative analyses among alternatives based on cost. Cost estimates were prepared based on readily available vendor information and quotations, cost estimating guides and experience. Capital costs are those required to implement a remedy and include both direct and indirect capital costs. Annual operation and maintenance costs are costs which are expected to be incurred yearly throughout implementation of the remedy. The estimated capital and operation and maintenance costs were calculated for each alternative along with a present worth cost, which represents the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action. Present worth costs were calculated for the life of the alternative (up to 30 years) at a 5% discount rate.

Detailed cost estimates for Alternatives 1 through 7C are presented in Tables 9 through 21. A summary of estimated costs for each alternative is presented in Table 6. Cost estimates are considered preliminary, but are sufficiently detailed for purposes of comparing the alternatives in the FS. Costs associated with the selected remedial alternative will be refined during remedial design.

The following are clarifications and assumptions made in developing the remedial alternative cost estimates:

- For each alternative, it was assumed that ground water monitoring would consist of periodic sampling of four wells and analysis for PCBs via NYSDEC ASP Method 91-3.
- In Alternatives 3A, 3B, 7A, 7B, and 7C, excavated dredged material/soil would be transported via rail car to U.S. Pollution Control, Inc.'s (USPCI's) TSCA-permitted chemical waste landfill in Lake Point, Utah.
- In Alternative 4, the mobile incineration unit treatment direct capital cost is based on vendor estimates and incorporates treatment operation costs,

analytical costs, ash collection and disposal costs, and air monitoring costs. Mobilization costs are also based on vendor estimates and include set-up, decontamination, and demobilization.

- In Alternatives 5A and 5B, the thermal desorption unit treatment direct capital cost is based on vendor estimates (See Appendix E) and incorporates treatment operation costs, analytical costs, afterburner operation costs, exhaust gas particulate disposal costs, and air monitoring costs. Mobilization costs are also based on vendor estimates and include set-up, decontamination, and demobilization.

- It was assumed for Alternative 6 that the treatment duration for *in situ* bioremediation would be 5 years.

- It should be noted that cost estimates for Alternatives 2A, 2B, 2C, 6, 7A, 7B, and 7C do not include possible future costs associated with repair of the County sewer in the event of failure. Costs were not estimated for these potential repairs due to the uncertainties associated with degree of repair necessary and timing.

3.2.8. State acceptance

State acceptance will be addressed in the Record of Decision (ROD) following the public comment period.

3.2.9. Community acceptance

Community acceptance will be addressed in the ROD following the public comment period.

3.3. Comparative analysis of alternatives

In the comparative analysis of alternatives, the performance of each alternative relative to the others was evaluated for each evaluation criterion.

3.3.1. Overall protection of human health and the environment
Adequate protection of human health and the environment would be achieved by each remedial alternative. Alternative 1 would be protective of human health and the environment, because under current study area conditions, human and ecological risks are acceptable.

Alternatives 2A, 2B, and 2C (containment alternatives) would provide approximately the same level of overall protectiveness of human health and the environment, utilizing different controls. In Alternative 2A, approximately 11 acres of the study area would be covered by clean soil and vegetation; fencing and deed restrictions would restrict access to other areas of the study area with PCB concentrations less than 25 mg/kg. In Alternative 2B, approximately 15 acres of the study area would be covered; fencing and deed restrictions would restrict access to other areas of the study area with PCB concentrations less than 10 mg/kg. In Alternative 2C, approximately 17 acres of the study area would be covered in order to preclude access to PCB concentrations greater than 1 mg/kg (surface) and 10 mg/kg (subsurface).

With equivalent soil covers as those in Alternatives 2A, 2B, and 2C (containment alternatives), Alternatives 7A, 7B, and 7C (removal/disposal/ containment alternatives) would provide similar protectiveness, although material with PCB concentrations greater than 50 mg/kg would be excavated and transferred to an off-site landfill, increasing risks related to disturbance and transport of the material.

Upon completion, Alternatives 3B and 5B (removal alternatives) provide approximately equal protection to Alternatives 2C and 7C (containment and removal/disposal/containment alternatives) through removal of dredged material/soil. However, these alternatives pose a potential hazard through air migration of PCBs via dust during implementation. Alternative 3B also poses potential risks associated with material transportation.

Alternatives 3A, 4, and 5A (removal alternatives) would be approximately equally protective because remaining/exposed surface PCBs in dredged material/soil would be less than 25 mg/kg study area-wide. As in Alternatives 2A and 7A (containment and removal/disposal/containment alternatives), restriction of access to other areas of the study area with PCB concentrations greater than 25 mg/kg would be maintained through fencing and deed restrictions. However, Alternatives 3A, 4, and 5A (removal alternatives) pose a potential hazard through air migration of PCBs during excavation of dredged material/soil. Furthermore, Alternative 3A would have potential risks associated with the transport of PCB contaminated dredged material/soil.

Protectiveness achieved by Alternative 6 (*in situ* treatment alternative) is unknown due to the innovative nature of employing *in situ* bioremediation for PCBs. Workers would be equally protected during implementation of each of the alternatives with use of appropriate protective equipment.

3.3.2. Compliance with applicable or relevant and appropriate requirements (ARARs)

Each remedial alternative would attain corresponding potential ARARs, with the exception of the NYS Class GA ground water standard, the attainment of which will be evaluated during the GM main plant RI/FS. Implementation of Alternatives 2A, 2B, and 2C (containment alternatives) would be consistent with the recommendations of USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990) for containment of low-threat material on-site. Alternatives 3A through 7C would meet or exceed the recommendations of USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990) for containment of low-threat material on-site. Alternatives 2A, 3A, 4, 5A, 6, and 7A would be consistent with the objectives of the PCB Spill Cleanup Policy. Alternatives 2B, 2C, 3B, 5B, 7B, and 7C meet more stringent cleanup levels than those in the PCB Spill Cleanup Policy for restricted access areas. Alternative 1, through no action, would not meet the cleanup levels in the PCB Spill Cleanup Policy or meet the recommendations of USEPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990).

3.3.3. Long-term effectiveness and permanence

Deed restrictions would discourage disturbance/contact with dredged material/soil in each alternative except for 3B and 5B. Furthermore, fence locks and maintenance would minimize contact with dredged material/soil in each alternative except for 3B and 5B. Both of these institutional actions would provide for long-term effectiveness and permanence. Both Alternatives 3B and 5B preclude contact with dredged material/soil through removal; therefore, deed and access restrictions would not be necessary.

The magnitude of residual risk over the long-term would be least for Alternatives 3B and 5B, which would result in surface and subsurface soil PCB concentrations of less than 1 mg/kg and 10 mg/kg, respectively, present at the site and Alternatives 2C and 7C which would result in only surface materials with PCB concentrations of less than 1 mg/kg being exposed.

Alternatives 2B and 7B provide the next lowest residual risk level, resulting in twelve acres of clean surface soil at the study area leaving exposed only areas with surface PCB concentrations less than 10 mg/kg; deed restrictions and fencing would be used to control the incremental increased residual risk associated with these alternatives.

Alternatives 2A, 3A, 4, 5A and 7A, would provide for the next least residual risk, with reduction of exposed surface dredged material/soil to those with PCB concentrations less than 25 mg/kg; deed restrictions and fencing would be used to control the incremental increased residual risk associated with these alternatives.

Alternative 6 would have some reduction of surface PCB concentrations, but because the technology is innovative, the reduction is undefined. It should be noted that there are acceptable risks associated with human health and the ecological system under the current study area conditions.

In each alternative, except Alternatives 3B and 5B, ground water monitoring, deed restrictions, and fencing would be adequate and reliable in restricting activities resulting in potential ingestion of or contact with dredged material/soil. Alternatives 3B and 5B incorporate ground water monitoring to evaluate ground water quality. However, deed and access restrictions are not necessary as potential ingestion and contact with dredged material is accomplished through material removal. Alternatives 2A through 5B and 7A through 7C have technologies that are considered to be adequate and reliable controls. The technology's effectiveness and reliability in Alternative 6 have not been proven.

3.3.4. Reduction of toxicity, mobility, or volume through treatment

Mobility, as discussed in this case, involves PCB mobility via particulate transport through erosion, although apparently currently minimal at the study area. As discussed in Section 2.2, it does not appear that PCBs exhibit mobility in leaching from dredged material/soil to ground water at the study area.

Alternative 1 would not achieve reduction of toxicity, mobility, or volume of PCBs through treatment, but there are acceptable human and ecological risks under current study area conditions. Some undefined reduction of PCB toxicity and mobility would be achieved by Alternative 6.

Alternatives 2A, 2B, 2C, 3A, 3B, 7A, 7B and 7C would achieve reductions of PCB mobility through containment. Alternatives 4, 5A, and 5B would attain reductions of toxicity, mobility, and volume of PCBs.

Alternatives 4, 5A, and 5B would destroy PCBs in dredged material/soil. Incineration (Alternative 4) has been proven effective in destroying PCBs up to 99.9999%; however, ash residual must be managed. In some applications, thermal desorption (Alternatives 5A and 5B) has been shown to achieve performance levels equivalent to Alternative 4, but treatability would be necessary to demonstrate its effectiveness in destroying PCBs in the dredged material/soil. Treatment efficiency for PCBs and residuals is unknown for Alternative 6.

3.3.5. Short-term effectiveness

Alternative 1 would be most effective in the short-term since there are acceptable human and ecological risks under current study area conditions, and Alternative 1 would not involve any disturbance of study area dredged material/soil. PCB transport would be minimized in Alternatives 2A through 7C through implementation of dust and drainage control measures.

Deed restrictions and fencing would effectively restrict community access to the study area in each alternative, except Alternatives 3B and 5B, where access restriction would not be necessary due to removal of material with PCB concentrations greater than 1 mg/kg in surface soils and 10 mg/kg in subsurface soils. Ground water monitoring, in each case, would not affect the community.

During remedial activities for each of the alternatives, workers would use adequate protective equipment and measures. Except for Alternative 6, the time until remedial action objectives are achieved is immediately following implementation. Alternatives 2A through 7C, except Alternative 6, would likely require one construction season to implement. The remediation time frame for Alternative 6 is unknown.

3.3.6. Implementability

The technologies to be used in each of the proposed alternatives would be readily constructed and maintained. With the exception of Alternative 6, each of the alternatives include technologies that are considered to be reliable. Alternative 6 includes an innovative biological treatment; the reliability is not known. Additional remedial actions could be readily implemented in each alternative.

Each of the remedial alternatives would employ monitoring in order to observe changes in ground water PCB concentrations at the study area. Implementation of land use restrictions for each of the alternatives, except Alternatives 3B and 5B, would require some coordination with the property owners, Onondaga County, Niagara Mohawk Power Corporation, The Pfaltzgraff Co., and the New York State Thruway Authority. Fence locks and routine inspection and maintenance would also be implemented in each alternative, except Alternatives 3B and 5B.

In Alternatives 3A, 3B, 7A, 7B, and 7C, a landfill facility and capacity are expected to be readily available. Mobile incineration is expected to be readily available as part of Alternative 4. In Alternatives 5A and 5B, a treatment unit and capacity are expected to be readily available. The necessary services, equipment, and off-site capacity in each alternative are expected to be readily available.

Each alternative is considered to be implementable from a property owner standpoint, because under Section 27-1313.3.a of the New York State Environmental Conservation Law and 6 NYCRR 375-1.3(u)(1), the current owner of the site is a responsible party and actions are proposed to be taken to address Onondaga County's proposed future use of the site.

3.3.7. Cost

Total estimated capital costs, annual operation and maintenance costs, and present worth costs are presented on Table 6 for each of the alternatives. Detailed costs for each alternative are presented on Tables 9 through 21.

Each alternative, except Alternatives 3B and 5B, had similar costs associated with ground water monitoring, deed restrictions, and fencing, as well as activities proposed to address Onondaga County concerns. The least costly alternative was Alternative 1; Alternative 3B was the most expensive.

3.3.8. State acceptance

State acceptance will be addressed in the ROD.

3.3.9. Community acceptance

Community acceptance will be addressed in the ROD.

4. Conclusions and recommendations

Thirteen remedial alternatives were assembled in this FS, consisting of seven base alternatives with variations based on PCB soil cleanup levels. The alternatives were evaluated in detail and compared to each other in the detailed analysis of alternatives.

Each alternative would meet the remedial action objective of monitoring PCB concentrations in shallow ground water. Deed restrictions and fencing in each alternative, except Alternatives 3B and 5B, would address the second remedial objective of minimization of contact with dredged material/soil containing greater than 25 mg/kg PCBs. Alternative 1 would involve no active remediation; there are, however, no unacceptable risks to human health or the environment associated with current study area conditions. Alternative 6 would provide treatment of surface dredged material/soil containing greater than 25 mg/kg PCBs, but its effectiveness and reliability are unproven.

Alternatives 2A, 3A, 4, 5A, and 7A provide for the elimination of direct contact with the dredged material/soil containing greater than 25 mg/kg PCBs with a soil cover or excavation, and provide for minimization of contact with dredged material/soil with PCB concentrations less than 25 mg/kg through deed restrictions and fencing. Alternative 2A would result in 11 acres of clean surface soils at the study area, and would involve only minor disturbance of PCB-contaminated dredged material/soil during regrading activities. Alternative 7A would also result in 11 covered acres at the study area, but would involve disturbance of material to excavate, transport and dispose off-site of dredged material soil with PCB concentrations greater than 50 mg/kg. Alternatives 3A, 4, and 5A would result in surface PCB concentrations less than 25 mg/kg, control through deed restrictions and fencing of remaining PCB-contaminated areas with concentrations greater than 1 mg/kg in surface soils and 10 mg/kg in subsurface soils, but would involve disturbance of PCB-contaminated dredged material/soil during excavation and regrading. Next to Alternative 1, remedial worker contact with PCBs would therefore be minimal in Alternative 2A.

Alternatives 2B and 7B provide for elimination of contact with PCBs greater than 10 mg/kg with a cover, and provide for minimization of contact with PCBs less than 10 mg/kg with deed restrictions and fencing. Alternative 2B would result in 15 acres of clean surface soils at the study area, and would involve only minor disturbance of PCB-contaminated dredged material/soil during regrading activities. Alternative 7B would also result in 15 covered acres at the study area, but would involve disturbance of material to excavate, transport and dispose off-site of dredged material soil with PCB concentrations greater than 50 mg/kg.

Finally, Alternatives 2C, 3B, 5B, and 7C provide for minimization of direct contact with the dredged material/soil containing greater than 10 mg/kg PCBs in subsurface soils or greater than 1 mg/kg in surface soils with a soil cover or excavation. Alternative 2C would result in 17 acres of clean surface soils at the study area, and would involve only minor disturbance of PCB-contaminated dredged material/soil during regrading activities. Alternative 7C would also result in 17 covered acres at the study area, but would involve disturbance of material to excavate, transport and dispose off-site of dredged material soil with PCB concentrations greater than 50 mg/kg. Alternatives 3B and 5B would result in surface and subsurface PCB concentrations of less than 1 mg/kg and 10 mg/kg, respectively, but would involve disturbance of PCB-contaminated dredged material/soil during excavation and regrading.

Alternative 2A is the remedial alternative recommended for implementation at the study area. Alternative 2A would provide for approximately the same level of overall protection of human health and the environment as Alternatives 2B and 2C, through use of different, but equally protective controls. Further, Alternative 2A would not require as much disturbance of dredged material/soil as would Alternatives 3A, 3B, 4, 5A, 5B, 7A, 7B, and 7C, and would consequently not result in risks associated with material excavation and transport. Alternative 2A would attain ARARs, and would be the most cost-effective alternative of the range considered.

GM believes Alternative 2A is protective of human health and the environment, attains ARARs, represents the best balance of the evaluation criteria, and is cost-effective. Accordingly, GM believes Alternative 2A is the appropriate remedial alternative for selection in accordance with the requirements for remedy selection as set forth in the NCP and NYSDEC's "TAGM on Selection of Remedial Actions at Inactive Hazardous Waste Sites" (NYSDEC, 1990). However, NYSDEC expressed a preference for a remedial alternative which reflected the PCB cleanup objectives of 1 mg/kg (surface) and 10 mg/kg (subsurface) set forth in NYSDEC TAGM 4046, entitled "Determination of Soil Cleanup Objectives and Cleanup Levels." In light of this preference, GM, without admitting the appropriateness of use of this TAGM's PCB standards under applicable legal or technical requirements, has developed a new remedial alternative, Alternative 8, which incorporates the use of the requested PCB standards. The new alternative, Alternative 8, involves the following:

- excavation and off-site disposal of dredged material/soil containing PCBs at concentrations greater than 50 mg/kg;
- regrading of dredged material/soil in the floodway;
- construction of an access road along the south bank of Ley Creek to facilitate potential future dredging operations;
- grading and installation of a vegetated soil cover over approximately 17 acres of dredged material/soil containing PCBs at concentrations greater than 10 mg/kg in subsurface soils and 1 mg/kg in surface soils to minimize erosion and direct contact;
- installation of fence gates and gravel paths to provide access to Onondaga County sewer manholes;
- grading and piping of drainage swales crossing the site;
- fencing;
- land use restrictions precluding disturbance of soil cover;
- routine ground water monitoring;
- routine inspection and maintenance; and
- five-year reviews.

To resolve NYSDEC's remedial issues, GM is willing to implement Alternative 8 with the understanding that in doing so, it is making no admissions and may seek the use of alternative PCB cleanup standards on other sites. The conceptual design for Alternative 8 is presented in Section 5.

5. Conceptual design

As described in Section 4, GM has developed a new alternative, Alternative 8, to reflect NYSDEC's request to use PCB cleanup objectives of 1 mg/kg (surface) and 10 mg/kg (subsurface) set forth in NYSDEC TAGM 4046. Figures 7 through 11 present aspects of the conceptual design for Alternative 8, which involves the following:

Removal of dredged material/soil containing PCBs at concentrations greater than or equal to 50 mg/kg. Areas designated on Figure 10 for excavation are in the vicinity of soil boring locations OBG-3, B-37, OBG-4/OBG-7A/OBG-7B, OBG-6, OBG-5, B-1, and B-6, where PCBs were detected at or above 50 mg/kg. The areas for excavation have been identified based on data collected during the RI. Due to the heterogeneity of the dredged material, no additional pre-construction borings will be performed during remedial design to identify the extent of excavation. Instead, dredged material/soil would be excavated from up to a 50 ft by 50 ft area around each boring location to the depth where PCBs were detected at or above 50 mg/kg. Composite sampling of the excavation base and sidewalls would be performed, and PCB field screening kits with limited confirmatory laboratory analysis would be used to confirm material remaining does not contain PCBs at or above 50 mg/kg. Up to 5,630 cu yd of dredged material/soil could be excavated. Excavated soils would be transported to an off-site commercial permitted landfill for disposal.

Floodway. The following actions will be performed for the floodway in the portion of the study area in which PCBs have been detected at concentrations greater than 10 mg/kg in the subsurface (depths greater than 1 ft) or greater than 1 mg/kg in the surface soils (top 1 ft). The floodway area is approximately depicted in Figure 8. Dredged material/soil will be regraded out of the first 25 feet of floodway south of Ley Creek to establish final elevations which do not result in increased flood elevations. Within the first 15 ft, a gravel road will be constructed to allow access to Ley Creek in the event that dredging is required in the future. The road will be underlain by low permeability materials (*e.g.*, flexible geomembrane/clay) to minimize erosion of dredged material/soil into the creek. Shoreline protection (*e.g.*, rip rap) may also be installed if it is judged to be necessary during remedial design.

For the area between 15 and 25 ft south of Ley Creek, low permeability materials (*e.g.*, flexible geomembrane/clay) overlain by a vegetated soil cover will be placed over the dredged material/soil to minimize erosion and direct contact. For the remainder of the floodway area in the study area (varying width throughout the site), a low permeability cover (*e.g.*, flexible geomembrane or clay) overlain by a vegetated soil cover will be installed to minimize erosion and direct contact.

Floodway activities will result in the placement of fill in wetland areas. NYS Freshwater Wetlands Permit Requirements regulations require that filling activities in Class 2 wetlands be approved only if it is determined that the proposed activity satisfies a pressing economic need that clearly outweighs the loss of or detriment to the benefit of the wetland. In NYSDEC's letter dated December 13, 1995 (Davies, 1995), it noted that the Division of Fish and Wildlife found that the potential reduction in PCB contamination to Ley Creek outweighs the loss of wetland, and that the proposed reduction in surface water pollution would satisfy a pressing economic or social need. Further, Section 404 of the Clean Water Act requires a permit for discharge of fill material in a wetland. Authorization for these activities will be requested under Nationwide Permit (NWP) #38, Cleanup of Hazardous and Toxic Waste.

Dredged material/soil consolidation. Dredged material/soil regraded out of the floodway will be both used as backfill in the excavations and consolidated in an area extending along the southern edge of the floodway on Onondaga County property in the study area. Additionally, dredged material/soil in the vicinity of boring location B-19 will be excavated from an approximate 6200 sq ft area and average 3 ft depth and relocated to the consolidation area or areas where PCBs greater than 50 mg/kg were removed; the excavation area at B-19 will be regraded. The consolidated dredged material/soil would be graded to slopes which would encourage runoff and provide structural stability. A 25 ft buffer area would be maintained between the southern edge of the consolidation area and the sewer pipeline route. A 12 inch vegetated soil cover would be placed on the consolidated dredged material/soil, as well as the remainder of the fenced study area south of the floodway. The objective of the soil cover is to minimize direct contact, rather than to minimize infiltration. The current western edge of the fence would be relocated approximately 700 ft east to reflect the western boundary of detected PCBs identified during the RI. The areal extent of the proposed soil cover is presented in Figure 7.

Consolidation activities may result in the placement of fill in wetland areas. As discussed above, NYSDEC has documented its approval of these activities (Davies, 1995) in view of the satisfaction of the PCB remedial objectives. As further discussed above, authorization for these activities will also be requested under NWP #38.

Onondaga County maintenance access. The four drainage swales which cross the study area will be graded back on each side, and a 12 inch vegetated soil cover will be placed in the swale flow channel. Additionally, a half pipe or formed concrete spill way will be placed in each swale flow channel. Consolidated dredged material/soil would not be placed in the swale pathways.

Access gates will be installed in the fence in the vicinity of each sewer manhole, which will be brought up to grade. Gravel paths will be constructed at these access gates leading to the manholes to provide Onondaga County with access to maintain the sewer. Additionally, at an access gate at the east end of the study area, the gravel path will be extended to the access road to be constructed along the south bank of Ley Creek.

Future land use and restrictions. Locks would be installed on the fence gates to minimize unauthorized access to the area. Land use restrictions would be used to preclude the conduct of activities which would potentially expose contaminated materials or impair the integrity of a soil cover without prior review and approval by NYSDEC. It is proposed that potential future activities, which are less predictable at the study area, such as sewer repair, sewer installation, widening of Factory Avenue, and replacement of utility poles, be dealt with on a case-by-case basis to address the potentially increased cost to undertake these activities due to the presence of PCBs.

Ground water monitoring. Ground water monitoring would provide a means to detect changes in PCB concentrations in the study area shallow ground water. The ground water monitoring program would involve periodic sampling of four wells in the study area and analysis for PCBs using NYSDEC ASP Method 91-3.

Inspection and maintenance. Constructed remedy components would be routinely inspected and maintained.

Five-year reviews. Five-year reviews would be conducted as required by the NCP due to the fact that PCB-containing dredged material/soil will remain on-site. The purpose of the five-year reviews is to evaluate the study area with respect to the continued protection of human health and the environment.

Cost. The preliminary estimated 30-year present worth cost for implementation of Alternative 8 is approximately $6.7 million. Estimated direct and indirect capital costs total approximately $3.6 million and $1.6 million, respectively. The estimated annual operation and maintenance cost is approximately $100,000. Alternative 8 estimated costs are summarized in Table 22.

Respectfully submitted,

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Tables

O'BRIEN & GERE ENGINEERS, INC.

Table 1
Screening of Technologies and Process Options
Dredged Material/Soil

Feasibility Study
Ley Creek Dredged Material Area

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
No Action	None	Not applicable	No action.	Required for consideration by NCP.
Institutional Actions	Access Restriction	Deed Restrictions	Land use restrictions for area of contamination.	Potentially Applicable
		Fencing	Installation of a fence surrounding the area of contamination.	Potentially Applicable
Containment Actions	Cover	12 inch soil overlay with vegetation	Vegetated soil layer covering dredged material.	Potentially Applicable
Removal Actions	Excavation	Excavation	Removal of dredged material using standard construction equipment (e.g. front-end loader, back hoe).	Potentially Applicable for limited volumes.
Disposal Actions	Land Disposal	Commercial Chemical Landfill	Placement of dredged material in an off-site landfill.	Potentially Applicable for limited volumes.

Table 2
Screening of Technologies and Process Options
Ground Water

Feasibility Study
Ley Creek Dredged Material Area

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
No Action	None	Not applicable	No action.	Required for consideration by NCP.
Institutional Actions	Monitoring	Ground Water Monitoring	Periodic ground water sampling and analysis to document existing conditions.	Potentially Applicable

Table 3
Evaluation of Process Options
Dredged Material/Soil

Feasibility Study
Ley Creek Dredged Material Area

General Response Action	Remedial Technology	Process Option	Effectiveness	Implementability	Cost
No Action	None	Not Applicable	Relies solely on natural attenuation.	Not Applicable	No Capital No O&M
Institutional Actions	Access Restriction	Deed Restrictions *	Effectiveness depends on continued implementation. Doesn't reduce contamination or prevent migration.	Readily Implementable	Low Capital No O&M
		Fencing *	Effectively minimizes access to the site.	Readily Implementable	Low Capital Very Low O&M
Containment Actions	Cover	12 inch soil cover * with vegetation	Effectively minimizes human and ecological contact with fill material.	Readily Implementable	Medium Capital Low O&M
Removal Actions	Excavation	Excavation *	Effectively removes contaminated soil.	Readily Implementable	High Capital No O&M
Disposal Actions	Land Disposal	Commercial * Chemical Landfill	Effective disposal method. Minimizes PCB migration.	Readily Implementable	High Capital No O&M

Note: * = Representative process option.

Table 3
Evaluation of Process Options
Dredged Material/Soil

Feasibility Study
Ley Creek Dredged Material Area

General Response Action	Remedial Technology	Process Option	Effectiveness	Implementability	Cost
Treatment Actions	Physical	Soil Washing	Effective for separation/segregation and volumetric reduction of hazardous materials in soils. Contaminated fine particles and wash water require further management.	Readily Implementable	High Capital No O&M
		Solidification/ Stabilization	Effective for reducing PCB mobility. Does not destroy or detoxify PCBs.	Readily Implementable	Medium Capital No O&M
	Chemical	Dechlorination	Through nucleophilic substitution, the reaction effectively detoxifies PCBs, producing non-toxic, non-mutagenic, and non-bioaccumulative products.	Readily Implementable	Medium Capital No O&M
		Solvent Washing/ Extraction	Variable effectiveness for PCB removal; extract management required.	Readily Implementable	Medium Capital No O&M
	Biological	*Ex Situ*	Variable effectiveness for PCB destruction; considered to be innovative for PCB treatment.	Readily Implementable	Medium Capital Medium O&M
		In Situ *	Variable effectiveness for PCB destruction; considered to be innovative for PCB treatment.	Readily Implementable	Low Capital Medium O&M
	Thermal	Incineration *	Very effective; capable of 99.9999% PCB destruction. Off gas control and ash disposal required.	Readily Implementable	High Capital No O&M
		Thermal Desorption *	Effectively uses direct or indirect heat exchange to volatilize PCBs from soil. The volatilized contaminants are typically incinerated; an air emissions control system is employed to remove acid gases and particulates in exhaust gas. Off-gas control is required.	Readily Implementable	Medium Capital No O&M
		Thermal Gas-Phase Reduction	Effective PCB destruction treatment. Off-gas contol is required.	Readily Implementable	High Capital No O&M
		In Situ Vitrification	Effective PCB destruction treatment. Soil moisture may limit efficiency of process. Vender experienced recent operational problems.	Readily Implementable	High Capital Low O&M

Note: * = Representative process option.

Table 4
Evaluation of Process Options
Ground Water

Feasibility Study
Ley Creek Dredged Material Area

General Response Action	Remedial Technology	Process Option	Effectiveness	Implementability	Cost
No Action	No Action	Not Applicable	Relies solely on natural degradation.	Not Applicable	No Capital No O&M
Institutional Actions	Monitoring	Ground Water * Monitoring	Useful for documentation of conditions.	Readily Implementable	Low Capital Medium O&M

* Representative Process Option

Table 5
Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	ALTERNATIVES												
			1	2A	2B	2C	3A	3B	4	5A	5B	6	7A	7B	7C
No Action			X												
Institutional Actions	Access Restrictions	Deed Restrictions	X	X	X	X	X		X	X		X	X	X	X
		Fencing - 1ppm PCBs[1]	X	X	X	X	X		X	X		X	X	X	X
	Monitoring	Ground Water Monitoring	X	X	X	X	X		X	X		X	X	X	X
Containment Actions	Cover	12-inch Vegetated Soil Cover - 25 ppm PCBs[2]		X									X		
		12-inch Vegetated Soil Cover - 10 ppm PCBs[3]			X									X	
		12-inch Vegetated Soil Cover - 10 ppm/1ppm PCBs[4]				X									X
Removal Actions	Excavation	Excavation - 50 ppm PCBs[5]											X	X	X
		Excavation - 25 ppm PCBs[2]					X		X	X					
		Excavation - 10 ppm/1 ppm PCBs[4]						X			X				
Disposal Actions	Land Disposal	Off-Site Commerical Landfill					X	X					X	X	X
Treatment Actions	Thermal Treatment	On-Site Incineration							X						
		On-Site Thermal Desorption								X	X				
	Biological Treatment	In-Situ Biological Treatment - 25 ppm PCBs[2]										X			
Miscellaneous Actions		Cross Culvert Lining, Sanitary Sewer Manhole Access Modifications, Creek Maintenance Access Road		X	X	X	X		X	X	X		X	X	X

Table 5 (cont.)
Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

Footnotes:

[1] Process option addresses PCBs exceeding 1 ppm in surface soil (top 12")

[2] Process option addresses PCBs exceeding 25 ppm in surface soil (top 12")

[3] Process option addresses PCBs exceeding 10 ppm in surface or subsurface soils.

[4] Process option addresses PCBs exceeding 10 ppm in subsurface soils (below 12" depth) or 1 ppm in surface soils (top 12")

[5] Process option addresses PCBs exceeding 50 ppm in surface and subsurface soils.

ama/P12

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 1 **No action. Ground water monitoring, deed restrictions and fencing.**	Alternative 2A **12 inch vegetative soil cover (surface soil >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 2B **12 inch vegetative soil cover (surface or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 2C **12 inch vegetative soil cover (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 3A **Dredged material/soil excavation and off-site landfill disposal (surface soils >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 3B **Dredged material/soil excavation and off-site landfill disposal (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), and ground water monitoring.**
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT						
Protection of Human Health	Acceptable risk to human health under current study area conditions. Deed restrictions and fencing would minimize the potential for ingestion of or contact with dredged material/soil. The use of appropriate protective equipment during ground water monitoring would minimize potential threat to workers.	Soil cover would minimize direct human contact with the dredged material/soil. Deed restrictions and fencing would restrict access that may result in breaching of the integrity of the cover and contact with the dredged material/soil, respectively. The use of appropriate protective equipment during remedial activities and ground water monitoring would minimize potential threat to remedial workers.	Soil cover would minimize direct human contact with the dredged material/soil. Deed restrictions and fencing would restrict access that may result in breaching of the integrity of the cover and contact with the dredged material/soil, respectively. The use of appropriate protective equipment during remedial activities and ground water monitoring would minimize potential threat to remedial workers.	Soil cover would minimize direct human contact with the dredged material/soil. Deed restrictions and fencing would restrict access that may result in breaching of the integrity of the cover and contact with the dredged material/soil, respectively. The use of appropriate protective equipment during remedial activities and ground water monitoring would minimize potential threat to remedial workers.	Excavating and transporting dredged material/soil to a TSCA-permitted commercial chemical landfill would minimize direct human contact with PCBs. Potential hazards to humans due to transportation of PCB contaminated dredged material/soil to the commercial chemical landfill. Deed restrictions and fencing would minimize access to the study area and disturbance of dredged material/soil. The use of appropriate protective equipment during remedial activities and ground water monitoring would minimize potential threat to remedial workers.	Excavating and transporting dredged material/soil to a TSCA-permitted commercial chemical landfill would minimize direct human contact with PCBs. Potential hazards to humans due to transportation of PCB contaminated dredged material/soil to the commercial chemical landfill. The use of appropriate protective equipment during remedial activities and ground water monitoring would minimize potential threat to remedial workers.
Protection of Environment	Acceptable ecological risks under current study area conditions.	A soil cover would minimize contact with the dredged material/soil by ecological receptors.	A soil cover would minimize contact with the dredged material/soil by ecological receptors.	A soil cover would minimize contact with the dredged material/soil by ecological receptors.	Excavating and transporting dredged material/soil would minimize contact with PCBs by ecological receptors. Potential for hazards to the environment due to transportation of dredged material to commercial chemical landfill.	Excavating and transporting dredged material/soil would minimize contact with PCBs by ecological receptors. Potential for hazards to the environment due to transportation of dredged material to commercial chemical landfill.

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 4 **Dredged material/soil excavation and incineration (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 5A **Dredged material/soil excavation (surface soils > 25 mg/kg PCBs), thermal desorption treatment, replacement, ground water monitoring, deed restrictions, and fencing.**	Alternative 5B **Dredged material/soil excavation (surface soils > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), thermal desorption treatment, replacement, and ground water monitoring.**	Alternative 6 ***In situ* biological treatment of dredged material/soil (surface soil > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7A **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7B **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7C **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT							
Protection of Human Health	Excavating and incinerating dredged material/soil would minimize human contact. Deed restrictions and fencing would minimize access to the study area and disturbance of dredged material/soil. The use of appropriate protective equipment during remedial activities and ground water monitoring would minimize potential threat to remedial workers.	Thermal desorption of dredged material/soil will effectively minimize human contact. PCBs would be volatilized (physically separated) from the dredged material/soil. Deed restrictions and fencing would minimize access to the study area and disturbance of dredged material/soil. The use of appropriate protective equipment during remedial activities and ground water monitoring would minimize potential threat to remedial workers.	Thermal desorption of dredged material/soil will effectively minimize human contact. PCBs would be volatilized (physically separated) from the dredged material/soil. The use of appropriate protective equipment during remedial activities and ground water monitoring would minimize potential threat to remedial workers.	*In situ* biological treatment would likely destroy some PCBs and would reduce human contact. Deed restrictions and fencing would minimize access to the study area and disturbance of dredged material/soil. The use of appropriate protective equipment during remedial activities and ground water monitoring would minimize potential threat to remedial workers.	Excavating and transporting dredged material/soil to a TSCA-permitted commercial landfill would minimize direct human contact with PCBs. Potential hazards to humans due to transportation of PCB contaminated dredged material/soil to the commercial chemical landfill. Soil cover would minimize direct human contact with the dredged material/soil. Deed restrictions and fencing would restrict access that may result in breaching of the integrity of the cover and contact with the dredged material/soil, respectively. The use of appropriate protective equipment during remedial activities and ground water monitoring would minimize potential threat to remedial workers.	Excavating and transporting dredged material/soil to a TSCA-permitted commercial landfill would minimize direct human contact with PCBs. Potential hazards to humans due to transportation of PCB contaminated dredged material/soil to the commercial chemical landfill. Soil cover would minimize direct human contact with the dredged material/soil. Deed restrictions and fencing would restrict access that may result in breaching of the integrity of the cover and contact with the dredged material/soil, respectively. The use of appropriate protective equipment during remedial activities and ground water monitoring would minimize potential threat to remedial workers.	Excavating and transporting dredged material/soil to a TSCA-permitted commercial landfill would minimize direct human contact with PCBs. Potential hazards to humans due to transportation of PCB contaminated dredged material/soil to the commercial chemical landfill. Soil cover would minimize direct human contact with the dredged material/soil. Deed restrictions and fencing would restrict access that may result in breaching of the integrity of the cover and contact with the dredged material/soil, respectively. The use of appropriate protective equipment during remedial activities and ground water monitoring would minimize potential threat to remedial workers.
Protection of Environment	Excavating and incinerating dredged material/soil would minimize contact with PCBs by ecological receptors.	Thermal desorption of dredged material/soil would minimize contact with PCBs by ecological receptors.	Thermal desorption of dredged material/soil would minimize contact with PCBs by ecological receptors.	*In situ* biological treatment would likely destroy some PCBs and reduce contact by ecological receptors.	Excavating, transporting of dredged material hotspots and soil cover would minimize potential contact with PCBs by ecological receptors. Potential for hazards to the environment due to transportation of dredged material to commercial chemical landfill.	Excavating, transporting of dredged material hotspots and soil cover would minimize potential contact with PCBs by ecological receptors. Potential for hazards to the environment due to transportation of dredged material to commercial chemical landfill.	Excavating, transporting of dredged material hotspots and soil cover would minimize potential contact with PCBs by ecological receptors. Potential for hazards to the environment due to transportation of dredged material to commercial chemical landfill.

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 1 No action. Ground water monitoring, deed restrictions and fencing.	Alternative 2A 12 inch vegetative soil cover (surface soil >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 2B 12 inch vegetative soil cover (surface or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 2C 12 inch vegetative soil cover (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 3A Dredged material/soil excavation and off-site landfill disposal (surface soils >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 3B Dredged material/soil excavation and off-site landfill disposal (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), and ground water monitoring.
COMPLIANCE WITH ARARs						
Chemical-Specific ARARs	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS.	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS.	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS.	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS.	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS.	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS.
Chemical-Specific TBCs	Not consistent with recommendations of PCB Spill Cleanup Policy or USEPA's PCB Superfund guidance.	Consistent with PCB Spill Cleanup Policy and with recommendation of USEPA's PCB Superfund guidance.	Consistent with recommendation of USEPA's PCB Superfund guidance. Meets more stringent cleanup levels than those in the PCB Spill Cleanup Policy for restricted access areas.	Consistent with recommendation of USEPA's PCB Superfund guidance. Meets more stringent cleanup levels than those in the PCB Spill Cleanup Policy for restricted access areas.	Meets or exceeds recommendations of USEPA's PCB Superfund guidance. Consistent with PCB Spill Cleanup Policy.	Meets or exceeds recommendations of USEPA's PCB Superfund guidance. Meets more stringent cleanup levels than those in the PCB Spill Cleanup Policy for restricted access areas.
Location-Specific ARARs	None.	Soil cover design and construction would be consistent with wetland and floodplain requirements.	Soil cover design and construction would be consistent with wetland and floodplain requirements.	Soil cover design and construction would be consistent with wetland and floodplain requirements.	Excavation would be conducted in a manner consistent with wetland requirements.	Excavation would be conducted in a manner consistent with wetland requirements.

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 4 **Dredged material/soil excavation and incineration (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 5A **Dredged material/soil excavation (surface soils > 25 mg/kg PCBs), thermal desorption treatment, replacement, ground water monitoring, deed restrictions, and fencing.**	Alternative 5B **Dredged material/soil excavation (surface soils > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), thermal desorption treatment, replacement, and ground water monitoring.**	Alternative 6 ***In situ* biological treatment of dredged material/soil (surface soil > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7A **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7B **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7C **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**
COMPLIANCE WITH ARARs							
Chemical-Specific ARARs	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS.	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS.	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS.	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS.	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS.	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS.	Attainment of NYS Class GA ground water standard will be evaluated as part of GM-IFG main plant site RI/FS..
Chemical-Specific TBCs	Meets or exceeds recommendations of USEPA's PCB Superfund guidance. Consistent with PCB Spill Cleanup Policy.	Meets or exceeds recommendations of USEPA's PCB Superfund guidance. Consistent with PCB Spill Cleanup Policy.	Meets or exceeds recommendations of USEPA's PCB Superfund guidance. Meets more stringent cleanup levels than those in the PCB Spill Cleanup Policy for restricted access areas.	Meets or exceeds recommendations of USEPA's PCB Superfund guidance. Consistent with PCB Spill Cleanup Policy.	Meets or exceeds recommendations of USEPA's PCB Superfund guidance. Consistent with PCB Spill Cleanup Policy.	Meets or exceeds recommendations of USEPA's PCB Superfund guidance. Meets more stringent cleanup levels than those in the PCB Spill Cleanup Policy for restricted access areas.	Meets or exceeds recommendations of USEPA's PCB Superfund guidance. Meets more stringent cleanup levels than those in the PCB Spill Cleanup Policy for restricted access areas.
Location-Specific ARARs	Excavation and incineration would be conducted in a manner consistent with wetland requirements. Incinerator would be operated in accordance with floodplain requirements.	Excavation and thermal desorption would be conducted in a manner consistent with wetland requirements. Thermal desorption unit would be operated in accordance with floodplain requirements.	Excavation and thermal desorption would be conducted in a manner consistent with wetland requirements. Thermal desorption unit would be operated in accordance with floodplain requirements.	*In situ* bioremediation would be conducted in a manner consistent with wetland and floodplain requirements.	Excavation and soil cover design and construction would be consistent with wetland and floodplain requirements.	Excavation and soil cover design and construction would be consistent with wetland and floodplain requirements.	Excavation and soil cover design and construction would be consistent with wetland and floodplain requirements.

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 1 No action. Ground water monitoring, deed restrictions and fencing.	Alternative 2A 12 inch vegetative soil cover (surface soil >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 2B 12 inch vegetative soil cover (surface or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 2C 12 inch vegetative soil cover (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 3A Dredged material/soil excavation and off-site landfill disposal (surface soils >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 3B Dredged material/soil excavation and off-site landfill disposal (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), and ground water monitoring.
Action-Specific ARARs	None.	Soil cover consistent with NYS hazardous waste landfill capping performance requirements. Particulate air quality standard would be attained through dust control. OSHA requirements would be met during construction.	Soil cover consistent with NYS hazardous waste landfill capping performance requirements. Particulate air quality standard would be attained through dust control. OSHA requirements would be met during construction.	Soil cover consistent with NYS hazardous waste landfill capping performance requirements. Particulate air quality standard would be attained through dust control. OSHA requirements would be met during construction.	Particulate air quality standard would be attained through dust control. OSHA requirements would be met during construction. Dredged material/soil with PCBs >50 ppm would be disposed at TSCA-approved/RCRA-permitted landfill. RCRA and DOT requirements would be attained during transportation. Marking and decontamination, if any, would meet TSCA requirements. RCRA and TSCA generator requirements would be followed.	Particulate air quality standard would be attained through dust control. OSHA requirements would be met during construction. Dredged material/soil with PCBs >50 ppm would be disposed at TSCA-approved/RCRA-permitted landfill. RCRA and DOT requirements would be attained during transportation. Marking and decontamination, if any, would meet TSCA requirements. RCRA and TSCA generator requirements would be followed.
Action-Specific TBCs	None.	Consistent with soil cover recommendations in USEPA's PCB Superfund guidance.	Consistent with soil cover recommendations in USEPA's PCB Superfund guidance.	Consistent with soil cover recommendations in USEPA's PCB Superfund guidance.	None.	None.

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 4 **Dredged material/soil excavation and incineration (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 5A **Dredged material/soil excavation (surface soils > 25 mg/kg PCBs), thermal desorption treatment, replacement, ground water monitoring, deed restrictions, and fencing.**	Alternative 5B **Dredged material/soil excavation (surface soils > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), thermal desorption treatment, replacement, and ground water monitoring.**	Alternative 6 ***In situ* biological treatment of dredged material/soil (surface soil > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7A **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7B **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7C **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**
Action-Specific ARARs	Particulate air quality standard would be attained through dust control. OSHA requirements would be met during construction. Dredged material/soil with PCBs >50 ppm would be incinerated in a TSCA-approved/RCRA-permitted mobile incinerator. NYS air pollution control substantive requirements would be met. Incineration residuals would be disposed of in accordance with appropriate TSCA and RCRA requirements. Marking and decontamination, if any, would meet TSCA requirements.	Particulate air quality standard would be attained through dust control. OSHA requirements would be met during construction. USEPA TSCA approval would be requested for use of thermal desorption as an alternative disposal method. Treatment unit would meet NYS RCRA substantive hazardous waste treatment facility requirements. Residuals would be disposed of in accordance with appropriate TSCA and RCRA requirements. Marking and decontamination, if any, would meet TSCA requirements.	Particulate air quality standard would be attained through dust control. OSHA requirements would be met during construction. USEPA TSCA approval would be requested for use of thermal desorption as an alternative disposal method. Treatment unit would meet NYS RCRA substantive hazardous waste treatment facility requirements. Residuals would be disposed of in accordance with appropriate TSCA and RCRA requirements. Marking and decontamination, if any, would meet TSCA requirements.	Particulate air quality standard would be attained through dust control. OSHA requirements would be met during construction. *In situ* bioremediation would be performed in accordance with NYS RCRA hazardous waste treatment facility requirements. Decontamination would meet TSCA requirements.	Soil cover consistent with NYS hazardous waste landfill capping performance requirements. Particulate air quality standard would be attained through dust control. OSHA requirements would be met during construction. Dredged material/soil with PCBs > 50 ppm would be disposed at TSCA-approved/RCRA-permitted landfill. RCRA and DOT requirements would be attained during transportation. Marking and decontamination, if any, would meet TSCA requirements. RCRA and TSCA generator requirements would be followed.	Soil cover consistent with NYS hazardous waste landfill capping performance requirements. Particulate air quality standard would be attained through dust control. OSHA requirements would be met during construction. Dredged material/soil with PCBs > 50 ppm would be disposed at TSCA-approved/RCRA-permitted landfill. RCRA and DOT requirements would be attained during transportation. Marking and decontamination, if any, would meet TSCA requirements. RCRA and TSCA generator requirements would be followed.	Soil cover consistent with NYS hazardous waste landfill capping performance requirements. Particulate air quality standard would be attained through dust control. OSHA requirements would be met during construction. Dredged material/soil with PCBs > 50 ppm would be disposed at TSCA-approved/RCRA-permitted landfill. RCRA and DOT requirements would be attained during transportation. Marking and decontamination, if any, would meet TSCA requirements. RCRA and TSCA generator requirements would be followed.
Action-Specific TBCs	None.	None.	None.	None.	Consistent with the soil cover recommendations in USEPA's PCB Superfund guidance.	Consistent with the soil cover recommendations in USEPA's PCB Superfund guidance.	Consistent with the soil cover recommendations in USEPA's PCB Superfund guidance.

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 1 No action. Ground water monitoring, deed restrictions and fencing.	Alternative 2A 12 inch vegetative soil cover (surface soil >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 2B 12 inch vegetative soil cover (surface or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 2C 12 inch vegetative soil cover (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 3A Dredged material/soil excavation and off-site landfill disposal (surface soils >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 3B Dredged material/soil excavation and off-site landfill disposal (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), and ground water monitoring.
LONG-TERM EFFECTIVENESS AND PERMANENCE						
Magnitude of Residual Risk	Acceptable risk associated with current study area conditions. Deed restrictions would discourage disturbance/contact with dredged material/soil. Fence locks and maintenance would minimize contact with dredged material/soil.	Vegetated 12 inch cover would minimize contact with PCBs > 25 mg/kg and would reduce areal extent of surficial PCBs. Deed restrictions would discourage disturbance of cover/contact with dredged material/soil. Fence locks and maintenance would minimize contact with dredged material/soil.	Vegetated 12 inch cover would minimize contact with PCBs > 10 mg/kg and would reduce areal extent of surficial PCBs. Deed restrictions would discourage disturbance of cover/contact with dredged material/soil. Fence locks and maintenance would minimize contact with dredged material/soil.	Vegetated 12 inch cover would minimize contact with PCBs > 1 mg/kg at surface and 10 mg/kg in subsurface and would reduce areal extent of surficial PCBs. Deed restrictions would discourage disturbance of cover/contact with dredged material/soil. Fence locks and maintenance would minimize contact with dredged material/soil.	Excavation and disposal would minimize contact with PCBs > 25 mg/kg. Deed restrictions would discourage disturbance/contact with dredged material/soil. Fence locks and maintenance would minimize contact with dredged material/soil.	Excavation and disposal would minimize contact with PCBs > 1 mg/kg at surface and 10 mg/kg in subsurface.
Adequacy and Reliability of Controls	Ground water monitoring is an adequate and reliable method of tracking aquifer conditions. Deed restrictions and fencing are adequate and reliable in restricting activities resulting in potential ingestion of or contact with dredged material/soil.	A vegetative soil cover is an adequate and reliable containment measure, with appropriate maintenance. Ground water monitoring is an adequate and reliable method of tracking conditions in the aquifer. Deed restrictions and fencing are adequate and reliable in restricting activities resulting in potential ingestion of or contact with dredged material/soil.	A vegetative soil cover is an adequate and reliable containment measure, with appropriate maintenance. Ground water monitoring is an adequate and reliable method of tracking conditions in the aquifer. Deed restrictions and fencing are adequate and reliable in restricting activities resulting in potential ingestion of or contact with dredged material/soil.	A vegetative soil cover is an adequate and reliable containment measure, with appropriate maintenance. Ground water monitoring is an adequate and reliable method of tracking conditions in the aquifer. Deed restrictions and fencing are adequate and reliable in restricting activities resulting in potential ingestion of or contact with dredged material/soil.	Excavation and disposal are considered to be effective and reliable. Ground water monitoring is an adequate and reliable method of tracking conditions in the aquifer. Deed restrictions and fencing are adequate and reliable in restricting activities resulting in potential ingestion of or contact with dredged material/soil.	Excavation and disposal are considered to be effective and reliable. Ground water monitoring is an adequate and reliable method of tracking conditions in the aquifer.
REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT						
Treatment Process Used and Materials Treated	None.	None.	None.	None.	None.	None.

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 4 Dredged material/soil excavation and incineration (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 5A Dredged material/soil excavation (surface soils > 25 mg/kg PCBs), thermal desorption treatment. replacement, ground water monitoring, deed restrictions, and fencing.	Alternative 5B Dredged material/soil excavation (surface soils > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), thermal desorption treatment, replacement, and ground water monitoring.	Alternative 6 *In situ* biological treatment of dredged material/soil (surface soil > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 7A Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 7B Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 7C Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.
LONG-TERM EFFECTIVENESS AND PERMANENCE							
Magnitude of Residual Risk	Excavation and incineration would minimize contact with PCBs > 25 mg/kg. Deed restrictions would discourage disturbance/contact with dredged material/soil. Fence locks and maintenance would minimize contact with dredged material/soil.	Excavation and thermal desorption would minimize contact with PCBs > 25 mg/kg. Deed restrictions would discourage disturbance/contact with dredged material/soil. Fence locks and maintenance would minimize contact with dredged material/soil.	Excavation and thermal desorption would minimize contact with PCBs > 1 mg/kg at surface and 10 mg/kg in subsurface.	*In situ* biological treatment effectiveness undefined. Likely some reduction of surface PCB concentrations. Deed restrictions would discourage disturbance/contact with dredged material/soil. Fence locks and maintenance would minimize contact with dredged material/soil.	Vegetated 12 inch cover would minimize contact with PCBs > 25 mg/kg and would reduce areal extent of surficial PCBs. Deed restrictions would discourage disturbance of cover/contact with dredged material/soil. Fence locks and maintenance would minimize conatct with dredged material/soil. Excavation and disposal would minimize contact with PCBs > 50 mg/kg.	Vegetated 12 inch cover would minimize contact with PCBs > 10 mg/kg and would reduce areal extent of surficial PCBs. Deed restrictions would discourage disturbance of cover/contact with dredged material/soil. Fence locks and maintenance would minimize conatct with dredged material/soil. Excavation and disposal would minimize contact with PCBs > 50 mg/kg.	Vegetated 12 inch cover would minimize contact with PCBs > 1 mg/kg at surface and 10 mg/kg in subsurface and would reduce areal extent of surficial PCBs. Deed restrictions would discourage disturbance of cover/contact with dredged material/soil. Fence locks and maintenance would minimize conatct with dredged material/soil. Excavation and disposal would minimize contact with PCBs > 50 mg/kg.
Adequacy and Reliability of Controls	Incineration is considered to be effective and reliable. Ground water monitoring is an adequate and reliable method of tracking conditions in the aquifer. Deed restrictions and fencing are adequate and reliable in restricting activities resulting in potential ingestion of or contact with dredged material/soil.	Thermal desorption as a treatment method is expected to be effective and reliable. Ground water monitoring is an adequate and reliable method of tracking conditions in the aquifer. Deed restrictions and fencing are adequate and reliable in restricting activities resulting in potential ingestion of or contact with dredged material/soil.	Thermal desorption as a treatment method is expected to be effective and reliable. Ground water monitoring is an adequate and reliable method of tracking conditions in the aquifer.	Effectiveness and reliability of *in situ* biological treatment is unproven. Ground water monitoring is an adequate and reliable method of tracking conditions in the aquifer. Deed restrictions and fencing are adequate and reliable in restricting activities resulting in potential ingestion of or contact with dredged material/soil.	A vegetative soil cover is an adequate and reliable containment measure, with appropriate maintenance. Ground water monitoring is an adequate and reliable method of tracking conditions in the aquifer. Deed restrictions and fencing and adequate and reliable in restricting activities resulting in potential ingestion of or contact with dredged material/soil. Excavation and disposal are considered to be effective and reliable.	A vegetative soil cover is an adequate and reliable containment measure, with appropriate maintenance. Ground water monitoring is an adequate and reliable method of tracking conditions in the aquifer. Deed restrictions and fencing and adequate and reliable in restricting activities resulting in potential ingestion of or contact with dredged material/soil. Excavation and disposal are considered to be effective and reliable.	A vegetative soil cover is an adequate and reliable containment measure, with appropriate maintenance. Ground water monitoring is an adequate and reliable method of tracking conditions in the aquifer. Deed restrictions and fencing and adequate and reliable in restricting activities resulting in potential ingestion of or contact with dredged material/soil. Excavation and disposal are considered to be effective and reliable.
REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT							
Treatment Process Used and Materials Treated	Incineration of dredged material/soil.	Thermal desorption of dredged material/soil.	Thermal desorption of dredged material/soil.	*In situ* biological treatment of dredged material/soil.	None.	None.	None.

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 1 No action. Ground water monitoring, deed restrictions and fencing.	Alternative 2A 12 inch vegetative soil cover (surface soil >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 2B 12 inch vegetative soil cover (surface or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 2C 12 inch vegetative soil cover (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 3A Dredged material/soil excavation and off-site landfill disposal (surface soils >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 3B Dredged material/soil excavation and off-site landfill disposal (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), and ground water monitoring.
Amount of Hazardous Material Destroyed or Treated	None.	None.	None.	None.	None.	None.
Degree of Expected Reduction of Toxicity, Mobility or Volume	None due to treatment.	A vegetative soil cover reduces erosion (mobility) of PCBs in the dredged material.	A vegetative soil cover reduces erosion (mobility) of PCBs in the dredged material.	A vegetative soil cover reduces erosion (mobility) of PCBs in the dredged material.	Reduction of on-site volume and mobility of PCB contaminated dredged material/soil with off-site landfill disposal.	Reduction of on-site volume and mobility of PCB contaminated dredged material/soil with off-site landfill disposal.
Degree to Which Treatment is Irreversible	No treatment.	No treatment.	No treatment.	No treatment.	No treatment.	No treatment.
Type and Quantity of Residuals Remaining After Treatment	No treatment.	No treatment.	No treatment.	No treatment.	No treatment.	No treatment.
SHORT-TERM EFFECTIVENESS						
Protection of Community During Remedial Actions	Community will be restricted from access to study area. Monitoring will not affect community.	Dust control will minimize PCB air migration. Community will be restricted from access to study area. Monitoring will not affect community.	Dust control will minimize PCB air migration. Community will be restricted from access to study area. Monitoring will not affect community.	Dust control will minimize PCB air migration. Community will be restricted from access to study area. Monitoring will not affect community.	Dust control will minimize PCB air migration during contruction and transport. Community will be restricted from access to study area. Monitoring will not affect community.	Dust control will minimize PCB air migration during contruction and transport. Community will be restricted from access to study area. Monitoring will not affect community.
Protection of Workers During Remedial Actions	Appropriate protective equipment would be used during monitoring activities.	Appropriate protective equipment would be utilized during monitoring and remedial activities.	Appropriate protective equipment would be utilized during monitoring and remedial activities.	Appropriate protective equipment would be utilized during monitoring and remedial activities.	Appropriate protective equipment would be utilized during monitoring and remedial activities.	Appropriate protective equipment would be utilized during monitoring and remedial activities.
Environmental Impacts	None.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control.

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 4 **Dredged material/soil excavation and incineration (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 5A **Dredged material/soil excavation (surface soils > 25 mg/kg PCBs), thermal desorption treatment, replacement, ground water monitoring, deed restrictions, and fencing.**	Alternative 5B **Dredged material/soil excavation (surface soils > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), thermal desorption treatment, replacement, and ground water monitoring.**	Alternative 6 ***In situ*** **biological treatment of dredged material/soil (surface soil > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7A **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7B **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7C **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**
Amount of Hazardous Material Destroyed or Treated	Effective up to 99.999% in destroying PCBs in dredged material/soil.	Thermal desorption is shown to achieve performance levels equivalent to incineration; treatability necessary to demonstrate destruction effectiveness for dredged material/soil.	Thermal desorption is shown to achieve performance levels equivalent to incineration; treatability necessary to demonstrate destruction effectiveness for dredged material/soil.	Destruction efficiency for PCBs unknown. Ongoing treatability study to indicate potential destruction efficiency for dredged material/soil.	None.	None.	None.
Degree of Expected Reduction of Toxicity, Mobility or Volume	Reduction of toxicity, mobility, and volume of PCB contaminated dredged material/soil.	Reduction of toxicity and mobility of PCB contaminated dredged material/soil.	Reduction of toxicity and mobility of PCB contaminated dredged material/soil.	Reduction of toxicity and mobility of PCB contaminated dredged material/soil.	Reduction of on-site volume and mobility of PCB contaminated dredged material/soil with off-site landfill disposal. A vegetative soil cover reduces erosion (mobility) of PCBs in the dredged material.	Reduction of on-site volume and mobility of PCB contaminated dredged material/soil with off-site landfill disposal. A vegetative soil cover reduces erosion (mobility) of PCBs in the dredged material.	Reduction of on-site volume and mobility of PCB contaminated dredged material/soil with off-site landfill disposal. A vegetative soil cover reduces erosion (mobility) of PCBs in the dredged material.
Degree to Which Treatment is Irreversible	Incineration is considered to be irreversible.	Thermal desorption is considered to be irreversible.	Thermal desorption is considered to be irreversible.	In situ biological treatment is considered to be irreversible.	No treatment.	No treatment.	No treatment.
Type and Quantity of Residuals Remaining After Treatment	Baghouse dust is expected to be a residual of incineration.	Baghouse dust is expected to be a residual of thermal desorption.	Baghouse dust is expected to be a residual of thermal desorption.	None.	No treatment.	No treatment.	No treatment.
SHORT-TERM EFFECTIVENESS							
Protection of Community During Remedial Actions	Dust control will minimize PCB air migration during excavation. Community will be restricted from access to study area. Monitoring will not affect community. Mobile incineration requires air emission controls.	Dust control will minimize PCB air migration during excavation. Monitoring will not affect community.	Dust control will minimize PCB air migration during excavation. Monitoring will not affect community.	Dust control will minimize PCB air migration during treatment. Community will be restricted from access to study area. Monitoring will not affect community.	Dust control will minimize PCB air migration. Community will be restricted from access to study area. Monitoring will not affect community.	Dust control will minimize PCB air migration. Community will be restricted from access to study area. Monitoring will not affect community.	Dust control will minimize PCB air migration. Community will be restricted from access to study area. Monitoring will not affect community.
Pr tection of Workers During Remedial Actions	Appropriate protective equipment would be utilized during monitoring and remedial activities.	Appropriate protective equipment would be utilized during monitoring and remedial activities.	Appropriate protective equipment would be utilized during monitoring and remedial activities.	Appropriate protective equipment would be utilized during monitoring and remedial activities.	Appropriate protective equipment would be utilized during monitoring and remedial activities.	Appropriate protective equipment would be utilized during monitoring and remedial activities.	Appropriate protective equipment would be utilized during monitoring and remedial activities.
Environmental Impacts	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control.	None.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control.

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 1 No action. Ground water monitoring, deed restrictions and fencing.	Alternative 2A 12 inch vegetative soil cover (surface soil >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 2B 12 inch vegetative soil cover (surface or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 2C 12 inch vegetative soil cover (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 3A Dredged material/soil excavation and off-site landfill disposal (surface soils >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.	Alternative 3B Dredged material/soil excavation and off-site landfill disposal (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), and ground water monitoring.
Time Until Remedial Action Objectives Are Achieved	Immediately following implementation.	Immediately following implementation (1 construction season).	Immediately following implementation (1 construction season).	Immediately following implementation (1 construction season).	Immediately following implementation (1 construction season).	Immediately following implementation (1 construction season).
IMPLEMENTABILITY						
Ability to Construct and Operate the Technology	Legal coordination with property owner required to implement deed restrictions. Fence locks and maintenance and monitoring readily implemented.	Soil cover readily constructed. Legal coordination with property owner required to implement deed restrictions. Fence locks and maintenance and monitoring readily implemented.	Soil cover readily constructed. Legal coordination with property owner required to implement deed restrictions. Fence locks and maintenance and monitoring readily implemented.	Soil cover readily constructed. Legal coordination with property owner required to implement deed restrictions. Fence locks and maintenance and monitoring readily implemented.	Excavation and disposal are readily implemented. Legal coordination with property owner required to implement deed restrictions. Fence locks and maintenance and monitoring readily implemented.	Excavation and disposal are readily implemented.
Reliability of Technology	Ground water monitoring, deed restrictions, and fencing reliable.	Covering of dredged material/soil and ground water monitoring, deed restrictions, and fencing are reliable.	Covering of dredged material/soil and ground water monitoring, deed restrictions, and fencing are reliable.	Covering of dredged material/soil and ground water monitoring, deed restrictions, and fencing are reliable.	Excavating, disposal, ground water monitoring, deed restrictions, and fencing are reliable.	Excavating, disposal, and ground water monitoring are reliable.
Ease of Undertaking Additional Remedial Actions, If Necessary	Additional remedial actions readily implemented.	Additional remedial actions readily implemented.	Additional remedial actions readily implemented.	Additional remedial actions readily implemented.	Additional remedial actions readily implemented.	Additional remedial actions readily implemented.
Ability to Monitor Effectiveness of Remedy	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.
Coordination With Other Agencies	Legal coordination with property owner neccessary to implement deed restrictions.	Legal coordination with property owner neccessary to implement deed restrictions.	Legal coordination with property owner neccessary to implement deed restrictions.	Legal coordination with property owner neccessary to implement deed restrictions.	Legal coordination with property owner neccessary to implement deed restrictions.	None.
Availability of Offsite Treatment, Storage and Disposal Services and Capacities	None required.	None required.	None required.	None required.	Landfill facility and capacity expected to be readily available.	Landfill facility and capacity expected to be readily available.

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 4 **Dredged material/soil excavation and incineration (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 5A **Dredged material/soil excavation (surface soils > 25 mg/kg PCBs), thermal desorption treatment, replacement, ground water monitoring, deed restrictions, and fencing.**	Alternative 5B **Dredged material/soil excavation (surface soils > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), thermal desorption treatment, replacement, and ground water monitoring.**	Alternative 6 ***In situ* biological treatment of dredged material/soil (surface soil > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7A **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7B **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7C **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**
Time Until Remedial Action Objectives Are Achieved	Immediately following implementation (1 construction season).	Immediately following implementation (1 construction season).	Immediately following implementation (1 construction season).	Remediation time frame unknown.	Immediately following implementation (1 construction season).	Immediately following implementation (1 construction season).	Immediately following implementation (1 construction season).
IMPLEMENTABILITY							
Ability to Construct and Operate the Technology	Excavation readily implemented. Mobile incineration readily constructed and operated. Trial burn likely necessary. Legal coordination with property owner required to implement deed restrictions. Fence locks and maintenance and monitoring readily implemented.	Thermal desorption system readily installed. Treatability necessary to establish operating parameters. Legal coordination with property owner required to implement deed restrictions. Fence locks and maintenance and monitoring readily implemented.	Thermal desorption system readily installed. Treatability necessary to establish operating parameters. Legal coordination with property owner required to implement deed restrictions.	Ongoing treatability study may provide construction and operating requirements.	Soil cover readily constructed. Excavation and disposal and readily implemented. Legal coordination with property owner required to implement deed restrictions. Fence locks and maintenance and monitoring readily implemented.	Soil cover readily constructed. Excavation and disposal are readily implemented. Legal coordination with property owner required to implement deed restrictions. Fence locks and maintenance and monitoring readily implemented.	Soil cover readily constructed. Excavation and disposal are readily implemented. Legal coordination with property owner required to implement deed restrictions. Fence locks and maintenance and monitoring readily implemented.
Reliability of Technology	Incineration, ground water monitoring, deed restrictions, and fencing are reliable.	Ground water monitoring, deed restrictions, and fencing are reliable. Treatability necessary to predict thermal desorption reliability.	Ground water monitoring, deed restrictions, and fencing are reliable. Treatability necessary to predict thermal desorption reliability.	*In situ* biological treatment is an innovative technology for PCBs; unknown reliability. Ground water monitoring, deed restrictions, and fencing are reliable.	Covering of dredged material/soil, excavation of hot spots, ground water monitoring, deed restrictions, and fencing are reliable.	Covering of dredged material/soil, excavation of hot spots, ground water monitoring, deed restrictions, and fencing are reliable.	Covering of dredged material/soil, excavation of hot spots, ground water monitoring, deed restrictions, and fencing are reliable.
Ease of Undertaking Additional Remedial Actions, If Necessary	Additional remedial actions readily implemented.	Additional remedial actions readily implemented.	Additional remedial actions readily implemented.	Additional remedial actions readily implemented.	Additional remedial actions readily implemented.	Additional remedial actions readily implemented.	Additional remedial actions readily implemented.
Ability to Monitor Effectiveness of Remedy	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.
Coordination With Other Agencies	Legal coordination with property owner neccessary to implement deed restrictions. Coordination with NYSDEC required regarding air emissions.	Legal coordination with property owner neccessary to implement deed restrictions.	None.	Legal coordination with property owner neccessary to implement deed restrictions.	Legal coordination with property owner neccessary to implement deed restrictions.	Legal coordination with property owner neccessary to implement deed restrictions.	Legal coordination with property owner neccessary to implement deed restrictions.
Availability of Offsite Treatment, Storage and Disposal Services and Capacities	Landfill facility and capacity for ash ex ected to be readily availble.	Landfill facility and capacity for ash expected to be readily availble.	Landfill facility and capacity for ash expected to be readily availble.	None required.	Landfill facility and capacity expected to be readi y available.	Landfill facility and capacity expected to be readily available.	Landfill facility and capacity expected to be readily available.

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 1 **No action. Ground water monitoring, deed restrictions and fencing.**	**Alternative 2A** **12 inch vegetative soil cover (surface soil >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	**Alternative 2B** **12 inch vegetative soil cover (surface or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	**Alternative 2C** **12 inch vegetative soil cover (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	**Alternative 3A** **Dredged material/soil excavation and off-site landfill disposal (surface soils >25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	**Alternative 3B** **Dredged material/soil excavation and off-site landfill disposal (surface soils >1 mg/kg PCBs or subsurface soils >10 mg/kg PCBs), and ground water monitoring.**
Availability of Necessary Equipment, Specialists and Materials	Sampling equipment, sampling personnel, and analytical laboratory readily available.	Sampling equipment, sampling personnel, analytical laboratory, excavating/construction vehicles, and soil materials readily available.	Sampling equipment, sampling personnel, analytical laboratory, excavating/construction vehicles, and soil materials readily available.	Sampling equipment, sampling personnel, analytical laboratory, excavating/construction vehicles, and soil materials readily available.	Sampling equipment, sampling personnel, analytical laboratory, excavating/construction vehicles, and fill materials readily available.	Sampling equipment, sampling personnel, analytical laboratory, excavating/construction vehicles, and fill materials readily available.
Availability of Prospective Technologies	None required.	Soil cover technology readily available.	Soil cover technology readily available.	Soil cover technology readily available.	Excavating technology readily available.	Excavating technology readily available.
COST						
Capital Costs	$5,500	$1,177,000	$1,488,000	$1,665,000	$4,356,000	$63,715,000
Operation and Maintenace Costs	$12,000	$35,000	$39,000	$41,000	$73,000	$0
Total Present Worth Costs	$216,000	$1,736,000	$2,112,000	$2,327,000	$5,508,000	$63,715,000
STATE ACCEPTANCE						
To be documented in the Record of Decision (ROD).						
COMMUNITY ACCEPTANCE						
To be assessed following the public comment period and documented in the ROD.						

Table 6
Detailed Analysis of Remedial Alternatives

Feasibility Study
Ley Creek Dredged Material Area

	Alternative 4 **Dredged material/soil excavation and incineration (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 5A **Dredged material/soil excavation (surface soils > 25 mg/kg PCBs), thermal desorption treatment, replacement, ground water monitoring, deed restrictions, and fencing.**	Alternative 5B **Dredged material/soil excavation (surface soils > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), thermal desorption treatment, replacement, and ground water monitoring.**	Alternative 6 ***In situ* biological treatment of dredged material/soil (surface soil > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7A **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface soils > 25 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7B **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**	Alternative 7C **Dredged material/soil excavation and off-site landfill disposal (surface and subsurface soils > 50 mg/kg PCBs), 12 inch vegetative soil cover (surface > 1 mg/kg PCBs or subsurface soils > 10 mg/kg PCBs), ground water monitoring, deed restrictions, and fencing.**
Availability of Necessary Equipment Specialists and Materials	Sampling equipment, sampling personnel, analytical laboratory, excavating/construction vehicles, and fill materials readily available.	Sampling equipment, sampling personnel, analytical laboratory, and thermal desorption equipment readily available.	Sampling equipment, sampling personnel, analytical laboratory, and thermal desorption equipment readily available.	Sampling equipment, sampling personnel, analytical laboratory, nutrients, oxygen, construction equipment readily available.	Sampling equipment, sampling personnel, analytical laboratory, and excavating/construction vehicles readily available.	Sampling equipment, sampling personnel, analytical laboratory, and excavating/construction vehicles readily available.	Sampling equipment, sampling personnel, analytical laboratory, and excavating/construction vehicles readily available.
Availability of Prospective Technologies	Incineration technology readily available.	Thermal desorption technology readily available.	Thermal desorption technology readily available.	*In situ* biological treatment technology readily available.	Soil cover and excavation technologies readily available.	Soil cover and excavation technologies readily available.	Soil cover and excavation technologies readily available.
COST							
Capital Costs	$7,039,000	$3,257,000	$43,762,000	$486,000	$1,489,000	$1,800,000	$1,977,000
Operation and Maintenace Costs	$110,000	$58,000	$0	$449,000	$39,000	$43,000	$45,000
Total Present Worth Costs	$8,760,000	$4,177,000	$43,762,000	$2,761,000	$2,114,000	$2,490,000	$2,705,000
STATE ACCEPTANCE							
To be documented in the Record of Decision (ROD).							
COMMUNITY ACCEPTANCE							
To be assessed following the public comment period and documented in the ROD.							

Table 7
Potential ARARs

Feasibility Study
Ley Creek Dredged Material Area

POTENTIAL CHEMICAL-SPECIFIC ARARS			
MEDIUM	CITATION	REQUIREMENTS	COMMENT
Ground Water	6 NYCRR Part 703 - Ground Water Quality Standards	Fresh ground waters must attain Class GA ground water quality standards. Class GA standard for PCBs is 0.1 μg/l.	Applicable to study area ground water.
POTENTIAL LOCATION-SPECIFIC ARARS			
LOCATION	CITATION	REQUIREMENTS	COMMENT
Wetlands	6 NYCRR Part 663 - Freshwater Wetlands Permit Requirements	Actions occurring in a designated freshwater wetland (within 100 ft) must be approved by NYSDEC or its designee. Activities occurring adjacent to freshwater wetlands must: • be compatible with preservation, protection, and conservation of wetland and benefits, • result in no more than insubstantial degradation to, or loss of, any part of the wetland, and • be compatible with public health/welfare.	Substantive requirements applicable for construction activities occurring in the study area. Study area is a portion of NYS Wetland SYE 6 (Class II).
Wetlands	Clean Water Act Section 404 and 33 CFR Part 330 - Nationwide Permit Program	Permit required for discharge of dredged or fill material in wetland. Nationwide permit exists for hazardous and toxic waste cleanup.	Potentially applicable for grading and backfill in the study area. Nationwide permit likely applicable.
Floodplains	6 NYCRR Part 373-2.2 - Location Standards for Hazardous Waste Treatment, Storage, and Disposal Facilities - 100 Year Flood Plain	Hazardous waste treatment, storage, or disposal facilities located in a 100-year flood plain must be designed, constructed, operated, and maintained to prevent washout of hazardous waste by a 100-year flood.	Applicable for on-site treatment alternatives; study area located in 100-year flood plain.

Table 7
Potential ARARs

Feasibility Study
Ley Creek Dredged Material Area

POTENTIAL ACTION-SPECIFIC ARARS			
ACTION	CITATION	REQUIREMENTS	COMMENT
Floodplains	6NYCRR Part 500 - Floodplain Management Regulations Development Permits	Development in a 100-year floodplain must be approved by NYSDEC. Construction must not result in increased flood elevations in the community.	Substantive requirements applicable for construction in the 100-year floodplain.
Soil Cover	6 NYCRR Subpart 373-2.14(g) - Closure and Post-Closure Care Hazardous Waste Secure Land Burial Facilities	Hazardous waste landfills must be covered with a final cover designed and constructed to: • provide long-term minimization of migration of liquid through the closed landfill, • function with minimum maintenance, • promote drainage and minimize cover erosion or abrasion, • accommodate settling and subsidence to maintain cover integrity, and • have a permeability less than or equal to natural subsoil permeability.	Requirements not applicable as study area not a landfill. Requirements potentially relevant and appropriate as dredged material and soil containing PCBs at concentrations greater than 50 ppm are listed hazardous wastes in NY.
Grading	40 CFR Part 761.60 - Disposal Requirements	PCBs at concentrations greater than 50 ppm removed from a disposal site must be disposed of in accordance with these TSCA requirements (discussed below).	Potentially applicable - USEPA TSCA evaluation of whether grading constitutes disposal made on a USEPA Regional basis.
Excavation, Grading, Soil Cover	40 CFR Part 50 - National Ambient Air Quality Standards	Study area air quality during earth moving activities must meet the National Ambient Air Quality Standard (NAAQS) for particulate matter (150 $\mu g/m^3$ 24-hour average concentration).	Applicable federal air quality standard.

Table 7
Potential ARARs

Feasibility Study
Ley Creek Dredged Material Area

POTENTIAL ACTION-SPECIFIC ARARS (CONT.)			
ACTION	CITATION	REQUIREMENTS	COMMENT
Landfill Disposal	6 NYCRR Part 376 - Land Disposal Restrictions	Liquid hazardous waste with PCBs >= 50 ppm PCBs are prohibited from land disposal and must be incinerated or burned in high efficiency boilers in accordance with 40 CFR 761 requirements. Other PCB wastes must be disposed of in accordance with the provisions of 40 CFR Part 761 (discussed above).	Applicable for dredged material/soil or residuals containing >50 ppm PCBs.
On-Site Treatment	6 NYCRR Subpart 373-2 - Final Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	On-site incineration, dechlorination, or *in situ* bioremediation must be performed in accordance with substantive requirements of hazardous waste treatment facility regulations.	Applicable for treatment of dredged material/soil containing >50 ppm PCBs.
Incineration	40 CFR 761.70 - Incineration	Incineration of dredged material/soil containing >50 ppm PCBs must occur in a TSCA-approved incinerator meeting the requirements outlined in these regulations.	Applicable for dredged material/soil containing >50 ppm PCBs.
Incineration	6 NYCRR Subpart 373-2.15 - Incinerators and Energy Recovery Units	Incineration of dredged material/soil containing >50 ppm PCBs must occur in an incinerator meeting the requirements outlined in these regulations.	Applicable for dredged material/soil containing >50 ppm PCBs.
Incineration	6 NYCRR Part 201 - Permits and Certificates	Incinerator must comply with the substantive requirements of these NYS air pollution control regulations.	Applicable for incineration of dredged material/soil.

Table 7
Potential ARARs

Feasibility Study
Ley Creek Dredged Material Area

ACTION	CITATION	REQUIREMENTS	COMMENT
POTENTIAL ACTION-SPECIFIC ARARS (CONT.)			
Incineration	6 NYCRR Subpart 219-2 - Municipal and Private Solid Waste Incineration Facilities	Incinerator must comply with the substantive requirements of these NYS air pollution control regulations.	Applicable for incineration of dredged material/soil.
Thermal Desorption, *In Situ* Bioremediation	40 CFR Part 761.60 - Disposal Requirements	Use of treatment method other than incineration or disposal method other than chemical waste landfill must be approved by USEPA Regional Administrator.	Applicable for dredged material/soil containing >50 ppm PCBs.
Thermal Desorption, *In Situ* Bioremediation	6 NYCRR Subpart 373-2.24 - Miscellaneous Units	Treatment of dredged material/soil containing >50 ppm PCBs must occur in a unit meeting the substantive requirements of these regulations: • prevention of contaminant migration to ground water/subsurface having adverse effect, • prevention of contaminant migration to surface water, wetlands, or surface soil having adverse effect, and • prevention of contaminant migration to air having adverse effect.	Applicable for dredged material/soil containing >50 ppm PCBs.
Residual Management	40 CFR 761.60 - Disposal Requirements	Treatment residuals containing >50 ppm PCBs must be disposed in accordance with appropriate requirements (based on medium) in these regulations.	Applicable for treatment residuals containing >50 ppm PCBs.

Table 7
Potential ARARs

Feasibility Study
Ley Creek Dredged Material Area

POTENTIAL ACTION-SPECIFIC ARARS (CONT.)			
ACTION	CITATION	REQUIREMENTS	COMMENT
Construction	29 CFR Part 1910 - Occupational Safety and Health Standards and 29 CFR Part 1926 - Safety and Health Regulations for Construction	Remedial construction activities must be conducted in accordance with applicable OSHA requirements.	Applicable for construction phase of remediation.
Transportation and Off-Site Disposal	6 NYCRR Part 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	Substantive hazardous waste generator and transportation requirements must be met when hazardous waste generated for disposal. Generator requirements include obtaining an EPA Identification Number and manifesting hazardous waste for disposal.	Applicable for off-site disposal of dredged material/soil containing >50 ppm PCBs.
Transportation and Off-Site Disposal	40 CFR Subpart K - PCB Waste Disposal Records and Reports	Dredged material/soil or residuals containing >50 ppm PCBs to be disposed off-site must be manifested in accordance with these requirements. An EPA Identification Number must be obtained for PCB waste generation, and EPA Notification of PCB Waste Activity form must be filed by generator if on-site storage (>30 days) prior to disposal and by transporter.	Applicable for off-site disposal of dredged material/soil containing >50 ppm PCBs.

Table 8
Potential TBCs

Feasibility Study
Ley Creek Dredged Material Area

POTENTIAL CHEMICAL-SPECIFIC TBCS			
MEDIUM	CITATION	REQUIREMENTS	COMMENT
Soil	40 CFR Part 761 Subpart G - PCB Spill Cleanup Policy	Requires cleanup of soil to 25 mg/kg PCBs by weight in restricted access areas for PCB spills involving 1 lb or more PCBs by weight.	TBC - USEPA codified policy for remediation of PCB-contaminated soil.
Soil	USEPA OSWER Directive No. 9355.4-01, *Guidance on Remedial Actions for Superfund Sites with PCB Contamination*, August 1990.	Recommends that low-threat material (PCBs at concentrations less than 500 ppm for non-residential industrial areas) be contained on-site.	TBC - guidance documenting USEPA recommended approach for evaluating and remediating federal Superfund sites with PCB contamination.
POTENTIAL ACTION-SPECIFIC TBCS			
ACTION	CITATION	REQUIREMENTS	COMMENT
Soil Cover	USEPA OSWER Directive No. 9355.4-01, *Guidance on Remedial Actions for Superfund Sites with PCB Contamination*, August 1990.	Outlines appropriate long-term management controls under various site scenarios. Advises that minimal long-term management controls are warranted where low PCB concentrations remain and direct contact risks sufficiently reduced. Provides for 12 inch vegetated soil cover for PCB concentrations not presenting a threat to ground water.	TBC - guidance documenting USEPA recommended approach for containing PCBs at federal Superfund sites.

Table 9

COST ESTIMATE - ALTERNATIVE 1

Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 1 (NO ACTION)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Direct Capital Costs				
Deed Restrictions			Lump Sum	$5,000
Fence Locks			Lump Sum	$500
			Total Direct Capital Costs	$5,500
Annual Operation & Maintenance Costs				
Ground Water Sampling Labor	8	day	$300	$2,400
Ground Water Sample Analysis	36	samples	$185	$6,660
Ground Water Monitoring Reports	4	day	$400	$1,600
Miscellaneous Site Work/Inspections	4	day	$300	$1,200
			Total Annual O&M Costs	$11,860
Five-Year Review (one-time cost every 5 yrs)			Lump Sum	$10,000
			Present Worth of Annual O&M Costs for 30 Years (i=5%)	$210,138
			ALTERNATIVE 1 TOTAL ESTIMATED COST	**$215,638**

Table 10

COST ESTIMATE - ALTERNATIVE 2A

Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 2A (12 INCH VEGETATIVE SOIL COVER FOR SURFACE SOILS >25 ppm PCBs)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Direct Capital Costs				
Clearing/Grubbing	11	acre	$5,000	$55,000
12 inch Soil Cover	17,500	CY	$13	$227,500
Seeding and Maintenance	53,000	SY	$3	$159,000
Cross Culvert Lining & Access Paths			Lump Sum	$60,000
Sanitary Sewer Manhole Access Modifications			Lump Sum	$50,000
Creek Maintenance Access Road			Lump Sum	$150,000
Rip Rap			Lump Sum	$65,000
Dust Control			Lump Sum	$5,000
Fence Locks			Lump Sum	$500
Deed Restrictions			Lump Sum	$5,000
Mobilization/Demobilization				$15,000
Health & Safety				$20,000
			Total Direct Capital Costs	**$812,000**
Indirect Capital Costs				
Contingency (25% Direct Capital Costs)				$203,000
Engineering (15% Direct Capital Costs)				$121,800
Legal Fees (5% Direct Capital Costs)				$40,600
			Total Indirect Capital Costs	**$365,400**
			Total Capital Cost	**$1,177,400**
Annual Operation & Maintenance Costs				
Ground Water Sampling Labor	8	day	$300	$2,400
Ground Water Sample Analysis	36	samples	$185	$6,660
Ground Water Monitoring Reports	8	day	$400	$3,200
Site Mowing	12	day	$300	$3,600
Site Inspection	4	day	$300	$1,200
Miscellaneous Site Work	4	day	$300	$1,200
Insurance (1% Direct Capital Cost)				$8,120
Reserve Fund (1% Direct Capital Cost)				$8,120
			Total Annual O&M Costs	**$34,500**
Five-Year Review (one-time cost every 5 yrs)			**Lump Sum**	**$10,000**
			Present Worth of Annual O&M Costs for 30 Years (i=5%)	**$558,171**
			ALTERNATIVE 2A TOTAL ESTIMATED COST	**$1,735,571**

Table 12

COST ESTIMATE - ALTERNATIVE 2C

Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 2C (12 INCH VEGETATIVE SOIL COVER FOR SURFACE SOILS >1 ppm PCBs OR SUBSURFACE SOILS >10 ppm PCBs)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Direct Capital Costs				
Clearing/Grubbing	17	acre	$5,000	$85,000
12 inch Soil Cover	27,600	CY	$13	$358,800
Seeding and Maintenance	83,000	SY	$3	$249,000
Cross Culvert Lining & Access Paths			Lump Sum	$60,000
Sanitary Sewer Manhole Access Modifications			Lump Sum	$50,000
Creek Maintenance Access Road			Lump Sum	$150,000
Rip Rap			Lump Sum	$150,000
Dust Control			Lump Sum	$5,000
Fence Locks			Lump Sum	$500
Deed Restrictions			Lump Sum	$5,000
Mobilization/Demobilization				$15,000
Health & Safety				$20,000
			Total Direct Capital Costs	**$1,148,300**
Indirect Capital Costs				
Contingency (25% Direct Capital Costs)				$287,075
Engineering (15% Direct Capital Costs)				$172,245
Legal Fees (5% Direct Capital Costs)				$57,415
			Total Indirect Capital Costs	**$516,735**
			Total Capital Cost	**$1,665,035**
Annual Operation & Maintenance Costs				
Ground Water Sampling Labor	8	day	$300	$2,400
Ground Water Sample Analysis	36	samples	$185	$6,660
Ground Water Monitoring Reports	8	day	$400	$3,200
Site Mowing	12	day	$300	$3,600
Site Inspection	4	day	$300	$1,200
Miscellaneous Site Work	4	day	$300	$1,200
Insurance (1% Direct Capital Cost)				$11,483
Reserve Fund (1% Direct Capital Cost)				$11,483
			Total Annual O&M Costs	**$41,226**
Five-Year Review (one-time cost every 5 yrs)			**Lump Sum**	**$10,000**
			Present Worth of Annual O&M Costs for 30 Years (i=5%)	**$661,567**
			ALTERNATIVE 2C TOTAL ESTIMATED COST	**$2,326,602**

Table 13

COST ESTIMATE - ALTERNATIVE 3A

Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 3A (EXCAVATION/DISPOSAL AT CHEMICAL LANDFILL FOR SURFACE SOILS > 25 ppm PCBs)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Direct Capital Costs				
Clearing/Grubbing	11	acre	$5,000	$55,000
Soil Excavation	6,600	CY	$5	$33,000
Transportation & Disposal	8,600	ton	$284	$2,442,400
Backfill	8,600	CY	$12	$103,200
Cross Culvert Lining & Access Paths			Lump Sum	$60,000
Sanitary Sewer Manhole Access Modifications			Lump Sum	$50,000
Creek Maintenance Access Roads			Lump Sum	$150,000
Dust Control			Lump Sum	$5,000
Fence Locks			Lump Sum	$500
Deed Restrictions			Lump Sum	$5,000
Mobilization/Demobilization				$50,000
Health & Safety				$50,000
			Total Direct Capital Costs	**$3,004,100**
Indirect Capital Costs				
Contingency (25% Direct Capital Costs)				$751,025
Engineering (15% Direct Capital Costs)				$450,615
Legal Fees (5% Direct Capital Costs)				$150,205
			Total Indirect Capital Costs	**$1,351,845**
			Total Capital Cost	**$4,355,945**
Annual Operation & Maintenance Costs				
Ground Water Sampling Labor	8	day	$300	$2,400
Ground Water Sample Analysis	36	samples	$185	$6,660
Ground Water Monitoring Reports	4	day	$400	$1,600
Site Inspection	4	day	$300	$1,200
Miscellaneous Site Work	4	day	$300	$1,200
Insurance (1% Direct Capital Cost)				$30,041
Reserve Fund (1% Direct Capital Cost)				$30,041
			Total Annual O&M Costs	**$73,142**
Five-Year Review (one-time cost every 5 yrs)			Lump Sum	$10,000
			Present Worth of Annual O&M Costs for 30 Years (i=5%)	**$1,152,195**
			ALTERNATIVE 3A TOTAL ESTIMATED COST	**$5,508,140**

Table 14

COST ESTIMATE - ALTERNATIVE 3B

Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 3B (EXCAVATION/DISPOSAL AT CHEMICAL LANDFILL FOR SURFACE SOILS > 1 ppm PCBs or SUBSURFACE SOILS >10 ppm PCBs)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Direct Capital Costs				
Clearing/Grubbing	17	acre	$5,000	$85,000
Soil Excavation	110,000	CY	$5	$550,000
Sheeting			Lump Sum	$500,000
Construction Water Mgmt.			Lump Sum	$100,000
Confirmatory Sampling			Lump Sum	$100,000
Transportation & Disposal	143,000	ton	$284	$40,612,000
Backfill	100,000	CY	$12	$1,200,000
Dust Control			Lump Sum	$5,000
Mobilization/Demobilization				$50,000
Health & Safety				$50,000
		Total Direct Capital Costs		**$43,252,000**
Indirect Capital Costs				
Contingency (25% Direct Capital Costs)				$10,813,000
Engineering (15% Direct Capital Costs)				$6,487,800
Legal Fees (5% Direct Capital Costs)				$2,162,600
		Total Indirect Capital Costs		**$19,463,400**
		Total Capital Cost		**$62,715,400**
		ALTERNATIVE 3B TOTAL ESTIMATED COST		**$62,715,400**

Table 15

COST ESTIMATE - ALTERNATIVE 4

Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 4 (EXCAVATION AND INCINERATION FOR SURFACE SOILS > 25 ppm PCBs)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Direct Capital Costs				
Clearing/Grubbing	11	acre	$5,000	$55,000
Soil Excavation	6,600	CY	$5	$33,000
Dust Control			Lump Sum	$5,000
Mobile Incineration	8,600	TON	$280	$2,408,000
Backfill	8,600	CY	$12	$103,200
Cross Culvert Lining & Access Paths			Lump Sum	$60,000
Sanitary Sewer Manhole Access Modifications			Lump Sum	$50,000
Creek Maintenance Access Road			Lump Sum	$150,000
Fence Locks			Lump Sum	$500
Deed Restrictions			Lump Sum	$5,000
Mobilization/Demobilization				$1,910,000
Health & Safety				$75,000
			Total Direct Capital Costs	**$4,854,700**
Indirect Capital Costs				
Contingency (25% Direct Capital Costs)				$1,213,675
Engineering (15% Direct Capital Costs)				$728,205
Legal Fees (5% Direct Capital Costs)				$242,735
			Total Indirect Capital Costs	**$2,184,615**
			Total Capital Cost	**$7,039,315**
Annual Operation & Maintenance Costs				
Ground Water Sampling Labor	8	day	$300	$2,400
Ground Water Sample Analysis	36	samples	$185	$6,660
Ground Water Monitoring Report	4	day	$400	$1,600
Site Inspection	4	day	$300	$1,200
Miscellaneous Site Work	4	day	$300	$1,200
Insurance (1% Direct Capital Cost)				$48,547
Reserve Fund (1% Direct Capital Cost)				$48,547
			Total Annual O&M Costs	**$110,154**
Five-Year Review (one-time cost every 5 yrs)			Lump Sum	$10,000
			Present Worth of Annual O&M Costs for 30 Years (i=5%)	**$1,721,162**
			ALTERNATIVE 4 TOTAL ESTIMATED COST	**$8,760,477**

Table 16

COST ESTIMATE - ALTERNATIVE 5A

Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 5A (EXCAVATION/THERMAL DESORPTION FOR SURFACE SOILS >25 ppm)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Direct Capital Costs				
Clearing/Grubbing	11	acre	$5,000	$55,000
Soil Excavation	6,600	CY	$5	$33,000
Thermal Desorption	8,600	CY	$200	$1,720,000
Backfill Treated Soil	8,600	CY	$5	$43,000
Cross Culvert Lining & Access Paths			Lump Sum	$60,000
Sanitary Sewer Manhole Access Modifications			Lump Sum	$50,000
Creek Maintenance Access Road			Lump Sum	$150,000
Dust Control			Lump Sum	$5,000
Fence Locks			Lump Sum	$500
Deed Restrictions			Lump Sum	$5,000
Mobilization/Demobilization				$50,000
Health & Safety				$75,000
		Total Direct Capital Costs		**$2,246,500**
Indirect Capital Costs				
Contingency (25% Direct Capital Costs)				$561,625
Engineering (15% Direct Capital Costs)				$336,975
Legal Fees (5% Direct Capital Costs)				$112,325
		Total Indirect Capital Costs		**$1,010,925**
		Total Capital Cost		**$3,257,425**
Annual Operation & Maintenance Costs				
Ground Water Sampling Labor	8	day	$300	$2,400
Ground Water Sample Analysis	36	samples	$185	$6,660
Ground Water Monitoring Reports	4	day	$400	$1,600
Site Inspection	4	day	$300	$1,200
Miscellaneous Site Work	4	day	$300	$1,200
Insurance (1% Direct Capital Cost)				$22,465
Reserve Fund (1% Direct Capital Cost)				$22,465
		Total Annual O&M Costs		**$57,990**
Five-Year Review (one-time cost every 5 yrs)			Lump Sum	$10,000
Present Worth of Annual O&M Costs for 30 Years (i=5%)				**$919,271**
ALTERNATIVE 5A TOTAL ESTIMATED COST				**$4,176,696**

Table 17

COST ESTIMATE - ALTERNATIVE 5B

Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 5B (EXCAVATION/THERMAL DESORPTION FOR SURFACE SOILS >1 ppm PCBs OR SUBSURFACE SOILS >10 ppm PCBs)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Direct Capital Costs				
Clearing/Grubbing	17.1	acre	$5,000	$85,500
Soil Excavation	110,000	CY	$5	$550,000
Confirmatory Sampling			Lump Sum	$100,000
Thermal Desorption	143,000	CY	$200	$28,600,000
Backfill Treated Soil	143,000	CY	$5	$715,000
Dust Control			Lump Sum	$5,000
Mobilization/Demobilization				$50,000
Health & Safety				$75,000
			Total Direct Capital Costs	**$30,180,500**
Indirect Capital Costs				
Contingency (25% Direct Capital Costs)				$7,545,125
Engineering (15% Direct Capital Costs)				$4,527,075
Legal Fees (5% Direct Capital Costs)				$1,509,025
			Total Indirect Capital Costs	**$13,581,225**
			Total Capital Cost	**$43,761,725**
			ALTERNATIVE 5B TOTAL ESTIMATED COST	**$43,761,725**

Table 18

COST ESTIMATE - ALTERNATIVE 6

Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 6 (IN SITU BIOLOGICAL TREATMENT FOR SURFACE SOILS > 25 ppm PCBs)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Direct Capital Costs				
Clearing/Grubbing	11	acre	$5,000	$55,000
Cross Culvert Lining & Access Paths			Lump Sum	$60,000
Sanitary Sewer Manhole Access Modifications			Lump Sum	$50,000
Creek Maintenance Access Road			Lump Sum	$150,000
Fence Locks			Lump Sum	$500
Deed Restrictions			Lump Sum	$5,000
Mobilization/Demobilization				$5,000
Health & Safety				$10,000
			Total Direct Capital Costs	**$335,500**
Indirect Capital Costs				
Contingency (25% Direct Capital Costs)				$83,875
Engineering (15% Direct Capital Costs)				$50,325
Legal Fees (5% Direct Capital Costs)				$16,775
			Total Indirect Capital Costs	**$150,975**
			Total Capital Cost	**$486,475**
Annual Operation & Maintenance Costs				
Ground Water Sampling Labor	8	day	$300	$2,400
Ground Water Sample Analysis	36	samples	$185	$6,660
Ground Water Monitoring Reports	4	day	$400	$1,600
Site Inspection	4	day	$300	$1,200
Miscellaneous Site Work	4	day	$300	$1,200
Insurance (1% Direct Capital Cost)				$3,355
Reserve Fund (1% Direct Capital Cost)				$3,355
In situ biological treatment annual costs (for first 5 years)				
Tilling/Nutrient Addition	143	acre	$3,000	$429,000
			Total Annual O&M Costs	**$448,770**
Five-Year Review (one-time cost every 5 yrs)			Lump Sum	$10,000
			Present Worth of Annual O&M Costs for 30 Years (i=5%)	**$2,274,684**
			ALTERNATIVE 6 TOTAL ESTIMATED COST	**$2,761,159**

Table 19

COST ESTIMATE - ALTERNATIVE 7A

Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 7A (EXCAVATION/DISPOSAL AT CHEMICAL LANDFILL FOR SURFACE AND SUBSURACE SOILS >50 ppm PCBs AND 12 INCH VEGETATIVE SOIL COVER FOR SURFACE SOILS >25 ppm PCBs)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Direct Capital Costs				
Clearing/Grubbing	11	acre	$5,000	$55,000
Soil Excavation	480	CY	$5	$2,400
Grading	630	CY	$2	$1,260
Sheeting			Lump Sum	$10,000
Construction Water Mgmt.			Lump Sum	$5,000
Confirmatory Sampling			Lump Sum	$2,500
Transportation & Disposal	630	ton	$284	$178,920
Cross Culvert Lining & Access Paths			Lump Sum	$60,000
Sanitary Sewer Manhole Access Modifications			Lump Sum	$50,000
Creek Maintenance Access Road			Lump Sum	$150,000
Rip Rap			Lump Sum	$65,000
12 inch Soil Cover	17,500	CY	$13	$227,500
Seeding and Maintenance	53,000	SY	$3	$159,000
Dust Control			Lump Sum	$5,000
Fence Locks			Lump Sum	$500
Deed Restrictions			Lump Sum	$5,000
Mobilization/Demobilization				$20,000
Health & Safety				$30,000
			Total Direct Capital Costs	**$1,027,080**
Indirect Capital Costs				
Contingency (25% Direct Capital Costs)				$256,770
Engineering (15% Direct Capital Costs)				$154,062
Legal Fees (5% Direct Capital Costs)				$51,354
			Total Indirect Capital Costs	**$462,186**
			Total Capital Cost	**$1,489,266**
Annual Operation & Maintenance Costs				
Ground Water Sampling Labor	8	day	$300	$2,400
Ground Water Sample Analysis	36	samples	$185	$6,660
Ground Water Monitoring Reports	8	day	$400	$3,200
Site Mowing	12	day	$300	$3,600
Site Inspection	4	day	$300	$1,200
Miscellaneous Site Work	4	day	$300	$1,200
Insurance (1% Direct Capital Cost)				$10,271
Reserve Fund (1% Direct Capital Cost)				$10,271
			Total Annual O&M Costs	**$38,802**
Five-Year Review (one-time cost every 5 yrs)			**Lump Sum**	**$10,000**
			Present Worth of Annual O&M Costs for 30 Years (i=5%)	**$624,298**
			ALTERNATIVE 7A TOTAL ESTIMATED COST	**$2,113,564**

Table 21

COST ESTIMATE - ALTERNATIVE 7C

Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 7C (EXCAVATION/DISPOSAL AT CHEMICAL LANDFILL FOR SURFACE AND SUBSURFACE SOILS >50 ppm PCBs AND 12 INCH VEGETATIVE SOIL COVER FOR SURFACE SOILS >1 ppm PCBs AND SUBSURFACE SOILS >10 ppm)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Direct Capital Costs				
Clearing/Grubbing	17	acre	$5,000	$85,000
Soil Excavation	480	CY	$5	$2,400
Grading	630	CY	$2	$1,260
Sheeting			Lump Sum	$10,000
Construction Water Mgmt.			Lump Sum	$5,000
Confirmatory Sampling			Lump Sum	$2,500
Transportation & Disposal	630	ton	$284	$178,920
Cross Culvert Lining & Access Paths			Lump Sum	$60,000
Sanitary Sewer Manhole Access Modifications			Lump Sum	$50,000
Creek Maintenance Access Road			Lump Sum	$150,000
Rip Rap			Lump Sum	$150,000
12 inch Soil Cover	27,600	CY	$13	$358,800
Seeding and Maintenance	83,000	SY	$3	$249,000
Dust Control			Lump Sum	$5,000
Fence Locks			Lump Sum	$500
Deed Restrictions			Lump Sum	$5,000
Mobilization/Demobilization				$20,000
Health & Safety				$30,000
			Total Direct Capital Costs	**$1,363,380**
Indirect Capital Costs				
Contingency (25% Direct Capital Costs)				$340,845
Engineering (15% Direct Capital Costs)				$204,507
Legal Fees (5% Direct Capital Costs)				$68,169
			Total Indirect Capital Costs	**$613,521**
			Total Capital Cost	**$1,976,901**
Annual Operation & Maintenance Costs				
Ground Water Sampling Labor	8	day	$300	$2,400
Ground Water Sample Analysis	36	samples	$185	$6,660
Ground Water Monitoring Reports	8	day	$400	$3,200
Site Mowing	12	day	$300	$3,600
Site Inspection	4	day	$300	$1,200
Miscellaneous Site Work	4	day	$300	$1,200
Insurance (1% Direct Capital Cost)				$13,634
Reserve Fund (1% Direct Capital Cost)				$13,634
			Total Annual O&M Costs	**$45,528**
Five-Year Review (one-time cost every 5 yrs)			**Lump Sum**	**$10,000**
			Present Worth of Annual O&M Costs for 30 Years (i=5%)	**$727,693**
			ALTERNATIVE 7C TOTAL ESTIMATED COST	**$2,704,594**

TABLE 22

COST ESTIMATE - ALTERNATIVE 8

Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 8 (EXCAVATION/DISPOSAL AT CHEMICAL LANDFILL FOR SURFACE AND SUBSURFACE SOILS >50 ppm PCBs AND 12 INCH VEGETATIVE SOIL COVER FOR SURFACE SOILS > 1 ppm AND SUBSURFACE SOILS > 10 ppm PCBS; REMOVAL OF FLOODWAY SOILS WITH SURFACE SOILS > 1 ppm PCBs AND INSTALLATION OF LOW PERMEABILITY COVER; SEWER AND CREEK ACCESS PATHS)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Direct Capital Costs				
FLOODWAY (0-25')				
Excavation	9,100	CY	$5	$45,500
Common Fill (8")	2,000	CY	$13	$26,000
Low Permeability Fill (12")	5,560	CY	$30	$166,800
Membrane (or equal)	150,000	SF	$0.50	$75,000
Grading	9,200	SY	$2	$18,400
Creek Maintenance Access Road	2,500	CY	$25	$62,500
Topsoil and Seeding (4")	9,200	SY	$3	$27,600
FLOODWAY (>25')				
Excavation	6,200	CY	$5	$31,000
Common Fill (8")	2,500	CY	$13	$32,500
Low Permeability Fill (12")	3,700	CY	$30	$111,000
Grading	11,200	SY	$2	$22,400
Topsoil and Seeding (4")	11,200	SY	$3	$35,840
CONSOLIDATION AREA				
Excavation at B-19	700	CY	$10	$7,000
Soil Consolidation	16,500	CY	$8	$132,000
Common Fill (8")	2,000	CY	$13	$26,000
Grading	7,400	SY	$2	$14,800
Topsoil and Seeding (4")	7,400	SY	$3	$23,680
REMAINING AREAS				
Common Fill (8")	9,400	CY	$13	$122,200
Grading	42,000	SY	$2	$84,000
Topsoil and Seeding (4")	42,000	SY	$3	$134,400
EXCAVATED AREAS >50 ppm				
Excavation	5,700	CY	$5	$28,500
Transportation & Disposal	7,410	TON	$284	$2,104,440
DRAINAGE SWALES				
Drainage Swale Excavation	500	CY	$5	$2,500
New Drainage Culvert	700	LF	$72	$50,400
Drainage Swale Grading	2,000	SY	$2	$4,000
SEWER ACCESS PATHS				
Sewer Access Path Excavation	250	CY	$5	$1,250
Sewer Maintenance Access Paths	250	CY	$25	$6,250

TABLE 22

COST ESTIMATE - ALTERNATIVE 8

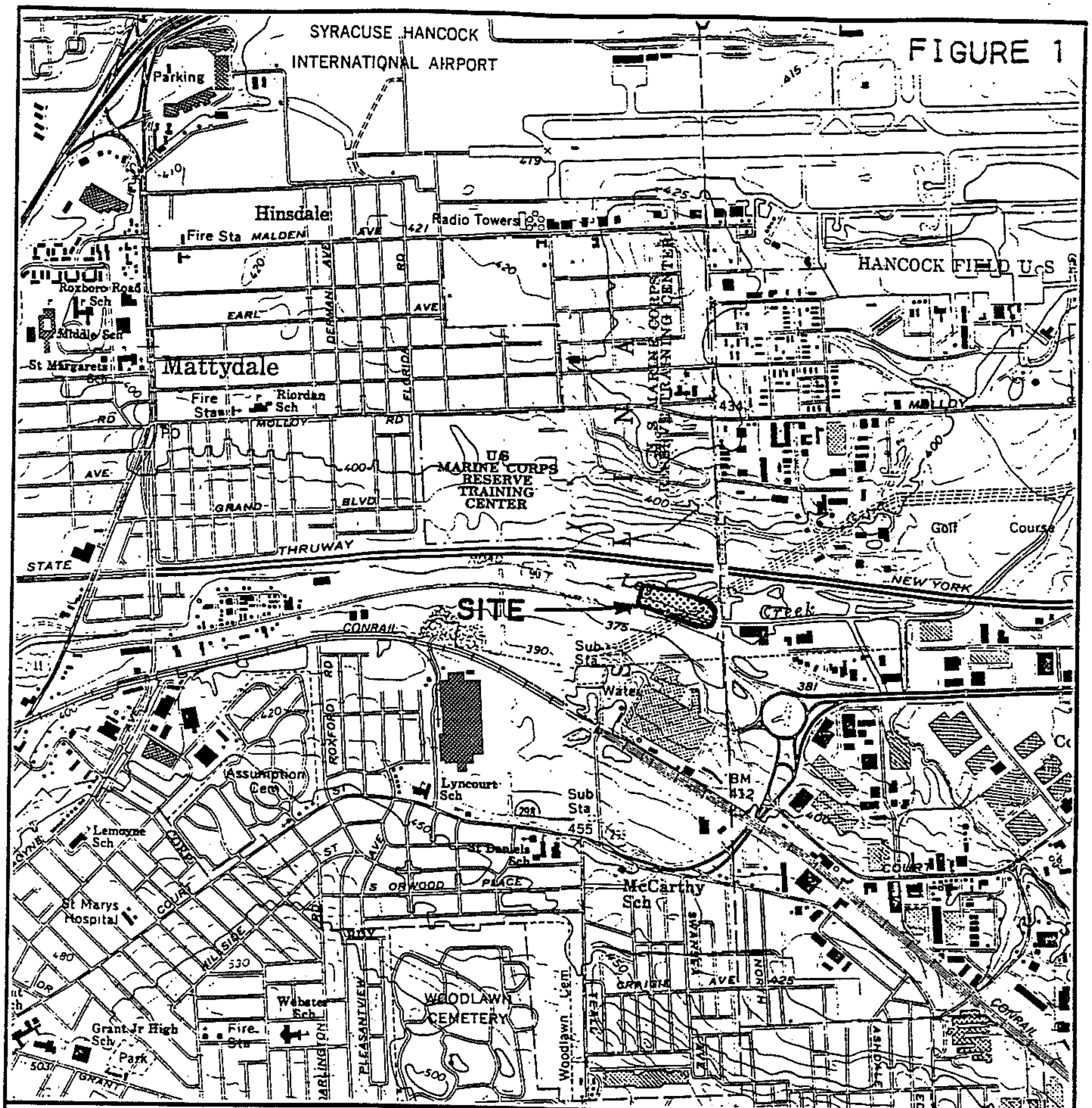
Feasibility Study
Ley Creek Dredged Material Area

ALTERNATIVE 8 (EXCAVATION/DISPOSAL AT CHEMICAL LANDFILL FOR SURFACE AND SUBSURFACE SOILS >50 ppm PCBs AND 12 INCH VEGETATIVE SOIL COVER FOR SURFACE SOILS > 1 ppm AND SUBSURFACE SOILS > 10 ppm PCBS; REMOVAL OF FLOODWAY SOILS WITH SURFACE SOILS > 1 ppm PCBs AND INSTALLATION OF LOW PERMEABILITY COVER; SEWER AND CREEK ACCESS PATHS)

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
OTHER COSTS				
Clearing/Grubbing	17	AC	$5,000	$85,000
Sheeting			Lump Sum	$20,000
Construction Water Mgmt.			Lump Sum	$25,000
Confirmatory Sampling			Lump Sum	$50,000
Dust Control			Lump Sum	$5,000
Fence Locks			Lump Sum	$500
Deed Restrictions			Lump Sum	$5,000
Mobilization/Demobilization			Lump Sum	$25,000
Health & Safety			Lump Sum	$35,000
			Total Direct Capital Costs	**$3,646,460**
Indirect Capital Costs				
Contingency (25% Direct Capital Costs)				$911,615
Engineering (15% Direct Capital Costs)				$546,969
Legal Fees (5% Direct Capital Costs)				$182,323
			Total Indirect Capital Costs	**$1,640,907**
			Total Capital Cost	**$5,287,367**
Annual Operation & Maintenance Costs				
Ground Water Sampling Labor	8	day	$300	$2,400
Ground Water Sample Analysis	36	samples	$185	$6,660
Ground Water Monitoring Reports	8	day	$400	$3,200
Site Mowing	12	day	$300	$3,600
Site Inspection	4	day	$300	$1,200
Miscellaneous Site Work	4	day	$300	$1,200
Insurance (1% Direct Capital Cost)				$36,465
Reserve Fund (1% Direct Capital Cost)				$36,465
			Total Annual O&M Costs	**$91,189**
Five-Year Review (one-time cost every 5 yrs)			**Lump Sum**	**$10,000**
			Present Worth of Annual O&M Costs for 30 Years (i=5%)	**$1,429,622**
			ALTERNATIVE 8 TOTAL ESTIMATED COST	**$6,716,989**

Figures

O'BRIEN & GERE
ENGINEERS, INC.



GENERAL MOTORS CORPORATION
INLAND FISHER GUIDE DIVISION
LEY CREEK DREDGED
MATERIAL AREA SITE
SYRACUSE, NEW YORK

SITE LOCATION MAP

0 2000 4000

SCALE IN FEET

ADAPTED FROM U.S.G.S. SYRACUSE EAST, NEW YORK QUADRANGLE

2/8/93
3247.035.130
GHS

O'BRIEN & GERE

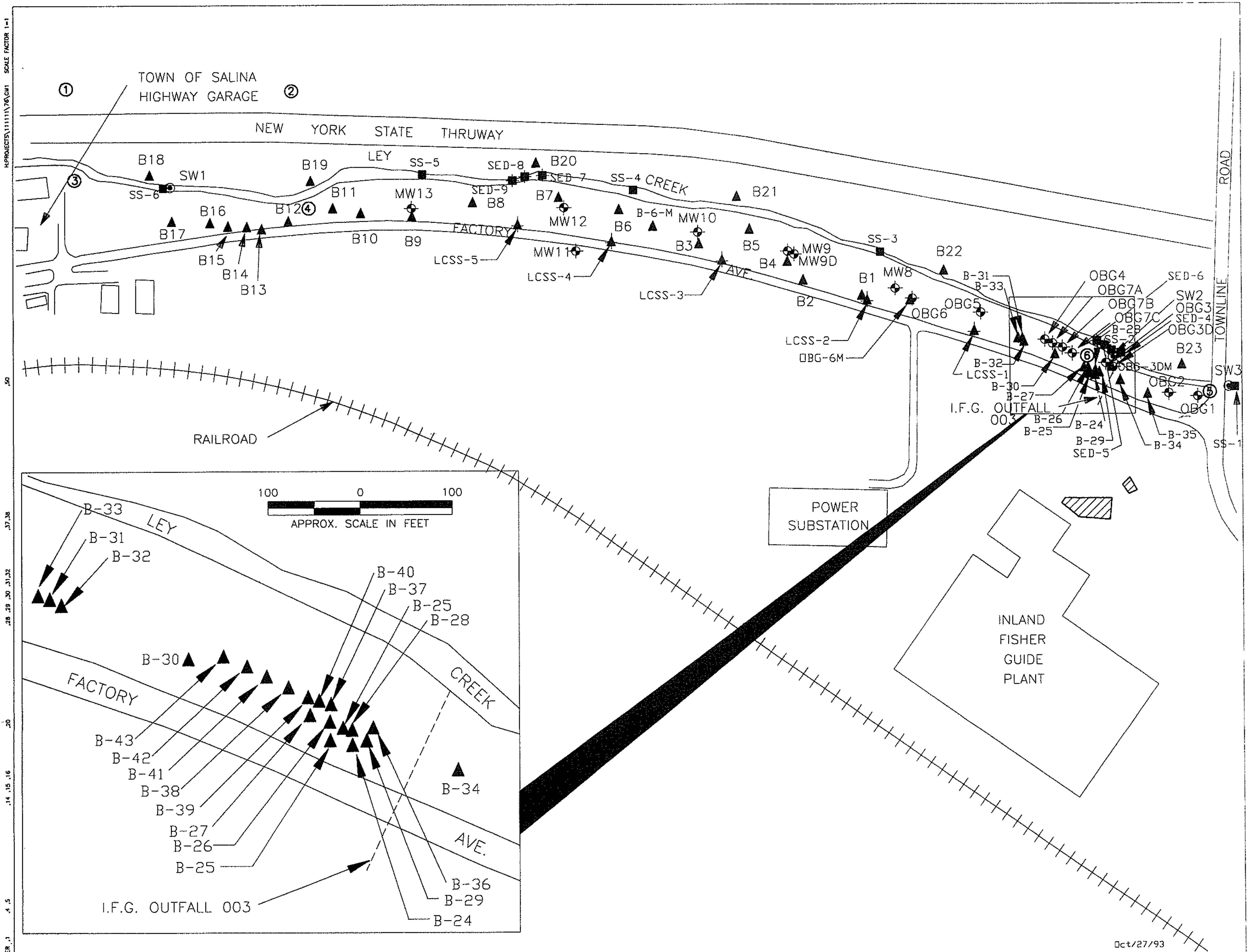


FIGURE 2
GENERAL MOTORS CORPORATION
INLAND FISHER GUIDE DIVISION
LEY CREEK DREDGED
MATERIAL AREA SITE
SYRACUSE, NEW YORK

LEGEND

- MONITORING WELL
- SOIL BORING LOCATION
- CLOSED SURFACE IMPOUNDMENT
- SURFACE WATER SAMPLE
- AIR SAMPLE
- SEDIMENT SAMPLE
- SURFACE SOIL SAMPLE
- SEDIMENT SAMPLE

NOTE: BLOWUP ILLUSTRATES SOIL BORINGS INSTALLED FROM 7/92 THRU 12/92. THE 12/92 SOIL BORINGS NOT SHOWN IN THE 1"=400' SCALE DUE TO SYMBOL DENSITY.

STUDY AREA MAP

400 0 400
APPROX. SCALE IN FEET

3247.078.312

ENGINEERS,INC.

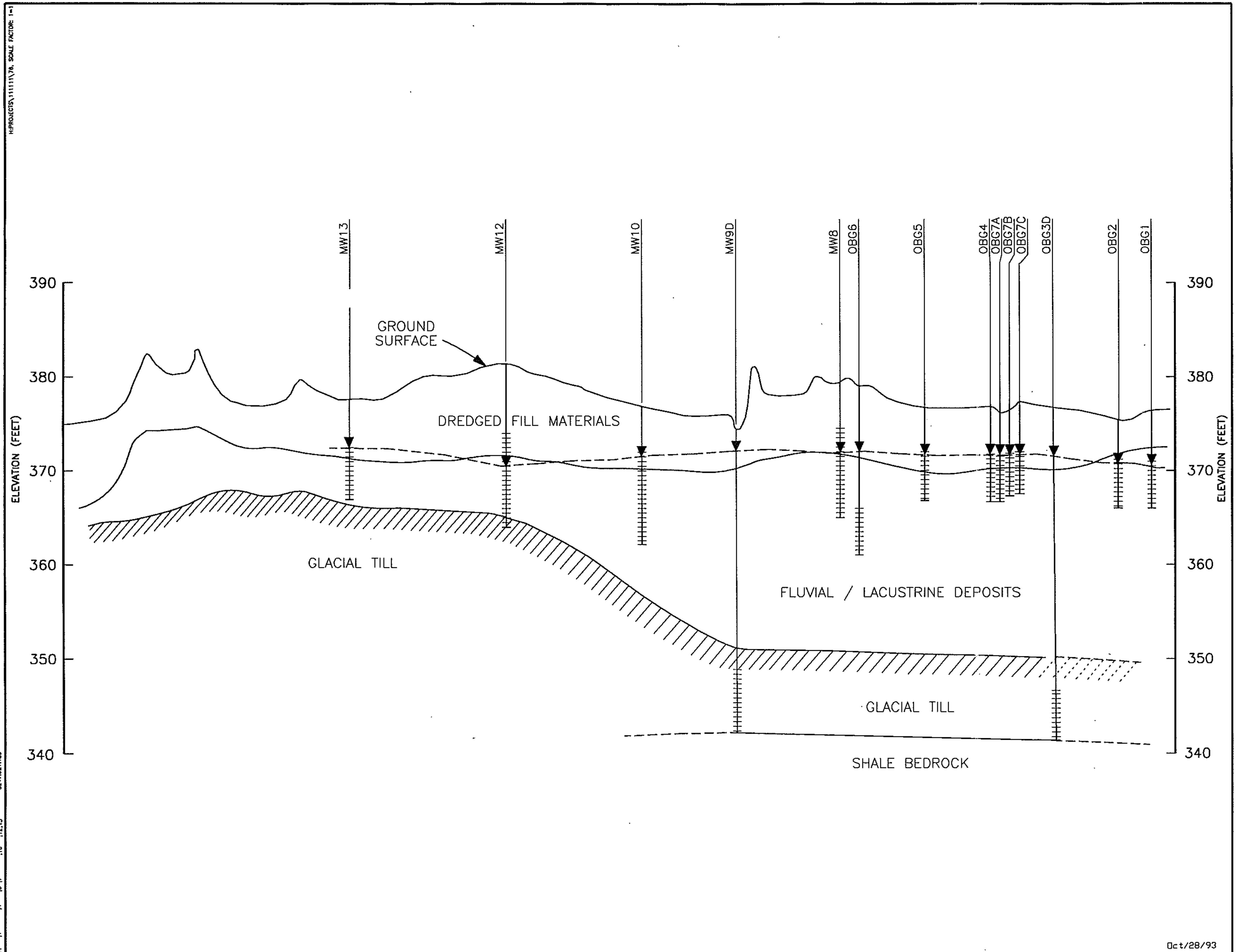


FIGURE 3

GENERAL MOTORS CORPORATION
INLAND FISHER GUIDE DIVISION
LEY CREEK DREDGED
MATERIAL AREA SITE
SYRACUSE, NEW YORK

GEOLOGIC CROSS SECTION 7/29/92

LEGEND

MONITORING WELL LOCATION

▼ GROUND WATER ELEVATION (7/29/92)

GROUND WATER TABLE

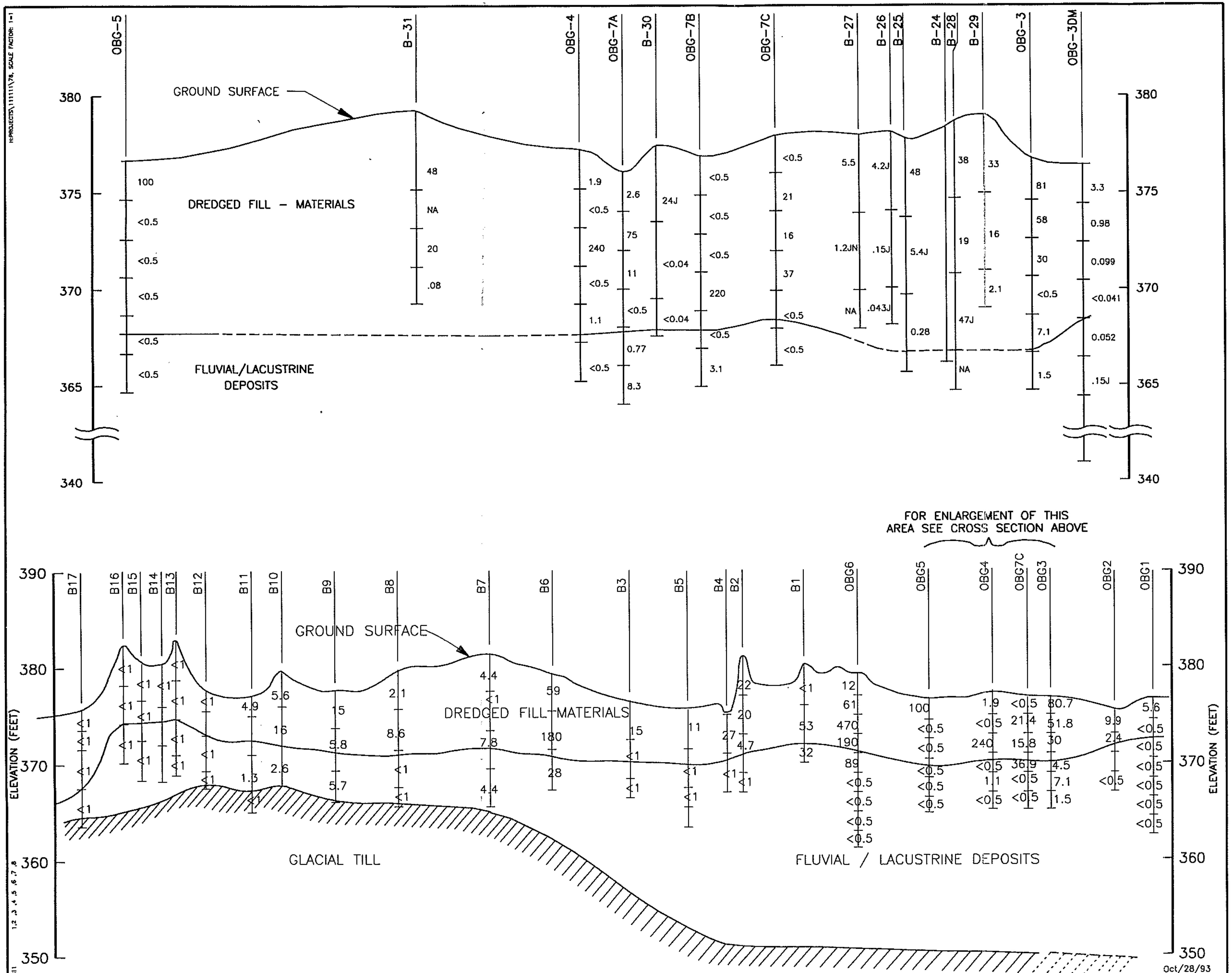
400 0 400

HORIZ. SCALE IN FEET

O'BRIEN & GERE ENGINEERS, INC.

FIGURE 4

GENERAL MOTORS CORPORATION
INLAND FISHER GUIDE DIVISION
LEY CREEK DREDGED
MATERIAL AREA SITE
SYRACUSE, NEW YORK



LEGEND

(symbol)	SOIL BORING LOCATION
.08	TOTAL PCB CONCENTRATION IN mg/Kg (ppm) DRY WEIGHT
4.2J	DETECTED CONCENTRATION ESTIMATED
1.2JN	DETECTED CONCENTRATION PRESUMPTIVELY PRESENT AT APPROXIMATED QUANTITY
NA	NOT ANALYZED

PCB CONCENTRATIONS IN DREDGED MATERIAL/SOIL CROSS SECTION

60 0 60
HORIZ. SCALE IN FEET FOR TOP CROSS SECTION

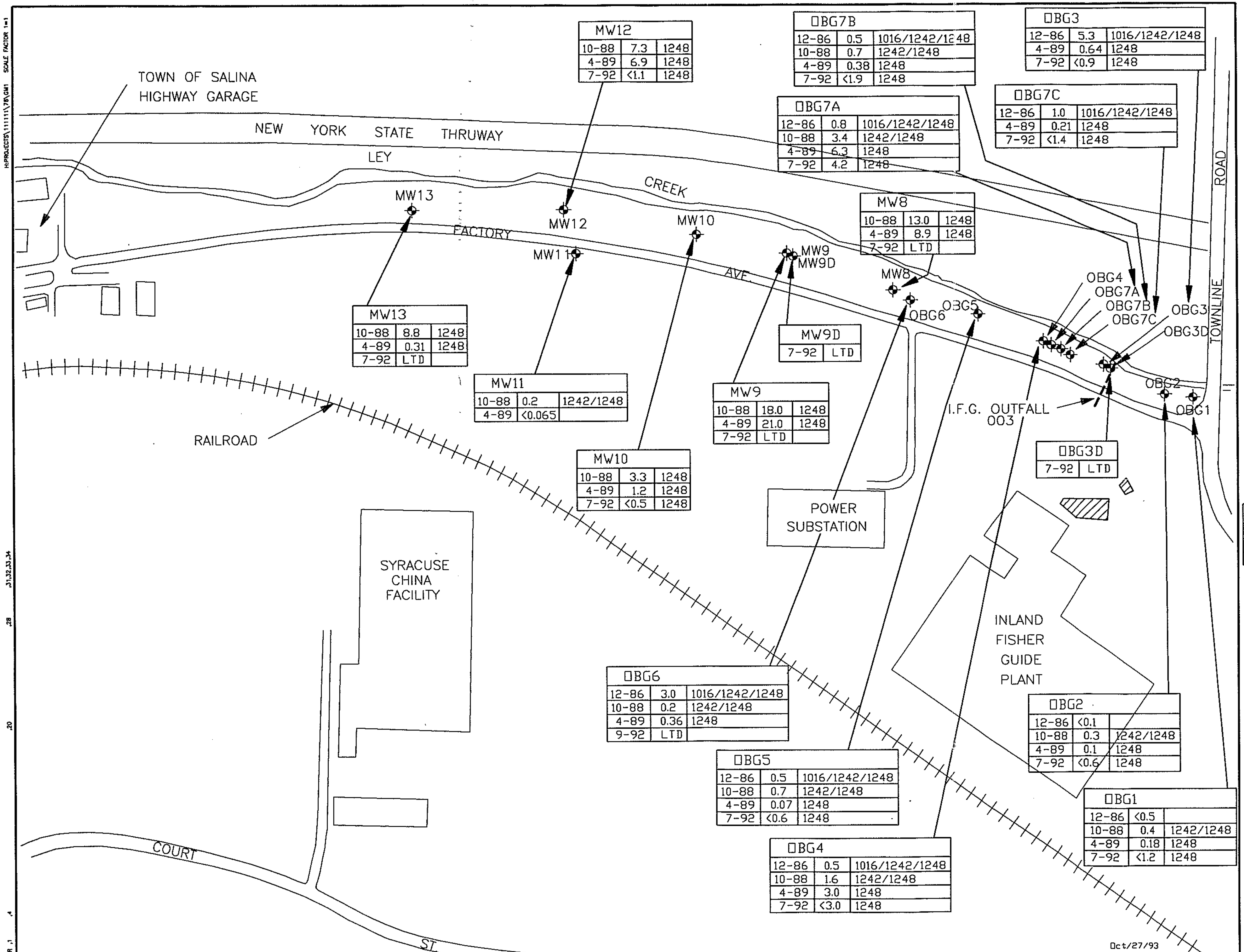
400 0 400
HORIZ. SCALE IN FEET FOR BOTTOM CROSS SECTION

3247.078.212

O'BRIEN & GERE ENGINEERS, INC.

FIGURE 5

GENERAL MOTORS CORPORATION
INLAND FISHER GUIDE DIVISION
LEY CREEK DREDGED
MATERIAL AREA SITE
SYRACUSE, NEW YORK



MW12

10-88	7.3	1248
4-89	6.9	1248
7-92	<1.1	1248

OBG7B

12-86	0.5	1016/1242/1248
10-88	0.7	1242/1248
4-89	0.38	1248
7-92	<1.9	1248

OBG3

12-86	5.3	1016/1242/1248
4-89	0.64	1248
7-92	<0.9	1248

OBG7A

12-86	0.8	1016/1242/1248
10-88	3.4	1242/1248
4-89	6.3	1248
7-92	4.2	1248

OBG7C

12-86	1.0	1016/1242/1248
4-89	0.21	1248
7-92	<1.4	1248

MW8

10-88	13.0	1248
4-89	8.9	1248
7-92	LTD	

MW13

10-88	8.8	1248
4-89	0.31	1248
7-92	LTD	

MW11

10-88	0.2	1242/1248
4-89	<0.065	

MW9D

7-92	LTD

MW9

10-88	18.0	1248
4-89	21.0	1248
7-92	LTD	

MW10

10-88	3.3	1248
4-89	1.2	1248
7-92	<0.5	1248

OBG3D

7-92	LTD

OBG6

12-86	3.0	1016/1242/1248
10-88	0.2	1242/1248
4-89	0.36	1248
9-92	LTD	

OBG5

12-86	0.5	1016/1242/1248
10-88	0.7	1242/1248
4-89	0.07	1248
7-92	<0.6	1248

OBG4

12-86	0.5	1016/1242/1248
10-88	1.6	1242/1248
4-89	3.0	1248
7-92	<3.0	1248

OBG2

12-86	<0.1	
10-88	0.3	1242/1248
4-89	0.1	1248
7-92	<0.6	1248

OBG1

12-86	<0.5	
10-88	0.4	1242/1248
4-89	0.18	1248
7-92	<1.2	1248

LEGEND

MONITORING WELL

CLOSED SURFACE IMPOUNDMENT

KEY

OBG2 — WELL ID
12-86 — SAMPLE DATE
0.3 — TOTAL PCB CONCENTRATION IN GROUND WATER (ug/l)
1248 — AROCLOR IDENTIFIED

LTD EACH AROCLOR WAS LESS THAN DETECTABLE AT DETECTION LIMITS OF 0.5 ug/l (1016,1232,1242,1248, 1254 AND 1260) AND 1.0 ug/l (1221).

PCB CONCENTRATIONS IN UNFILTERED GROUND WATER

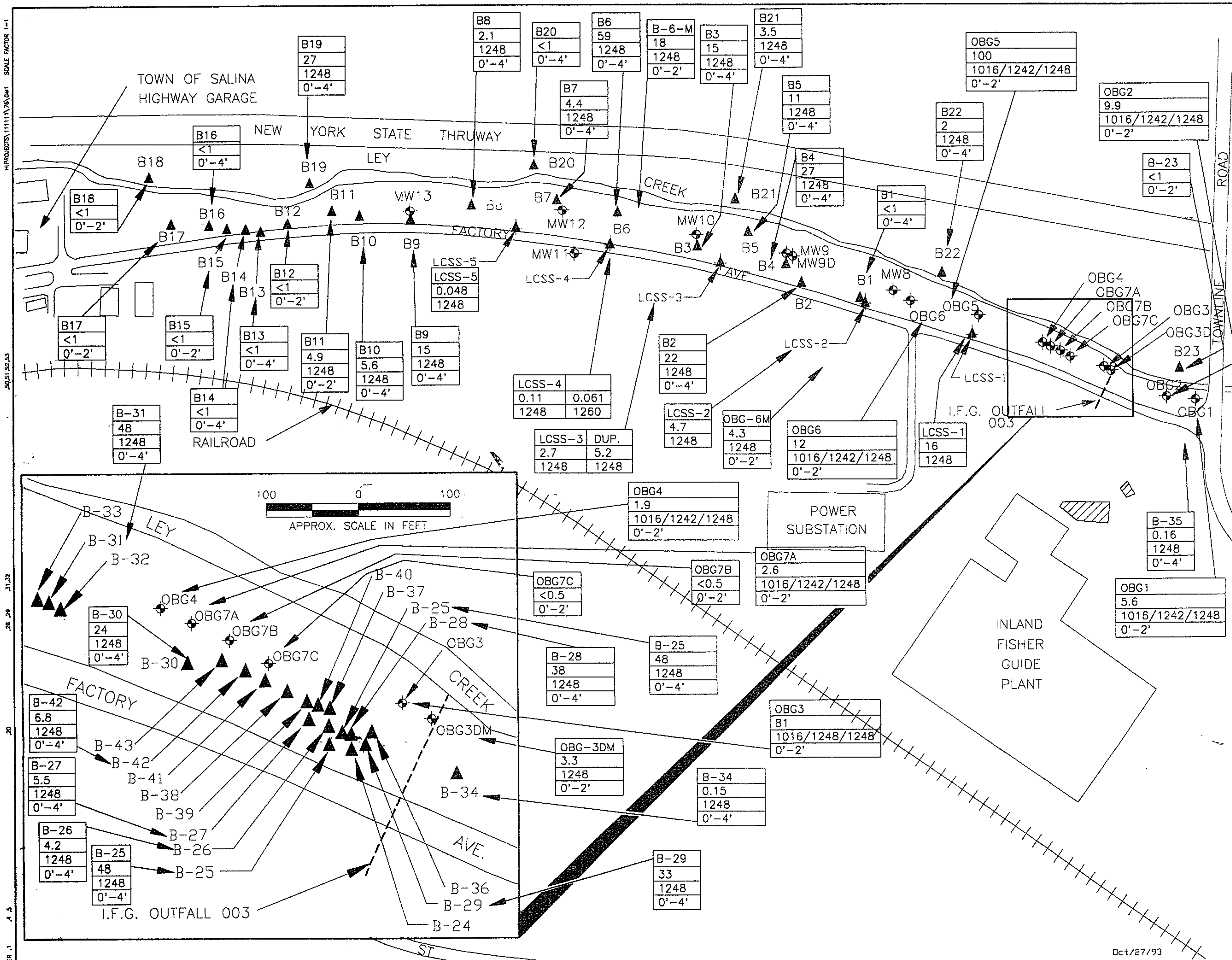
400 0 400
APPROX. SCALE IN FEET

3247.078.312

O'BRIEN & GERE ENGINEERS, INC.

FIGURE 6

GENERAL MOTORS CORPORATION
INLAND FISHER GUIDE DIVISION
LEY CREEK DREDGED
MATERIAL AREA SITE
SYRACUSE, NEW YORK



LEGEND

- MONITORING WELL
- SOIL BORING LOCATION
- CLOSED SURFACE IMPOUNDMENT
- SURFACE SOIL SAMPLE

B-35	SAMPLE ID
0.16	PCB CONC. (Mg/Kg)
1248	AROCLOR
0'-4'	SAMPLE DEPTH

NOTE: BLOWUP ILLUSTRATES SOIL BORINGS INSTALLED FROM 7/92 THRU 12/92. THE 12/92 SOIL BORINGS NOT SHOWN IN THE 1"=400' SCALE DUE TO SYMBOL DENSITY.

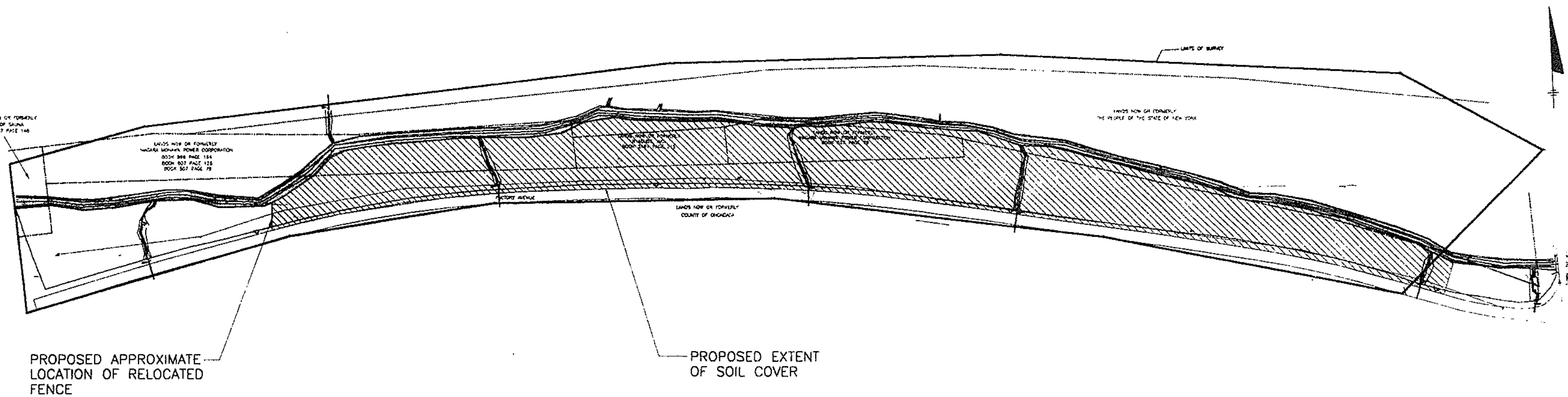
PCB CONCENTRATIONS IN SURFACE DREDGED MATERIALS/SOILS

400 0 400

APPROX. SCALE IN FEET

3247.078.312

O'BRIEN & GERE ENGINEERS, INC.



LEGEND:

- SEWER
- PROPERTY BOUNDARY
- PROPOSED EXTENT OF SOIL COVER

NOTE:

1) NORTH ORIENTATION AND COORDINATE DATUM ARE BASED ON THE CENTRAL ZONE OF NEW YORK STATE PLANE COORDINATE SYSTEM AS ESTABLISHED BY DIFFERENTIAL G.P.S. METHODS.
2) VERTICAL DATUM IS BASED ON N.G.V.D. 1929.
3) UNABLE TO PLOT THE RIGHT OF WAYS THE BEAR TRAP-LEY CREEK DRAINAGE DISTRICTS AS THEY DO NOT FIT THE PROPERTY LINES.
4) BASE MAP GENERATED BY C.T. MALE ASSOCIATES, P.C. - 1995

This drawing was prepared at the scale indicated in the title block. Inaccuracies in the stated scale may be introduced when drawings are reproduced by any means. Use the graphic scale bar in the title block to determine the actual scale of this drawing.

1" = 200' — 200 0 200 400

NO.	DATE	REVISION	INIT.

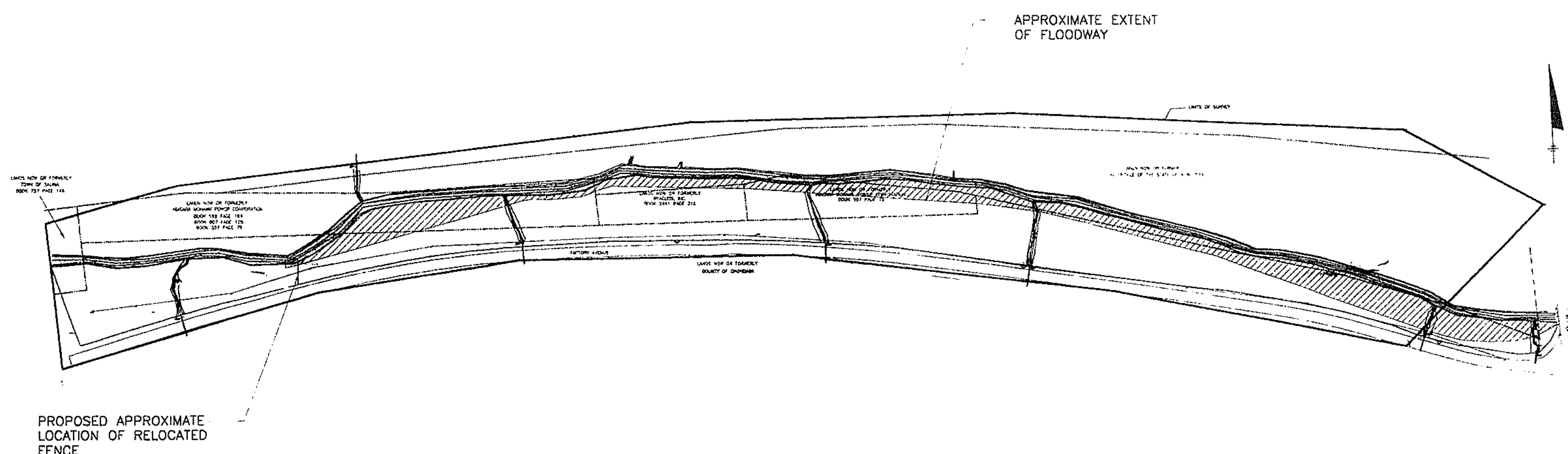
O'BRIEN & GERE ENGINEERS, INC.

GENERAL MOTORS CORPORATION
SYRACUSE, NEW YORK

GENERAL
LEY CREEK DREDGED MATERIAL AREA FS
PROPOSED EXTENT OF SOIL COVER

FILE NO. 3247.078-01P
DATE MARCH 1996

FIG. 7
R-0



LEGEND:

SEWER
PROPERTY BOUNDARY
FLOODWAY (APPROXIMATE)

NOTE:
1) NORTH ORIENTATION AND COORDINATE DATUM ARE BASED ON THE CENTRAL ZONE OF NEW YORK STATE PLANE COORDINATE SYSTEM AS ESTABLISHED BY DIFFERENTIAL G.P.S. METHODS.
2) VERTICAL DATUM IS BASED ON N.G.V.D. 1929.
3) UNABLE TO PLOT THE RIGHT OF WAYS THE BEAR TRAP-LEY CREEK DRAINAGE DISTRICTS AS THEY DO NOT FIT THE PROPERTY LINES.
4) BASE MAP GENERATED BY C.T. MALE ASSOCIATES, P.C. – 1995
5) FLOODWAY PLOTTED FROM 1982 FEDERAL EMERGENCY MANAGEMENT AGENCY FLOOD BOUNDARY AND FLOODWAY MAP.

This drawing was prepared at the scale indicated in the title block. Inaccuracies in the stated scale may be introduced when drawings are reproduced by any means. Use the graphic scale bar in the title block to determine the actual scale of this drawing.

1"=200' 200 0 200 400

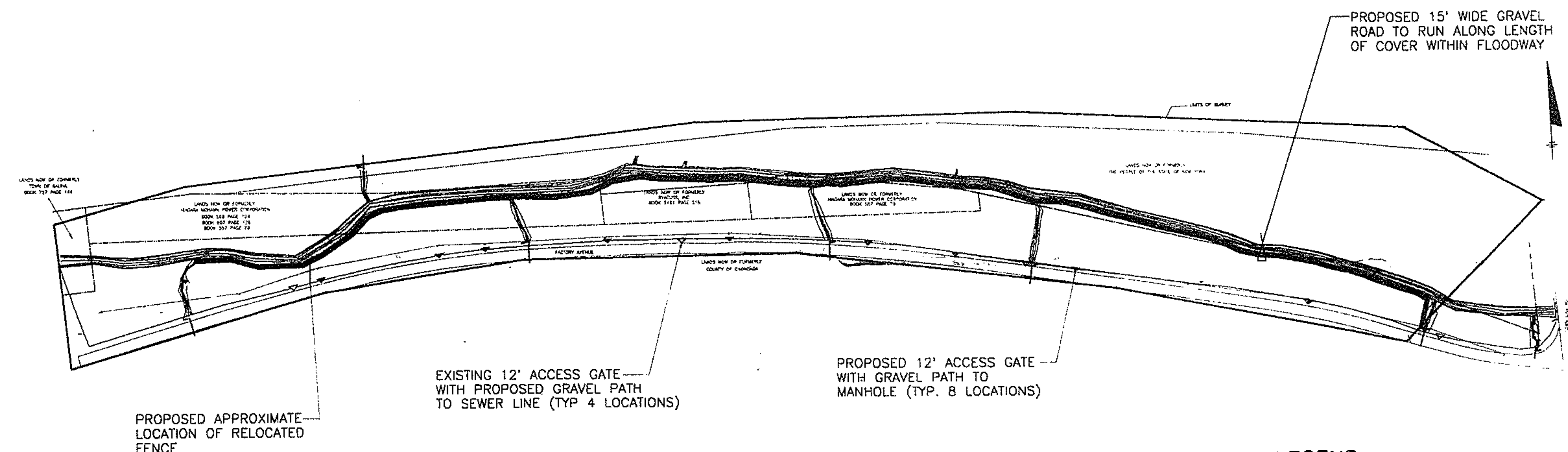
NO.	DATE	REVISION	INIT.

O'BRIEN & GERE ENGINEERS, INC.

GENERAL MOTORS CORPORATION
SYRACUSE, NEW YORK

GENERAL
LEY CREEK DREDGED MATERIAL AREA FS
APPROXIMATE LOCATION OF FLOODWAY

FILE NO. 3247.078-02P
DATE MARCH 1996
FIG. 8
R-0



LEGEND:

- GRAVEL ACCESS ROAD
- SEWER
- PROPERTY BOUNDARY
- MANHOLE ACCESS GATE
- EXISTING ACCESS GATE

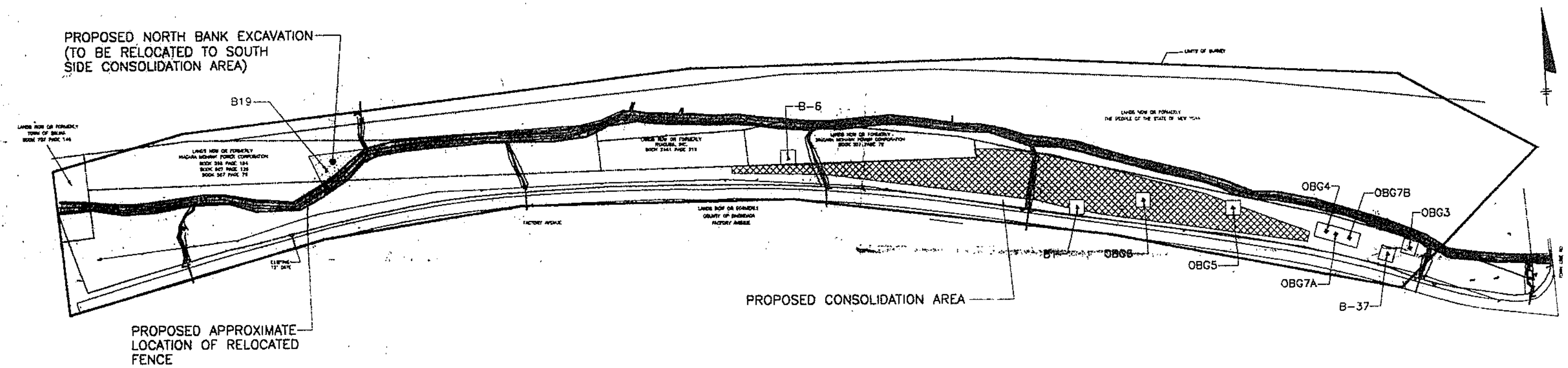
NOTE:

1) NORTH ORIENTATION AND COORDINATE DATUM ARE BASED ON THE CENTRAL ZONE OF NEW YORK STATE PLANE COORDINATE SYSTEM AS ESTABLISHED BY DIFFERENTIAL G.P.S. METHODS.
2) VERTICAL DATUM IS BASED ON N.G.V.D. 1929.
3) UNABLE TO PLOT THE RIGHT OF WAYS THE BEAR TRAP–LEY CREEK DRAINAGE DISTRICTS AS THEY DO NOT FIT THE PROPERTY LINES.
4) BASE MAP GENERATED BY C.T. MALE ASSOCIATES, P.C. – 1995

This drawing was prepared at the scale indicated in the title block. Inaccuracies in the stated scale may be introduced when drawings are reproduced by any means. Use the graphic scale bar in the title block to determine the actual scale of this drawing.

1"=200' (200 0 200 400)	NO. / DATE / REVISION / INIT.	O'BRIEN & GERE ENGINEERS, INC.	GENERAL MOTORS CORPORATION SYRACUSE, NEW YORK	GENERAL LEY CREEK DREDGED MATERIAL AREA FS PROPOSED ACCESS GATES/ROAD	FILE NO 3247.078-03P DATE MARCH 1996	FIG. 9 R-0

JWM LCDM-3.DWG 1=200



LEGEND:

- SEWER
- PROPERTY BOUNDARY
- PROPOSED HOT SPOT EXCAVATION
- MONITORING WELL
- SOIL BORING
- SURFACE SOIL SAMPLE
- PROPOSED CONSOLIDATION AREA

NOTE:

1) NORTH ORIENTATION AND COORDINATE DATUM ARE BASED ON THE CENTRAL ZONE OF NEW YORK STATE PLANE COORDINATE SYSTEM AS ESTABLISHED BY DIFFERENTIAL G.P.S. METHODS.
2) VERTICAL DATUM IS BASED ON N.G.V.D. 1929.
3) UNABLE TO PLOT THE RIGHT OF WAYS THE BEAR TRAP-LEY CREEK DRAINAGE DISTRICTS AS THEY DO NOT FIT THE PROPERTY LINES.
4) BASE MAP GENERATED BY C.T. MALE ASSOCIATES, P.C. – 1995

This drawing was prepared at the scale indicated in the title block. Inaccuracies in the stated scale may be introduced when drawings are reproduced by any means. Use the graphic scale bar in the title block to determine the actual scale of this drawing.

1" = 200' — 200 0 200 400

NO.	DATE	REVISION	INIT.

O'BRIEN & GERE ENGINEERS, INC.

GENERAL MOTORS CORPORATION

SYRACUSE, NEW YORK

GENERAL

LEY CREEK DREDGED MATERIAL AREA FS

PROPOSED EXCAVATIONS & CONSOLIDATION AREA

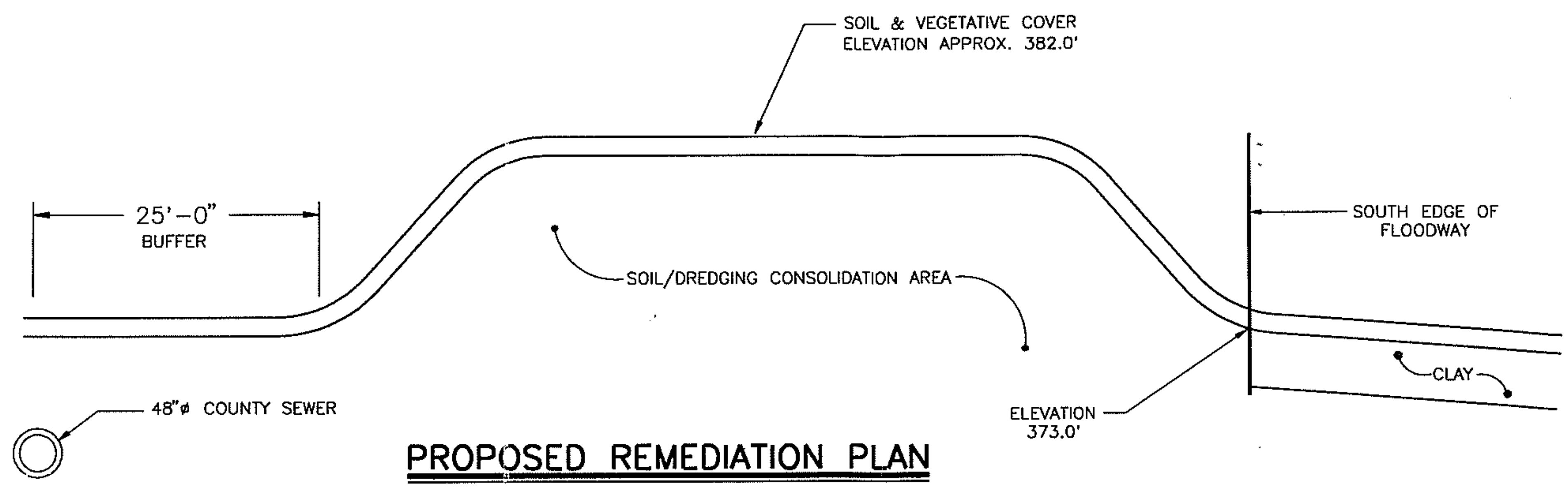
FILE NO. 3247.078-04P

DATE MARCH 1996

FIG. 10

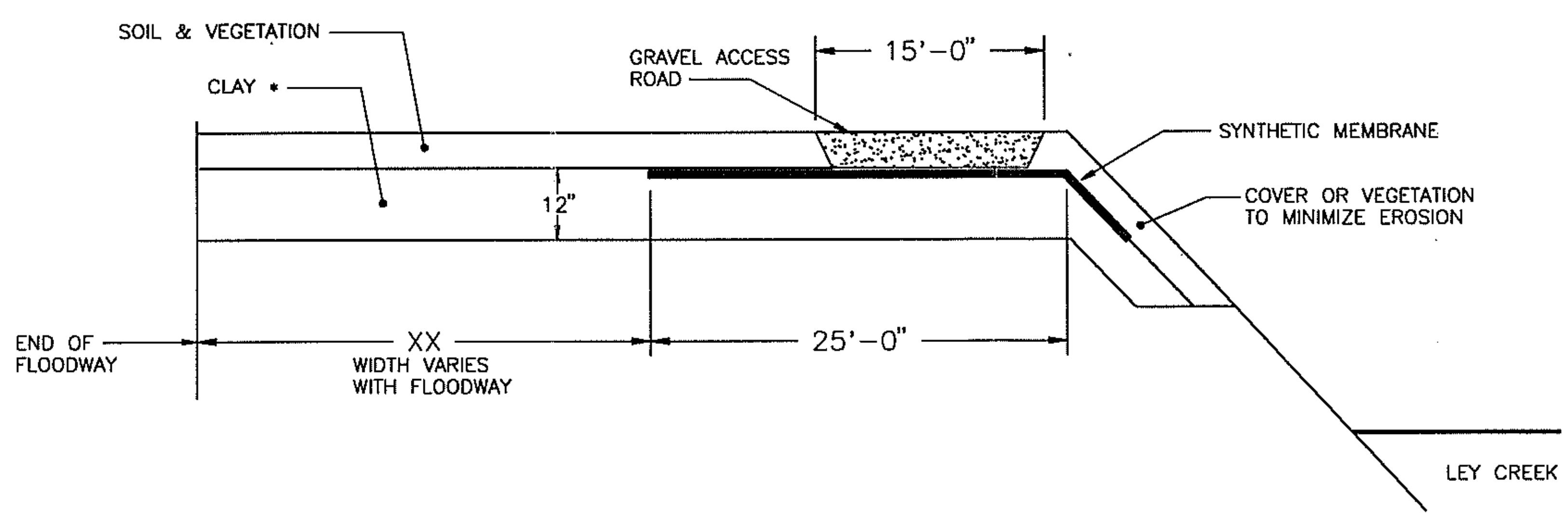
R-0

FIGURE 11



PROPOSED REMEDIATION PLAN
SECTION - CONSOLIDATION AREA

NOT TO SCALE



PROPOSED REMEDIATION PLAN
SECTION - FLOODWAY ALONG SOUTH SIDE OF LEY CREEK

NOT TO SCALE

NOTE:
MATERIALS USED AS PART OF THE LOW PERMEABILITY COVER (SYNTHETIC MEMBRANE & CLAY SHOWN) SHALL BE EVALUATED DURING DESIGN.

GENERAL MOTORS CORP.
SYRACUSE, NEW YORK
LEY CREEK DREDGED
MATERIAL AREA FS
PROPOSED CROSS-SECTIONS

NOT TO SCALE

FILE NO. 3247.078-05P

O'BRIEN & GERE ENGINEERS, INC.

Appendices

O'BRIEN & GERE
ENGINEERS, INC.

APPENDIX A

LEACHABILITY STUDY DATA - FIRST STUDY

H2M LABS, INC.
575 Broad Hollow Road, Melville, N.Y. 11747
(516)694-3040 FAX:(516)694-4122

LAB NO: 9322842

O'BRIEN & GERE ENGINEERS, INC.
5000 BRITTONFIELD PKY.
E. SYRACUSE, NY 13057

TYPE...... SOIL
ROUTINE
METHOD.... GRAB

DATE COLLECTED. 07/15/93
DATE RECEIVED.. 07/16/93
COLLECTED BY... CL99
PROJECT NO..... 3247.078

POINT NO:
LOCATION: SOIL 1

REMARKS: LEY CREEK RI/FS
ANALYZE PCB BY METHOD 91-3

PCB'S - (mg/kg)

PARAMETER (S)	RESULT	PARAMETER (S)	RESULT
AROCLOR 1016	<16		
AROCLOR 1221	<16		
AROCLOR 1232	<16		
AROCLOR 1242	61		
AROCLOR 1248	<16		
AROCLOR 1254	<32		
AROCLOR 1260	<32		

COPIES TO:

DATE ISSUED 08/[illegible]/93

DATE EXTRACTED. 07/19/93
DATE RUN....... 07/31/93
DATE REPORTED.. 08/02/9[illegible]

LABORATORY DIRECTOR

ORIGINAL

H2M LABS, INC.

575 Broad Hollow Road, Melville, N.Y. 11747
(516)694-3040 FAX:(516)694-4122

LAB NO: 9322843

O'BRIEN & GERE ENGINEERS,INC.
5000 BRITTONFIELD PKY.
E. SYRACUSE, NY 13057

TYPE...... SOIL
ROUTINE
METHOD.... GRAB

DATE COLLECTED. 07/15/93
DATE RECEIVED.. 07/16/93
COLLECTED BY... CL99
PROJECT NO..... 3247.078

POINT NO:
LOCATION: SOIL 1

REMARKS: LEY CREEK RI/FS
ANALYZE PCB BY METHOD 91-3
TCLP PREP.

PCB'S - (ug/l)

PARAMETER (S)	RESULT	PARAMETER (S)	RESULT
AROCLOR 1016	<0.5		
AROCLOR 1221	<0.5		
AROCLOR 1232	<0.5		
AROCLOR 1242	<0.5		
AROCLOR 1248	<0.5		
AROCLOR 1254	<1.0		
AROCLOR 1260	<1.0		

COPIES TO:

DATE ISSUED 10/01/93

DATE RUN....... 10/01/93
DATE REPORTED.. 10/01/93

ORIGINAL

LABORATORY DIRECTOR

H2M LABS, INC.
575 Broad Hollow Road, Melville, NY
(516)694-3040 FAX:(516)694-4122

LAB NO: 9322844

O'BRIEN & GERE ENGINEERS, INC.
5000 BRITTONFIELD PKY.
E. SYRACUSE, NY 13057

TYPE...... SOIL
ROUTINE
METHOD.... GRAB

DATE COLLECTED. 07/15/93
DATE RECEIVED.. 07/16/93
COLLECTED BY... CL99
PROJECT NO..... 3247.078

POINT NO:
LOCATION: SOIL 2

REMARKS: LEY CREEK RI/FS
ANALYZE PCB BY METHOD 91-3

PCB'S - (mg/kg)

PARAMETER (S)	RESULT	PARAMETER (S)	RESULT
AROCLOR 1016	<16		
AROCLOR 1221	<16		
AROCLOR 1232	<16		
AROCLOR 1242	56		
AROCLOR 1248	<16		
AROCLOR 1254	<32		
AROCLOR 1260	<32		

DATE ISSUED 08/05/9.

COPIES TO:

DATE EXTRACTED. 07/19/93
DATE RUN....... 07/31/93
DATE REPORTED.. 08/02/93

J M [signature]
LABORATORY DIRECTOR

ORIGINAL

H2M LABS, INC.

575 Broad Hollow Road, Melville, N.Y. 11747
(516)694-3040 FAX:(516)694-4122

LAB NO: 9322845

O'BRIEN & GERE ENGINEERS,INC.
5000 BRITTONFIELD PKY.
E. SYRACUSE, NY 13057

TYPE...... SOIL
ROUTINE
METHOD.... GRAB

DATE COLLECTED. 07/15/93
DATE RECEIVED.. 07/16/93
COLLECTED BY... CL99
PROJECT NO..... 3247.078

POINT NO:
LOCATION: SOIL 2

REMARKS: LEY CREEK RI/FS
ANALYZE PCB BY METHOD 91-3
TCLP PREP.

PCB'S - (ug/l)

PARAMETER (S)	RESULT	PARAMETER (S)	RESULT
AROCLOR 1016	<0.5		
AROCLOR 1221	<0.5		
AROCLOR 1232	<0.5		
AROCLOR 1242	<0.5		
AROCLOR 1248	<0.5		
AROCLOR 1254	<1.0		
AROCLOR 1260	<1.0		

COPIES TO:

DATE ISSUED 10/01/93

DATE RUN....... 10/01/93
DATE REPORTED.. 10/01/93

J M [signature] LABORATORY DIRECTOR

ORIGINAL

Sample Custody

Chain of custody procedures documented in the RI/FS Work Plan (O'Brien & Gere Engineers, 1992) will be followed for the leachability study.

Analytical Procedures

Sample analysis will be performed by H2M Laboratories, Inc. PCB analysis of dredged material/soil and leachate will be performed using Method 8080 with NYSDEC Category B deliverables, in accordance with the quality control requirements of the QAPP in the RI/FS Work Plan (O'Brien & Gere Engineers, 1992). The detection limit for this Method 8080 analysis of leachate is 0.1 ug/l PCBs; a method detection limit study will be performed to verify the detection limit. PCB extracts will be treated with sulfuric acid to remove hydrocarbon interference. Decachlorobiphenyl will be used as a surrogate compound with recovery limits from 60 to 150 percent.

TOC analysis will be performed in accordance with the Lloyd Kahn method used during the RI. TCLP extraction will be conducted in accordance with the protocol presented in SW-846 (3rd edition; Revision 1; July 1992).

Data Reduction, Validation, and Reporting

Data will be managed, validated, and reported in accordance with procedures presented in the RI/FS Work Plan (O'Brien & Gere Engineers, 1992). Additionally, validation of the TCLP extraction will be performed in accordance with USEPA-Region II's Standard Operating Procedure (SOP) No. HW-7, "TCLP Data Validation", Revision #1 (March 1992).

Quality Assurance/Quality Control

Overall QA/QC for the study will be performed in accordance with the procedures presented in the RI/FS Work Plan (O'Brien & Gere Engineers, 1992). For the immunoassay field screening activities, modified QA/QC procedures will be applied as follows:

- One field duplicate will be collected and analyzed for every 20 dredged material/soil samples. The field duplicate will be prepared and analyzed in a different preparation batch than the original sample, allowing the collection, preparation, and analysis variability to be evaluated.
- Matrix spike/matrix spike duplicate (MS/MSD) samples will not be collected for the screening activities.
- One preparation blank consisting of clean sand will be prepared and screened with each sample batch or every twenty samples, whichever is more frequent.
- Field screening data will not be validated.

Health and Safety

Sampling personnel will follow procedures outlined in the Health and Safety Plan presented as Appendix B of the RI/FS Work Plan (O'Brien & Gere Engineers, 1992).

Reporting

Results of the leachability study will be documented in a report which will be presented as an appendix to the final FS Report.

Schedule

A proposed project schedule is attached.

References

O'Brien & Gere Engineers, Inc. "Work Plan; Remedial Investigation/Feasibility Study; Ley Creek Dredged Material Area." February 1992.

GENERAL MOTORS CORPORATION
INLAND FISHER GUIDE DIVISION
SYRACUSE, NEW YORK

DREDGED MATERIAL/SOIL LEACHABILITY STUDY
PROJECT SCHEDULE

Leachability Study coordination - week of 8/15/94

Leachability Study sample collection - 8/25/94

Receipt of Leachability Study sample data - by 9/19/94

Leachability Study data validation - week of 9/19/94

1. Data Validation

1.1. General

Five soil samples and one aqueous field blank were collected and analyzed for total polychlorinated biphenyl (PCB) and total organic carbon (TOC) content using USEPA SW-846[1] methods 8080 and 9060, respectively. Additionally, these samples were analyzed by the Toxicity Characteristic Leaching Procedure (TCLP) for PCBs using USEPA SW-846 methods 1311 and 8080. These analyses were provided by H2M Labs, Inc. (H2M Labs) of Melville, New York.

1.2. Data Validation Protocols

Procedures utilized in the data quality review were consistent with those specified in the *CLP Organics Data Review and Preliminary Review* (EPA Region II, 1991). The purpose of the data quality review was to provide an independent focused evaluation regarding data quality to ascertain the usability of the data to meet the project data quality objectives (DQOs). During the data quality review, the laboratory reports and field documentation records were reviewed and the following quality assurance/quality control (QA/QC) parameters were evaluated:

- Case narrative;
- Holding times;
- Initial calibration data;
- Continuing calibration data;
- Method blanks;
- Surrogate recoveries;
- Matrix spike/matrix spike duplicate results; and,
- Compound quantification and identification.

1.3. Data Validation Qualifiers

Data validation is a process of reviewing written records and documentation generated during an analytical measurement for the purpose of providing an independent opinion regarding the quality and usability of data generated by that measurement. During the validation, data are evaluated to determine if the measurement was

---

1 *Test Methods for Evaluating Solid Wastes*, SW-846 Third Edition, USEPA, November 1986.

conducted in accordance with the quality assurance criteria specified for that measurement. Data usability was established as a result of the data validation process using the following data qualifiers:

"U" Indicates that the sample was analyzed, but the compound of interest was not detected. The sample detection limits are, therefore, presented followed by the "U" notation.

"J" Indicates that the result should be considered approximate. This qualifier is used when the data validation procedure identifies a minor deficiency in the data generation process. The decision to add the "J" qualifier is based on the quantitative validation criteria contained in the data validation guidelines. The identity of the analyte is not brought into question, however, the "J" qualifier results in a loss of confidence in the precision and/or accuracy of the reported value, and therefore is presented as an approximated value.

2. Data Quality Evaluation

2.1. PCB Analyses

The following QA/QC parameters for the PCB analyses using the analytical protocols specified above were found to meet validation criteria: case narrative, holding times, initial calibration data, continuing calibration data, and method blanks. Excursions from QA/QC criteria are summarized below.

Surrogate Recovery

Several of the surrogate recoveries for L-4, L-5, and TL-1 exceeded the upper control limit that defines acceptable surrogate recovery. The detected PCB results for these samples were not qualified due to these deviations because the high surrogate recoveries were attributed to interferences caused by the sample matrix. Also, the samples that exceeded surrogate recovery limits were re-analyzed utilizing a diluted sample aliquot in an attempt to reduce the matrix interferences. These diluted re-analyses exhibited at least one chromatographic column that met surrogate recovery criteria for both surrogate compounds.

Matrix Spike/Matrix Spike Duplicate Results

The matrix spike/matrix spike duplicate (MS/MSD) analysis of L-1 exceeded recovery limits with values that ranged from 200 to 360 percent for Aroclors 1016 and 1260. These values were attributed to the elevated level of Aroclor 1242 detected in the sample. Therefore, this sample did not require qualification for MS/MSD deviations.

Compound Quantification and Identification

The detected concentrations of Aroclor 1016 and 1248 in samples L-1 and TL-1 were incorrectly identified by the laboratory. The detected Aroclor pattern in these samples was determined to be Aroclor 1242 during data validation. The results for these samples were recalculated as a result of the data validation to represent the detected Aroclor 1242 results which were reported on the edited laboratory data summary forms. The edited Aroclor 1242 results for these samples were 82,000 μg/Kg and 5.4 μg/L for L-1 and TL-1, respectively.

The PCB analyses for this investigation were conducted using dual column confirmation analysis. The percent difference (%D) between the calculated results for the two columns is required to be less than 25 percent. This value was exceeded for the detected Aroclor 1248 results for L-2, L-3, L-4, L-5, TL-3, and TL-4 with %Ds that ranged from 27.9 to 93.5 percent. Additionally, the recalculated 1242 results for TL-1 exhibited a %D of 30.6 percent. Due to these deviations the detected PCB results for the samples specified above were approximated (J).

Due to the elevated levels of PCBs in the samples several samples required re-analysis with a dilution. The detected sample results from the diluted analyses were combined with the results from the non-diluted analyses to provide the lowest detection limits for the non-detected compounds.

2.1. TOC Analyses

Five soil samples analyzed by H2M Labs for TOC content by USEPA SW-846 method 9060 were validated according to the procedures in the *CLP Organics Data Review and Preliminary Review* (EPA Region II, 1991). Excursions from validation criteria were not observed for the QA/QC parameters specified above. Therefore, qualification of the sample data was not required.

3. Overall Data Assessment

Overall, these data were determined to be usable for qualitative and quantitative purposes. Although, 9.3 percent of the data were qualified as approximate for exceeding PCB analysis dual column confirmation %D criteria. The detected PCB results for TL-3, which exhibited a dual column %D of 93.5 percent, were not qualified as unusable (R) as required in *CLP Organics Data Review and Preliminary Review* (EPA Region II, 1991) because the variation in the detected responses was attributed to matrix interferences caused by coeluting peaks. The detected Aroclor 1016 and 1248 results for L-1 and TL-1 were re-calculated to represent detected concentrations of Aroclor 1242 based on pattern comparison with the calibration standards.

Table 1 (Appendix C)
Data Validation Results
Second Leachability Study
Feasibility Study
Ley Creek Dredged Material Area

Sample ID	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	% Solids	TOC
L-1 (soil)	1220 U	2300 U	1200 U	82000	1200 U	1200 U	1200 U	84.8	32100
L-2 (soil)	1300 U	2600 U	1300 U	1300 U	32000 J	1300 U	1300 U	78.0	42200
L-3 (soil)	1200 U	2500 U	1200 U	1200 U	9200 J	1200 U	1200 U	80.7	28300
L-4 (soil)	1200 U	2400 U	1200 U	1200 U	54000 J	1200 U	1200 U	83.1	28100
L-5 (soil) (duplicate of L-4)	1200 U	2400 U	1200 U	1200 U	67000 J	1200 U	1200 U	81.9	15400
TL-1 (water) (leachate from L-1)	0.10 U	0.20 U	0.10 U	5.4 J	0.10 U	0.10 U	0.10 U	N/A	N/A
TL-2 (water) (leachate from L-2)	0.10 U	0.21 U	0.10 U	0.10 U	0.27	0.10 U	0.10 U	N/A	N/A
TL-3 (water) (leachate from L-3)	0.10 U	0.20 U	0.10 U	0.10 U	0.18 J	0.10 U	0.10 U	N/A	N/A
TL-4 (water) (leachate from L-4)	0.10 U	0.20 U	0.10 U	0.10 U	0.18 J	0.10 U	0.10 U	N/A	N/A
TL-5 (water) (leachate from L-5)	0.10 U	0.20 U	0.10 U	0.10 U	0.19	0.10 U	0.10 U	N/A	N/A
Field Blank (water)	0.10 U	0.20 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	N/A	N/A

NOTES:

1) U = Not detected at the indicated quantition limit
2) J = Detected results are estimated
3) TOC = total organic carbon
4) Soil Sample Aroclor Units = ug/kg; TOC units = mg/kg
5) Water Sample Units = ug/l
6) N/A = Not Applicable

APPENDIX D

HAZARD QUOTIENT EVALUATION - GREAT BLUE HERON

RESULTS OF HAZARD QUOTIENT CALCULATIONS FOR GREAT BLUE HERON AT THE LEY CREEK DREDGED MATERIAL AREA STUDY AREA

Introduction

The purpose of this report is to estimate the hazard of PCB levels in Ley Creek surface water, sediments, and fish to great blue heron (*Ardea herodias*). An ecological assessment conducted for the Ley Creek Dredged Material Area Study Area identified the great blue heron as a sensitive species of concern that would be representative of risk to piscivorous inhabitants of the surrounding environs. To calculate risk to great blue herons inhabiting the site, the hazard quotient method (Barnthouse and Suter, 1986; USEPA, 1989) was used to compare the PCB exposure concentration (ingestion of forage, sediment, and water) to toxicologic endpoints (reproduction, growth effects, etc.). Hazard quotients are expressed as ratios of potential dietary intake to documented Lowest Observed Adverse Effects Levels (LOAELs).

$$\text{Hazard Quotient} = \frac{\text{Total Daily Intake}}{\text{LOAEL}}$$

A hazard quotient greater than 1 indicates that the exposure to PCBs could cause deleterious effects to the exposed population. A hazard quotient less than 1 indicates that the potential for risk is low.

Methods

Recent site monitoring data have shown that ingestion of fish, sediment, and water are complete exposure pathways for the great blue heron. Data from 1992 fish sampling, 1988/1989 and 1992 sediment sampling and 1988/1989 surface water sampling events were used to estimate great blue heron daily ingestion of PCBs attributable to the respective media. Daily intake of PCBs via each applicable pathway was calculated using the following equations:

DI_{forage} = PCB concentration in forage x % of diet x AUF x IR x 1/BW

$DI_{sediment}$ = PCB concentration in sediment x AUF x IR x 1/BW

DI_{water} = PCB concentration in surface water x AUF x IR x 1/BW

Total DI = $DI_{forage} + DI_{sediment} + DI_{water}$

DI = Daily Intake
AUF = Area Use Factor
IR = Ingestion Rate
BW = Body Weight

Summarized below are ingestion rates, body weight, diet, and home range of the great blue heron. This information was obtained from published literature.

		Reference
Body Weight:	3.0 Kg	Newell et al., 1987
Dietary Ingestion Rate:	0.6 Kg/day	Newell et al., 1987
Home Range:	30,000 ha	Erwin and Spendelow, 1991
Soil Ingestion Rate:	54 g/day[1]	Beyer et al., 1991
Water Ingestion Rate:	0.12 L/day	Calder and Braun, 1983
Diet:	Fish, invertebrates, small mammals	Ehrlich et al., 1988

1 Estimated soil/sediment ingestion rate (9% of dietary ingestion rate) using shore bird and Canada goose data, soil/sediment ingestion rates for great blue heron are not available.

An area use factor is calculated to estimate the proportion of time the great blue heron would use the site relative to its home range. It is defined as 1 if the study area is greater than the home range of a species. If the area is less than the home range, a ratio of study area size to home range size is used. For purposes of this analysis, the great blue heron is assumed to feed exclusively at the site (AUF = 1). However, published literature estimates its feeding area to be 30,000 ha (74,130 acres)(Erwin and Spendelow, 1991).

In addition, the great blue heron's diet consists primarily of fish and to a lesser extent, aquatic invertebrates and small mammals (Ehrlich et al., 1988). As a conservative measure, this analysis assumes the great blue heron feeds exclusively on fish.

A literature search was conducted to find dietary doses of PCBs reported to cause chronic toxic effects to great blue herons. Since PCB toxicity information for the great blue heron is lacking, a "best-fit" surrogate species, the screech owl (*Otus asio*), was selected from the available data. The selection of the screech owl to be representative of the great blue heron is consistent with a similar study conducted by Oak Ridge National Laboratory (MacIntosh et al., 1992). The proposed total PCB dietary ingestion criterion for the protection of birds (Eisler, 1986) was selected for use in the calculation. This criterion is based on the results of an experiment in which screech owls, fed 3 ppm of Aroclor 1248 for two breeding seasons, experienced no reproductive effects (McLane and Hughes, 1980 in Eisler, 1986). The dietary dose was converted to a body weight basis (0.6 mg/kg/day) by assuming the great blue heron consumes 20% of its body weight per day (Dose mg/kg x Ingestion Rate x 1/BW). Generally, a hazard quotient is calculated using the LOAEL. However, for purposes of this analysis, the No Observed Effect Level (NOEL) was used. The NOEL presents a more conservative estimate of potential risk than the LOAEL.

Hazard quotients for two exposure scenarios were calculated. Scenario 1 was calculated using arithmetic mean PCB levels in fish, sediment, and surface water collected on-site. As a conservative measure, analytical results below the detection limit were not included in the mean calculations. Scenario 2, a more conservative estimate, was calculated using mean PCB levels plus one standard deviation for fish and sediment (Note: PCBs were only detected in one of six surface water samples; therefore, the standard deviation could not be calculated for surface water). In addition, the PCB fish flesh concentration that would represent a hazard to great blue heron was back-calculated by setting the hazard quotient equal to one for each scenario.

Results and Discussion

The calculations for the hazard quotients are presented in Attachment 1. The results of each scenario follow.

Scenario 1: Mean PCB concentrations in fish, sediment, and water

Hazard Quotient = 0.275

If the hazard quotient = 1, mean PCB concentration in fish must be > 2.60

Scenario 2: Mean + SD PCB concentrations in fish and sediment, mean concentration in water (SD not available)

Hazard Quotient = 0.55

If the hazard quotient = 1, mean PCB concentration in fish must be > 2.57

The maximum PCB concentration detected in fish samples was 2.4 mg/kg of Aroclor 1248. According to the hazard quotient method, neither scenario indicates that the exposure to PCBs could cause deleterious effects to the great blue heron at Ley Creek. A hazard quotient less than 1 indicates that the potential for risk is low.

LITERATURE CITED

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ATTACHMENT 1

HAZARD QUOTIENT CALCULATIONS

Scenario I: Mean concentrations of PCB in forage, sediment, and water.

$DI_{(forage)}$ = 0.623 mg/kg x 1 x 1 x 0.6 kg/day x ⅓ kg
= 0.125 mg/kg/day

$DI_{(sediment)}$ = 2.21 mg/kg x 1 x 0.054 kg/day x ⅓ kg
= 3.98×10^{-2} mg/kg/day

$DI_{(water)}$ = 0.0014 mg/L x 1 x 0.12 L/day x ⅓ kg
= 5.6×10^{-5} mg/L/day

DI_{total} = $0.125 + 3.98 \times 10^{-2} + 5.6 \times 10^{-5}$
= 0.165 mg/kg/day

Hazard Quotient = $\frac{0.165 \text{ mg/kg/day}}{0.6 \text{ mg/kg/day}}$

HQ = 0.275

****

If HQ = 1, what concentration of PCBs would be detected in fish?
(Assume mean PCB concentrations in sediment and water remain constant)

C = PCB fish concentration

$$1 = \frac{(C \text{ mg/kg} \times 1 \times 1 \times 0.6 \text{ kg/day} \times ⅓ \text{ kg}) + (2.21 \text{ mg/kg} \times 1 \times 0.054 \text{ kg/day} \times ⅓\text{kg}) + (0.0014 \text{ mg/L} \times 1 \times 0.12 \text{ L/day} \times ⅓\text{kg})}{0.6 \text{ mg/kg/day}}$$

$0.6 = (C \times 1 \times 1 \times 0.6 \times ⅓) + 7.966 \times 10^{-2}$

C = 2.60 mg/kg

Scenario II: Mean plus standard deviation (SD) PCB concentrations in forage and sediment (SD not available for water)

$DI_{(forage)}$ = 1.213 mg/kg x 1 x 1 x 0.6 kg/day x ⅓kg
= 0.243 mg/kg/day

$DI_{(sediment)}$ = 4.80 mg/kg x 0.054 kg/day x ⅓kg
= 8.64×10^{-2} mg/kg/day

$DI_{(water)}$ = 0.0014 mg/L x 1 x 0.12 L/day x ⅓kg
= 5.6×10^{-5} mg/L/day

DI_{total} = $0.243 + 8.64 \times 10^{-2} + 5.6 \times 10^{-5}$
= 0.329 mg/kg/day

Hazard Quotient = $\frac{0.329 \text{ mg/kg/day}}{0.6 \text{ mg/kg/day}}$

HQ = .55

****

If HQ = 1, what concentration of PCBs would be detected in fish?
(Assume PCB concentrations in sediment and water remain constant)

C = PCB fish concentration

$$1 = \frac{(C \text{ mg/kg} \times 1 \times 1 \times 0.6 \text{ kg/day} \times ⅓ \text{ kg}) + (4.80 \text{ mg/kg} \times 1 \times 0.054 \text{ kg/day} \times ⅓\text{kg}) + (0.0014 \text{ mg/L} \times 1 \times 0.12 \text{ L/day} \times ⅓\text{kg})}{0.6 \text{ mg/kg/day}}$$

$$0.6 = (C \times 1 \times 1 \times 0.6 \times ⅓) + 8.646 \times 10^{-2}$$

C = 2.57 mg/kg

INPUT CALCULATION VALUES

	PCB CONCENTRATIONS		
	Water (Aroclor 1248)	Sediment (Aroclor 1248)	Forage (Aroclors 1248 & 1260)
Mean	1.4ppb	2.21 mg/kg dry wt.	.623 mg/kg wet wt.
Mean plus Standard Deviation	---	4.80	1.213
Number of Detections	1	9	19
Standard Error	---	2.7466	.5898

Average Body Weight (BW) = 3.0 kg
Dietary Ingestion Rate = 0.6 kg/day
Territory Size = 30,000 ha = 74130 acres
Study Area Size = 5200 feet x 15 feet = 78,000 square feet = 1.79 acres
Area Use Factor = 1.79/74130 = 2.415×10^{-5}
Soil Ingestion Rate = 54 g/day = .0554 kg/day
Water Ingestion Rate = 0.12 L/day
Diet = 85% fish almost all aquatic

****

.45 mg/kg/day = NOAEL Aroclor 1248 (McLane & Hughes 1980 in Eisler, 1986.) (3ppm) converted assuming that the owls consumed 15% of their BW/day.

.60 mg/kg/day = NOAEL (3ppm) converted assuming Great Blue Heron (GBH) consumes 20% of BW/day or dose (mg/kg) x Ingestion Rate (kg/day) x 1/BW kg

4.1 ppm LOEL criterion for PCBs in GBH eggs
=.82 mg/kg/day

APPENDIX E

LOW TEMPERATURE THERMAL DESORPTION COST ESTIMATE DOCUMENTATION

APPENDIX E

O'Brien & Gere Engineers, Inc. completed a database search to identify a thermal desorption unit treatment cost for Alternatives 5A and 5B. The following range of unit costs was obtained from the Vendor Information System for Innovative Treatment Technologies (VISITT) database:

Vendor	Unit Cost Range
Remedial Technologies, Inc.	\$100 - \$600/ton
Seaview Thermal Systems	\$50 - \$400/ton
HRUBETZ Environmental Services	\$20 - \$100/ton
Southwest Soil Remediation	\$40 - \$250/ton
O'Brien & Gere Technical Services, Inc.	\$50 - \$100/ton
Clean Berkshires, Inc.	\$40 - \$300/ton
Ariel Industries, Inc.	\$65 - \$200/ton
Separation & Recovery Systems, Inc.	\$50 - \$150/ton
Soiltech ATP Systems, Inc.	\$120 - \$400/ton
ECOVA Corp.	\$200 - \$500/ton
Westinghouse	\$150 - \$300/ton

The approximate average unit cost range based on the above-listed information is \$80 - \$300 per ton. Assuming 1.3 tons per cubic yard soil, the approximate average unit cost range would be \$100 -\$390 per cubic yard. Direct communications with three vendors (Westinghouse, Clean Berkshires, Inc., and O'Brien & Gere Technical , Inc.) indicated that a unit treatment cost in the vicinity of \$200 per cubic yard would be an appropriate estimate for site-specific conditions.

Exhibits

O'BRIEN & GERE ENGINEERS, INC.

EXHIBIT A

TOPOGRAPHIC AND PROPERTY BOUNDARY SURVEY (UNDER SEPARATE COVER)

EXHIBIT B

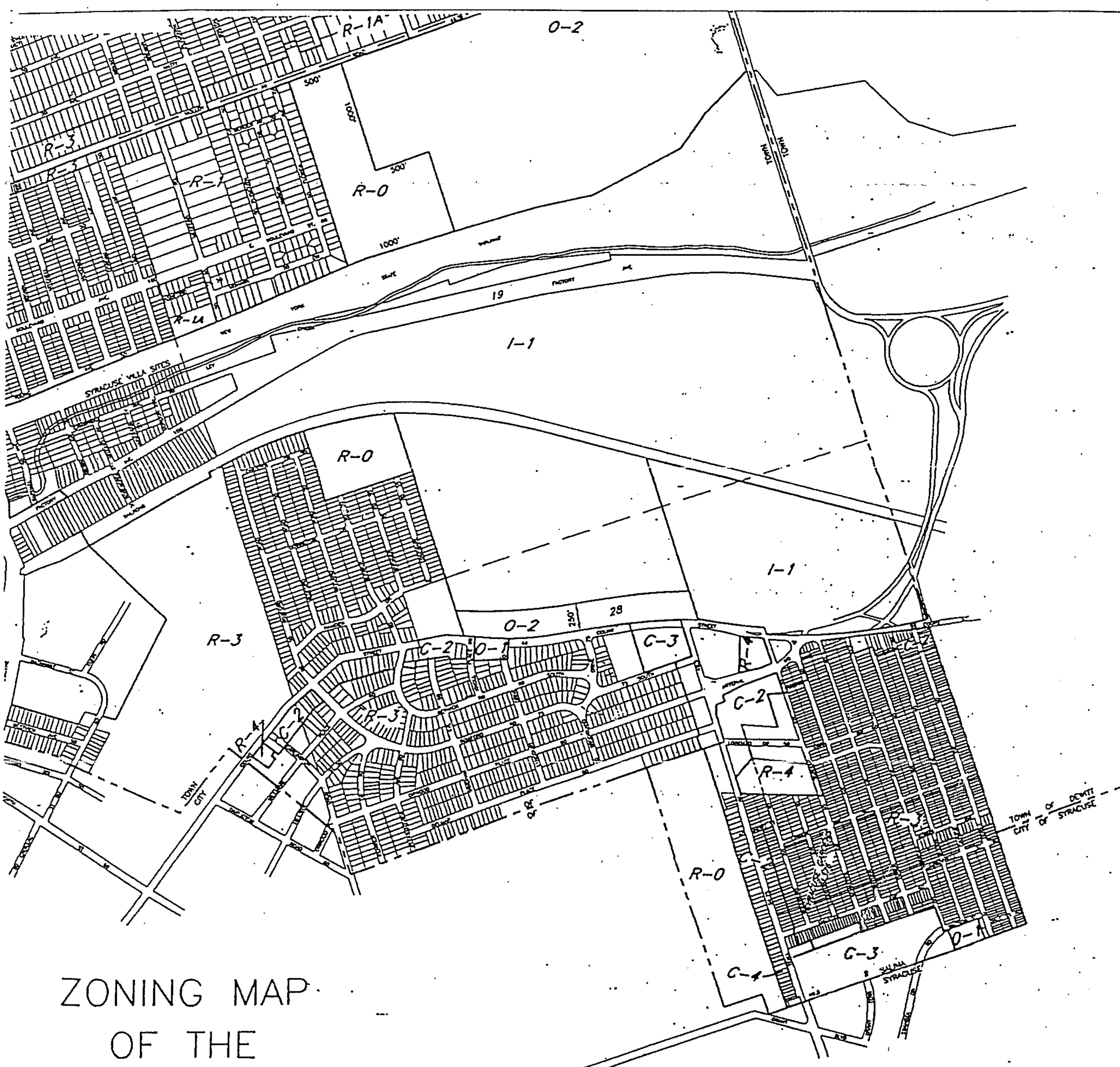
ZONING MAP OF THE TOWN OF SALINA

I, the undersigned Clerk of the Town of Salina, do hereby certify the above entitled Zoning Map of the Town of Salina is a part of the "Zoning Ordinance of the Town of Salina" as amended by the amendment duly enacted on July 7, 1969 and amended October 5, 1994, and that said Zoning Ordinance was duly published and posted as required by law and that said Zoning Map being a part thereof was duly posted and that the same are all in force and effect as of the date hereof.

Date October 5, 1994 By Colleen A. [signature]

UPDATE TO OCTOBER 5, 1994

DISTRICT	USE
R-1	ONE FAMILY RESIDENTIAL DISTRICT
R-1A	ONE FAMILY RESIDENTIAL DISTRICT
R-2	ONE & TWO FAMILY RESIDENTIAL DISTRICT
R-3	ONE & TWO FAMILY RESIDENTIAL DISTRICT
R-4	MULTIPLE - RESIDENCE DISTRICT
R-5	HIGH DENSITY RESIDENTIAL DISTRICT
R-O	OPEN LAND DISTRICT
R-T	PLANNED MOBILE HOME PARK DISTRICT
C-1	NEIGHBORHOOD COMMERCIAL DISTRICT
C-2	HIGHWAY COMMERCIAL DISTRICT
C-3	PLANNED COMMERCIAL DISTRICT
O-1	PROFESSIONAL OFFICE DISTRICT
O-2	OFFICE & LIGHT INDUSTRIAL PARK DISTRICT
I-1	INDUSTRIAL DISTRICT



ZONING MAP OF THE TOWN OF SALINA

PART OF

ZONING ORDINANCE OF THE TOWN OF SALINA

AS AMENDED OCTOBER 5, 1994

ONONDAGA COUNTY, NEW YORK

500 0 500 1000 1500

CLOUGH, HARBOUR & ASSOCIATES

ENGINEERS, SURVEYORS & PLANNERS

117 METROPOLITAN PARK DR. LIVERPOOL, NY 13088

EXHIBIT C

FLOOD BOUNDARY AND FLOODWAY MAP

KEY TO MAP

500-Year Flood Boundary

100-Year Flood Boundary

FLOODWAY FRINGE — FLOODWAY

100-Year Flood Boundary

500-Year Flood Boundary

Approximate 100-Year Flood Boundary

Cross Section Line (A)—(A)

Elevation Reference Mark RM7 x

River Mile • M1.5

NOTES TO USER

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

This map was prepared to facilitate flood plain management activities only; it may not show all special flood hazard areas in the community or all planimetric features outside of the flood plain. Refer to the latest official Flood Insurance Rate Map for any additional areas of special flood hazard.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1/20 inch.

For adjoining map panels, see separately printed Index to Map Panels.

NATIONAL FLOOD INSURANCE PROGRAM

FLOODWAY

FLOOD BOUNDARY AND FLOODWAY MAP

TOWN OF
SALINA, NEW YORK
ONONDAGA COUNTY

PANEL 7 OF 8
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
360591 0007

EFFECTIVE DATE:
AUGUST 16, 1982

Federal Emergency Management Agency

EXHIBIT D

LEY CREEK INTERCEPTOR SEWER INSTALLATION DATA

LABORATORIES, INC.

Laboratory Report

CLIENT OBG TECHNICAL SERVICES, INC. JOB NO. 2488.084.517

DESCRIPTION GM, Inland Fisher Guide Division, Syracuse, NY

MATRIX: See Below

Analyzed 6-26-91 DATE COLLECTED 6-26-91 DATE RECEIVED 6-26-91

	Sample #	PCB	Aroclor	PERCENT TOTAL SOLIDS	TOTAL CHROMIUM
Soils (mg/kg dry weight):					
150'± from W. End @ 10'± Below Grade	M6978	15.	1242/1248	79.	-
150'± from W. End @ 13'± Below Grade	M6979	<0.7	-	82.	-
150'± from W. End @ 16'± Below Grade	M6980	<0.7	-	77.	-
Cell #3 Grid #A1	M6981	-	-	82.	48.
Cell #3 Grid #A2	M6982	-	-	82.	220.
Cell #3 Grid #A3	M6983	-	-	75.	83.
Cell #3 Grid #A4	M6984	-	-	84.	240.
Cell #3 Grid #A5	M6985	-	-	83.	75.
Cell #3 Grid #A6	M6986	-	-	84.	1200.
Water (µg/l):					
From Well @ E. End of Trench 150'± from W. End	M6987	5.9	1242/1248	-	-

Comments:

Certification No.: 10155

Units: See Above

Authorized: [signature]

Date: July 8, 1991

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

LABORATORIES, INC.

Laboratory Report

CLIENT: OBG TECHNICAL SERVICES, INC. JOB NO. 2488.084.517

DESCRIPTION: GM, Inland Fisher Guide Division, Syracuse, NY

MATRIX: See Below

Analyzed 6-28-91 DATE COLLECTED 6-28-91 DATE RECEIVED 6-28-91

	Sample #	PCB	Aroclor	PERCENT TOTAL SOLIDS
Soil (mg/kg dry weight):				
13' Below Grade-Confirmation Sample	M7253	<0.7	-	77.
Water (µg/l):				
Water from Well	M7254	150.	1242/1248	-
Wipe (Total µg):				
Wipe on East End Sheets	M7255	<1.	-	-

Comments:

Certification No.: 10155

Units: See Above

Authorized: [signature]

Date: July 8, 1991

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

DRAFT

TE: / /

Upstate Laboratories, Inc.
Analysis Results
Report Number:
Client I.D.: MEMPHIS CONSTRUCTION, INC.

APPROVAL:
QC:
Lab I.D.: 10170
Sampled by: Client

I.22191193 Mat:Water LEY CREEK 122.30 8/9/91 0810H G

PARAMETERS	RESULTS	DATE ANAL.	KEY
PCB			
Aroclor 1221		08/12/91	34
Aroclor 1016		08/12/91	34
Aroclor 1232		08/12/91	34
Aroclor 1242		08/12/91	34
Aroclor 1248		08/12/91	34
Aroclor 1254		08/12/91	34
Aroclor 1260		08/12/91	34
Total PCB	<0.1ug/l	08/12/91	

Results are on an as rec.d basis unless otherwise stated.

OBG LABORATORIES, INC.

Laboratory Report

CLIENT: OBG TECHNICAL SERVICES, INC. JOB NO. 2488.084.517

DESCRIPTION: GM Fisher Guide

MATRIX: Water

Date Analyzed 7-18-91 DATE COLLECTED 7-17-91 DATE RECEIVED 7-17-91

Description	Sample #	PCB	Aroclor		
#1 Influent from Memphis trench	M8255	10	1242/1248*		

Comments: *Altered Aroclor pattern

Certification No.: 10155

Units: µg/1

Authorized:

Date: July 18, 1991

LABORATORIES, INC.

Laboratory Report

CLIENT: OBG TECHNICAL SERVICES, INC.

DESCRIPTION: GM, Inland Fisher Guide Division, Syracuse, NY

JOB NO. 2488.084.517

MATRIX: Water

Date Analyzed 7-18-91 DATE COLLECTED 7-18-91 DATE RECEIVED 7-18-91

	Sample #	PCB	Aroclor		
Influent of #1 Tank from Memphis Dig	M8337	80.	1242/1248*		

Comments: *Altered Aroclor pattern.

Certification No.: 10155

Units: µg/l

Authorized: [signature]

LABORATORIES, INC.

Laboratory Report

CLIENT OBG TECHNICAL SERVICES, INC. JOB NO. 2488.084.517

DESCRIPTION GM, Inland Fisher Guide Division, Syracuse, NY

MATRIX: Water

Date Analyzed 7-19-91 DATE COLLECTED 7-19-91 DATE RECEIVED 7-19-91

	Sample #	PCB	Aroclor		
Influent of #1 Tank from Memphis Dig	M8361	6.8	1242/1248*		

Comments: *Altered Aroclor pattern.

Certification No.: 10155

Units: µg/l

Authorized: [signature]

OBG LABORATORIES, INC.

LEVEL OF REPORT: II

DATE SCHEDULED:

Laboratory Report

BIN #: —

CLIENT: OBG Technical Services PO# 7910 JOB NO. 2488.084.511

DESCRIPTION: GM Inland Fisher Guide

MATRIX: Water

Date analyzed: 7/22/91 DATE COLLECTED 7-22-91 DATE RECEIVED 7-22-91

Description:	Lab#:		PCB	Aroclor
Influent	018462		1.0	1242/1248*
Effluent	563		<.065	—

RUSH

**COPY. CHECK: TAA____ / AC____ / ARM____ / MNP____ / DRB____

Comments:

* Altered aroclor pattern.

Certification No.: 10155

Units: µg/l

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

Authorized: ____________________

Date: ____________________

OBG LABORATORIES, INC.

LEVEL OF REPORT: II

DATE SCHEDULED: ________

Laboratory Report

BIN #: ____

CLIENT: OBG Technical Services PO# 7910 JOB NO. 2488.084.517

DESCRIPTION: GM Inland Fisher Guide

MATRIX: Water

Date analyzed: 7/24/91 DATE COLLECTED: 7-24-91 DATE RECEIVED: 7-24-91

Sample No:	M8616				
Description:	Influent Memphis Const Bldg				
PCB	0.67				
Aroclor	1242/1248*				

RUSH!

**COPY CHECK: TAA____ / AC____ / ARM____ / MNP____ / DRB____

Comments:

* Altered aroclor pattern

Certification No.: 10155

Units: µg/L

Authorized: ________________

Date: ________________

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

SECTION LEADER: AC
LEVEL OF REPORT: II
DATE SCHEDULED: ____

OBG LABORATORIES, INC.

Laboratory Report

BIN #: ____

CLIENT: OBG Technical Services PO 7970 JOB NO. 24881.084.517
DESCRIPTION: GM Inland Fisher Guide
MATRIX: Water
Date analyzed: 7/25/91 DATE COLLECTED 7-25-91 DATE RECEIVED 7-25-91

Description:	Lab#:		PCB	Aroclor
Effluent from Memphis dig	M8657		0.43	1242/1248*
Effluent from process	M8658		<0.065	—

RUSH.

**COPY. CHECK: TAA ___ / AC ___ / ARM ___ / MNP ___ / DRB ___

Comments:
* Altered aroclor pattern.

Certification No.: 10155
Units: µg/L

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
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Authorized: ____
Date: ____

LABORATORIES, INC.

SECTION LEADER: AC
LEVEL OF REPORT: I
DATE SCHEDULED: ______

Laboratory Report

BIN #: —

CLIENT: OBG Technical Services Inc JOB NO. 2488.084.517

DESCRIPTION: GM Fisher Guide

MATRIX: Water

Date analyzed: 7/26/91 DATE COLLECTED 7-26-91 DATE RECEIVED 7-26-91

Description	Sample #		PCB'S	Aroclor	
Influent Sample Tank #1 from Memphis trench on Factory Ave	M8780		0.18	1242/1248*	
Effluent of Memphis dig thru BDV Process	M8781		<0.065	–	

COPY CHECK: TAA____/ARM____/AC X /MNP____/DRB____

Comments:

* Altered aroclor pattern.

Certification No.: 10155

Units: µg/L

Authorized: ______

Date: ______

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OBG LABORATORIES, INC.

LEVEL OF REPORT: II

DATE SCHEDULED:

RUSH

Laboratory Report

BIN #:

CLIENT: OBG Technical Services JOB NO. 2488 084517

DESCRIPTION: GM Fisher Guide

MATRIX: Water

Date analyzed: 7/29/91 DATE COLLECTED: 7/29/91 DATE RECEIVED: 7/29/91

Description	Sample #		PCB	Aroclor	
#3 Influent tank #1 from Memphis Dig Factory All	M8882		1.8	1242/1248*	
#1 Effluent of Memphis Dig for RDU Process	M8881		<0.065	–	

COPY CHECK: TAA___/ARM___/AC X /MNP___/DRB___

Comments:

* Altered aroclor pattern.

Certification No.: 10155

Units: μg/L

Authorized:

Date:

OBG Laboratories, Inc., an O'Brien & Gere Limited Company
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

OBG LABORATORIES, INC.

LEVEL OF REPORT: ___

DATE SCHEDULED: ___

Laboratory Report

BIN #: ___

CLIENT: OBG Technical Services JOB NO. 2488.084.517

DESCRIPTION: GM Unland Fisher Guide

MATRIX: Water

Date analyzed: 7/30/91 DATE COLLECTED 7-30-91 DATE RECEIVED 7-30-91

Description:	Lab#:		PCB	AROCLOR
~~Influent~~	M8921		0.64	1242/1248*
Effluent	↓ 22		<0.065	-

RUSH!

**COPY. CHECK: TAA___ / AC___ / ARM___ / MNP___ / DRB___

Comments:

* Altered aroclor pattern.

Certification No.: 10155

Units: µg/L

Authorized: ___

Date: ___

LABORATORIES, INC.

SECTION LEADER: [signature]
LEVEL OF REPORT: 1
DATE SCHEDULED: ______

Laboratory Report

BIN #: ______

CLIENT: OBG Technical Services JOB NO. 2488084517
DESCRIPTION: GM Fisher Guide
MATRIX: Water

Date analyzed: 7/31/91 DATE COLLECTED: 7/31/91 DATE RECEIVED: 7/31/91

Description	Sample#		PCBs	Arochlor	
Influent from Memphis Dig on Factory Ave	M9085		0.20	1242/1248*	
Effluent from Memphis [illegible]	M9086		<0.065	-	

COPY CHECK: TAA___/ARM___/AC X /MNP___/DRB___

Comments:

* Altered arochlor pattern.

Certification No.: 10155

Units: µg/l

Authorized: ______

Date: ______

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
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OBG LABORATORIES, INC.

SECTION LEADER: HC
LEVEL OF REPORT: I
DATE SCHEDULED: ____

Laboratory Report

BIN #: —

CLIENT: OBG Technical Services   JOB NO. 2488.084.517

DESCRIPTION: GM Fisher Guide

MATRIX: Water

Date analyzed: 8/1/91   DATE COLLECTED: 8/1/91   DATE RECEIVED: 8/1/91

Description	Sample #		PCB	Aroclor	
Influent from Memphis Dig Factory Ave	M9209		29.	1242/1248*	
Effluent from Memphis Dig after [illegible] System	M9210		<0.065	—	

COPY CHECK: TAA____/ARM____/AC ✓ /MNP____/DRB____

Comments:

* Altered aroclor pattern.

Certification No.: 10155

Units: μg/L

Authorized: ____

Date: ____

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LABORATORIES, INC.

LEVEL OF REPORT: 4

DATE SCHEDULED:

Laboratory Report

BIN #:

CLIENT OBG Technical Services - PO 1970 JOB NO. 2488.084.517

DESCRIPTION GM Fisher Guide

MATRIX: Water

Date analyzed: 8/2/91 DATE COLLECTED 8-2-91 DATE RECEIVED 8-2-91

Description:	Sample #:		PCB	AROCLOR
Influent	M9313		0.15	1242/1248*
Effluent	↓14		<0.065	–

**COPY. CHECK: TAA____ / AC____ / ARM____ / MNP____ / DRB____

Comments:

* Altered aroclor pattern.

Certification No.: 10155

Units: µg/L

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
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Authorized:

Date:

OBG LABORATORIES, INC.

LEVEL OF REPORT: 4

DATE SCHEDULED: ______

Laboratory Report

BIN #: ______

CLIENT OBG Technical Services PO# 7970 JOB NO. 2488.084.517

DESCRIPTION GM Fisher Guide

MATRIX: Water

Date analyzed: 8/6/91 DATE COLLECTED 8-6-91 DATE RECEIVED 8-6-91

Description:	Sample#	PCB	Arochlor
Influent	M9428	59.	1242+1260
Effluent	M9429	0.13	1260

RUSH!

**COPY CHECK: TAA____ / AC____ / ARM____ / MNP____ / DRB____

Comments:

Certification No.: 10155

Units: µg/L

Authorized: ______

Date: ______

OBG Laboratories, Inc., an O'Brien & Gere Limited Company
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OBG LABORATORIES, INC.

SECTION LEADER: AC
LEVEL OF REPORT: II
DATE SCHEDULED: ____

Laboratory Report

BIN #: ____

CLIENT OBG Technical Services PO-7970 JOB NO. 2488.084.517

DESCRIPTION GM Fisher Guide

MATRIX: Water

Date analyzed: 8/7/91 DATE COLLECTED 8-7-91 DATE RECEIVED 8-7-91

Description:	Sample #		PCB	AROCLOR
Influent	M4509		1.1	1242* + 1260
Effluent	510		<0.065	-

RW 8/7

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments:

* Altered aroclor pattern.

Certification No.: 10155

Units: µg/L

Authorized: ____

Date: ____

SECTION LEADER:

LEVEL OF REPORT: II

DATE SCHEDULED:

OBG LABORATORIES, INC.

Laboratory Report

BIN #: —

CLIENT OBG Technical Services PO# 7978 JOB NO. 2488.084.517

DESCRIPTION GM Fisher Guide

MATRIX: Water

Date analyzed: 8/8/91 DATE COLLECTED 8-8-91 DATE RECEIVED 8-8-91

Description:	Sample #:		PCB	AROCLOR
Influent	M9722		0.29	1242+1260*
Effluent	↓ 23	—	<0.065	—

RUSH!

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments:

* Altered aroclor pattern.

Certification No.: 10155

Units: µg/L

Authorized:

Date:

OBG LABORATORIES, INC.

SECTION LEADER: TC
LEVEL OF REPORT: II
DATE SCHEDULED:

Laboratory Report

BIN #: 80

CLIENT: OBG Technical Services PO-7970 JOB NO. 2488.084.517
DESCRIPTION: GM Fisher Guide
MATRIX: Water
Date analyzed: 8/9/91 DATE COLLECTED: 8-9-91 DATE RECEIVED: 8-9-91

Description:	Lab#:		PCB	AROCLOR
Influent	M9820		0.20	1260
Effluent	↓ 21		0.22	1242 + 1260*

RUSH

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments:
* altered aroclor pattern.

Certification No.: 10155
Units: μg/L

Authorized:
Date:

DATE: / /

DRAFT

Upstate Laboratories, Inc.
Analysis Results
Report Number:
Client I.D.: MEMPHIS CONSTRUCTION, INC.

APPROVAL:
QC:
Lab I.D.: 10170
Sampled by: Client

ID:22091119 Mat:Soil LEY CREEK 122+00 SOIL 8/8/91 0800H G

PARAMETERS	RESULTS	KEY
EPA 8080		
Aroclor 1016		34
Aroclor 1221		34
Aroclor 1232		34
Aroclor 1242		19
Aroclor 1248	87mg/kg	34
Aroclor 1254		34
Aroclor 1260		34
Total PCB	87mg/kg	19

All results are on an as rec.d basis unless otherwise stated.

DATE: / /

Upstate Laboratories, Inc.
Analysis Results
Report Number:
Client I.D.: MEMPHIS CONSTRUCTION, INC.

APPROVAL:
QC:
Lab I.D.: 10170
Sampled by: Client

ID:22191193 Mat:Water LEY CREEK 122.30 8/9/91 0810H G

PARAMETERS	RESULTS	KEY
PCB		
Aroclor 1221		
Aroclor 1016		34
Aroclor 1232		34
Aroclor 1242		34
Aroclor 1248		34
Aroclor 1254		34
Aroclor 1260		34
Total PCB	<0.1ug/l	34

All results are on an as rec.d basis unless otherwise stated.

SECTION LEADER: ____

LEVEL OF REPORT: II

DATE SCHEDULED: ____

OBG LABORATORIES, INC.

Laboratory Report

BIN #: ____

CLIENT: OBG Technical Services A#7970 JOB NO. 2488.084.517

DESCRIPTION: GM Fisher Guide

MATRIX: H_2O

Date analyzed: 8/12/91 DATE COLLECTED: 8-12-91 DATE RECEIVED: 8-12-91

Description:	Lab#:		PCB	AROCLOR
Influent	M9976		0.52	1242+1260*
Effluent	977		<0.065	-

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments:

* Altered aroclor pattern.

Certification No.: 10155

Units: µg/L

Authorized: ____

Date: ____

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DATE: / /

DRAFT

Upstate Laboratories, Inc.
Analysis Results
Report Number:
Client I.D.: MEMPHIS CONSTRUCTION, INC.

APPROVAL:
QC: [signature]
Lab I.D.: 10170
Sampled by: Client

ID:22491011 Mat:Water LEY CREEK 122+50 WATER 8/12/91 0955H G

PARAMETERS	RESULTS	KEY
PCB		
Aroclor 1221		
Aroclor 1016		34
Aroclor 1232		34
Aroclor 1242		34
Aroclor 1248		34
Aroclor 1254		34
Aroclor 1260		34
Total PCB	<0.1ug/1	34

All results are on an as rec.d basis unless otherwise stated.

OBG LABORATORIES, INC.

SECTION LEADER: RC
LEVEL OF REPORT: II
DATE SCHEDULED:

Laboratory Report

BIN #: —

CLIENT OBG Technical Services — 7970 JOB NO. 2488.084.517

DESCRIPTION GM Fisher Guide

MATRIX: H_2O

Date analyzed: 8/13/91 DATE COLLECTED 8-13-91 DATE RECEIVED 8-13-91

Description:	Lab:		PCB	Aroclor
Influent	N0079		0.12	1242/1248*
Effluent	↓ 80		<0.065	—

RUSH!

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments:

* Altered aroclor pattern.

Certification No.: 10155

Units: µg/L

Authorized:

Date:

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SECTION LEADER: AC.
LEVEL OF REPORT: II
DATE SCHEDULED: ____

OBG LABORATORIES, INC.

Laboratory Report

BIN #: ____

CLIENT OBG Technical Services PO-7910 JOB NO. 2488.084.517
DESCRIPTION GM Fisher Guide
MATRIX: Water
Date analyzed: 8/14/91 DATE COLLECTED 8-14-91 DATE RECEIVED 8-14-91

Description:	lab#:		PCB	Aroclor
Influent	N0157		6.6	1242/1248*
Effluent	↓ 58		<0.065	—

RUSH

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments:
* Altered aroclor pattern.

Certification No.: 10155
Units: µg/L

Authorized:
Date:

DATE: 08/20/91

DRAFT

Upstate Laboratories, Inc.
Analysis Results
Report Number:
Client I.D.: MEMPHIS CONSTRUCTION, INC.

APPROVAL:
QC: MF RD
Lab I.D.: 10170
Sampled by: Client

ID:22691043 Mat:Water LEY CREEK DECON SHOWER 8/13/91 1445H G

PARAMETERS	RESULTS	DATE ANAL.	KEY
Total Chromium			
PCB		/ /	
Aroclor 1221			
Aroclor 1016		08/16/91	34
Aroclor 1232		08/16/91	34
Aroclor 1242		08/16/91	34
Aroclor 1248		08/16/91	34
Aroclor 1254		08/16/91	34
Aroclor 1260		08/16/91	34
Total PCB		08/16/91	34
	<0.1ug/1	08/06/91	

ID:22691044 Mat:Water LEY CREEK 123+00 WATER 8/14/91 0945H G

PARAMETERS	RESULTS	DATE ANAL.	KEY
Total Chromium			
PCB		/ /	
Aroclor 1221			
Aroclor 1016		08/16/91	34
Aroclor 1232		08/16/91	34
Aroclor 1242		08/16/91	34
Aroclor 1248		08/16/91	34
Aroclor 1254		08/16/91	34
Aroclor 1260		08/16/91	34
Total PCB		08/16/91	34
	<0.1ug/1	08/16/91	

ID:22691045 Mat:Soil LEY CREEK 123+00 SOIL 8/14/91 0945H G

PARAMETERS	RESULTS	DATE ANAL.	KEY
Total Chromium			
PCB		/ /	
Aroclor 1221			
Aroclor 1016		08/15/91	34
Aroclor 1232		08/15/91	34
Aroclor 1242		08/15/91	34
Aroclor 1248		08/15/91	34
Aroclor 1254		08/15/91	34
		08/15/91	34

Results are on an as rec.d basis unless otherwise stated.

OBG LABORATORIES, INC.

SECTION LEADER: AC.
LEVEL OF REPORT: II
DATE SCHEDULED: ______

Laboratory Report

BIN #: ______

CLIENT OBG Technical Services (7910) JOB NO. 2488.084.517
DESCRIPTION GM Fisher Guide

MATRIX: H_2O

Date analyzed: 8/15/91 DATE COLLECTED 8-15-91 DATE RECEIVED 8-15-91

Description:	Sample No:		PCB	Aroclor
Influent	N0211		3.8	1242/1248*
Effluent	N0212		<0.065	—

RUSH!!

COPY CHECK: TAA___/ARM___/AC___/MNP___/DRB___

Comments:

* Altered aroclor pattern.

Certification No.: 10155

Units: µg/l

Authorized: ______________

DATE: 08/20/91

DRAFT

Upstate Laboratories, Inc.
Analysis Results
Report Number:
Client I.D.: MEMPHIS CONSTRUCTION, INC.

APPROVAL:
QC: MF PQD
Lab I.D.: 10170
Sampled by: Client

ID:22791028 Mat:Water LEY CREEK 126+62 2 MEMPHIS WATER 8/15/91 1235H G

PARAMETERS	RESULTS	KEY
Total Chromium		
PCB		
Aroclor 1221		34
Aroclor 1016		34
Aroclor 1232		34
Aroclor 1242	13ug/1	
Aroclor 1248		34
Aroclor 1254		34
Aroclor 1260		34
Total PCB	13ug/1	

All results are on an as rec.d basis unless otherwise stated.

SECTION LEADER: [illegible]
LEVEL OF REPORT: II
DATE SCHEDULED: ____

Laboratory Report

OBG LABORATORIES, INC.

BIN #: ____

CLIENT: OBG Technical Services (7970) JOB NO. 2488.084.517

DESCRIPTION: GM Fisher Guide

MATRIX: H2O

Date Analyzed: 8-16-91 DATE COLLECTED: 8-16-91 DATE RECEIVED: 8-16-91

Description:	LAB#:		PCB	Aroclor
Influent	N0242		0.48	1242/1248*
Effluent	N0243		<0.065	-

RUSH

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments:

* Altered aroclor pattern

Certification No.: 10155

Units: µg/L

Authorized: ____

Date: ____

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state Laboratories, Inc.
Analysis Results
Report Number:
Client I.D.: MEMPHIS CONSTRUCTION, INC.

APPROVAL:
QC:
Lab I.D.: 10170
Sampled by: Client

ID: 23991008 Mat: Water LEY CREEK TRENCH WATER 123+45 AT 19' 8/27/91 0745H G

PARAMETERS	RESULTS	DATE ANAL.	KEY
Total Chromium		/ /	
EPA 608			
Aroclor 1016		08/28/91	34
Aroclor 1221		08/28/91	34
Aroclor 1232		08/28/91	34
Aroclor 1242	2.9ug/l	08/28/91	
Aroclor 1248		08/28/91	34
Aroclor 1254		08/28/91	34
Aroclor 1260		08/28/91	34
Total PCB	2.9ug/l	08/28/91	

ID: 23991009 Mat: Soil LEY CREEK SOIL 124+00 AT 7' 8/27/91 0745H G

PARAMETERS	RESULTS	DATE ANAL.	KEY
Total Chromium		/ /	
EPA 8080			
Aroclor 1016		08/28/91	34
Aroclor 1221		08/28/91	34
Aroclor 1232		08/28/91	34
Aroclor 1242	1300mg/kg	08/28/91	19
Aroclor 1248		08/28/91	34
Aroclor 1254		08/28/91	34
Aroclor 1260		08/28/91	34
Total PCB	1300mg/kg	08/28/91	19

All results are on an as rec.d basis unless otherwise stated.

state Laboratories, Inc.
Analysis Results
Report Number:
lient I.D.: MEMPHIS CONSTRUCTION, INC.

APPROVAL:
QC:
Lab I.D.: 10170
Sampled by: Client

ID: 23991008 Mat: Water LEY CREEK TRENCH WATER 123+45 AT 19' 8/27/91 0745H G

PARAMETERS	RESULTS	DATE ANAL.	KEY
Total Chromium		/ /	
EPA 608			
Aroclor 1016		08/28/91	34
Aroclor 1221		08/28/91	34
Aroclor 1232		08/28/91	34
Aroclor 1242	2.9ug/l	08/28/91	
Aroclor 1248		08/28/91	34
Aroclor 1254		08/28/91	34
Aroclor 1260		08/28/91	34
Total PCB	2.9ug/l	08/28/91	

D: 23991009 Mat: Soil LEY CREEK SOIL 124+00 AT 7' 8/27/91 0745H G

PARAMETERS	RESULTS	DATE ANAL.	KEY
Total Chromium		/ /	
EPA 8080			
Aroclor 1016		08/28/91	34
Aroclor 1221		08/28/91	34
Aroclor 1232		08/28/91	34
Aroclor 1242	1300mg/kg	08/28/91	19
Aroclor 1248		08/28/91	34
Aroclor 1254		08/28/91	34
Aroclor 1260		08/28/91	34
Total PCB	1300mg/kg	08/28/91	19

l results are on an as rec.d basis unless otherwise stated.

OBG LABORATORIES, INC.

SECTION LEADER: [illegible]
LEVEL OF REPORT: II
DATE SCHEDULED: 9-6-91

Laboratory Report

BIN #: 49

CLIENT: OBG Technical Service JOB NO. 2488.084.577

DESCRIPTION: Gul Fisher Guide.

MATRIX: See below

Date Analyzed: 10-1-91 DATE COLLECTED 9-6-91 DATE RECEIVED 9-6-91

	Sample #	~~Held~~ PCB	Aroclor	PCTS	
Influent Water	N1447	83.	1248	—	
Memphis factory line 10' deep Soil	↓ 48	2.6	1242/1248	92	

COPY CHECK: TAA___/ARM___/AC___/MNP___/DRB___

Comments:

SAMPLES ON HOLD!

Certification No.: 10155

Units: For Soil mg/kg Dry Weight
For Water [illegible]

Authorized:

Date:

Soil Sample to be analyzed for normal turnaround.

DRAFT

DATE: 09/10/91

Upstate Laboratories, Inc.
Analysis Results
Report Number:
Client I.D.: MEMPHIS CONSTRUCTION, INC.

APPROVAL: ____
QC: ____
Lab I.D.: 10170
Sampled by: Client

ID:24991119 Mat:Soil LEY CREEK 127+10 @ 10' SOIL 9/6/91 1330H G

PARAMETERS	RESULTS	DATE ANAL.	KEY
Total Chromium		/ /	
EPA 8080			
Aroclor 1016		09/10/91	34
Aroclor 1221		09/10/91	34
Aroclor 1232		09/10/91	34
Aroclor 1242	18mg/kg	09/10/91	19
Aroclor 1248		09/10/91	34
Aroclor 1254		09/10/91	34
Aroclor 1260		09/10/91	34
Total PCB	18mg/kg	09/10/91	19

ID:24991120 Mat:Water LEY CREEK 127+10 @ 10' TRENCH WATER 9/6/91 1330H G

PARAMETERS	RESULTS	DATE ANAL.	KEY
EPA 608			
Aroclor 1016		09/10/91	34
Aroclor 1221		09/10/91	34
Aroclor 1232		09/10/91	34
Aroclor 1242	7.9ug/l	09/10/91	
Aroclor 1248		09/10/91	34
Aroclor 1254		09/10/91	34
Aroclor 1260		09/10/91	34
Total PCB	7.9ug/l	09/10/91	

ID:24991121 Mat:Water LEY CREEK 127+10 @ 10' TRENCH WATER 9/6/91 1330H G

PARAMETERS	RESULTS	DATE ANAL.	KEY
Total Chromium		/ /	

All results are on an as rec.d basis unless otherwise stated.

OBG LABORATORIES, INC.

SECTION LEADER: [illegible]
LEVEL OF REPORT: II
DATE SCHEDULED: 9-12-91

Laboratory Report

BIN #: 58

CLIENT: OBG Technical Service JOB NO. 2488.084.517

DESCRIPTION: Gue Fisher Guide.

MATRIX: See Below.

Date Analyzed: 9-20-91 DATE COLLECTED 9-12-91 DATE RECEIVED 9-12-91

	Sample #	PCB	PCB	Aroclor
Influent - water	N1923	490	—	1242 / 1248
Factory Ave. 12' Deep Soil	↓ 24	HOLD	HOLD	

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments:

Normal Turnaround!

Certification No.: 10155

Units: ug/L

Authorized:

Date:

OBG LABORATORIES, INC.

Laboratory Report

SECTION LEADER: a

LEVEL OF REPORT: 1

DATE SCHEDULED: 9-17-91

BIN #: 43

CLIENT: OBG Technical Service JOB NO. 2488.084.577

DESCRIPTION: GM Fisher Guide. Syracuse, NY. MATRIX: clay

Date Analyzed: 9-20-91 DATE COLLECTED 9-17-91 DATE RECEIVED 9-17-91

	Sample #	PCB	Aroclor	PCTS
Clay layer Factory Ave.	A21846	<0.T	-	77
* Dirt on Factory Ave.	87	25.	1242/1248	48
Influent - Factory Ave.	88	110.	1248	—

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB ✓

Comments:

* No Longer on HOLD - Please analyze - routine turnaround!

Certification No.: 10155

Units: Soil: mg/kg water: µg/L

Authorized:

Date:

OBG Laboratories, Inc. an O'Brien & Gere Limited Company
5000 Brittonfield Parkway / Suite 300, Box 4942, Syracuse, NY 13221 (315) 437-0200

LABORATORIES, INC.

SECTION LEADER: AC
LEVEL OF REPORT: II
DATE SCHEDULED: 9-24-91

Laboratory Report

BIN #: 113

CLIENT: OBG Technical Service JOB NO. 2488.084.577
DESCRIPTION: GM, Fisher Guide.
MATRIX: See below.
Date Analyzed - Water: 9-25-91 DATE COLLECTED 9-24-91 DATE RECEIVED 9-24-91
- Soil 9/30/91

	Sample #	PCB	AROCLOR	PCTS
Water - Ucomphees Trench	N2588	14	1242/1248	—
Dirt - "	89	<0.7	—	78
Clay - "	90	<0.7	—	75

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB ✓

Comments:

Normal Turnaround!

Certification No.: 10155

Units: water µg/L
Soil mg/kg Dry weight

OBG Laboratories, Inc., an O'Brien & Gere Limited Company
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

Authorized:

Date:

SECTION LEADER: AC

LEVEL OF REPORT: II

DATE SCHEDULED: 9-25-91

OBG LABORATORIES, INC.

Laboratory Report

BIN #: 46

CLIENT: OBG Technical Service JOB NO. 2488.084.577

DESCRIPTION: GM Fisher Guide.

MATRIX: Water

Date Analyzed: 10-2-91 DATE COLLECTED 9-25-91 DATE RECEIVED 9-25-91

	Sample #	PCB	Aroclor		
Influent-Memphis on Factory Ave	N3832	8.7	1248		

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments:

Certification No.: 10155

Units: µg/L

Authorized:

Date:

OBG LABORATORIES, INC.

SECTION LEADER: AC
LEVEL OF REPORT: II
DATE SCHEDULED: 9-27

Laboratory Report

BIN #: 44

CLIENT OBG Technical Services PO# 7970 JOB NO. 2488.084.517

DESCRIPTION GM Fisher Guide

MATRIX: Below

Date Analyzed Water 10-1-91 DATE COLLECTED 9-26-91 DATE RECEIVED 9-26-91

Soil: 10-6-91

Description:	Matrix:	Sample #:	PCTS	PCB	Aroclor
130+40, 12'deep, Sample from Memphis	Clay	N2930	76.	<0.7	—
130+46 8'deep, split sample	Soil	31	42.	<1.5	—
130+21 19'deep, Split Water	Water	32	—	1.7	1242/1248

COPY CHECK: TAA___/ARM___/AC___/MNP___/DRB ✓

Comments:

Normal Turnaround.

Certification No.: 10155

Units: mg/kg Dry Weight
Water: ug/L

Authorized:

Date:

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

OBG LABORATORIES, INC.

SECTION LEADER: AC
LEVEL OF REPORT: II
DATE SCHEDULED: 10-3-91

Laboratory Report

BIN #: 80

CLIENT OBG Technical Service JOB NO. 2488.084.517

DESCRIPTION GM Fisher Guide

MATRIX: Water.

Date Analyzed: 10-4-91 DATE COLLECTED 10-3-91 DATE RECEIVED 10-3-91

	Sample #	PCB.	Aroclor		
* Effluent OBG Tech Pass Thru RDV	N4496	<0.065	—		
Influent.	97	11.	1242/1248		

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments:

Certification No.: 10155

Units: ug/L

*RUSH! others is normal Turnaround!

Date:

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

OBG LABORATORIES, INC.

SECTION LEADER: AC
LEVEL OF REPORT: II
DATE SCHEDULED: ________

Laboratory Report

BIN #: 94

CLIENT OBG Technical Services PO# 7970 JOB NO. 2488.084.517
DESCRIPTION GM Fisher Guide
MATRIX: Water
Date Analyzed: 10-7-91 DATE COLLECTED 10-7-91 DATE RECEIVED 10-7-91

Description:	Sample no:		PCB	Aroclor	
Effluent (from Tech)	N4790	RUSH!	0.15	1242	
Influent (from Tech)	↓ 91	NORMAL	1.0	1242/1248	

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments:

Certification No.: 10155

Units: ug/L

Authorized: ____________

Date: ____________

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

LABORATORIES, INC.

SECTION LEADER: AC
LEVEL OF REPORT: II
DATE SCHEDULED: 10-9-91

Laboratory Report

BIN #: 57

CLIENT: OBG Technical Service JOB NO. 2488.084.517

DESCRIPTION: GM Fisher Guide.

MATRIX: Water.

Date analyzed: 10/10/91 DATE COLLECTED 10-9-91 DATE RECEIVED 10-9-91

	Sample #	PCB			
* Effluent	N4989	<0.065			
* " MS	N4989-S				
* " MSD	N4989-MSD				
Influent.	N4990	12.			

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Certification No.: 10155

Units: µg/L

Comments:

* Rush! other is normal Turnaround!

Authorized:

Date:

OBG LABORATORIES, INC.

SECTION LEADER: AC
LEVEL OF REPORT: II
DATE SCHEDULED: 10-11-91

Laboratory Report

BIN #: 4

CLIENT: OBG Technical Service. JOB NO. 2488.084.517.

DESCRIPTION: GM Fisher Guide.

MATRIX: Water.

Date Analyzed: ~~10-11-91~~ see below DATE COLLECTED 10-11-91 DATE RECEIVED 10-11-91

	Date analyzed:	Sample #	PCB	Aroclor		
*Effluent	10-11-91	N5025	<0.065	—		
Influent	11-07-91	↓ 96	6.3	1242**		

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments: ** Altered aroclor pattern. Certification No.: 10155

* Rush! other normal Turnaround!

μg/L

Authorized:

Date:

OBG LABORATORIES, INC.

SECTION LEADER: AC
LEVEL OF REPORT: II
DATE SCHEDULED: ______

Laboratory Report

BIN #: 11

CLIENT OBG Technical Services PO 7970 JOB NO. 2488.084.517

DESCRIPTION GM Fisher Guide

MATRIX: Water

Date Analyzed: 10-24-91 DATE COLLECTED 10-24-91 DATE RECEIVED 10-24-91

Description:	Sample no:		PCB	Aroclor	
Influent - NORMAL	N6072		0.12	1242	
Effluent - RUSH!	" 73		<0.065	—	

COPY CHECK: TAA____/ARM____/AC____/MNP____/DRB____

Comments:

Certification No.: 10155

Units: µg/L

Authorized: ______________

Date: ______________

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

EXHIBIT E

NYSDEC COMMENTS - HAZARD QUOTIENT EVALUATION

Post-It™ brand fax transmittal memo 7671	# of pages ▸ 2
To MAUREEN SALAMYER	From Steve Scharf
Co. O'BRIEN & GERE	Co. NYSDEC
Dept.	Phone # (518) 457-4343
Fax (315) 463-7554	Fax #

M E M O R A

TO: Steve Scharf

FROM: Jack Cooper

DATE: August 16, 1994

RE: Ley Creek Fish and Wildlife Impact Analysis September 1993

I recall providing some comments on this before. They may have been verbal. Below are some specific comments on the FWIA included in the September 1993 version of the Remedial Investigation for Ley Creek Dredged Material Area.

I feel the FWIA does an acceptable job in characterizing the fish and wildlife habitat and species which may utilize the area. I do disagree with some of their conclusions about the overall value of the habitat to the receptor species. The consultant essentially dismisses the area as an urbanized area which has minimal value for fish and wildlife. They especially down play the habitat value of the creek environment. I disagree, this area is an island of wildlife habitat in an otherwise area of high human influence. The available habitat becomes that much more important. It also sets up the situation that resident wildlife are concentrated within the area, spending the majority of their feeding activity here.

Species especially at risk are the upper level predators that feed upon fish, amphibians and invertebrates. All of these prey species have been demonstrated to bioaccumulate PCBs to harmful levels. The site studies have documented significant PCB accumulation in fish and crayfish to levels of 5 PPM and above. Species at risk would include, in addition to the great blue heron, raccoon, mink, hawks, wading birds, waterfowl among others.

While the great blue heron may be a major user of the stream habitat, I don't believe that it could be considered as a representative species in its response to contaminant problems. In addition there are a number of factors that reduce the validity of the hazard quotient modeling exercise conducted by the consultant:

* Toxicity data used to develop NOEL/LOEL was from a different species, the screech owl. This species may or may not respond similarly to the heron. I could not determine if any <u>uncertainty or application factor</u> was used to convert the data. Newell et. al. suggests an application factor of 0.1 when using interspecies toxicity data.

* Contaminant burden data of food organisms used only the fish tissue levels of 2.4 PPM. Past studies have shown crayfish with PCBs at about 5 PPM, crayfish are also an important prey of heron.

* While the consultants calculations represent PCB concentrations in prey of up to 2.5 PPM as not presenting a risk, Newell et. al. developed a fish flesh criteria for the protection of wildlife of 0.1 PPM.

CONCLUSION

- Studies have documented PCB concentrations in sediment of Ley Creek that exceed sediment screening values.

- There has been "hits" of PCB in the water of Ley Creek.

- Dredge spoil adjacent to the creek has high levels of PCBs.

- The Ley Creek stream corridor is valuable fish and wildlife habitat used by many different species.

- Contamination pathways are complete for many of these fish and wildlife species.

- Fish and amphibians from Ley Creek have body burdens of PCBs up to 5 PPM greatly exceeding the fish flesh criteria recommended by Newell et. al..

- Ley Creek is in the Onondaga Lake drainage and is likely contributing to loading of the lake.

- While it is likely that PCBs are bioaccumulating through the food chain along the Ley Creek corridor and potentially impacting resident wildlife, it is likely not having a significant impact of the regional wildlife population.

REFERENCES

Newell, A.,D.W. Johnson, and L. Allen. 1987. Niagara River Biota Contamination Project: Fish Flesh Criteria for Piscivorous Wildlife. New York Department of Environmental Conservation, Technical Report 87-3, Albany.

USEPA, 1993. Wildlife Exposure Factors Handbook, Volume 1 of 2 and Volume 2 of 2. U.S. Environmental Protection Agency, Office of Health and Environmental Assessment, Office of Research and Development, Washington, DC EPA/600/R-93/187a

Biologist 3 (Ecology)
Ecotoxicology Section

EXHIBIT F

BIODEGRADATION PILOT STUDY PROGRESS REPORT

PROGRESS REPORT

PILOT STUDY FOR THE BIODEGRADATION OF PCB CONTAMINATED SOIL AT THE IFG SYRACUSE PLANT SITE

LEY CREEK DREDGED MATERIAL AREA

NAO SYRACUSE PLANT
GENERAL MOTORS CORPORATION
SYRACUSE, NEW YORK

MAY, 1994

BACKGROUND

Contaminated soil dredgings in an embankment along a reach of Ley Creek, in proximity to the General Motors NAO plant site in Syracuse, New York, contain low levels of polychlorinated biphenyls (PCBs). As part of a study for the development of innovative and cost-effective PCB remediation methods, a work plan for a bioreactor study using site soil, groundwater, and microorganisms was submitted to the New York State Department of Environmental Conservation and was approved in April, 1993. The work plan was implemented in June, 1993 and a comprehensive progress report was submitted in December, 1993 detailing the study for the June to October, 1993 period.

Results from the June to October period indicated that the microbial activities in the reactors, as determined by monitoring microbial population count and respiration gases, have decreased significantly after three months of incubation. GC analysis of the PCBs in the reactors showed over 90% of the dichlorobiphenyls which made up of 2% of Aroclor 1248 and 13% of Aroclor 1242 was degraded in the unsaturated reactors. In addition, three trichlorobiphenyl congeners were partially degraded. No evidence of degradation was observed in the saturated reactors. Biodegradation was not enhanced in the two reactors enriched with culture. The microbial population in these reactors dropped to the levels similar to the unenriched reactors after only 72 hours of incubation. This indicates failure of the reactor environment to sustain the culture.

BIOREACTOR MONITORING RESULTS: NOVEMBER TO MAY, 1994

No further improvement of biological activities was observed during the next month of incubation. The reactors were opened and flushed with fresh groundwater allowing the groundwater originally in the reactors and any dissolved organic products to drain and be replaced by fresh groundwater. Nutrients were again added to reactors 2 and 4 and the reactors remained open to the atmosphere. Soil samples were obtained from the reactors two months later and analyzed for PCBs and microbial count. Results showed no further degradation of the PCBs and low total microbial count (10^3 CFU/mL) as well as low count of biphenyl-degraders (10^2). Meanwhile, laboratory studies have demonstrated a significant enhancement of PCB biodegradation by the addition of co-substrates.

Enhancement of PCB biodegradation with co-substrates (lab. studies)

Aroclors 1242 and 1248 generally consist of mainly PCB congeners with three or four chlorines and are poor sources of energy to support the growth of PCB-degrading bacterial strains. Laboratory studies were conducted to evaluate co-substrates that will provide the energy to sustain the microbes as well as induce the PCB-degrading enzymes. Results showed significant enhancement of PCB biodegradation by using co-substrates. Certain PCB congeners were degraded 100% after short periods of incubation. Figure 1 shows that over 90% of dichloro and trichlorobiphenyl congners from Aroclor 1242 were degraded by the site microbes in the presence of co-substrates after 15 days of incubation.

Addition of co-substrates to bioreactors

Co-substrates used in the laboratory studies were added to two of the reactors in March of 1994. Enriched culture of biphenyl-degraders grown in the laboratory and suspended in nutrient medium was initially mixed with the co-substrates in 4-L of groundwater. The solution was added to reactors 2 and 4 and allowed to percolate through the soil. After one week, co-substrates mixed with groundwater were applied to the two reactors. On the second week, soil samples were obtained from the reactors and sent to the lab for analysis. Following sampling, co-substrates mixed with groundwater were again applied to the same reactors. The addition of co-substrates mixed with groundwater to the two reactors was repeated two more times every other weeks. Two sets of soil samples were collected prior to the addition.

The soil samples were plated on tryptic soy agar and mineral salt medium (MSM) with biphenyl vapors to determine total microbial count and biphenyl-degrading microbial count. The results (Table 1) show a high total microbial count (10^7 to 10^8 CFU/mL), as expected, and also a robust population of biphenyl-degrading microbes (10^4 to 10^5 CFU/mL). The consistency of the microbial population over a period of five weeks shows that viable biphenyl-degrading mirobes are being sustained in the reactors. Figure 2 shows biphenyl-degrading microbes from reactor 2 growing on an MSM plate. The brown coloration surrounding the colonies is indicative of the presence of a biodegradative by-product. However, analysis of the soil samples by gas chromatography did not show further degradation of the PCBs in the reactor soil.

CONCLUSION

Biological activities in the bioreactors continue to decrease six months into the study. Flushing of the reactors to remove any accumulation of products did not improve biodegradation. Laboratory studies have shown that the use of co-substrates can significantly enhance PCB biodegradation. The application of co-substrates to the bioreactors resulted in sustaining the biphenyl-degrading microbial population but fail to induce further PCB biodegradation. It seems that in a static system such as the bioreactor, bioavailability of the PCBs to the microbes remains a major problem.

Table 1. Results from microbiological analysis of soil samples

	TSA CFU/mL	MSM/biphenyl CFU/mL
April 7, 1994		
reactor 2	$3.1x10^7$	$4x10^4$
reactor 4	$2.5x10^7$	$2x10^5$
April 26, 1994		
reactor 2	$5x10^8$	$4x10^4$
reactor 4	$4x10^8$	$3x10^5$
May 5, 1994		
reactor 2	$1.2x10^7$	$2x10^4$
reactor 4	$4.0x10^9$	$6x10^4$

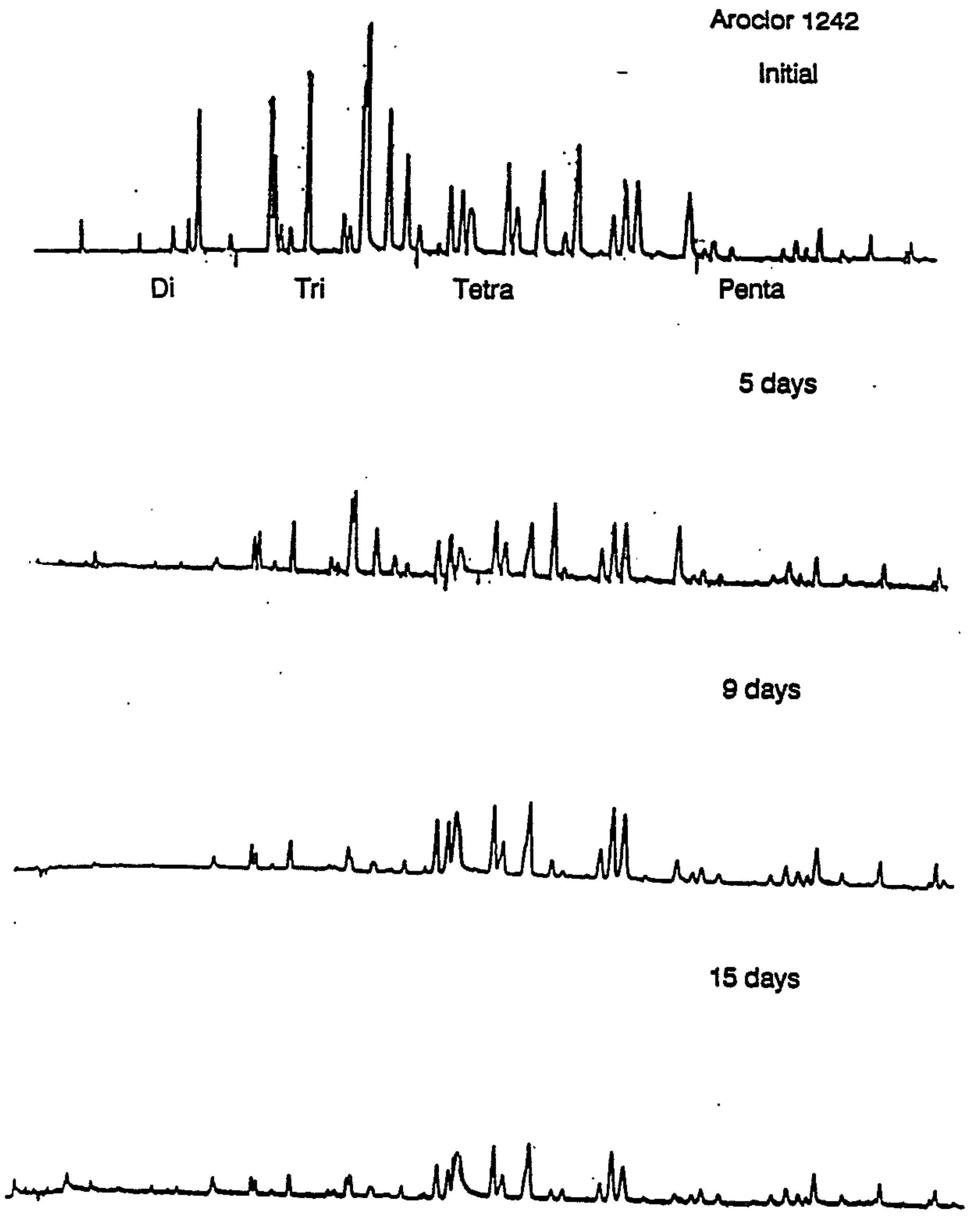

Figure 1. Aroclor 1242 biodegradation in the presence of co-substrate

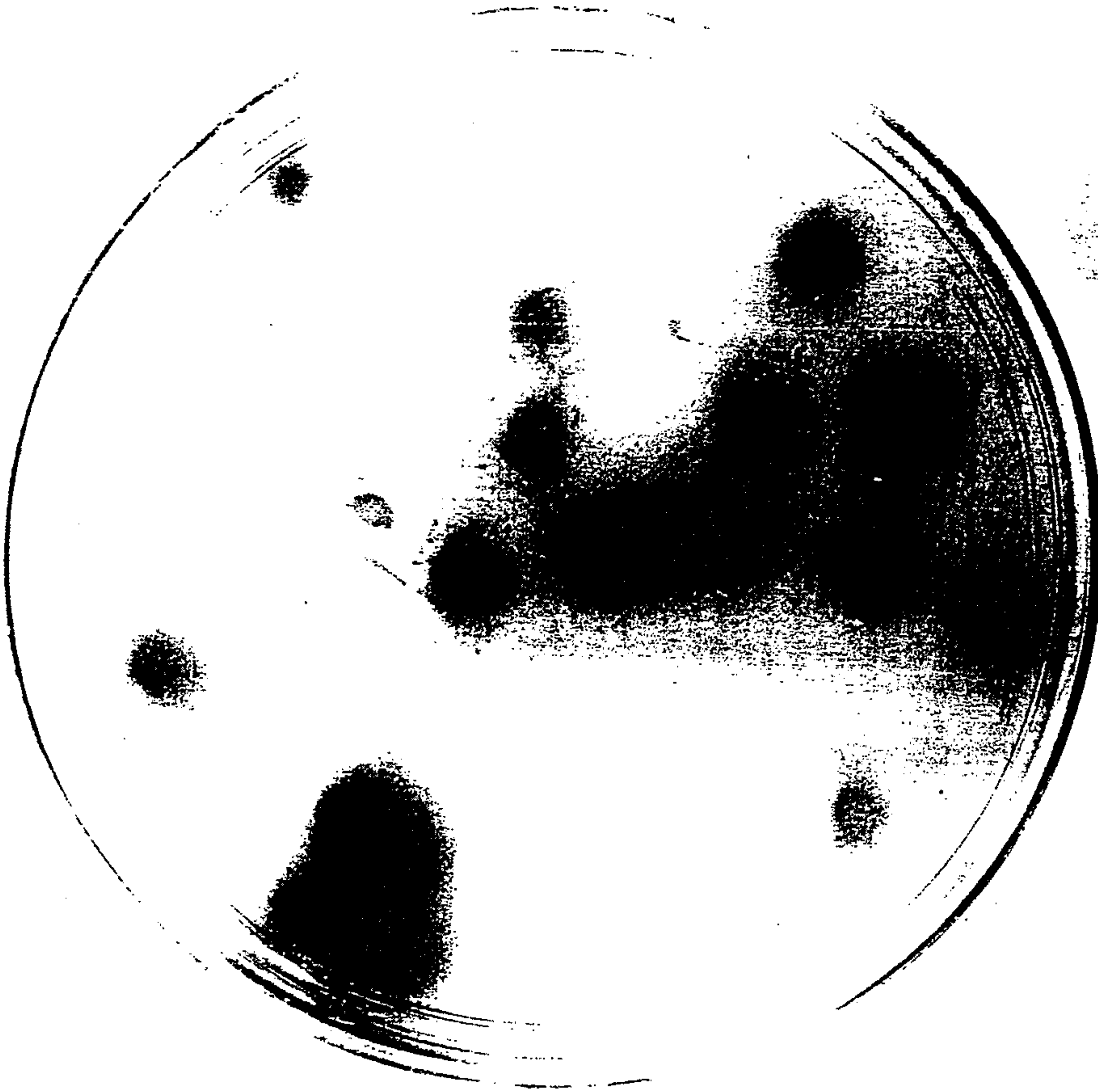

Figure 2. Biphenyl-degrading colonies from reactor 2 soil.