

**Interim
Eighteenmile Creek Area of
Concern (AOC) Strategic Plan for
Beneficial Use Impairment (BUI)
Delisting**

Contract No. W912P4-10-D-0002

March 2011

Prepared for:
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of Engineers®**
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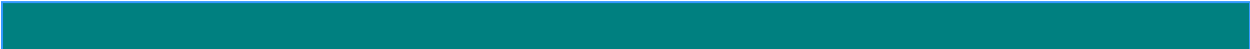
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List of Abbreviations and Acronyms

AOC	Area of Concern
BUI	Beneficial Use Impairment
E & E	Ecology and Environment, Inc.
EPA	(United States) Environmental Protection Agency
ERDC	U.S. Army Engineer Research and Development Center
FS	Feasibility Study
GLLA	Great Lakes Legacy Act
GLNPO	(EPA) Great Lakes National Program Office
GLRI	Great Lakes Restoration Initiative
HWS	Hazardous Waste Site
IJC	International Joint Commission
mg/kg	milligrams per kilogram
NCSWCD	Niagara County Soil and Water Conservation District
NYSDEC	New York State Department of Environmental Conservation
OU	Operable Unit
PAHs	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
RAC	Remedial Advisory Committee
RAP	Remedial Action Plan
RD	Remedial Design
RIBS	(NYSDEC) Rotating Integrated Basin Study
SAP	Sampling and Analysis Plan
TSS	total suspended solids
USACE	United States Army Corps of Engineers
WLO	Western Lake Ontario

Executive Summary

This report recommends a series of actions to improve relevant conditions in the Eighteenmile Creek Area of Concern (AOC) and document restoration and protection of beneficial uses in support of the eventual delisting or re-designation of this AOC. The actions thus identified are listed in Table ES-1 and fall into three general categories: (1) remediation; (2) monitoring and assessment; and (3) other. A score was assigned to each action based on the number of Beneficial Use Impairment (BUI) delisting criteria that each action would ultimately address. The maximum score is 11. The remediation projects all received high scores, 8 or 9, because these actions address the principal cause of all use impairments at Eighteenmile Creek (i.e., polychlorinated biphenyl [PCB] contamination of sediment). The assessment and monitoring actions received comparatively low scores, except for the fish monitoring action. Fish tissue analysis is a good indicator of PCB contamination in aquatic systems and therefore this action will provide a measure of the effectiveness of remedial actions in reducing PCB levels in Eighteenmile Creek sediments. The two actions in the other category also received comparatively low scores. A low score indicates that a project addresses a few, but not all, delisting criteria. All of the projects identified in this report are important for BUI delisting and, eventually, delisting of the AOC as a whole.

Table ES-1 also presents an approximate schedule for implementing the actions in this report. In essence, Table ES-1 represents the overall strategy for delisting the individual BUIs and, eventually, the Eighteenmile Creek AOC as a whole. The following actions are recommended:

- It is recommended that remediation of the Eighteenmile Creek Corridor Site and Former Flintkote Plant Site be undertaken before remediation of in-stream contaminated sediments. Because acceptable remedial alternatives for these sites have been proposed (NYSDEC 2010b, 2006b), it is anticipated that the actual remediation of these sites can be conducted within the next approximately six years.
- It is recommended that the Feasibility Study (FS) and Remedial Design (RD) for the Upper Mountain Road site be completed within the next approximately three years and remedial work be completed within three years thereafter.
- It is recommended that an FS and RD for contaminated sediment in Eighteenmile Creek, excluding the corridor site, be developed during the next ap-

proximately six years, concurrent with remediation of the Eighteenmile Creek Corridor Site, Former Flintkote Plant Site, and Upper Mountain Road Site.

- We recommend that two actions—use of the TrophicTrace model to develop a sediment remedial goal for Eighteenmile Creek and a pilot study on treatment of sediments with powdered activated carbon (PAC) to reduce PCB bioavailability—be implemented within the next two years. Both actions will provide data useful for developing remedial alternatives for the FS/RD for in-stream contaminated sediments in Eighteenmile Creek.
- Remediation of in-stream contaminated sediment is assumed to begin as soon as possible after the FS/RD for in-stream contaminated sediment is developed and hazardous waste site (HWS) remediation in Lockport, New York, is completed.
- It is expected that the mink survey and exposure assessment project can be completed in either 2011 or 2012. This project is designed to be completed over the course of a calendar year. It should be noted that the U.S. Army Corps of Engineers – Buffalo District (USACE) is currently preparing a factsheet for a potential project for Western Lake Ontario regional stakeholders entitled *Survey for Levels of Bioaccumulative Chemicals in Wildlife Prey and Tissues and Wildlife Deformities within Western Lake Ontario and its Tributaries*. The factsheet project, if implemented, should satisfy the data requirements for the Bird and Animal Deformities BUI.
- Baseline sampling of fish from different trophic levels and baseline benthic-community sampling should be implemented before the onset of remedial work at the HWSs in Lockport, New York. Long-term monitoring of fish and benthos should be implemented every five years after baseline sampling.
- Three ongoing New York State Department of Environmental Conservation (NYSDEC) programs—Rotating Integrated Basin Studies (RIBS), annual fish stocking, and state discharge permit monitoring and renewal—are assumed to continue indefinitely to provide ongoing stewardship for the Eighteenmile Creek system. Currently, it is unknown if the RIBS program can be modified by NYSDEC to include a sample location in the Eighteenmile Creek AOC. If not, then all future benthic community data for the AOC will come from the *Baseline Sampling and Long-term Monitoring of the AOC Benthic Community* project (see Section 2.4 and Appendix B.8).
- Lastly, after baseline monitoring and each round of long-term monitoring of fish and benthos, the Remedial Advisory Committee (RAC) should re-evaluate the status of each BUI based on the new data, and recommend delisting BUIs, if appropriate. Revision of delisting criteria, if appropriate and desirable, may be considered at these points in the overall process.

The following conclusions can be drawn based on Table ES-1 and evaluation presented in this report:

- BUIs at Eighteenmile Creek are the result of the large inventory of PCBs in sediment upstream from Burt Dam and subsequent bioaccumulation of PCBs in fish.
- A suite of actions originating at the local, state, and federal levels are required to remediate source areas in Lockport, New York, and in-stream sediments between Lockport and the mouth of the creek at Lake Ontario. Some actions have been taken (e.g., FS/RD for the Eighteenmile Creek Corridor Site and Former Flintkote Plant Site, sediment investigation for Eighteenmile Creek above Burt Dam), but further work remains to be done.
- Collectively, the actions identified in this report should be capable of eliminating BUIs in Eighteenmile Creek within 10 to 15 years, if the approximate schedule in Table ES-1 can be followed. The availability of federal and state funds for the large-scale remediation projects that are needed will be a critical factor in deciding whether the schedule can be kept.
- Coordination between local, state, and federal groups under strong local leadership is needed to advance the overall BUI delisting process for Eighteenmile Creek.

During the process of developing this strategic plan, Ecology and Environment, Inc. (E & E) received input from the Niagara County Soil and Water Conservation District (NCSWCD), USACE, NYSDEC, United States Environmental Protection Agency (EPA), and others. Nonetheless, this plan should not be considered to be approved by these agencies. This plan represents consultant study recommendations to the Eighteenmile Creek AOC Remedial Action Plan (RAP) Coordinator and Remedial Advisory Committee (RAC). It is up to the RAP Coordinator and RAC to accept all or some of the recommendations and incorporate what is appropriate into the Eighteenmile Creek RAP as an addendum to the current RAP Stage 2 Report. Because the RAP Stage 2 Report is the official government document of record, the AOC RAP addendum must be approved by NYSDEC, as the State steward of the AOC under the Statewide Water Quality Program, and then be reviewed by EPA and submitted to the International Joint Commission (IJC), though no IJC concurrence is needed. Throughout the process, it is the responsibility of NYSDEC and EPA to judge whether the Stage 2 RAP addendum complies with state/federal requirements.

Table ES-1 Action Implementation Strategy for the Eighteenmile Creek AOC.

Action	Year (approximate)																			Remarks
	2011	2012	2013	2014	2015	2016	2017	2018	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027		
Remediation																				
FS and RD for Remediation of In-stream Contaminated Sediments																				Occurs during HWS remediation in Lockport; may require < 5 years.
Inactive HWS Remediation: Eighteenmile Creek Corridor (Site 932121) and Flintkote (B-00161-9)																				Recommended that remedial work be implemented in the next 6 years.
Inactive HWS Remediation: Upper Mountain Road (Site 932112)																				FS/RD preparation from 2011 to 2013 with remediation from 2014 to 2016 recommended.
Pilot Study on Treatment of Contaminated Sediments with PAC to Reduce PCB Bioavailability																				Implementation in 2011or 2012 recommended.
Remediation of In-stream Contaminated Sediments																				Implementation assumed to require 5 years.
Use TTM to Establish Sediment Remedial Goals for PCBs in Eighteenmile Creek																				Implementation in 2011or 2012 recommended.
Monitoring and Assessment																				
Mink Survey and Exposure Assessment for Eighteenmile Creek AOC and Watershed																				To be implemented in 2011 or 2012, if WLO factsheet project* does not proceed.
Baseline Sampling and Long-term Monitoring of Fish from Different Trophic Levels																				Baseline sampling to occur before HWS remediation; with monitoring every 5 years thereafter.
Baseline Sampling and Long-term Monitoring of the AOC Benthic Community																				Baseline sampling to occur before HWS remediation; with monitoring every 5 years thereafter.
Continued NYSDEC RIBS Assessments with Modifications to Include AOC Sampling**																				Ongoing NYSDEC program assumed to continue, with sampling every 5 years.
Other																				
Continued Annual Fish Stocking and Rearing																				Ongoing NYSDEC program assumed to continue.
Continued SPDES Discharge Permit Monitoring and Renewal																				Ongoing NYSDEC program assumed to continue.
BUI Status Check																				
Evaluate Attainment of Delisting Criteria and Delist BUIs as Appropriate																				Do after each round of sampling.

Key:

- AOC = Area of Concern.
- BUI = Beneficial Use Impairment.
- FS = Feasibility Study.
- HWS = Hazardous Waste Site.
- NYSDEC = New York State Department of Environmental Conservation.
- PAC = powdered activated carbon.
- PCBs = polychlorinated biphenyls.
- RD = Remedial Design.
- RIBS = Rotating Integrated Basin Studies.
- SPDES = State Pollutant Discharge Elimination System.
- TTM = TrophicTrace model.
- WLO = Western Lake Ontario.

Notes:

- Indicates that project is implemented or ongoing during that calendar year.
- * Survey for Levels of Bioaccumulative Chemicals in Wildlife Prey and Tissues and Wildlife Deformities within Western Lake Ontario and its Tributaries.
- ** At this time, it is unknown if NYSDEC will be able to modify the RIBS sampling for Eighteenmile Creek to include a site in the AOC.

1

Introduction

Ecology and Environment (E & E) has prepared this *Strategic Plan for Beneficial Use Impairment Delisting for the Eighteenmile Creek Area of Concern* for the USACE under Contract Number W912P4-10-D-002 (Lake Ontario Sediment Management and Great Lakes Restoration Initiative [GLRI] Planning). This report satisfies, in part, the requirements outlined as Task 11 in the USACE Architect-Engineer Scope of Work (per Contract No. W912P4-10-D-0002).

During the process of developing this strategic plan, E & E received input from the Niagara County Soil and Water Conservation District (NCSWCD), USACE, New York State Department of Environmental Conservation (NYSDEC), United States Environmental Protection Agency (EPA), and others. Nonetheless, this plan should not be considered to be approved by these agencies. This plan represents consultant study recommendations to the Eighteenmile Creek Area of Concern (AOC) Remedial Action Plan (RAP) Coordinator and Remedial Advisory Committee (RAC). It is up to the RAP Coordinator and RAC to accept all or some of the recommendations and incorporate what is appropriate into the Eighteenmile Creek RAP as an addendum to the current RAP Stage 2 Report. Because the RAP Stage 2 Report is the official government document of record, the AOC RAP addendum must be approved by NYSDEC, as the State steward of the AOC under the Statewide Water Quality Program, and then be reviewed by EPA and submitted to the International Joint Commission (IJC), though no IJC concurrence is needed. Throughout the process, it is the responsibility of NYSDEC and EPA to judge whether the Stage 2 RAP addendum complies with state/federal requirements.

The remainder of this report is organized as follows:

- The remainder of Section 1 describes the project scope and objectives; the Eighteenmile Creek AOC and watershed; Beneficial Use Impairments (BUIs) and delisting criteria for the AOC; and ongoing projects relevant to BUI delisting.
- Section 2 identifies actions needed to satisfy each delisting criterion for each BUI and provides approximate cost estimates for the identified actions.
- Section 3 summarizes the actions identified in Section 2 and presents an overall strategy or schedule for implementation.

- Conclusions are provided in Section 4.

1.1 Scope and Objectives

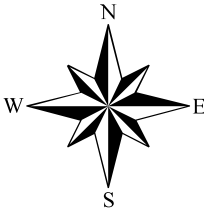
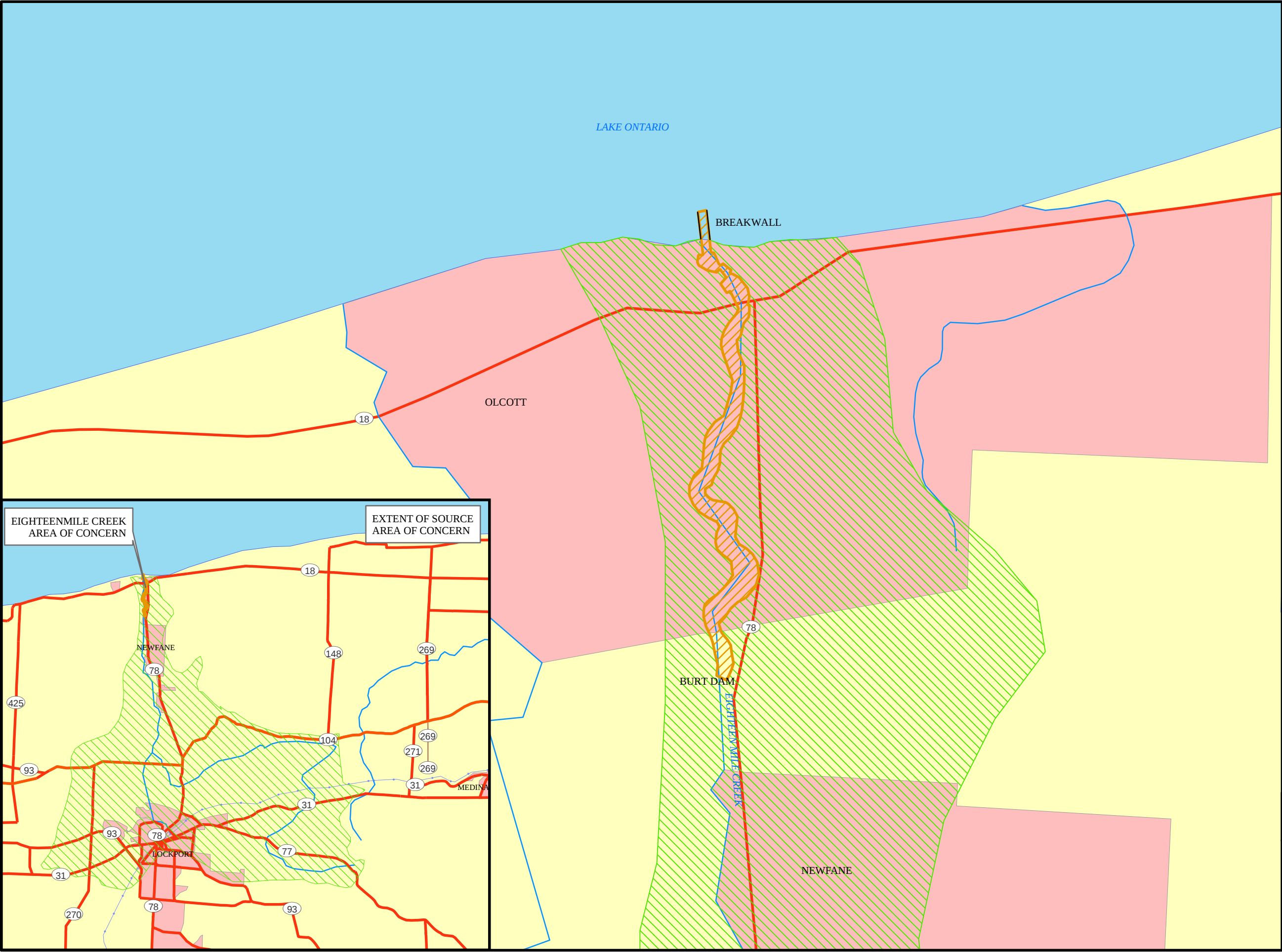
This strategic plan recommends a series of actions to: (a) improve relevant conditions in the Eighteenmile Creek AOC to the maximum extent practicable and (b) document restoration and protection of beneficial uses in the AOC in support of its delisting or re-designation. This strategic plan also includes preliminary cost estimates for the recommended actions.

1.2 Eighteenmile Creek AOC Location and Description

The Eighteenmile Creek AOC is located in Niagara County, New York (see Figure 1-1). The creek flows generally north through central Niagara County and discharges via Olcott Harbor into Lake Ontario, approximately 18 miles east of the mouth of the Niagara River. The AOC includes Olcott Harbor and extends upstream to the farthest point at which backwater conditions exist during Lake Ontario's highest monthly average lake level (see Figure 1-1). This point is located just downstream of Burt Dam, approximately 2 miles south of Olcott Harbor. This portion of the watershed is a unique gorge habitat that attracts recreational boaters, anglers, birders, and waterfowl hunters.

Only a small portion of the Eighteenmile Creek basin was originally designated an AOC by the IJC. However, for two reasons, since the Eighteenmile Creek RAP process began, the AOC has been considered the impact area and the upper watershed as the source area (NYSDEC 1997). First, except for potential impacts from agricultural operations adjacent to the current AOC boundary, there are no documented sources or source areas of contamination within the AOC. Second, various investigations conducted over the past 35 years have suggested that contaminants may be entering the AOC from upstream areas. Specifically, PCBs, copper, lead, and other metals have been found in creek sediment and bank fill in Lockport, New York, at concentrations well above applicable NYSDEC standards, indicating that contaminant sources exist in this area (NYSDEC 2006a, E & E 2009a). Other contaminant source areas may exist along the creek between Lockport and the AOC (NYSDEC 2001).

Additional information regarding the characteristics of the Eighteenmile Creek AOC and watershed are available in the *Eighteenmile Creek State of the Basin Report* (E & E 2007), *Beneficial Use Impairment Investigation Report for Eighteenmile Creek* (E & E 2009b), and additional publications and factsheets available from the Eighteenmile Creek RAP website (www.eighteenmilecreekrap.com).



LEGEND

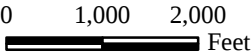
- MAJOR ROADS
- SURFACE WATER
- URBAN AREAS
- EXTENT OF AREA OF CONCERN (EIGHTEENMILE CREEK REMEDIAL ACTION PLAN, AUGUST 1997)
- EXTENT OF SOURCE AREA OF CONCERN (EIGHTEENMILE CREEK REMEDIAL ACTION PLAN, AUGUST 1997)

NOTES:

AREA OF CONCERN BOUNDARY AS APPROVED BY THE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION ON JULY 27, 2005.

THE SOURCE AREA OF CONCERN DESIGNATED FOR THE EIGHTEENMILE CREEK AREA OF CONCERN IS DEFINED IN THE 1997 REMEDIAL ACTION PLAN AS THE EIGHTEENMILE CREEK WATERSHED, AND WAS DERIVED FROM FIGURE 2.2 OF THE 1997 REMEDIAL ACTION PLAN.

SOURCE: MODIFIED FROM THE NEW YORK DEPARTMENT OF ENVIRONMENTAL CONSERVATION 1997, AND ESRI, 2005.



**EIGHTEENMILE CREEK, NEW YORK
AREA OF CONCERN**

Great
Lakes
National
Program
Office



1.3 BUIs, Delisting Targets, and Current Status

There are a maximum of 14 BUIs applied by the IJC to an AOC (IJC 1991). These BUIs can be classified as: impaired, impairment inconclusive, needs further assessment, not impaired, in recovery, or being addressed by another responsible party. Currently, five beneficial uses are considered impaired for the Eighteenmile Creek AOC (EPA 2010). The BUIs and their delisting criteria for Eighteenmile Creek are listed in Table 1-1. The delisting targets for the Eighteenmile Creek AOC were developed locally by the Eighteenmile Creek RAP Coordinator and RAC through a thorough assessment process and are consensus-based. If warranted, the criteria listed in Table 1-1 may be revised by the RAC based on the results of future monitoring and assessment and/or unforeseen future developments in the AOC.

Table 1-1 Beneficial Use Impairments and Delisting Criteria for the Eighteenmile Creek AOC

BUI	BUI Status	Delisting Criteria
1. Restrictions on Fish and Wildlife Consumption	Impaired	There are no AOC-specific fish and wildlife consumption advisories issued by New York State; AND Contaminant levels in fish and wildlife must not be due to contaminant input from the watershed upstream of Burt Dam.
3. Degradation of Fish and Wildlife Populations	Impaired	Fish and wildlife diversity, abundance, and condition are statistically similar to diversity, abundance and condition of populations at non-AOC control sites; AND PCB levels in bottom-dwelling fish do not exceed the critical PCB tissue concentration for effects on fish (440 micrograms per kilogram [$\mu\text{g/kg}$] of weight; Dyer et al. 2000).
5. Bird or Animal Deformities or Reproduction Problems	Impaired	No reports of wildlife population deformities or reproductive problems from wildlife officials above expected natural background levels; AND Contaminant levels in bottom-dwelling fish do not exceed the level established for the protection of fish-eating wildlife (NYSDEC Fish Flesh Criteria); OR In the absence of fish data, the toxicity of sediment-associated contaminants does not exceed levels associated with adverse effects on wildlife (NYSDEC Fish & Wildlife Bioaccumulation Sediment Criteria)
6. Degradation of Benthos	Impaired	Benthic macroinvertebrate communities are “non-impacted” or “slightly impacted” according to NYSDEC indices; OR

Table 1-1 Beneficial Use Impairments and Delisting Criteria for the Eighteenmile Creek AOC

BUI	BUI Status	Delisting Criteria
		In the absence of NYSDEC data, riffle habitats require benthic macroinvertebrate communities with a species richness higher than 20, EPT richness greater than 6, a biotic index value greater than 4.51, and a percent model affinity greater than 50; OR
		In the absence of benthic community data, this use will be considered restored when the level of toxic contaminants in sediments is not significantly higher than controls.
7. Restrictions on Dredging Activities	Impaired	When contaminants in AOC sediments (located within the actual or potential dredging areas identified for the improvement of ship navigation) do not exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities.

Source: EPA 2010.

Key:

- AOC = Area of Concern.
- BUI = Beneficial Use Impairment.
- EPT = Ephemeroptera, Plecoptera, and Trichoptera.
- NYSDEC = New York State Department of Environmental Conservation.
- PCB = Polychlorinated biphenyl.

The process of delisting or re-designating an AOC begins with re-designating or delisting each individual BUI. Individual BUIs can be re-designated to one of three re-designations (NYSDEC 2010a):

- Not impaired – delisting criteria achieved to the maximum extent practicable and environmental program oversight and monitoring are identified;
- In recovery – remedial measures and RAP process work accomplished to the maximum extent possible; oversight and longer term monitoring identified; or
- Referred to be resolved by another responsible party – the RAP process collaborates to assign responsibility to address the resolution of a concern to another responsible environmental program and/or management plan.

Once all of the individual BUIs have been re-designated, the entire AOC can be re-designated as “delisted” or “in-recovery” (NYSDEC 2010a). An area in recovery should be re-evaluated periodically to determine if the area has achieved the “delisted” goal. NYSDEC, EPA, and IJC concurrence is required to delist individual BUIs and the AOC as a whole. NYSDEC (2010a) and EPA (2001) describe the steps in the delisting process.

1.4 Ongoing Work to Characterize Sediment Contamination and Bioaccumulation

Over the past several years, E & E and USACE have initiated new investigations in the Eighteenmile Creek system to better understand the nature and extent of sediment contamination and PCB biomagnification. These studies include sediment sampling for PCBs, metals, and other contaminants upstream from Burt Dam; determination of sediment bed thickness to support sediment volume estimates; and development of a TrophicTrace model to help better understand bio-magnification of PCBs in the aquatic food web of the creek. These investigations are described in turn below.

1.4.1 Sediment Sampling Upstream from Burt Dam

The EPA Great Lakes National Program Office (GLNPO) Great Lakes Legacy Act (GLLA) site characterization project is assessing the nature and extent of sediment contamination upstream from Burt Dam and the potential for migration of contaminants from upstream source areas, including in-stream sediments. The project builds on the NYSDEC assessment and proposed remediation plan for upstream source areas adjacent to the New York State Barge Canal in Lockport, New York (NYSDEC 2010b). The GLLA project includes characterization of three miles of deep sediment in the impoundments behind two dams (Burt Dam and Newfane Dam) and nine miles of shallow creek bed sediment that runs through isolated rural areas downstream of the primary source area in Lockport, New York. Results from over 300 samples were evaluated for PCBs, polycyclic aromatic hydrocarbons (PAHs), and metals contamination. Preliminary results for total PCBs and selected metals are provided in Appendix A (A.1 and A.2).

1.4.2 Sampling to Support Sediment Volume Estimates

In the studies mentioned above, the chemical data show the extent of sediment contamination by PCBs and other chemicals within Eighteenmile Creek. However, additional physical data are needed to estimate the volume of contaminated sediment. Therefore, beginning in the fall of 2010, sediment thickness was measured and the creek's bank-full width was verified during field surveys conducted by E & E as part of the GLLA project. These measurements will be used to estimate the volume of contaminated sediment present within Eighteenmile Creek upstream of Burt Dam. Results are not yet available.

1.4.3 TrophicTrace Food Web Model

The U.S. Army Engineer Research and Development Center (ERDC) is developing a TrophicTrace food web model for Eighteenmile Creek (Gustavson et al. 2010). The objective of the project is to evaluate organic contaminant bioaccumulation, trophic transfer, and consequent risks in creek sections above and below Burt Dam. The following points regarding this effort are noteworthy:

- The TrophicTrace food web model and its underlying mathematical structure (Gobas 1993) are well-accepted and have been used in a number of regulatory applications.

- Two sections of Eighteenmile Creek will be modeled: (1) Olcott Harbor to Burt Dam and (2) Burt Dam to Newfane Dam.
- The modeling effort will focus on PCBs for a variety of reasons, including: (1) PCBs are the primary risk driver in the Eighteenmile Creek system; (2) PCBs have the most robust and current dataset; (3) chlorinated pesticides and dioxins are not particularly elevated or prevalent in sediment in the Eighteenmile Creek system; and (4) focusing on a single contaminant class will permit a more intensive sampling to support the modeling effort compared to the sampling amount that could be conducted if multiple contaminant classes were modeled.
- The modeling effort will use surface water PCBs congener data collected by EPA; sediment PCB congener data from USACE (2004a, b) and sampling in 2009 and 2010; and fish PCB congener data collected in 2010 (see Gustavson et al. 2010 for data review).
- ERDC is modeling total PCBs based on a sum of congeners. They may also explore bioaccumulation of select individual congeners.
- The TrophicTrace model can be used to develop sediment concentrations that serve as remedial goals for a site; it is commonly employed at Superfund sites for this purpose. Remedial goals are established on the basis of risk to receptors.
- Another primary function of TrophicTrace and other food-web bioaccumulation models is to evaluate various "what if" scenarios regarding remediation. For example, if actions are taken to reduce the sediment PCB concentration to a particular level, what will be the impact to fish tissue concentrations and risk to receptors?

ERDC will not be developing a sediment remedial goal for Eighteenmile Creek as part of the scope of work described in Gustavson et al. (2010); however, this could be undertaken as a follow-up task.

2

BUI and Projects/Actions to Address Impairments

For each of the five impaired beneficial uses at the Eighteenmile Creek AOC (see Table 1-1), the cause(s) of the impairment and recommended actions to correct the situation are described. If an action is recommended for more than one BUI, the same action is described in each table for each BUI it addresses. In addition, rough cost estimates for recommended actions are provided (see Table 2-1). The discussion below is organized by BUI, typically with a subheading for each delisting criterion for that BUI.

Table 2-1 Summary of Cost Estimates for Recommended Actions in the Eighteenmile Creek AOC and Watershed

Action	Approximate Cost Estimate ¹	Remarks
Inactive HWS remediation: Eighteenmile Creek Corridor (Site 932121) and Former Flintkote Plant (Site B-00161-9).	\$16,178,000 (Corridor Site) <u>\$5,614,000 (Flintkote).</u> \$21,792,000 (total)	See Section 2.1 and Appendix B.1 for basis of cost estimate.
Sediment remediation FS/RD for in-stream sediment in Eighteenmile Creek.	\$2.2 million (FS) <u>\$1.5 million (RD)</u> \$3.7 million (total)	See Section 2.1 for basis of cost estimate.
Remediation of in-stream contaminated sediments (excluding the portion of the creek channel within the corridor site).	\$28.8 to 40.3 million	See Section 2.1 and Appendix B.2 for basis of cost estimate.
Baseline sampling and long-term, post-remediation monitoring of fish from different trophic levels.	\$65,950 (baseline) \$59,950 (long-term)	See Section 2.1 and Appendix B.3 for monitoring program details and basis of cost estimate. Long-term monitoring cost estimate is for one round (i.e., each time the sampling is done).

2 BUI and Projects/Actions to Address Impairments

Table 2-1 Summary of Cost Estimates for Recommended Actions in the Eighteenmile Creek AOC and Watershed

Action	Approximate Cost Estimate ¹	Remarks
Pilot study on treatment of contaminated sediments with powdered activated carbon to reduce PCB bioavailability.	\$70,820	See Section 2.1 and Appendix B.4 for description of study and basis of cost estimate.
Use of the TrophicTrace model to establish site-specific sediment remedial goals for PCBs in Eighteenmile Creek.	Up to \$512,000 depending on the amount of additional data collection.	See Appendix B.5 for basis of cost estimate.
Mink survey and exposure assessment for Eighteenmile Creek AOC and watershed.	\$83,400	See Section 2.2.1 and Appendix B.6 for project description and basis of cost estimate.
Continued annual fish stocking and pen rearing.	\$298,930	See Section 2.2.1 and Appendix B.7 for basis of cost estimate.
Inactive HWS remediation: Upper Mountain Road (Site 932112).	\$681,000 to \$8,818,000	See Section 2.2.1 for basis of cost estimate.
Baseline sampling and long-term, post-remediation monitoring of the AOC benthic community.	\$41,570 (baseline) \$33,320 (long-term)	See Section 2.4 and Appendix B.8 for monitoring program details and basis of cost estimate. Long-term monitoring cost estimate is for one round (i.e., each time the sampling is done).
Prepare technical memorandum to NYSDEC regarding modification to RIBS sampling in Eighteenmile Creek.	\$1,800	See Section 2.4 for basis of cost estimate.

Note: 1 = 2011 dollars.

Key:

- AOC = Area of Concern.
- BUI = Beneficial Use Impairment.
- FS = Feasibility Study.
- HWS = Hazardous Waste Site.
- NYSDEC = New York State Department of Environmental Conservation.
- PCB = Polychlorinated biphenyls.
- RD = Remedial Design.
- RIBS = Rotating Integrated Basin Studies.

2 BUI and Projects/Actions to Address Impairments

2.1 BUI #1 -- Restrictions on Fish and Wildlife Consumption

Both human and ecological receptors using the Eighteenmile Creek system may be at risk from PCBs and perhaps other chemicals in fish based on recent investigations (E & E 2009b) and current fish consumption advisories (NYSDOH 2010). Elevated levels of PCBs in fish in Eighteenmile Creek appear to be the result of bioaccumulation from sediment (USACE 2004a, b; Gustavson et al. 2010). The situation above Burt Dam is worse than in the AOC; that is, sediment PCB levels are greater and fish advisories more stringent above the dam. Recent sediment sampling by E & E for EPA shows that surface sediment PCB levels are greater in the portion of the creek near the source areas in Lockport than in downstream reaches (see Appendix A.2). Source areas along the creek in Lockport were characterized by NYSDEC (2006a) and E & E (2009a). Remediation of these upstream areas is critical for addressing both delisting criteria for this BUI—*No AOC-specific Advisories* and *No Upstream Causes of AOC Impairment* (see Table 1-1).

Recommended Actions

1. *Inactive Hazardous Waste Site Remediation: Eighteenmile Creek Corridor (Site 932121) and Former Flintkote Plant (Site B-00161-9).* Total cost estimate: \$21,792,000 (\$16,178,000 + \$5,614,000, respectively). NYSDEC (2010b) estimated an overall cost of \$16.2 million for remediation of Operable Units (OUs) 1, 3, 4, 5, and 6 within the Corridor Site. The estimated costs of the preferred alternative for each OU are: OU 1—Eighteenmile Creek and Mill-race, \$8,818,000; OU 3—Former United Paperboard Property, \$1,985,000; OU 4—Upton Park, \$3,438,00; OU 5—White Transportation Property, \$681,000; and OU 6—Water Street Residential Properties, \$1,256,000. For the Former Flintkote Plant Site (OU2), NYSDEC (2006b) estimated remedial costs to be \$5.6 million. See Appendix B.1 for additional information regarding these cost estimates.
2. *Sediment Remediation Feasibility Study (FS) and Remedial Design (RD) for Eighteenmile Creek.* Cost estimates: \$2.2 million for FS and \$1.5 million for RD. These estimates are based on E & E's understanding of the Eighteenmile Creek system, our understanding of data gaps that must be filled before the FS can be completed, and experience in developing sediment remediation FS and RD reports for other sites on the Great Lakes and elsewhere. We estimate that 30 to 40% of the FS cost estimate may be needed to address data gaps. For example, developing a better understanding of sediment and PCB transport in the Eighteenmile Creek system will involve additional data collection and modeling.
3. *Remediation of In-Stream Contaminated Sediments (excluding the portion of the creek channel within the Eighteenmile Creek Corridor Site).* Cost estimate: \$28.8 to 40.3 million. To arrive at a rough cost estimate for this action, E & E examined remedial costs for other large contaminated sediment sites on

2 BUI and Projects/Actions to Address Impairments

the Great Lakes (see Appendix B.2). Actual or estimated remedial costs for over 90 sediment projects are available (www.epa.gov/glla/remed/GreatLakesSedimentManagementPlan.pdf). The costs for completed sediment remediation projects range from \$2,000,000 to \$97,000,000 for remediation of 5,000 to 784,000 cubic yards of contaminated sediments. For these sites, there is a correlation between sediment volume remediated and cost ($r\text{-squared} = 0.9227$; $n = 12$; $\text{cost} = 114.97[\text{volume}] + 5,814,229$). If one assumes that the volume of sediment requiring remediation at Eighteenmile Creek is between 200,000 and 300,000 cubic yards, then remedial costs are predicted to range from \$28.8 to 40.3 million based on the above relationship. Regarding implementation of sediment remediation at Eighteenmile Creek, E & E recommends that this action not begin until after Corridor Site remediation is complete. We also recommend that remediation of in-stream sediment begin with the reach of Eighteenmile Creek closest to the Corridor site and move progressively downstream, culminating with remediation of contaminated sediment in the navigation channel of Olcott Harbor. Sediment remediation of the navigational channel will have the added benefit of addressing BUI #7 (Restrictions on Dredging Activities).

4. *Baseline Sampling and Long-term, Post-remediation Monitoring of Fish from Different Trophic Levels.* Cost estimates: \$65,950 (baseline) and \$59,950 (post-remedial). The costs of baseline sampling and one round of post-remedial sampling are estimated to be \$65,950 and \$59,950, respectively. The estimate for post remedial sampling is less than the estimate for baseline sampling because the Sampling and Analysis Plan (SAP) prepared for baseline sampling is assumed to be useful for post-remedial sampling with little or no modification. This cost estimate is based on collection and analysis of five forage fish composite samples and five game fish samples from each of three reaches of Eighteenmile Creek: (1) below Burt Dam; (2) between Newfane and Burt Dams; and (3) upstream from Newfane Dam. The fish samples will be analyzed for PCBs, lipids, and percent moisture. Support for this cost estimate is provided in Appendix B.3.
5. *Pilot Study on Treatment of Contaminated Sediments with Powdered Activated Carbon to Reduce PCB Bioavailability.* Cost estimate: \$70,820. This *in situ* technique binds toxic organic chemicals in sediments and reduces uptake into the aquatic food web and toxic impacts to the benthic community. The method involves use of a high pressure water jet to inject PAC at varying depths into contaminated sediments. Up to 90% reduction in PCB bioavailability has been observed at sites where this method has been used (<http://www.clu-in.org/contaminantfocus/default.focus/sec/Sediments/cat/Overview/>). E & E recommends that a laboratory bench-top study be undertaken to evaluate the potential effectiveness of this method for reducing PCB bioavailability in Eighteenmile Creek sediment. If implemented, the study results will be incorporated into the Eighteenmile Creek FS and used to help develop additional remedial alternatives. This treatment method may be useful at Eighteenmile Creek as a polishing step in areas where sediment dredg-

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ing is implemented and/or as the principal means of sediment remediation in areas that are difficult or impossible to access for dredging. Appendix B.4 provides additional information about the proposed study and support for the cost estimate. It should be noted that USACE is preparing a factsheet for a potential project for Western Lake Ontario regional stakeholders entitled *Pilot Study on Use of Powdered Activated Carbon to Reduce Bioavailability of Polychlorinated Biphenyls (PCBs) in Eighteenmile Creek Sediment*. The project described in the USACE factsheet and this recommended action are identical.

6. *Use of the TrophicTrace (TT) Model (Gustavson et al. 2010) to Establish Site-specific Sediment Remedial Goals for PCBs in Eighteenmile Creek. Cost estimate: Up to \$512,000 (depending on amount of additional data collection).* A sediment remedial goal for PCBs in Eighteenmile Creek is needed to define areas of the creek channel in need of remediation. Risk assessment methods based on realistic, site-specific exposure scenarios, exposure parameters, and bioaccumulation factors result in the most reliable remedial goals. A cost estimate and description for this action was provided by Karl Gustavson (see Appendix B.5).

2.2 BUI #3 -- Degradation of Fish and Wildlife Populations

2.2.1 Criterion 1: Wildlife Diversity, Abundance, and Condition in the AOC are Similar to Non-AOC Control Sites

In 2007, E & E (2009b) conducted a fish and wildlife survey in the Eighteenmile Creek AOC and a suitable reference creek, Oak Orchard Creek. This investigation found that diversity and abundance of fish, amphibians, and birds at the Eighteenmile Creek AOC and Oak Orchard Creek were similar, suggesting no impairment for these wildlife groups at Eighteenmile Creek (E & E 2009b). Unfortunately, the mammal survey data from E & E (2009b) were limited and qualitative and therefore inadequate for drawing conclusions with certainty. Further evaluation of mammal diversity and abundance is recommended. E & E recommends that follow-up work be focused on the American mink (*Neovison vison*) because PCB levels in fish from Eighteenmile Creek may be great enough to result in reproductive impairment of mink (E & E 2009b). A project to evaluate the relative abundance of mink in the Eighteenmile Creek system and their dietary exposure to PCBs is described below.

Recommended Actions

1. *Mink Survey and Exposure Assessment for Eighteenmile Creek AOC and Watershed. Cost estimate: \$83,400.* Wellman and Haynes (2006) studied mink, a sentinel species, in the Rochester AOC to address two BUIs: *Degradation of Fish and Wildlife Populations* and *Bird or Animal Deformities or Reproductive Problems*. That study used weather-proof video surveillance equipment to examine mink relative abundance and reproduction (as indicated by the presence of young mink) in and out of the AOC. Implementation of a similar

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video surveillance study is recommended for Eighteenmile Creek to determine if mink are present and reproducing along the creek above and below Burt Dam. The video surveillance data for Eighteenmile Creek can be compared with similar data collected by Wellman and Haynes (2006) at Iroquois National Wildlife Refuge and Bergen Swamp to qualitatively evaluate if mink relative abundance in the Eighteenmile Creek system differs from these reference areas. In addition, to better define mink exposure to PCBs in the Eighteenmile Creek AOC and watershed, E & E recommends that the mink exposure assessment presented in E & E (2009b) be reevaluated in light of the new fish PCB data collected in 2010 to support the Eighteenmile Creek TT model (Gustavson et al. 2010). Details regarding this project and support for the cost estimate are provided in Appendix B.6. It should be noted that USACE is preparing a factsheet for a potential project for Western Lake Ontario regional stakeholders entitled *Survey for Levels of Bioaccumulative Chemicals in Wildlife Prey and Tissues and Wildlife Deformities within Western Lake Ontario and its Tributaries*. This action is a scaled back version of the project described in that factsheet. If the factsheet project is implemented, then it would be redundant to also implement this action.

An additional action is recommended under this delisting criterion to bolster fish abundance in the AOC.

1. *Continued Annual Fish Stocking and Pen Rearing.* Cost estimate: \$298,930 annually to stock at 2009 levels. Fish stocking helps to address this delisting criterion by contributing to game fish abundance in the Eighteenmile Creek AOC. Currently, fish stocking in Eighteenmile Creek is done by NYSDEC; however, it is possible that NYSDEC may stop fish stocking in the future for budgetary reasons. Hence, this recommended action is contingent upon future NYSDEC capacity. Details regarding this project and support for the cost estimate are provided in Appendix B.7

2.2.2 Criterion 2: PCBs in Bottom-Dwelling Fish Do Not Exceed Critical Tissue Concentrations for Effects on Fish

This delisting criterion is not being met based on the high levels of total PCBs found in bullheads collected recently from the AOC (E & E 2009b). The problem in the AOC is largely due to upstream sources, primarily the large inventory of PCBs in sediment above Burt Dam and in the Corridor Site in Lockport, New York. Remediation of these sources is critical to satisfying this delisting criterion. Therefore, the projects recommended and described under BUI #1 (Restrictions on Fish and Wildlife Consumption; see Section 2.1) also are recommended here.

Recommended Actions

1. *Inactive Hazardous Waste Site Remediation: Eighteenmile Creek Corridor (Site 932121) and Former Flintkote Plant (Site B-00161-9).*

2 BUI and Projects/Actions to Address Impairments

2. *Sediment Remediation Feasibility Study (FS) and Remedial Design (RD) for Eighteenmile Creek.*
3. *Remediation of In-stream Contaminated Sediments.*
4. *Baseline Sampling and Long-term, Post-remediation Monitoring of Fish from Different Trophic Levels.*
5. *Pilot Study on Treatment of Contaminated Sediments with Powdered Activated Carbon to Reduce PCB Bioavailability.*
6. *Use of the Trophic Trace Model (TTM, Gustavson et al. 2010) to Establish Sediment Remedial Goals for PCBs in Eighteenmile Creek.*

2.3 BUI #5 -- Bird or Animal Deformities or Reproductive Problems

2.3.1 Criterion 1: No Reports of Deformities or Reproductive Problems above Expected Background Levels

No bird or mammal deformities were observed during the 2007 investigation conducted by E & E (2009b). However, that investigation was not designed to detect the types of deformities (e.g., jaw lesions in mink) that may result from PCB exposure. Furthermore, the E & E (2009b) investigation suggested that mink reproduction may be impacted by elevated PCB concentrations in AOC-resident fish. Additional work is recommended to determine if mink in the Eighteenmile Creek AOC and watershed are being affected by PCBs. The *Mink Survey and Exposure Assessment for Eighteenmile Creek AOC and Watershed* project described in Section 2.2.1 also is recommended here because it will provide data relevant to understanding possible mink reproduction problems in the Eighteenmile Creek system.

Table 2-2 PCB Concentrations in Eighteenmile Creek Fish

Sample Set	Species	Number of Samples	Sample Type	Total PCBs (mg/kg)
July 1987 downstream of Burt Dam	Carp	3	Whole fish	mean 9.3
July 1992 downstream of Burt Dam	Largemouth bass	12	Standard Fillet	3.6
	Carp	10	Standard Fillet	6.8
	Smallmouth bass	8	Standard Fillet	1.5
	Brown bullhead	11	Standard Fillet	1.5
July 1992 upstream of Burt Dam	Largemouth bass	11	Standard Fillet	3.8
	Black crappie	12	Standard Fillet	6.5
	White sucker	10	Standard Fillet	3.2
	Northern pike	3	Standard Fillet	5.2
	Rock bass	3	Standard Fillet	2.3
	Walleye	1	Standard Fillet	6.7
	Channel catfish	2	Standard Fillet	15.3

2 BUI and Projects/Actions to Address Impairments

Table 2-2 PCB Concentrations in Eighteenmile Creek Fish

Sample Set	Species	Number of Samples	Sample Type	Total PCBs (mg/kg)
August 2007 downstream of Burt Dam	Brown bullhead	8	Whole fish	0.89 to 6.1 (mean 3.2)

Source:

NCSWCD 2008; shading added by E&E.

Key:

Bold = Exceeds U.S. Food & Drug Administration (FDA) limit for human consumption of 2 milligrams per kilogram (mg/kg) for PCBs.

NCSWCD = Niagara County Soil and Water Conservation District.

NYSDEC = New York State Department of Environmental Conservation.

PCB = Polychlorinated biphenyl.

Shading = Exceeds NYSDEC fish flesh criterion (0.11 mg/kg) for total PCBs for protection of piscivorous wildlife against carcinogenic and non-carcinogenic effects (Newell et al. 1987).

2.3.2 Criterion 2: Bioaccumulative Chemicals in Bottom-Dwelling Fish Do Not Exceed Levels Established to Protect Fish-Eating Wildlife

PCB levels in bullheads collected from the Eighteenmile Creek AOC were found to be great enough to adversely affect reproduction of piscivorous mammals (i.e., mink; E & E 2009b). In addition, all fish analyzed from Eighteenmile Creek since 1987 exceed the NYSDEC fish flesh criterion for total PCBs for protection of fish-eating wildlife (0.11 milligrams per kilogram [mg/kg]) by an order of magnitude or more (see Table 2-1). As noted in Section 2.1, elevated PCB levels in fish in Eighteenmile Creek are the result of elevated PCB levels in sediment, especially the large inventory of PCBs in sediment above Burt Dam and in the Corridor Site in Lockport, New York. Remediation of these sources is critical to satisfying this delisting criterion. Therefore, the six projects recommended to address BUI #1 (Restrictions on Fish and Wildlife Consumption; see Section 2.1) also are recommended here.

Recommended Actions

1. *Inactive Hazardous Waste Site Remediation: Eighteenmile Creek Corridor (Site 932121) and Former Flintkote Plant (Site B-00161-9).*
2. *Sediment Remediation Feasibility Study (FS) and Remedial Design (RD) for Eighteenmile Creek.*
3. *Remediation of In-stream Contaminated Sediments.*
4. *Baseline Sampling and Long-term, Post-remediation Monitoring of Fish from Different Trophic Levels.*
5. *Pilot Study on Treatment of Contaminated Sediments with Powdered Activated Carbon to Reduce PCB Bioavailability.*

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6. *Use of the Trophic TraceModel (TTM, Gustavson et al. 2010) to Establish Sediment Remedial Goals for PCBs in Eighteenmile Creek.*

2.3.3 Criterion 3: Bioaccumulative Chemicals in Sediment Do Not Exceed NYSDEC Criteria for Adverse Effects on Wildlife

PCB levels in surface sediment from Eighteenmile Creek greatly exceed the NYSDEC (1999) PCB sediment bioaccumulation criterion for wildlife protection (0.014 mg/kg for 1% organic carbon). The exceedance of the criterion is generally greatest in the portion of the creek immediately downstream from the Corridor Site in Lockport, New York, where the average surface sediment total PCB concentration is 9.7 mg/kg (see Appendix A.2). However, surface sediment in all other reaches of the creek also exceeded the criterion (see Appendix A.2). Remediation of upstream PCB source areas and of sediment throughout the creek is critical to satisfying this delisting criterion. Therefore, the projects recommended to address BUI #1 (Restrictions on Fish and Wildlife Consumption; see Section 2.1) also are recommended here.

Recommended Actions

1. *Inactive Hazardous Waste Site Remediation: Eighteenmile Creek Corridor (Site 932121) and Former Flintkote Plant (Site B-00161-9).*
2. *Sediment Remediation Feasibility Study (FS) and Remedial Design (RD) for Eighteenmile Creek.*
3. *Remediation of In-Stream Contaminated Sediments.*
4. *Baseline Sampling and Long-term, Post-remediation Monitoring of Fish from Different Trophic Levels.*
5. *Pilot Study on Treatment of Contaminated Sediments with Powdered Activated Carbon to Reduce PCB Bioavailability.*
6. *Use of the Trophic Trace Model (TTM, Gustavson et al. 2010) to Establish Sediment Remedial Goals for PCBs in Eighteenmile Creek.*

Two additional projects identified by NCSWCD (2010) in the *December 2010 Addendum to the Stage 1/2 RAP* are included under this delisting criterion because they will help reduce inputs of bioaccumulative chemicals and other substances to Eighteenmile Creek. These projects are:

1. *Continued Discharge Permit Monitoring and Renewal (State Pollution Discharge Elimination System [SPDES]). Cost estimate: Not provided.* NYSDEC runs the SPDES program in New York State currently and is expected to continue doing so.

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2. *Inactive Hazardous Waste Site Remediation: Upper Mountain Road—Site #932112.* Cost estimate: \$681,000 to \$8,818,000. Data collected by NYSDEC (2007a) during the site investigation suggests that the Old Upper Mountain Road Site is a contaminant contributor to Eighteenmile Creek. A wide range of contaminants including volatiles, PAHs and other semivolatiles, metals, pesticides, and PCBs are present in site soils at levels in excess of NYSDEC cleanup standards. E & E suspects that the cost to remediate the Upper Mountain Road site will be similar to the cost of remediation of one to two OUs at the Eighteenmile Creek Corridor site. Estimated remedial costs for the Corridor Site range from \$681,000 for OU 5 (White Transportation Property) to \$8,818,000 for OU 1 (Eighteenmile Creek and Millrace) (see Section 2.1).

2.4 BUI #6 -- Degradation of Benthos

Available benthic community data from the NYSDEC Rotating Integrated Basin Study (RIBS) program are insufficient to determine with confidence the true status of this BUI in the Eighteenmile Creek AOC (NYSDEC 2007b). Nonetheless, impairment is suspected based on the ubiquitous nature of sediment contamination in the Eighteenmile Creek watershed. Also, a recent investigation by Makarewicz and Lewis (2010) identified significant ongoing sources of nutrients and total suspended solids (TSS) to the Eighteenmile Creek watershed. Some nutrients (e.g., unionized ammonia-nitrogen) can be toxic to benthic life under certain conditions. High TSS can adversely affect benthic organisms by smothering their habitat. There are three delisting criteria for this BUI. Two of the criteria are based on benthic community composition and one criterion is based on sediment toxicity. Only one of the three criteria needs to be satisfied to delist this BUI; however, a single well-designed project could provide the data needed to evaluate all three criteria. Two such projects are described below.

Recommended Actions

1. *Baseline Sampling and Long-term, Post-remediation Monitoring of the AOC Benthic Community.* Cost estimates: \$41,570 (baseline) and \$33,320 (post-remedial). The costs of baseline sampling and one round of long-term, post-remedial sampling are estimated to be \$41,570 and \$33,320, respectively. The estimate for post-remedial sampling is less than the estimate for baseline sampling because the SAP prepared for baseline sampling will be useful for post-remedial sampling with little or no modification. This action will examine benthic macroinvertebrate community composition, sediment toxicity, and sediment chemistry at three locations in the AOC. Additional details and support for this cost estimate are provided in Appendix B.8.
2. *Continued RIBS Assessments in the AOC with Modification as Appropriate to Collect Data Required to Advance Delisting.* Cost Estimate: \$1,800. The NYSDEC RIBS sampling program does not evaluate benthic community composition or sediment toxicity in the Eighteenmile Creek AOC (NYSDEC 2007b). However, E & E understands that NYSDEC is open to suggestions regarding improving the program to better meet the needs of the public. For

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this project, E & E will prepare a brief technical memorandum to NYSDEC proposing modifications to the RIBS sampling program in Eighteenmile Creek so that the resulting RIBS data better support the BUI delisting process. The cost estimate for this task will include the time (12 hours at \$150 per hour) needed to prepare the memorandum and communicate with NCSWCD and NYSDEC regarding the recommendations. We expect that the memorandum will be provided to the Eighteenmile Creek RAP Coordinator, who will forward the memorandum to NYSDEC.

In addition, because sediment quality in the AOC is impaired as a result of the widespread sediment contamination in areas upstream from the AOC, the six projects described in Section 2.1 also are relevant to the eventual delisting of this BUI. These projects are:

1. *Inactive Hazardous Waste Site Remediation: Eighteenmile Creek Corridor (Site 932121) and Former Flintkote Plant (Site B-00161-9).*
2. *Sediment Remediation Feasibility Study (FS) and Remedial Design (RD) for Eighteenmile Creek.*
3. *Remediation of In-stream Contaminated Sediments.*
4. *Baseline Sampling and Long-term, Post-remediation Monitoring of Fish from Different Trophic Levels.*
5. *Pilot Study on Treatment of Contaminated Sediments with Powdered Activated Carbon to Reduce PCB Bioavailability.*
6. *Use of the Trophic Trace Model (TTM, Gustavson et al. 2010) to Establish Sediment Remedial Goals for PCBs in Eighteenmile Creek.*

Also relevant to the eventual delisting of this BUI are the last two projects listed in Section 2.3.3; these projects are:

1. *Continued Discharge Permit Monitoring and Renewal (SPDES).*
2. *Inactive Hazardous Waste Site Remediation: Upper Mountain Road—Site #932112.*

2.5 BUI #7 -- Restrictions on Dredging Activities

Dredge spoils from the AOC are not suitable for open-lake disposal or beneficial uses because of elevated levels of PCBs and metals. Elevated concentrations of these contaminants in AOC sediments are the result of upstream sources, primarily the large inventory of PCBs and metals in sediment above Burt Dam and in the Lockport Corridor Site, contributions from inactive hazardous waste sites, and potential contributions from ongoing, regulated discharges. Remediation and continued control of these sources are critical to the eventual delisting of this BUI.

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Therefore, the following projects identified and described in Section 2.1 also are recommended to address this beneficial use impairment.

Recommended Actions

1. *Inactive Hazardous Waste Site Remediation: Eighteenmile Creek Corridor (Site 932121) and Former Flintkote Plant (Site B-00161-9).*
2. *Sediment Remediation Feasibility Study (FS) and Remedial Design (RD) for Eighteenmile Creek.*
3. *Remediation of In-stream Contaminated Sediments.* As mentioned in Section 2.1, it is expected that remediation of in-stream sediment will begin within the reach of Eighteenmile Creek closest to the Corridor Site and move progressively downstream, culminating with sediment remediation in the navigational channel of Olcott Harbor. Remediation of the navigational channel will directly address this BUI. Also, it is expected that remediation of this final portion of the creek will be a multiagency effort involving USACE, which has authority for navigational dredging, EPA, which has authority for sediment remediation under the GLLA, and other agencies.
4. *Baseline Sampling and Long-term, Post-remediation Monitoring of Fish from Different Trophic Levels.*
5. *Pilot Study on Treatment of Contaminated Sediments with Powdered Activated Carbon to Reduce PCB Bioavailability.*
6. *Use of the Trophic Trace Model (TTM, Gustavson et al. 2010) to Establish Sediment Remedial Goals for PCBs in Eighteenmile Creek.*

3

Summary of Proposed Actions and Overall Delisting Strategy

Table 3-1 lists the actions identified in Section 2 and shows their relationships to the delisting criteria for each BUI. The actions can be divided into three categories: (1) remediation; (2) monitoring and assessment; and (3) other. E & E assigned a score to each action. The score equals the tally of the “X”s in the delisting criteria columns in Table 3-1. The maximum score is 11, which corresponds to the number of delisting criteria for the five Eighteenmile Creek BUIs. The remediation projects all received high scores, 8 or 9, because these actions address the cause of most of the BUIs (i.e., PCB-contaminated sediments). The assessment and monitoring actions received comparatively low scores, except for the fish monitoring action. Fish tissue analysis is a good indicator of PCB contamination in aquatic systems and therefore the fish monitoring action will provide a measure of the effectiveness of remedial actions in reducing PCB levels in Eighteenmile Creek sediments. The two actions in the other category also received comparatively low scores. A low score indicates that a project addresses only a few, but not all, of the delisting criteria. All of the projects identified in this report are important for BUI delisting and, eventually, delisting of the AOC as a whole.

Table 3-2 presents an approximate schedule for implementing the actions identified above. In essence, Table 3-2 represents the overall strategy for delisting the individual BUIs and, eventually, the Eighteenmile Creek AOC as a whole. The following actions are recommended:

- It is recommended that remediation of the Eighteenmile Creek Corridor Site and Former Flintkote Plant Site be undertaken before remediation of in-stream contaminated sediments. Because acceptable remedial alternative plans for these sites have been proposed (NYSDEC 2010b, 2006b), it is anticipated that the actual remediation of these sites can be conducted within the next approximately six years.
- It is recommended that the FS and RD for the Upper Mountain Road site be completed within the next approximately three years and site remedial work be completed within three years thereafter.

3 Summary of Proposed Actions and Overall Delisting Strategy

- It is recommended that an FS and RD for contaminated sediment in Eighteenmile Creek, excluding the Corridor Site, be developed during the next approximately six years, concurrent with remediation of the Eighteenmile Creek Corridor Site, Former Flintkote Plant Site, and Upper Mountain Road Site.
- We recommend that two actions—use of the TrophicTrace model to develop a sediment remedial goal for Eighteenmile Creek and a pilot study on treatment of sediment with PAC to reduce PCB bioavailability—can be implemented within the next two years. Both actions will provide data useful for developing remedial alternatives for the FS/RD for in-stream contaminated sediments in Eighteenmile Creek.
- Remediation of in-stream contaminated sediment is assumed to begin as soon as possible after the FS/RD for in-stream contaminated sediment is developed and HWS remediation in Lockport, New York, is completed.
- It is expected that the mink survey and exposure assessment project can be completed in either 2011 or 2012. This project is designed to be completed over the course of a calendar year. It should be noted that USACE is currently preparing a factsheet for a potential project for Western Lake Ontario regional stakeholders entitled *Survey for Levels of Bioaccumulative Chemicals in Wildlife Prey and Tissues and Wildlife Deformities within Western Lake Ontario and its Tributaries*, which, if completed, should satisfy the data needs of the Bird or Animal Deformities BUI.
- Baseline sampling of fish from different trophic levels and baseline benthic-community sampling should be implemented before the onset for remedial work at HWSs in Lockport, New York. Long-term monitoring of fish and benthos should be implemented every five years after baseline sampling.
- Three ongoing NYSDEC programs—continued RIBS assessments, annual fish stocking, and SPDES discharge permit monitoring and renewal—are assumed to continue indefinitely to provide ongoing stewardship for the Eighteenmile Creek system. Currently, it is unknown if the RIBS program can be modified by NYSDEC to include a sample location in the Eighteenmile Creek AOC. If not, then all future benthic community data for the AOC will come from the *Baseline Sampling and Long-term Monitoring of the AOC Benthic Community* project (see Section 2.4 and Appendix B.8).
- Lastly, after baseline monitoring and each round of long-term monitoring of fish and benthos, the RAC should re-evaluate the status of each BUI based on new data and recommend delisting BUIs, if appropriate. Revision of delisting criteria, if appropriate and desirable, may be considered at these points in the overall process.

Table 3-1 Summary of Relationships Between Proposed Actions and BUIs for Eighteenmile Creek

Action	Score*	BUI 1: Restrictions on Fish and Wildlife Consumption		BUI 3: Degradation of Fish and Wildlife Populations		BUI 5: Bird or Animal Deformities or Reproductive Problems			BUI 6: Degradation of Benthos			BUI 7: Restrictions on Dredging
		Criterion 1	Criterion 2	Criterion 1	Criterion 2	Criterion 1	Criterion 2	Criterion 3	Criterion 1	Criterion 2	Criterion 3	Criterion 1
		No AOC-specific advisories	No upstream causes of impairment	Wildlife diversity & abundance in AOC similar to reference area	PCB levels in bottom-dwelling fish less than 440 µg/kg	No reports of deformities	Chemical residues in fish < NYSDEC fish flesh criteria	Chemical levels in sediment < NYSDEC fish & wildlife bioaccumulation sediment criteria	Non-impacted or slightly impacted benthic community	Acceptable species richness, EPT richness, and other metrics.	No toxicity compared with controls	No restrictions on dredging or disposal of dredged sediment
Remediation												
FS and RD for Remediation of In-stream Contaminated Sediments	9	X	X		X		X	X	X	X	X	X
Inactive HWS Remediation: Upper Mountain Road (Site 932112)	8	X	X		X			X	X	X	X	X
Inactive HWS Remediation: Corridor Site (Site 932121) and Flintkote (B-00161-9)	9	X	X		X		X	X	X	X	X	X
Pilot Study on Treatment of Contaminated Sediments with PAC to Reduce PCB Bioavailability	9	X	X		X		X	X	X	X	X	X
Remediation of In-stream Contaminated Sediments	9	X	X		X		X	X	X	X	X	X
Use TTM to Establish Sediment Remedial Goals for PCBs in Eighteenmile Creek	9	X	X		X		X	X	X	X	X	X
Monitoring and Assessment												
Mink Survey and Exposure Assessment for Eighteenmile Creek AOC and Watershed	2			X		X						
Baseline Sampling and Long-term Monitoring of Fish from Different Trophic Levels	9	X	X		X		X	X	X	X	X	X
Baseline Sampling and Long-term Monitoring of the AOC Benthic Community	3								X	X	X	
Continued NYSDEC RIBS Assessments with Modifications to Include AOC	3								X	X	X	

Table 3-1 Summary of Relationships Between Proposed Actions and BUIs for Eighteenmile Creek

Action	Score*	BUI 1: Restrictions on Fish and Wildlife Consumption		BUI 3: Degradation of Fish and Wildlife Populations		BUI 5: Bird or Animal Deformities or Reproductive Problems			BUI 6: Degradation of Benthos			BUI 7: Restrictions on Dredging
		Criterion 1	Criterion 2	Criterion 1	Criterion 2	Criterion 1	Criterion 2	Criterion 3	Criterion 1	Criterion 2	Criterion 3	Criterion 1
		No AOC-specific advisories	No upstream causes of impairment	Wildlife diversity & abundance in AOC similar to reference area	PCB levels in bottom-dwelling fish less than 440 µg/kg	No reports of deformities	Chemical residues in fish < NYSDEC fish flesh criteria	Chemical levels in sediment < NYSDEC fish & wildlife bioaccumulation sediment criteria	Non-impacted or slightly impacted benthic community	Acceptable species richness, EPT richness, and other metrics.	No toxicity compared with controls	No restrictions on dredging or disposal of dredged sediment
Other												
Continued Annual Fish Stocking and Rearing	1			X								
Continued SPDES Discharge Permit Monitoring and Renewal	4							X	X	X	X	

Note:
* Score is based on a tally of the Xs in the delisting criteria columns; maximum value is 11.

Key:

- AOC = Area of Concern.
- BUI = Beneficial Use Impairment.
- EPT = Ephemeroptera, Plecoptera, Trichoptera
- FS = Feasibility Study.
- HWS = Hazardous Waste Site.
- < = less than.
- NYSDEC = New York State Department of Environmental Conservation.
- PAC = powdered activated carbon.
- PCBs = polychlorinated biphenyls.
- RD = Remedial Design.
- RIBS = Rotating Integrated Basin Studies.
- SPDES = State Pollutant Discharge Elimination System.
- TTM = TrophicTrace model.
- µg/kg = micrograms per kilogram.

Table 3-2 Action Implementation Strategy for the Eighteenmile Creek AOC.

Action	Year (approximate)																			Remarks
	2011	2012	2013	2014	2015	2016	2017	2018	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027		
Remediation																				
FS and RD for Remediation of In-stream Contaminated Sediments																				Occurs during HWS remediation in Lockport; may require < 5 years.
Inactive HWS Remediation: Eighteenmile Creek Corridor (Site 932121) and Flintkote (B-00161-9)																				Recommended that remedial work be implemented in the next 6 years.
Inactive HWS Remediation: Upper Mountain Road (Site 932112)																				FS/RD preparation from 2011 to 2013 with remediation from 2014 to 2016 recommended.
Pilot Study on Treatment of Contaminated Sediments with PAC to Reduce PCB Bioavailability																				Implementation in 2011or 2012 recommended.
Remediation of In-stream Contaminated Sediments																				Implementation assumed to require 5 years.
Use TTM to Establish Sediment Remedial Goals for PCBs in Eighteenmile Creek																				Implementation in 2011or 2012 recommended.
Monitoring and Assessment																				
Mink Survey and Exposure Assessment for Eighteenmile Creek AOC and Watershed																				To be implemented in 2011 or 2012, if WLO factsheet project* does not proceed.
Baseline Sampling and Long-term Monitoring of Fish from Different Trophic Levels																				Baseline sampling to occur before HWS remediation; with monitoring every 5 years thereafter.
Baseline Sampling and Long-term Monitoring of the AOC Benthic Community																				Baseline sampling to occur before HWS remediation; with monitoring every 5 years thereafter.
Continued NYSDEC RIBS Assessments with Modifications to Include AOC Sampling**																				Ongoing NYSDEC program assumed to continue, with sampling every 5 years.
Other																				
Continued Annual Fish Stocking and Rearing																				Ongoing NYSDEC program assumed to continue.
Continued SPDES Discharge Permit Monitoring and Renewal																				Ongoing NYSDEC program assumed to continue.
BUI Status Check																				
Evaluate Attainment of Delisting Criteria and Delist BUIs as Appropriate																				Do after each round of sampling.

Key:

- AOC = Area of Concern.
- BUI = Beneficial Use Impairment.
- FS = Feasibility Study.
- HWS = Hazardous Waste Site.
- NYSDEC = New York State Department of Environmental Conservation.
- PAC = powdered activated carbon.
- PCBs = polychlorinated biphenyls.
- RD = Remedial Design.
- RIBS = Rotating Integrated Basin Studies.
- SPDES = State Pollutant Discharge Elimination System.
- TTM = TrophicTrace model.
- WLO = Western Lake Ontario.

Notes:

- Indicates that project is implemented or ongoing during that calendar year.
- * Survey for Levels of Bioaccumulative Chemicals in Wildlife Prey and Tissues and Wildlife Deformities within Western Lake Ontario and its Tributaries.
- ** At this time, it is unknown if NYSDEC will be able to modify the RIBS sampling for Eighteenmile Creek to include a site in the AOC.

4

Conclusions

This report identifies and describes actions that are critical to addressing BUIs in Eighteenmile Creek and provides rough cost estimates for these actions. Based on this exercise, the following conclusions can be drawn:

- The five BUIs at Eighteenmile Creek are largely the result of the large inventory of PCBs in sediment upstream from Burt Dam and subsequent bioaccumulation of PCBs in fish.
- A suite of actions originating at the local, state, and federal levels are required to remediate source areas in Lockport, New York, and in-stream sediments between Lockport and the mouth of the creek at Lake Ontario. Some actions have been taken (e.g., FS/RD for the Eighteenmile Creek Corridor Site and Former Flintkote Plant Site, sediment investigation for Eighteenmile Creek above Burt Dam), but much still remains to be done (see Appendix C for a timeline of previous investigations of Eighteenmile Creek).
- Collectively, the actions identified in this report should be capable of eliminating BUIs in Eighteenmile Creek within 10 to 15 years, if the approximate schedule in Table 3-2 can be followed. The availability of federal and state funds for the large-scale remediation projects that are needed will be a critical factor in deciding whether the schedule can be kept.
- Coordination between local, state, and federal groups under strong local leadership is needed to advance the overall BUI delisting process for Eighteenmile Creek.

5

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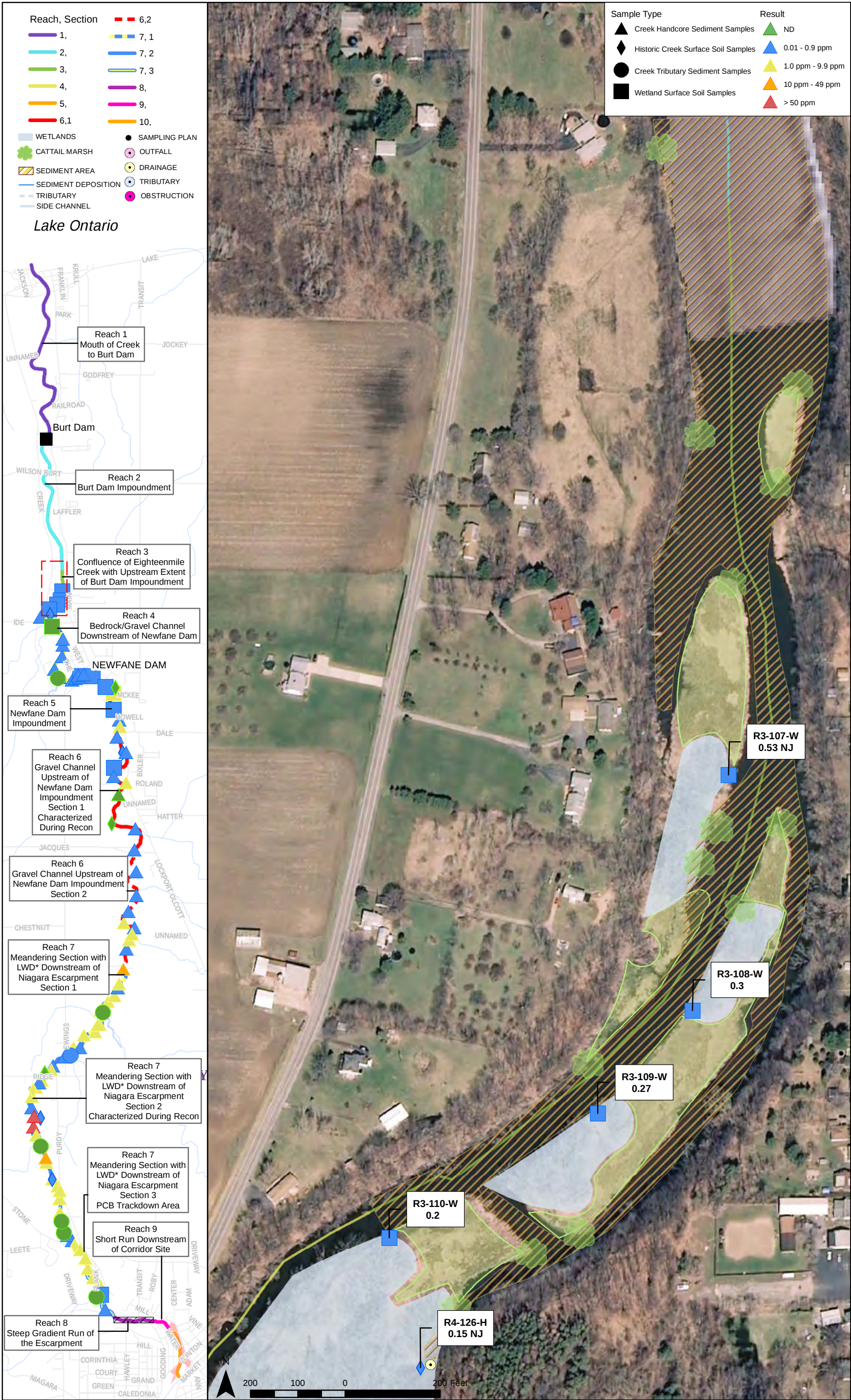
port to the New York Great Lakes Protection Fund, New York State Department of Environmental Conservation (NYSDEC), 270 Michigan Avenue, Buffalo, New York.

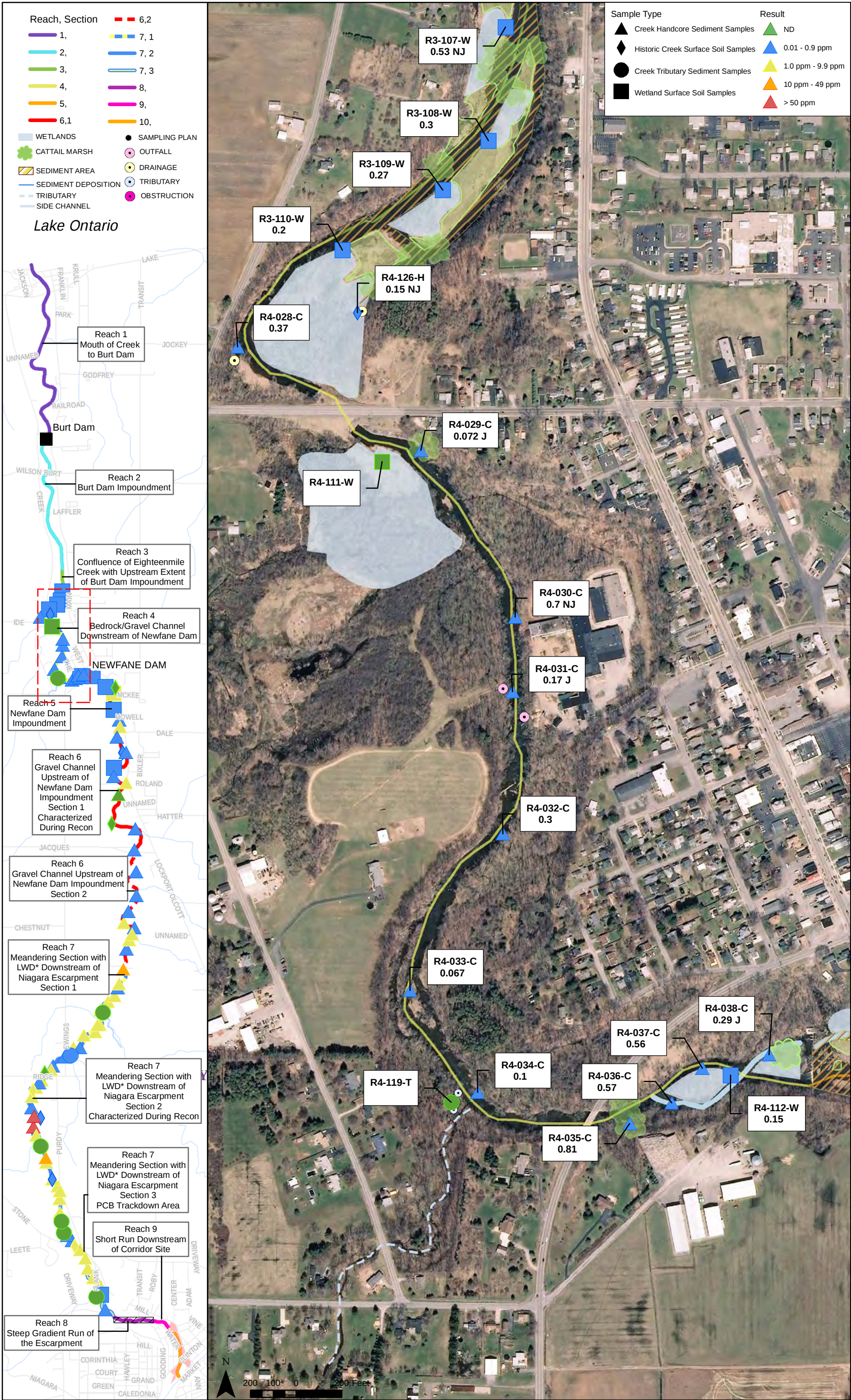
A

Data Summaries from the GLLA Sediment Characterization Study at Eighteenmile Creek

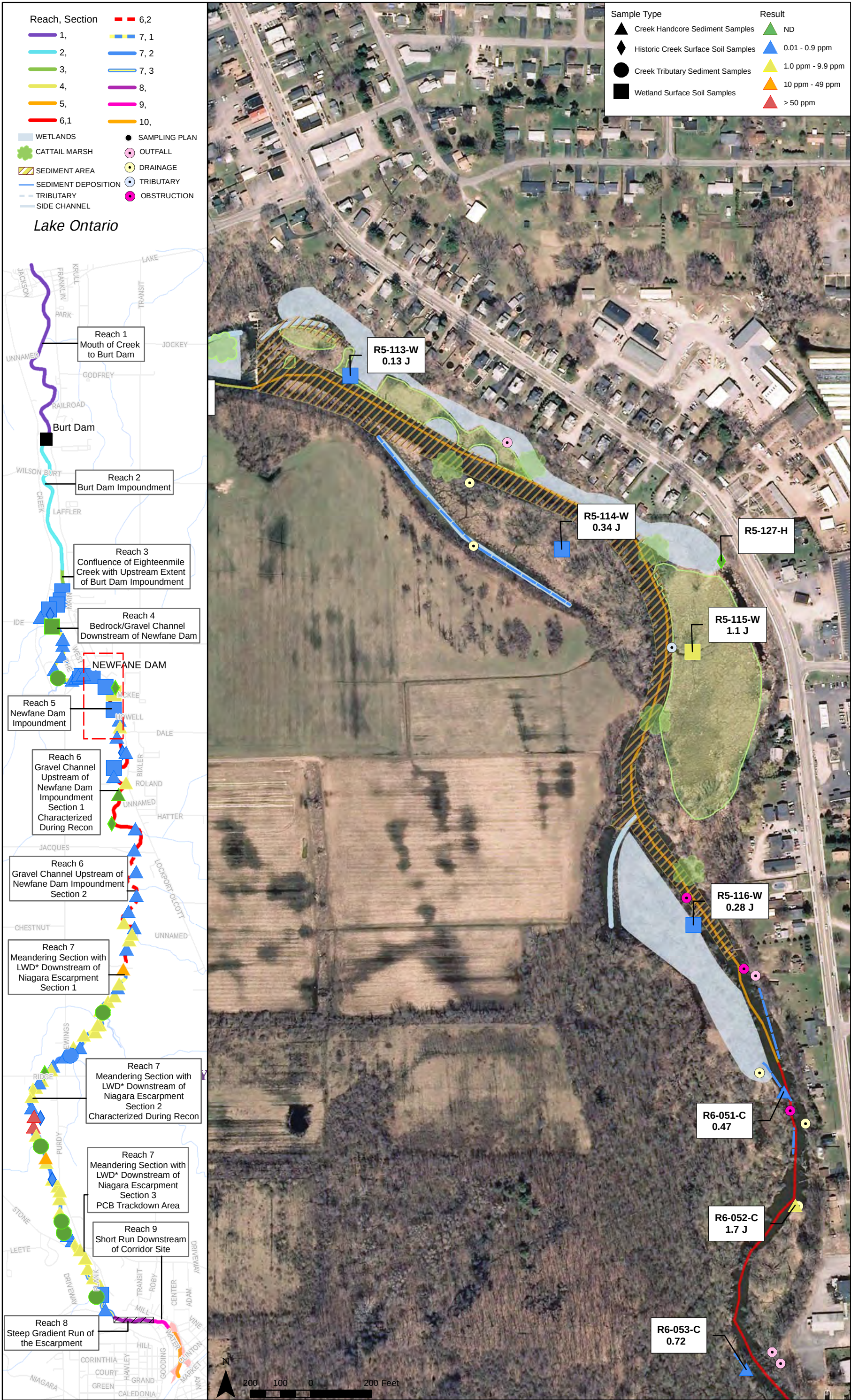
Appendix A: Sediment Data from Recent Investigations

This appendix presents preliminary sediment data for polychlorinated biphenyls (PCBs) and selected metals collected recently (2009 and 2010) from Eighteenmile Creek above Burt Dam. Appendix A.1 presents a series of figures showing total PCB levels in surface sediment. Appendix A.2 includes an abstract and poster presented at the Sixth International Conference on Remediation of Contaminated Sediments in New Orleans, Louisiana from 7 to 11 February 2011.

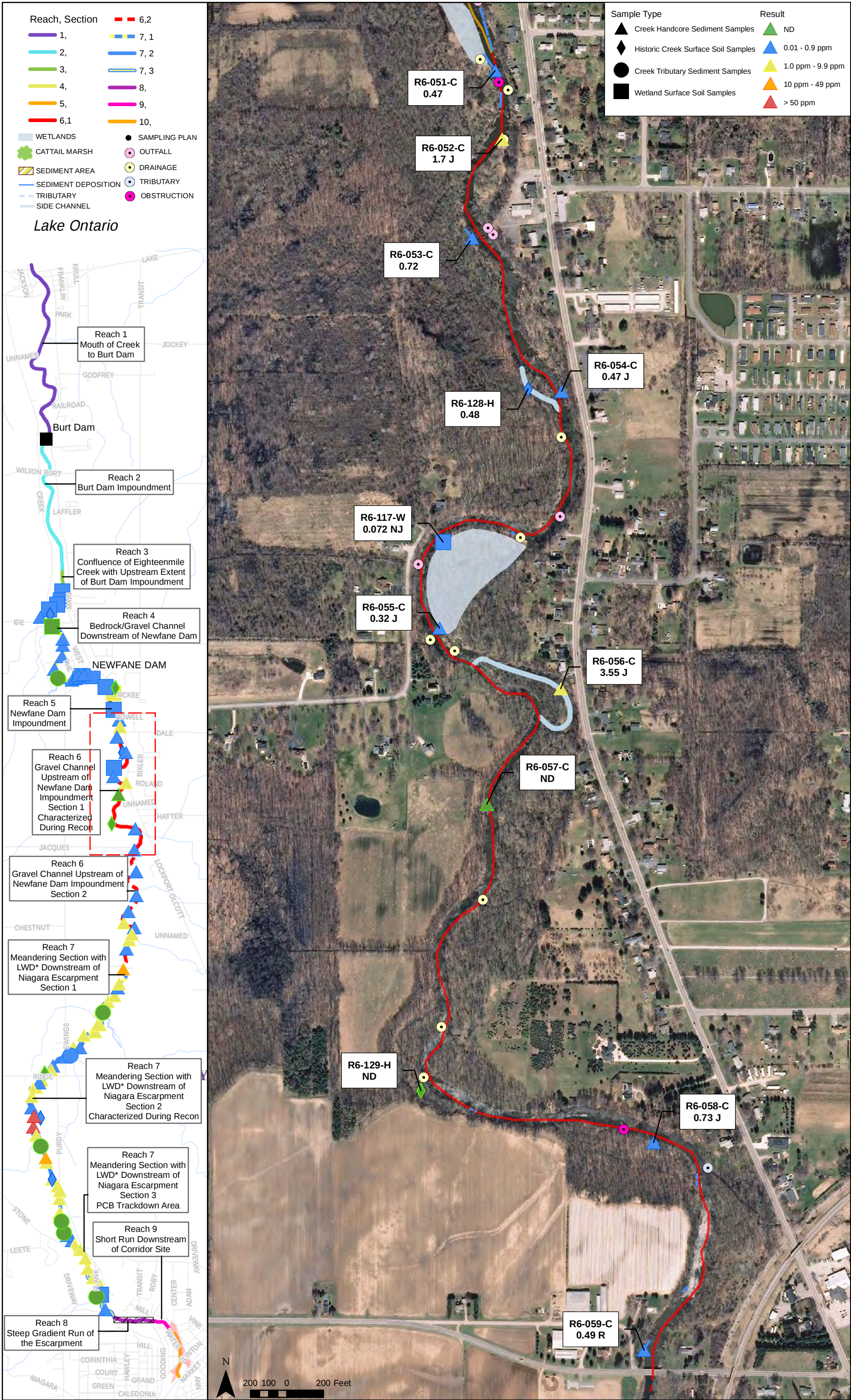




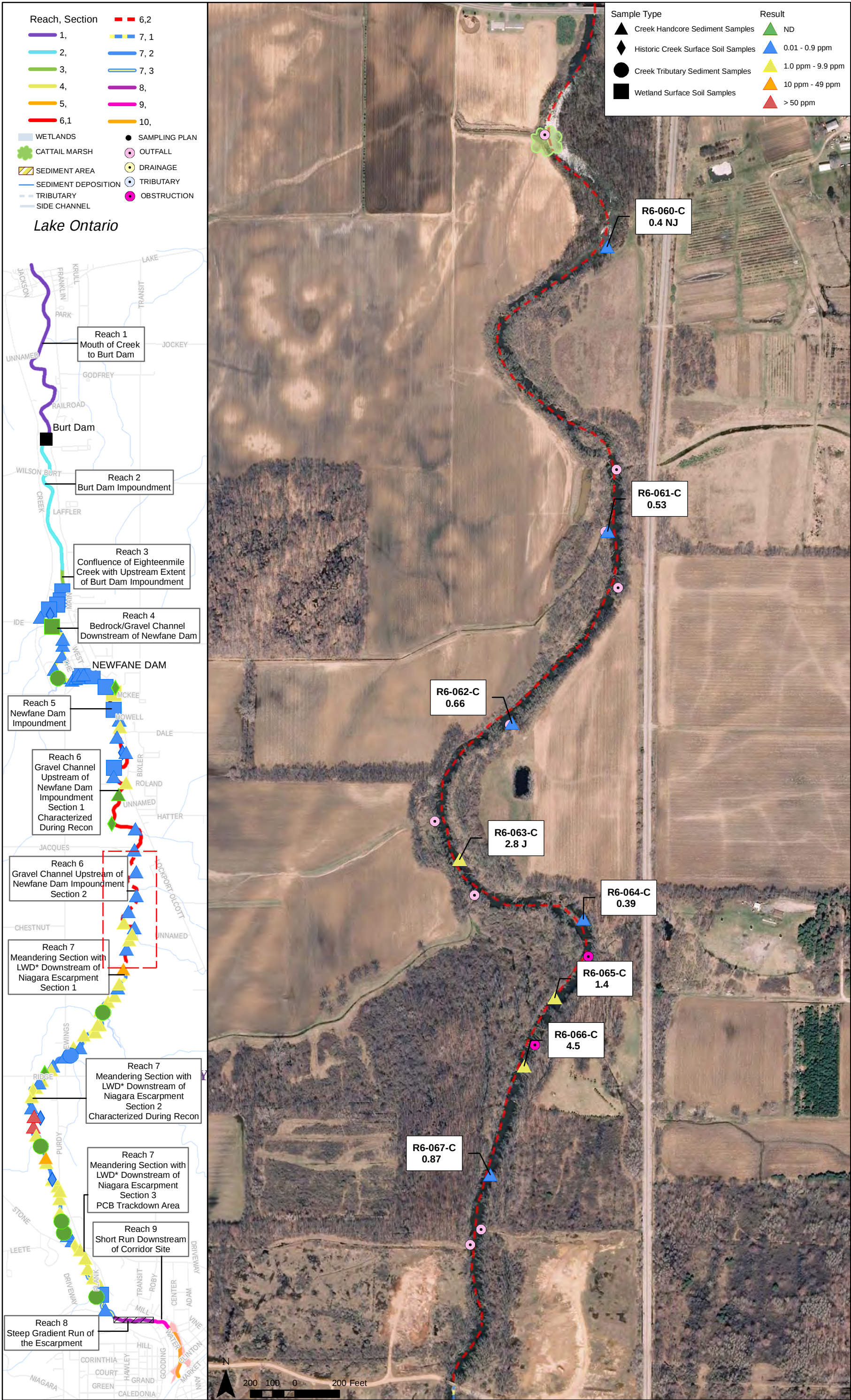
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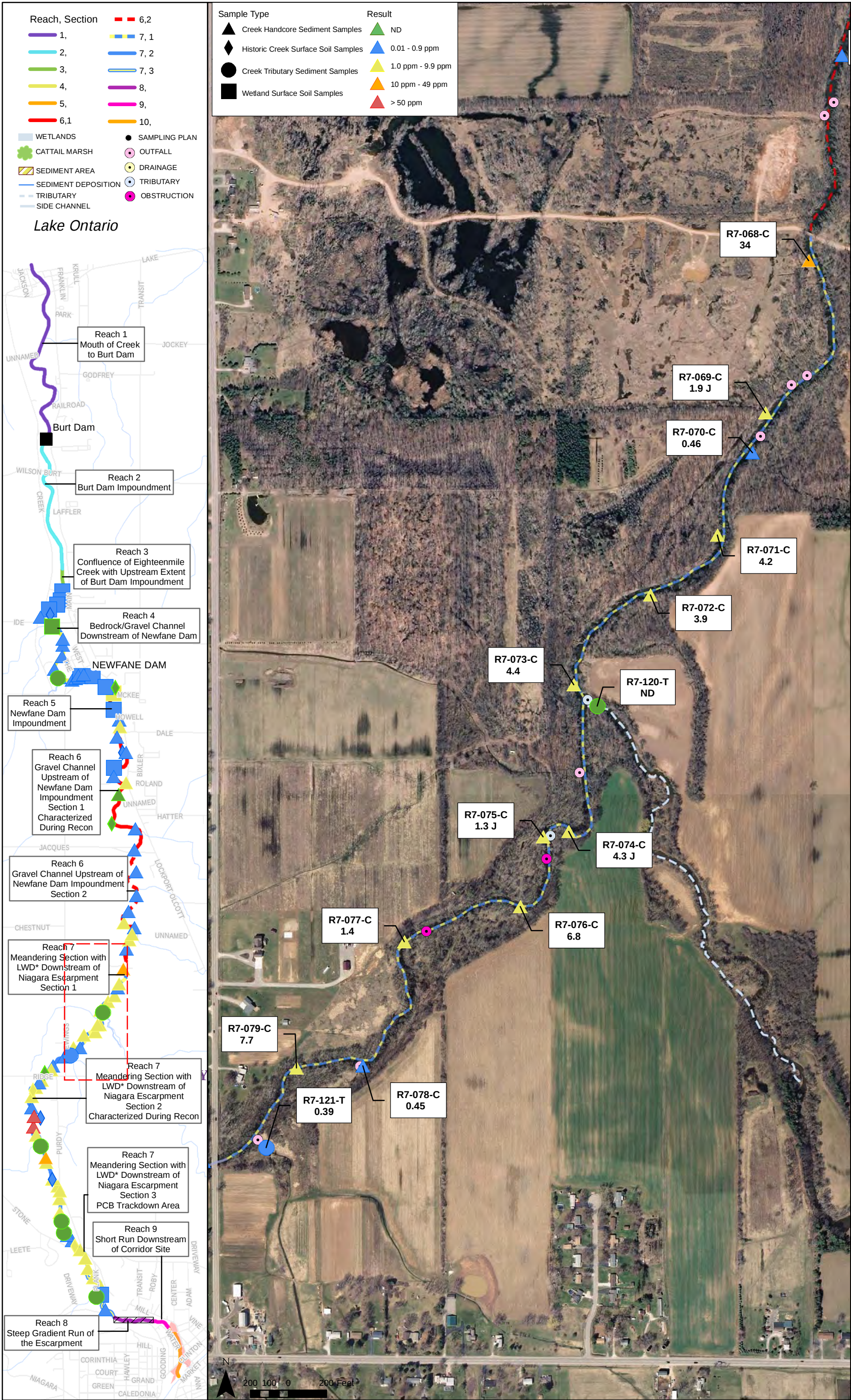
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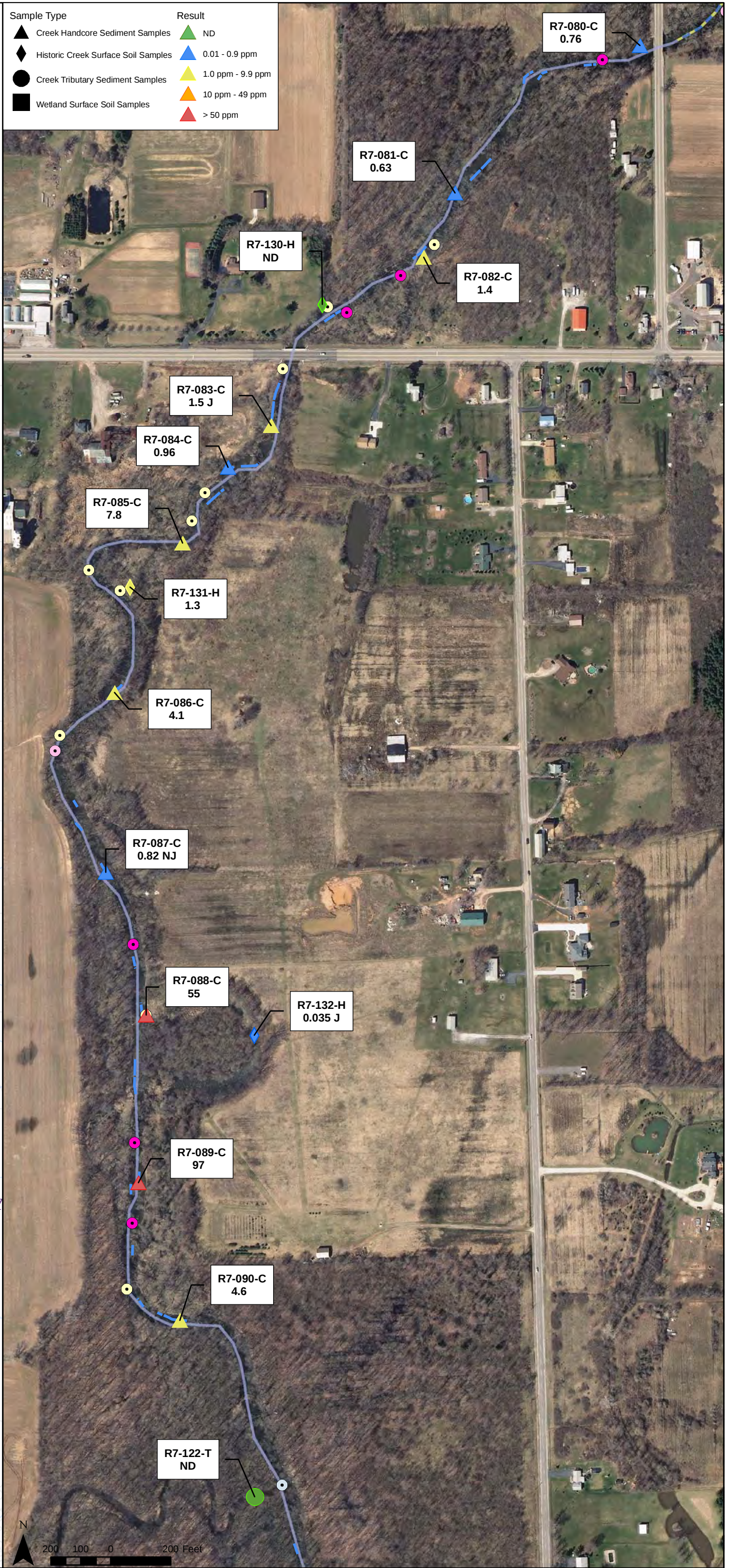
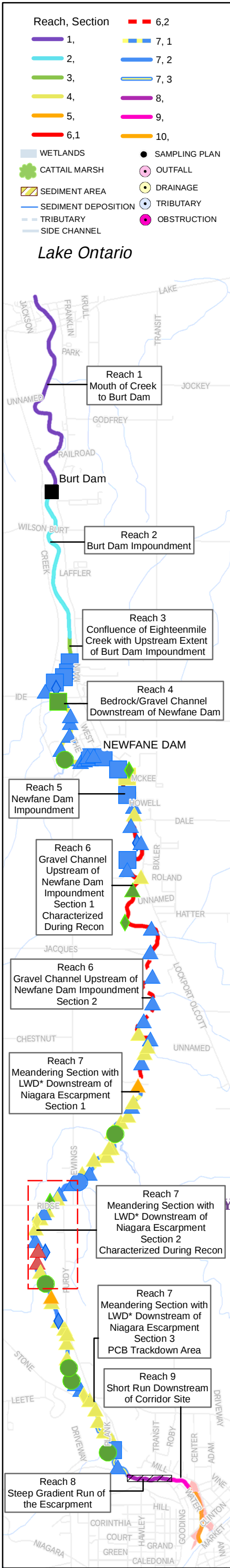
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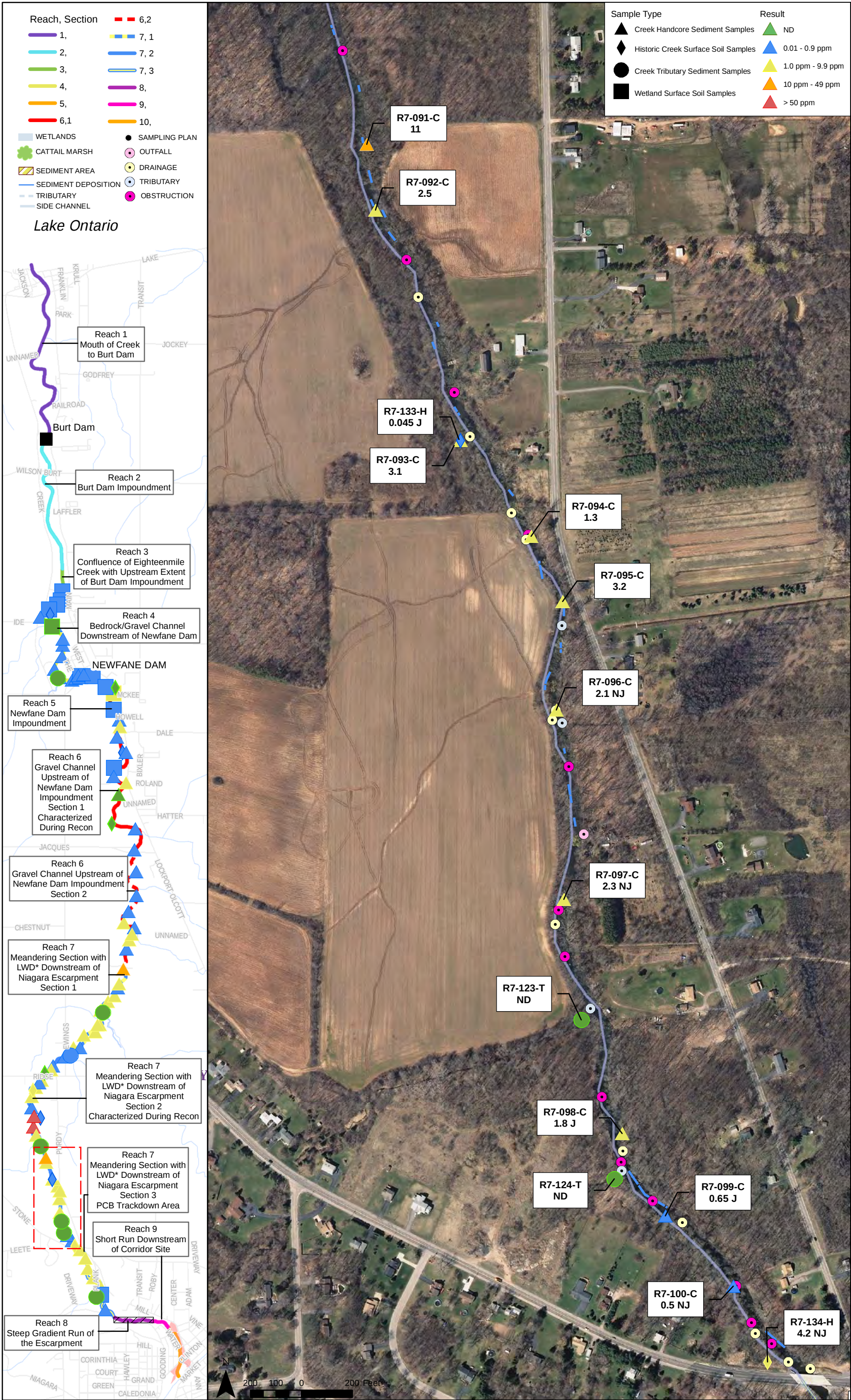
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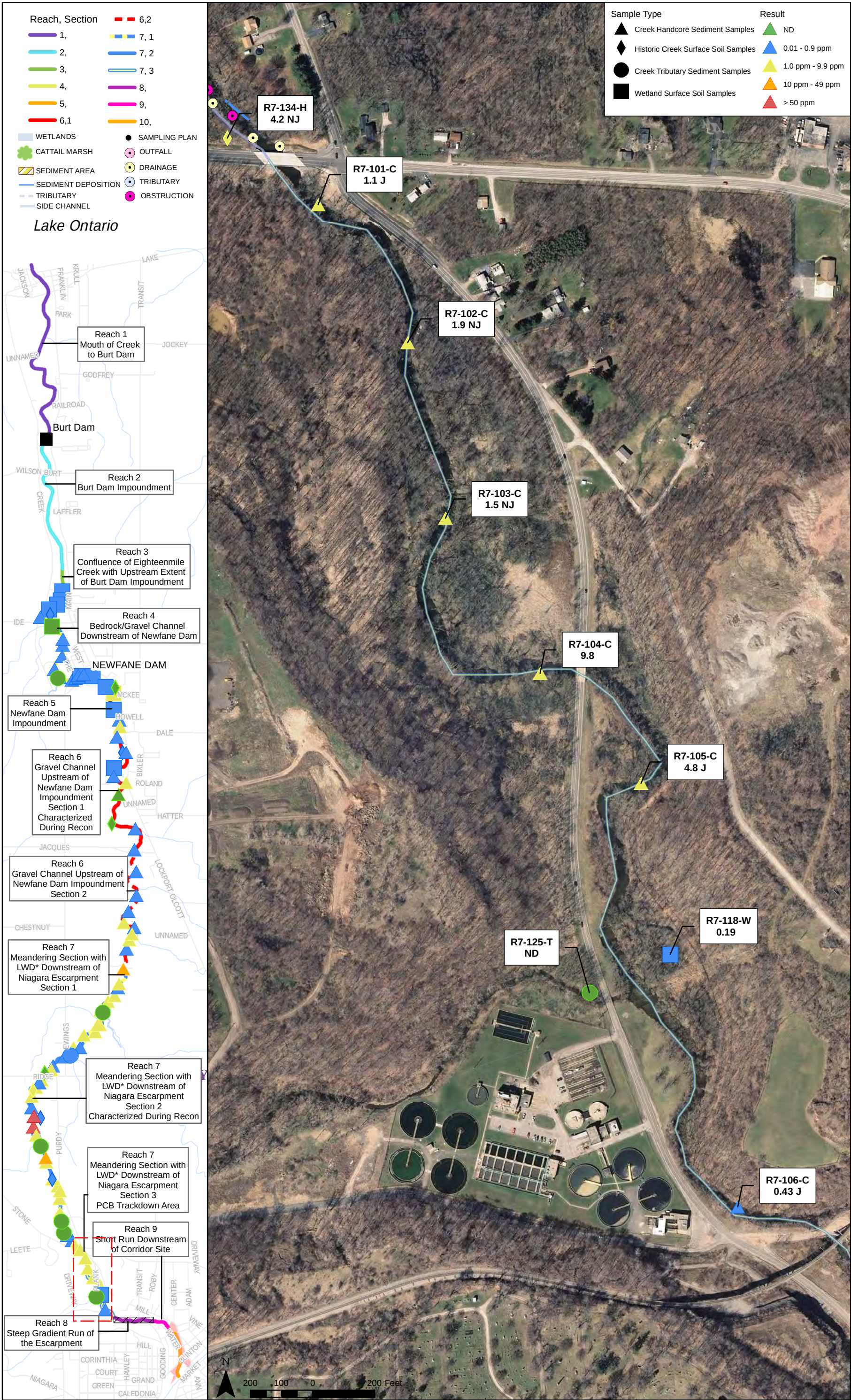
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Reach 7 Section 2 Part 1 2009 Site Characterization PCB Results



Reach 7 Section 2 Part 2 2009 Site Characterization PCB Results



Reach 7 Section 3 2009 Site Characterization PCB Results

Great Lakes Legacy Act Assessment of the Migration of Contaminants from Upstream Sources in the Eighteenmile Creek AOC

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Mitigation of these impacts from contaminated sediments is critical because the AOC is the second most visited fishing destination in the Lake Ontario basin, attracting up to 15,000 anglers annually.

Eighteenmile Creek, Niagara County, New York is designated as a Great Lakes Area of Concern (AOC) on Lake Ontario. The AOC, considered the “Impact Area,” includes Olcott Harbor at the mouth of the creek and extends upstream to Burt Dam, approximately 2 miles south. The “Source Area” extends another 13 miles to Lockport and the New York State (NYS) Barge Canal. Historical investigations indicated that the sediments within the AOC and in the Lockport area are contaminated with PCBs, metals, and PAHs. The U.S. EPA GLNPO Great Lakes Legacy Act (GLLA) site characterization project in the AOC is assessing the migration of contaminants between the ‘Impact Area’ and “Source Area”.

Recent bioaccumulation studies performed in the AOC (“Impact Area”) by the U.S. Army Corps of Engineers (USACE) and under a grant from U.S EPA Region 2 indicate that PCB levels in surficial sediments are highly bioavailable and present a bioaccumulation risk and metal contamination may exert chronic toxicity (USACE, 2004). Concentrations of PCBs in brown bullheads are 10 times greater than background and exceed critical PCB tissue concentrations (E & E, 2009). Characterizing the source of this contamination is critical to addressing impacts on human health, fish, and wildlife and moving the AOC toward delisting.

Delineation of the nature and extent of PCB contamination indicates isolated pockets of high concentrations of contaminated sediment (>50 ppm) interspersed with general mixing of contaminated sediment from upstream to downstream. On average, concentrations in the surface samples are lower than subsurface samples indicating contamination is from historical sources. Data from wetlands, historical creek channels, and tributaries support this conclusion. Concentrations of metals as represented by lead generally follow PCB concentration patterns. PAHs were also found throughout the creek but their concentration showed greater variability and the potential for other ongoing sources. Concentrations of all contaminants exceed various human and ecological risk based screening criteria values by up to a factor of 50.

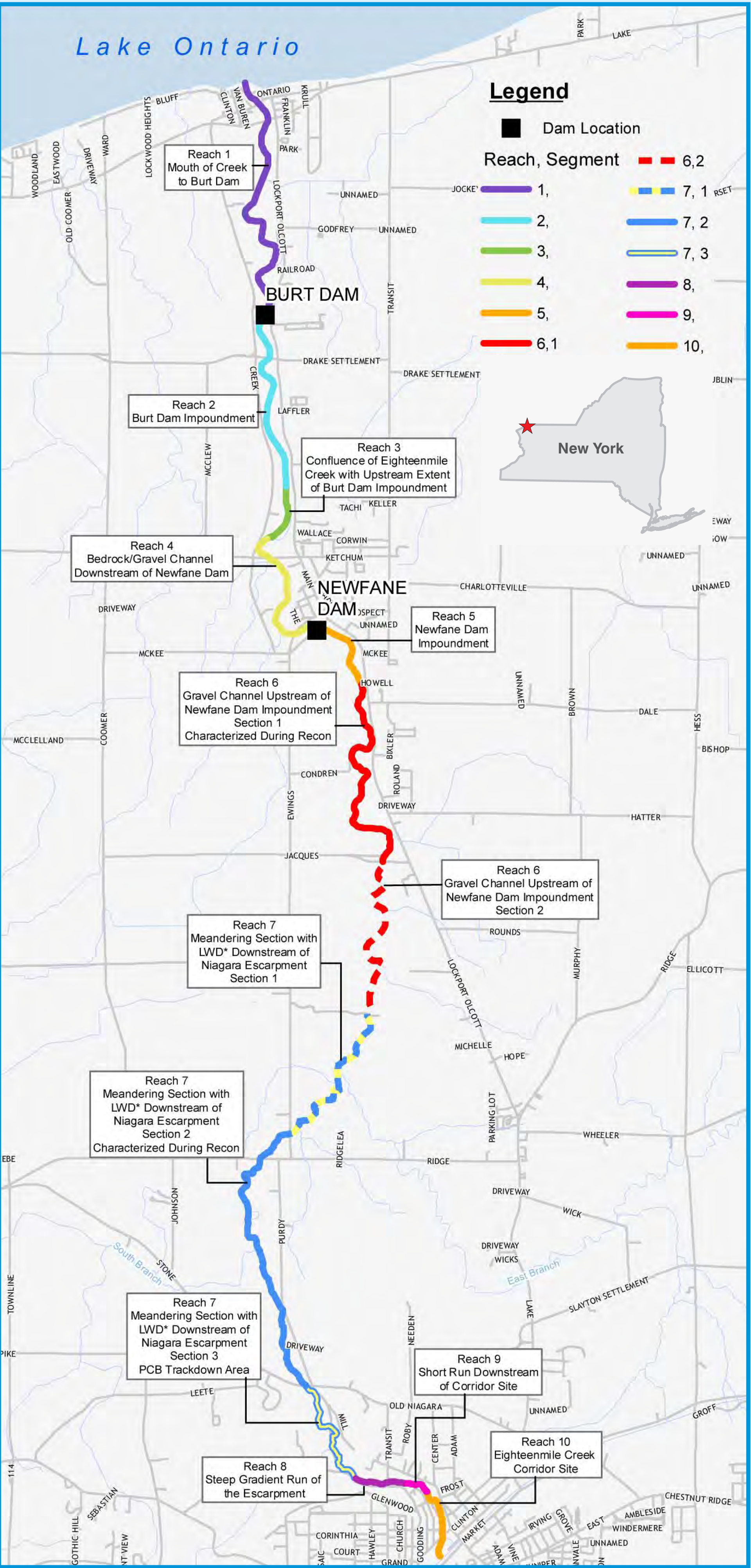
Analysis of remedial alternatives is challenging because of the length of creek, volume of contaminated sediment, and isolated areas of sediment deposition. Location of sediment depositional areas and assessment of impacts of additional flows on sediment transport from the Barge Canal draining and East Branch of the watershed are under investigation.

Average Contaminant Concentrations by Reach

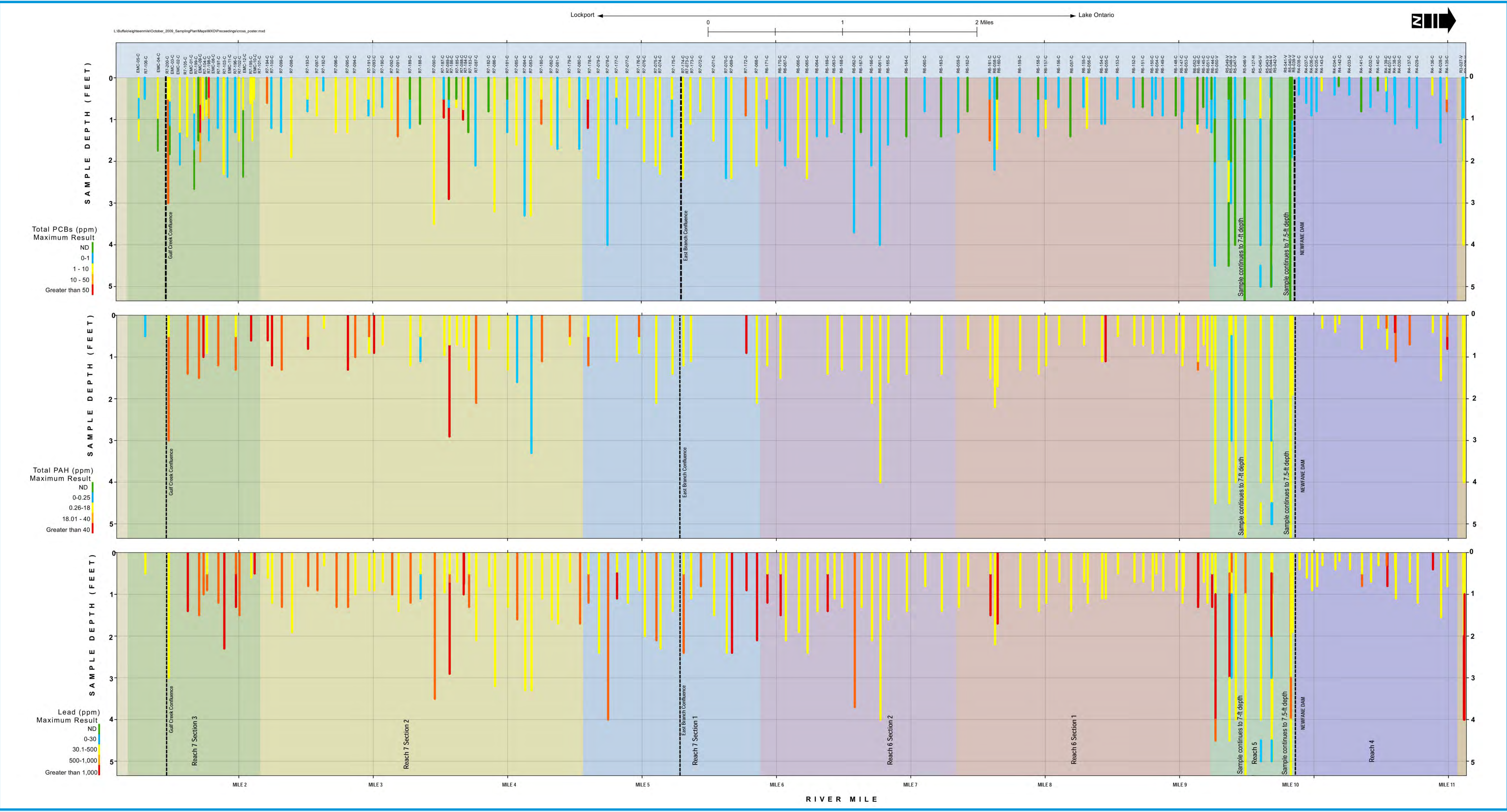
	Surface			Subsurface			Wetlands, Historical Creek Channels and Tributaries		
	PCBs (total) (ug/kg)	PAHs (total) (ug/kg)	LEAD (mg/kg)	PCBs (total) (ug/kg)	PAHs (total) (ug/kg)	LEAD (mg/kg)	PCBs (total) (ug/kg)	PAHs (total) (ug/kg)	LEAD (mg/kg)
R2	410	1800	300	1700	4600	2000	320	2100	380
R3	1300	2900	600	1900	5900	2200	150	1200	130
R4	2400	30000	480	380	21000	270	490	27000	290
R5	340	3600	510	400	1900	790	280	4000	360
R6	330	2700	370	1400	10000	780	770	10000	280
R7	9700	28000	560	7500	34000	720			



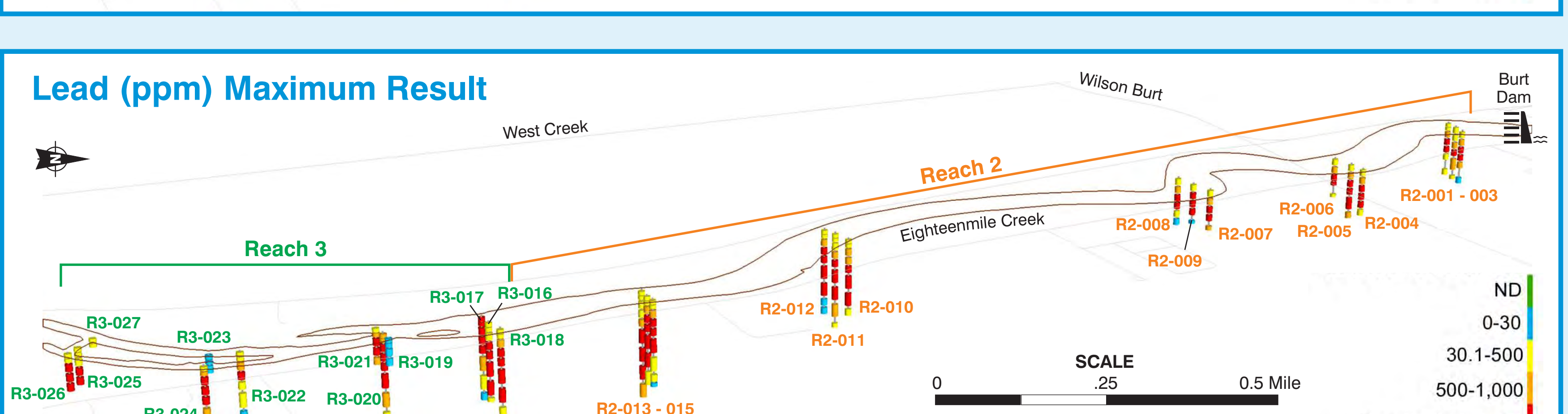
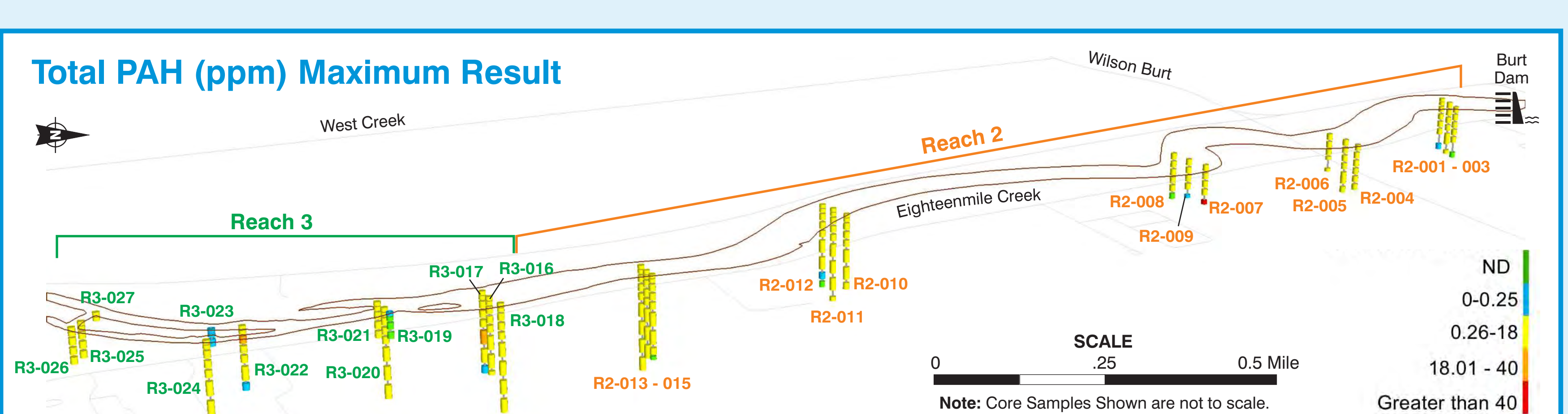
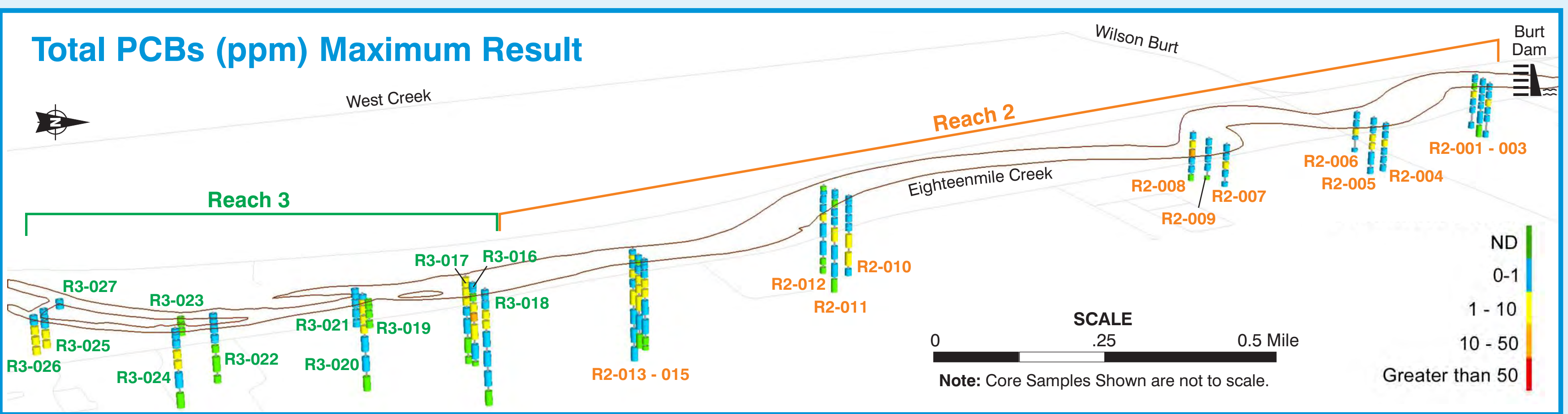
Over 500 samples were collected from 39 vibracore and 166 hand-core/shovel locations. Samples were tested for PCBs, PAHs, and metals contamination.



The GLLA project characterizes 9 miles of shallow creek bed and 1 mile of impoundment behind Newfane Dam. The creek runs through isolated rural areas downstream of the source area and has sediment depths up to 4 feet in the shallow creek bed and 7 feet behind Newfane Dam.



The GLLA project characterizes 2 miles of impoundment behind Burt Dam with water depths ranging from 1.0 to 37 feet and sediment depths up to 12 feet.



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GLLA Assessment of the Migration of Contaminants from Upstream Sources in the Eighteenmile Creek AOC

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Eighteenmile Creek, Niagara County, New York is designated as a Great Lakes Area of Concern (AOC) on Lake Ontario. The AOC, considered the “Impact Area,” includes Olcott Harbor at the mouth of the creek and extends upstream to Burt Dam, approximately 2 miles south. The “Source Area” extends another 13 miles to Lockport and the New York State (NYS) Barge Canal. Historical investigations indicated that the sediments within the AOC and in the Lockport area are contaminated with PCBs, metals, and dioxin. Recent bioaccumulation studies performed in the AOC Impact Area by the U.S. Army Corps of Engineers (USACE) and under a grant from U.S EPA Region 2 indicate that PCB levels in surficial sediments are highly bioavailable and present a bioaccumulation risk and metal contamination may exert chronic toxicity (USACE, 2008). Concentrations of PCBs in brown bullheads are 10 times greater than background and exceed critical PCB tissue concentrations (E & E, 2009). Mitigation of these impacts from contamination sediments are critical because the AOC is the second most visited fishing destination in the Lake Ontario basin, attracting up to 15,000 anglers annually.

The U.S. EPA GLNPO Great Lakes Legacy Act (GLLA) site characterization project in the AOC is assessing the migration of contaminants from the upstream Source Areas. The project builds on the NYS Department of Environmental Conservation (DEC) assessment and proposed remediation plan for the upstream source area adjacent to the NYS Barge Canal. The GLLA project includes characterization of 3 miles of deep sediment in the impoundment behind two dams and 9 miles of shallow creek bed sediment that runs through isolated rural areas downstream of the source area. Results of over 300 samples collected from 39 vibracores and 200 hand cored samples were evaluated for PCBs, PAHs, and metals contamination.

Delineation of the nature and extent of PCB contamination indicate isolated pockets of high concentrations of contaminated sediment (>50 ppm) interspersed with general mixing of contaminated sediment from upstream to downstream. Data from wetlands, historical creek channels and tributaries indicate the source of PCB contamination is limited to upstream areas. PAHs and metals were also found throughout the creek but the concentration showed greater variability and additional sampling to investigate other potential sources is ongoing. PCBs and metals were found at elevated levels in subsurface sediments in the impoundment areas. Concentrations of all contaminants exceed various human and ecological risk based screening criteria values by up to a factor of 50.

Analysis of remedial alternatives is challenging because of the length of creek, volume of contaminated sediment, and isolated areas of sediment deposition. Location of sediment depositional areas and assessment of impacts of additional flows on sediment transport from the canal draining and East Branch of the watershed are under investigation.

B

Cost Estimates

Appendix B

Rough Cost Estimates and Descriptions of Recommended Actions

This appendix presents rough cost estimates and descriptions of recommended actions to advance delisting of beneficial use impairments at Eighteenmile Creek, Niagara County, New York. This appendix includes seven subsections:

- Appendix B.1 -- Remedial Costs for the Eighteenmile Creek Corridor Site and Former Flintkote Plant Site, Lockport, New York.
- Appendix B.2 -- Range of Sediment Remedial Costs for Great Lakes Sediment Sites.
- Appendix B.3 -- Rough Cost Estimate for Baseline Sampling and Long-Term, Post-Remedial Monitoring of Fish from Different Trophic Levels in the Eighteenmile Creek System.
- Appendix B.4 -- Pilot Study on Use of Powdered Activated Carbon to Reduce Bioavailability of Polychlorinated Biphenyls (PCBs) in Eighteenmile Creek Sediment.
- Appendix B.5 -- Rough Cost Estimate for Use of TrophicTrace Model to Establish Site-specific Sediment Remedial Goals for PCBs in Eighteenmile Creek.
- Appendix B.6 -- Mink Survey and Exposure Assessment within the Eighteenmile Creek Area of Concern (AOC) and Watershed: Project Description and Cost Estimate.
- Appendix B.7 -- Cost Estimate for Stocking Eighteenmile Creek with Salmonid Species.
- Appendix B.8 -- Rough Cost Estimate for Baseline Sampling and Long-Term, Post-Remedial Monitoring of the Benthic Community in the Eighteenmile Creek System.

Appendix B.1.1

Remedial Costs for the Eighteenmile Creek Corridor Site (Site No. 932121), Lockport, New York

Introduction

The New York State Department of Environmental Conservation (NYSDEC), in consultation with the New York State Department of Health (NYSDOH), is proposed remedies for Operable Units (OU) 1, 3, 4, 5 and 6 of the Eighteenmile Creek Corridor Site. These remedies are described in the Proposed Remedial Action Plan (RAP) for the site (NYSDEC 2010). Included below is a summary of the remedial goals and proposed remedial alternatives and their costs identified in the RAP. The site location map and OU map are included in Figures 1 and 2 (from NYSDEC 2010), respectively.

Summary of Remedial Goals

The remediation goals for this site are to eliminate or reduce to the extent practicable:

- Exposures of residents, anglers and workers at or around the site to semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and inorganic compounds in surface soil/fill, subsurface soil/fill, and sediment;
- Environmental exposures of flora or fauna to SVOCs, PCBs, and inorganic compounds in surface soil/fill, subsurface soil/fill and sediment;
- The release of contaminants from subsurface soil/fill into groundwater that may create exceedances of groundwater quality standards; and
- The release of contaminants from surface soil/fill and subsurface soil/fill into Eighteenmile Creek and the millrace through erosion and the discharge of contaminated storm water runoff.

Further, the remediation goals for the site include attaining to the extent practicable of:

- 6 NYCRR Part 375 soil cleanup objectives;
- TAGM 4046 soil cleanup objectives when Part 375 soil cleanup objectives are not available; and
- Sediment Screening Concentration Guidelines (SCGs) derived from the Department's Technical Guidance for Screening Contaminated Sediments.

Summary of Proposed Remedial Alternatives

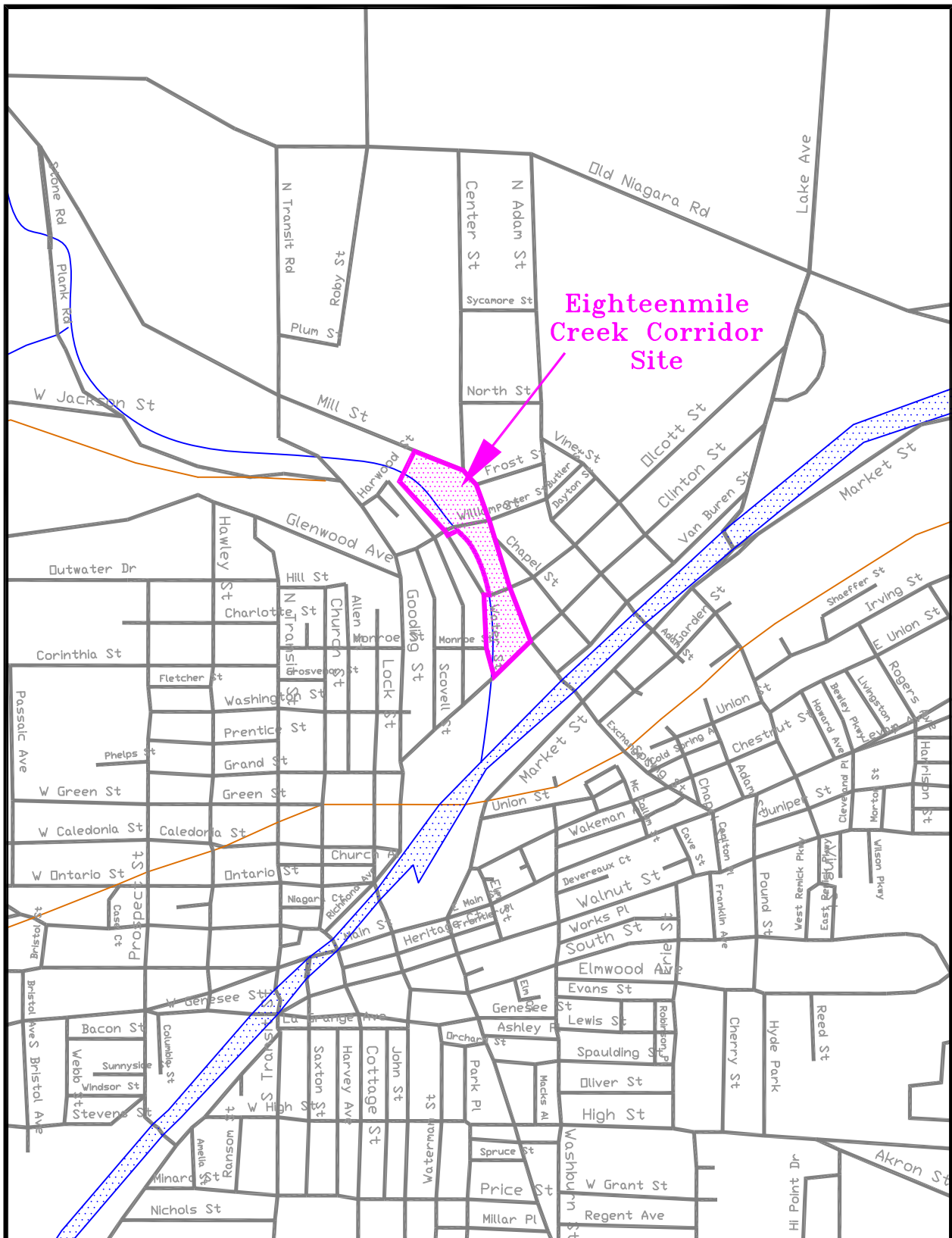
Table B.1-1, below, provides a summary of the costs for the proposed remedial alternatives identified for each OU. Costs of other alternatives that were evaluated and not selected are excluded from the table.

Reference

New York State Department of Environmental Conservation (NYSDEC). 2010. *Proposed Remedial Action Plan, Eighteenmile Creek Corridor Site, Operable Unit No. 1, 3, 4, 5 and 6, Lockport, Niagara County, New York, Site No. 932121*. Prepared by NYSDEC Division of Environmental Remediation. Available from <http://www.dec.ny.gov/chemical/49445.html> (accessed 12-5-10).

Table B.1-1 – Summary of Proposed Remedial Alternative Costs for the Eighteenmile Creek Corridor Site.				
Operable Unit	Remedial Alternative(\$)	Capital Costs(\$)	Annual Costs (\$)	Total Present Worth (\$)
1	Alt 7 - Sediment and Creek Bank Excavation with Restoration and Long-Term Monitoring: Dam and Pump Around	8,566,000	8,300 (annual) 18,200 (periodic)	8,818,000
3	Alt 3 - Hazardous Waste Removal with Bank Stabilization and Long-Term Monitoring	1,706,000	8,300 (annual) 24,700 (periodic)	1,985,000
4	Alt 3 - Hazardous Waste Removal with Bank Stabilization and Long-Term Monitoring	3,166,000	8,300 (annual) 22,900 (periodic)	3,438,000
5	Alt 3 - Hazardous Waste Removal with Bank Stabilization and Long-Term Monitoring	447,000	8,300 (annual) 14,000 (periodic)	681,000
6	Alt 4 - Limited Excavation with Bank Stabilization and Long-Term Monitoring	1,256,000	0	1,256,000
<i>Total Costs</i>		<i>15,141,000</i>	<i>33,200 (annual) 79,800 (periodic)</i>	<i>16,178,000</i>

Source: NYSDEC (2010)



Lockport Quadrangle

Scale Depends on Final Plotted Size

SITE LOCATION MAP

DIVISION OF ENVIRONMENTAL REMEDIATION

DATE: 02/20/03

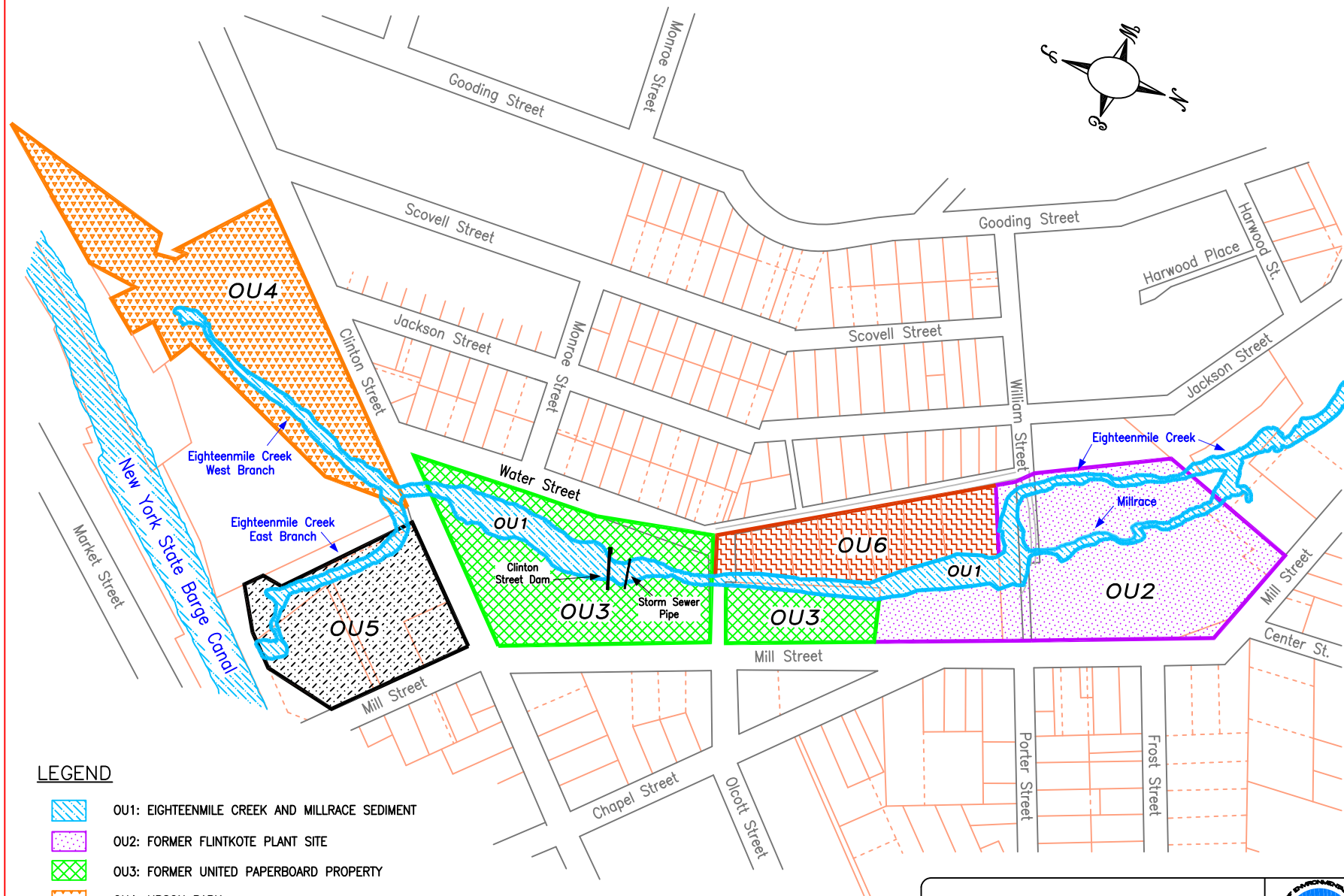
DRAWING: Location Map.dwg

SITE:

EIGHTEENMILE CREEK CORRIDOR



FIGURE 1



LEGEND

-  OU1: EIGHTEENMILE CREEK AND MILLRACE SEDIMENT
-  OU2: FORMER FLINTKOTE PLANT SITE
-  OU3: FORMER UNITED PAPERBOARD PROPERTY
-  OU4: UPSON PARK
-  OU5: WHITE TRANSPORTATION PROPERTY
-  OU6: WATER STREET RESIDENTIAL PROPERTIES

OPERABLE UNIT LOCATION MAP

DIVISION OF ENVIRONMENTAL REMEDIATION

DATE: 08/12/09

DRAWING: Site Wide Map.dwg

SITE NAME:

EIGHTEENMILE CREEK CORRIDOR

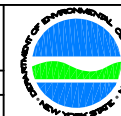


FIGURE 2

Appendix B.1.2

Estimates Remedial Costs for Former Flintkote Plant Site, Lockport, New York

Introduction

The New York State Department of Environmental Conservation (NYSDEC or Department) has selected a remedial action for the Former Flintkote Plant Site (B-00161-9) in its Record of Decision (ROD) published in 2006. Included below is a summary of the remedial goals and a description and cost for the selected remedial alternative. A site location map, site features map, and hazardous fill area map are provided as Figures 1, 2, and 7, respectively. The figures were taken directly from NYSDEC (2006) without modification.

Summary of Remedial Goals

The remediation goals for this site are to eliminate or reduce to the extent practicable:

- Exposures of persons at or around the site to semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), pesticides, and metals in surface soil/fill, subsurface ash/fill, creek and millrace sediment, unfiltered groundwater, sediments in buildings, waste in buildings, and standing water in buildings;
- Environmental exposures of flora or fauna to SVOCs, PCBs, and metals in surface soil/fill, subsurface ash fill, and creek and millrace sediment;
- The release of contaminants from subsurface ash fill into groundwater that may create exceedances of groundwater quality standards; and
- The release of contaminants from surface soil/fill, subsurface ash fill, unfiltered groundwater, sediments in buildings, waste in buildings, and standing water in buildings into Eighteenmile Creek and the millrace through the discharge of contaminated stormwater runoff, discharge of contaminated sediments, waste and standing water in buildings, and erosion of contaminated surface soil/fill and subsurface ash fill.

Further, the remediation goals for the site include attaining to the extent practicable:

- Ambient water quality standards;
- Technical Administrative Guidance Memorandum (TAGM) 4046 soil cleanup objectives; and
- Sediment screening concentration guidelines (SCGs).

Summary of Proposed Remedial Alternative

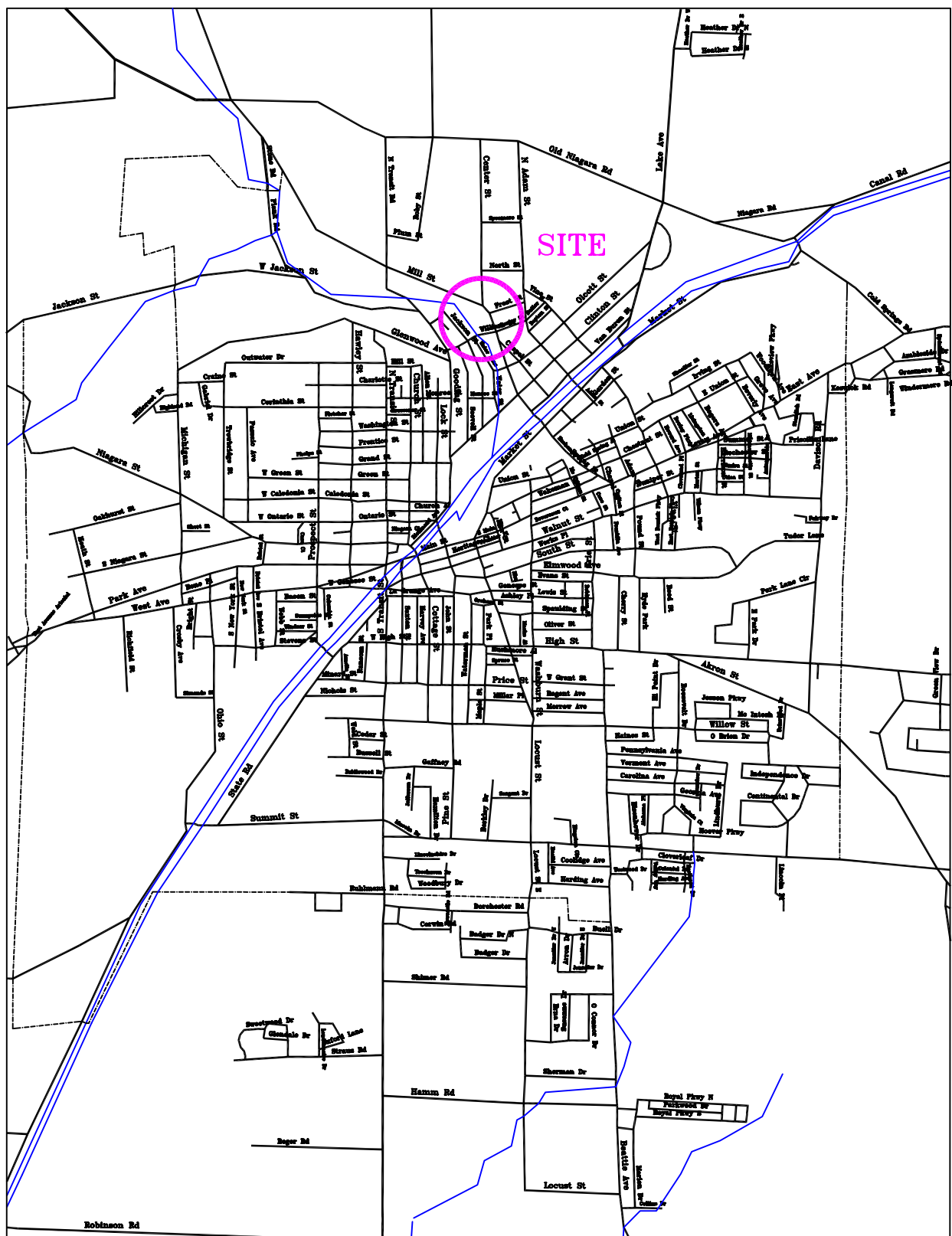
Table 1, below, provides a summary of the costs for the proposed remedial alternative identified in the ROD. Costs of other alternatives that were evaluated and not selected are excluded from the table.

Table 1 – Summary of Proposed Remedial Alternative Costs			
Selected Remedial Alternative	Capital Costs (\$)	Annual Costs (\$)	Total Present Worth (\$)
Alternative 4 – Excavation and Containment	5,552,000	6,800 (annual)	5,614,000

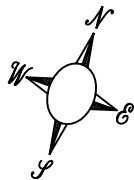
Source: NYSDEC (2006).

Reference

New York State Department of Environmental Conservation (NYSDEC). 2006. *Environmental Restoration Record of Decision: Former Flintkote Plant Site, City of Lockport Niagara County, New York, Site Number B-00161-9*. Prepared by NYSDEC Division of Environmental Remediation.



Lockport Quadrangle Scale Depends on Final Plotted Size	SITE LOCATION MAP		
	DIVISION OF ENVIRONMENTAL REMEDIATION		
	DATE: 08/29/00	DRAWING: LOCATION2.DWG	
	SITE: FORMER FLINTKOTE PLANT SITE		
FIGURE 1			



Residential Properties
(Not Part of Site)

Water Street

Flintkote Site,
Water Street Section

Residential Properties
(Not Part of Site)

Half Buried
Concrete Structure

Eighteenmile Creek

Timber Debris on
Slopes

Flintkote Site,
198 Mill Street

Partially Demolished
Buildings

Mill Street

William Street

Residential Properties
(Not Part of Site)

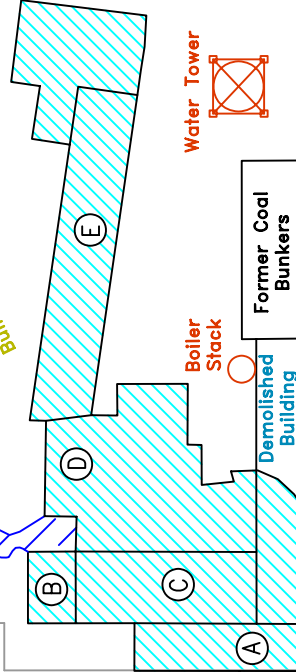
Eighteenmile Creek

Flintkote Site,
The Island

Millrace

Building Debris on Slopes

Flintkote Site,
300 Mill Street



Water Tower

Boiler Stack

Former Coal
Bunkers

Demolished
Building

Mill Street
Center

Chapel Street

Residential Properties
(Not Part of Site)

Porter St.

Residential Properties
(Not Part of Site)

Frost St.



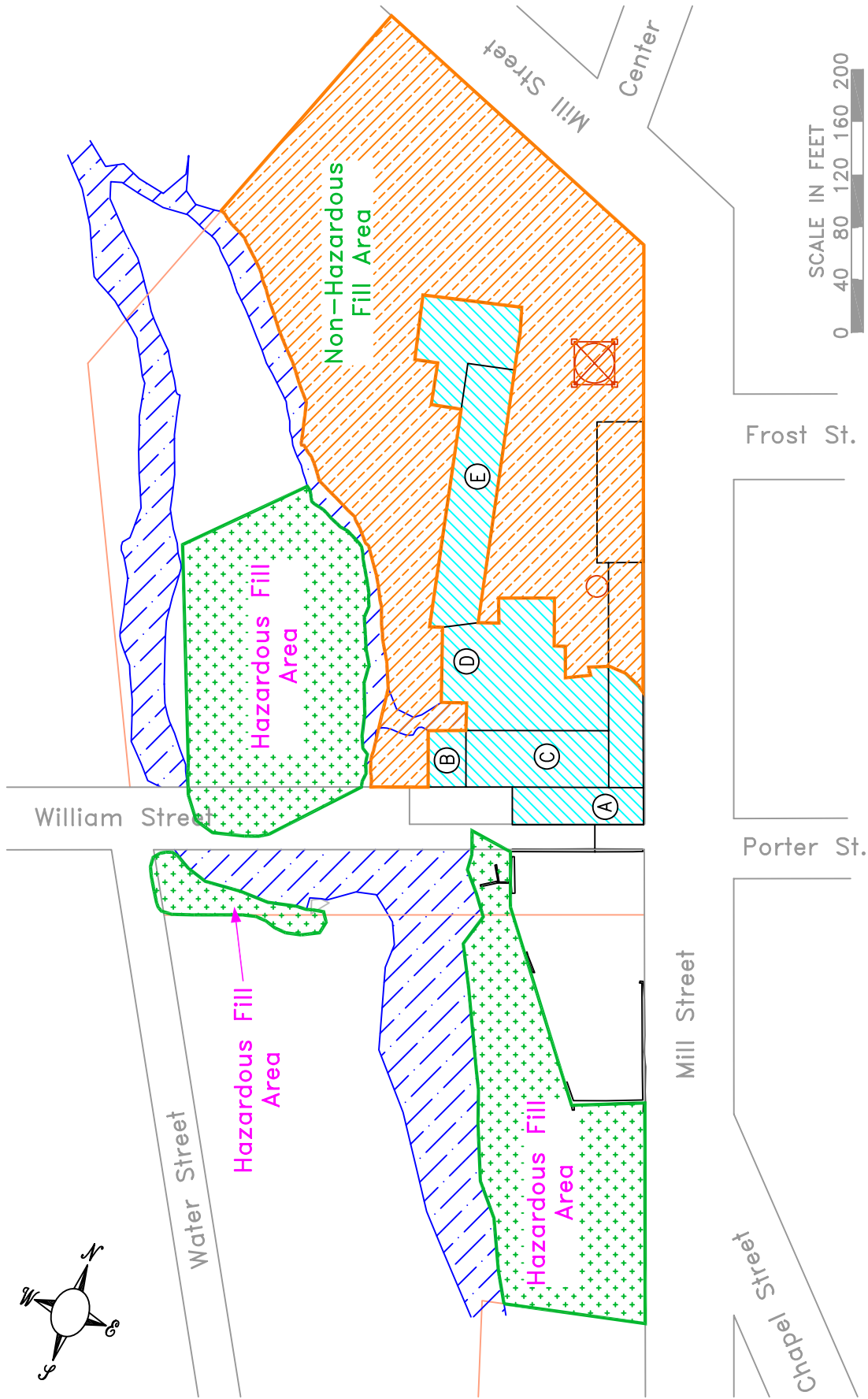
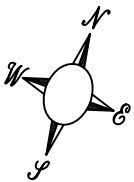
FLINTKOTE SITE MAP

DIVISION OF ENVIRONMENTAL REMEDIATION

DATE: 05/11/00 DRAWING: SITEMAP.DWG

SITE: FORMER FLINTKOTE PLANT SITE

FIGURE 2



Appendix B.2

Range of Sediment Remedial Costs for Great Lakes Sediment Sites

This appendix includes two tables that were used to help understand the cost of sediment remedial work at Eighteenmile Creek. The first table in this appendix was taken from the United States Environmental Protection Agency (EPA) Great Lakes Legacy Act web page (www.epa.gov/glla/remed/GreatLakesSedimentManagementPlan.pdf). The second table includes a subset of sites from the first table for which sediment remedial projects have been completed. Use of the information in these tables to estimate a cost for sediment remediation at Eighteenmile Creek (excluding the Corridor Site in Lockport, New York) is discussed in Section 2.1.

Great Lakes AOC Contaminated Sediment Site Management Plan - (October 29, 2010)

Site Name / Location	State	AOC	Estimated Volume of Contaminated Sediments	Estimated Cost (Average)	Responsible Office / Authority	Assessment Status	Remediation Complete?	Current Phase	Start Date (Current Phase)	Expected End Date (Current Phase)
MINNESOTA SITES										
St. Louis River/Interlake/Duluth Tar Superfund Site	MN	St. Louis River	455,000	\$45,600,000	State Superfund	Full	No	Implementation		
St. Louis River/Interlake/Duluth Tar Superfund Site - Carbon Mat (GLLA betterment to Superfund Remedy)	MN	St. Louis River	80,000	\$1,200,000	Legacy	Full	Yes	Carbon Mat Complete	2009	2010
St. Louis River/US Steel Superfund Site	MN	St. Louis River	225,000	\$27,500,000	Superfund		No	Assessment		2015
Minnesota Slip	MN	St. Louis River	33,000	\$6,000,000	Not Determined		No	Feasibility		
Minnesota Sites Needing Assessment										
Superior Bay Sites	MN	St. Louis River	4,329,000	\$433 million - \$4.3 billion	Not Determined	Not assessed	No			
St. Louis Bay Sites	MN	St. Louis River	3,418,000	\$342 million - \$3.4 billion	Not Determined	Not assessed	No			
Lower St. Louis River	MN	St. Louis River	4,872,000	\$487 million - \$4.9 billion	Not Determined	Not assessed	No			
Upper St. Louis River	MN	St. Louis River	4,986,000	\$499 million - \$5 billion	Not Determined	Not assessed	No			
WISCONSIN SITES										
St. Louis River/Duluth Harbor/Newton Creek/Superior Bay	WI	St. Louis River	500,000	\$27,500,000	Superfund		No	Assessment		
St. Louis River - Howards Bay	WI	St. Louis River	680,000		Legacy	Partial	No	Assessment	2010	2010
Hog Island / Newton Creek Inlet	WI	St. Louis River	40,000	\$6,300,000	Legacy	Full	Yes	Remediation Complete		2005
Fox River/Lower Green Bay [Superfund: OU 1 - Little Lake Butte des Morts]	WI	Fox River / Green Bay	784,000	\$97,000,000	Superfund	Full	Yes	Remediation Complete		2009
Fox River/Lower Green Bay [Superfund: OU 2 - Appleton to Little Rapids]	WI	Fox River / Green Bay	46,000	\$10,000,000	Superfund	Full	No	Implementation		2011
Fox River/Lower Green Bay [Superfund: OU 3 - Little Rapids to DePere]	WI	Fox River / Green Bay	586,000	\$26,000,000	Superfund	Partial	No	Implementation		2019
Fox River/Lower Green Bay [Superfund: OU 4- DePere to Green Bay]	WI	Fox River / Green Bay	5,880,000	\$258,000,000	Superfund	Partial	No	Implementation		2019
Fox River/Lower Green Bay [Superfund: OU 5 - Green Bay] - Monitored Natural Recovery	WI	Fox River / Green Bay	29,000,000	\$40,000,000	Superfund	Partial	No			
Appleton MGP Site (Lower Fox River)	WI	Fox River / Green Bay			Not Determined	Not Assessed	No			
Hewitt Machines (Lower Fox River)	WI	Fox River / Green Bay			Not Determined	Not Assessed	No			
Two MGP Sites in Neenah (Lower Fox River)	WI	Fox River / Green Bay			Not Determined	Not Assessed	No			
Fond du Lac River (Upper Fox River Basin)	WI	Fox River / Green Bay			Not Determined		No			
Silver Creek / Ripon MGP Site (Upper Fox River basin)	WI	Fox River / Green Bay			Not Determined		No			
Oshkosh MGP (Upper Fox River basin)	WI	Fox River / Green Bay			Superfund	Partial	No	Assessment		
Green Bay MGP (Upper Fox River Basin)	WI	Fox River / Green Bay			Superfund	Partial	No	Assessment		
Menominee River [RCRA: Ansul site]	WI	Menominee River	250,000	\$28,750,000	RCRA	Partial	No	Design	2011	2013
Menominee River MGP Site (Boom Landing)	WI	Menominee River	2,000	\$850,000	Superfund	Partial	No			

Site Name / Location	State	AOC	Estimated Volume of Contaminated Sediments	Estimated Cost (Average)	Responsible Office / Authority	Assessment Status	Remediation Complete?	Current Phase	Start Date (Current Phase)	Expected End Date (Current Phase)
Menekaunee Harbor	WI	Menominee River			Not Determined	Partial	No			
Milwaukee Estuary - Miscellaneous sites	WI	Milwaukee Estuary	300,000	\$52,500,000	Not Determined		No	Unknown		
Kinnickinnic River	WI	Milwaukee Estuary	167,000	\$23,000,000	Legacy	Full	Yes	Remediation Complete	2009	2009
Lincoln Park (Phase 1 - Lincoln Creek / West Oxbow)	WI	Milwaukee Estuary	100,000	\$22,000,000	Legacy	Full	No	Design	2010	2011
Lincoln Park (Phase 2 - East Oxbow / Milwaukee River)	WI	Milwaukee Estuary			Not Determined	Partial	No	Assessment	2010	2010
Blatz Pavilion - WDNR Cleanup	WI	Milwaukee Estuary	5,000	\$2,000,000	WDNR	Full	Yes	Remediation Complete	2008	2008
Milwaukee Estuary [Menomonee R. Superfund: Moss American NPL site]	WI	Milwaukee Estuary	64,000	\$18,500,000	Superfund	Full	Yes	Remediation Complete		2010
Milwaukee Estuary [Superfund: Solvay Coke removal action]	WI	Milwaukee Estuary	50,000	\$12,500,000	Superfund		No	Assessment		
Cedar Creek - Milwaukee River Basin [Superfund: Amcast Industrial Corp. Cedar Creek]	WI	Milwaukee Estuary	75,000	\$15,000,000	Superfund		No	Feasibility		
Cedar Creek - Milwaukee River Basin [Superfund: Mercury Marine Cedar Creek]	WI	Milwaukee Estuary	150,000	\$30,000,000	Superfund		No	Feasibility		
Sheboygan River Upper Reach [Superfund: Sheboygan River and Harbor NPL site]	WI	Sheboygan River	35,000	\$15,000,000	Superfund		Yes	Remediation Complete		
Sheboygan River Lower Reach [Superfund: Sheboygan River and Harbor NPL site]	WI	Sheboygan River	50,000	\$10,000,000	Superfund		No	Design Complete		
Sheboygan River: Camp Marina MGP	WI	Sheboygan River	10,000	\$5,000,000	Superfund	Partial	No	Design		
Sheboygan River Lower Reach [Legacy Act]	WI	Sheboygan River	60,000	\$15,000,000	Legacy	Partial	No	Assessment	2010	2011
ILLINOIS SITES										
Waukegan Harbor [Superfund: Outboard Marine Corp. NPL site]	IL	Waukegan	280,000	\$36,000,000	Superfund	Full	No	Design		
INDIANA SITES										
Indiana Harbor Canal [Corps: WRDA, Indiana Harbor and Ship Canal dredging project]	IN	Grand Calumet River	4,000,000	\$350,000	Corps	Partial	No	CDF Construction		2011
Grand Calumet River West Branch - Reaches 1,2 (Roxanna Marsh)	IN	Grand Calumet River	266,000	\$46.400,000	Legacy	Full	No	Design / Implementation		
Grand Calumet River West Branch - Reaches 3,4,5 (Hammond Sanitary District)	IN	Grand Calumet River	110,000	\$22,500,000	Legacy	Full	No			

Site Name / Location	State	AOC	Estimated Volume of Contaminated Sediments	Estimated Cost (Average)	Responsible Office / Authority	Assessment Status	Remediation Complete?	Current Phase	Start Date (Current Phase)	Expected End Date (Current Phase)
Saginaw River/Bay (RCRA, Corps, NRDA)	MI	Saginaw River / Bay		\$1,000,000	Other		No	Assessment		
Clinton River	MI	Clinton River	50000	\$10,000,000	Legacy		No	Assessment		
Deer Lake/Carp River/Carp Creek	MI	Deer Lake	2,500,000	\$49,375,000	Other		No	Monitored Natural Recovery		
Black Lagoon - Trenton Channel	MI	Detroit River	115,000	\$9,300,000	Legacy	Full	Yes	Remediation Complete		2005
Detroit River / Trenton Channel	MI	Detroit River	250,000	\$35,000,000	RCRA / Legacy	Partial	No	Assessment / Feasibility	2010	2011
Connors Creek (City of Detroit)	MI	Detroit River	150,000		Other		No	Monitoring		
Kalamazoo River (Area 1: Plainwell Impoundment)	MI	Kalamazoo River			Superfund					
Kalamazoo River (Area 2: Otsego City Impoundment)	MI	Kalamazoo River		\$36,000,000	Superfund					
Kalamazoo River (Area 3: Otsego Impoundment)	MI	Kalamazoo River		\$44,000,000	Superfund					
Kalamazoo River (Area 4: Trowbridge Impoundment)	MI	Kalamazoo River		\$126,000,000	Superfund					
Kalamazoo River (Area 5: Trowbridge to Allegan City Dam)	MI	Kalamazoo River			Superfund					
Kalamazoo River (Area 6: Lake Allegan)	MI	Kalamazoo River			Superfund					
Kalamazoo River (Area 7: Allegan Dam to Lake Michigan)	MI	Kalamazoo River			Superfund					
Manistique River [Superfund: Manistique River and Harbor non-time critical removal action]	MI	Manistique River	111,000	\$30 - 50 million	Superfund	Full	Yes	Remediation Complete		2004
Manistique River (Legacy)	MI	Manistique River	150,000	\$ 20,000,000	Legacy	Partial	No	Assessment	2010	2011
Ruddiman Creek	MI	Muskegon Lake	90,000	\$ 13,000,000	Legacy	Full	Yes	Remediation Complete		2006
Ryerson Creek	MI	Muskegon Lake	50,000	\$7,500,000	Legacy		No	Assessment		
Division Street Outfall	MI	Muskegon Lake	50,000	\$7,500,000	Legacy		No	Design		
Raisin River	MI	River Raisin	100,000	\$12,000,000	Legacy	Partial	No	Design		2011
Raisin River (Corps strategic dredging / advance Maintenance)	MI	River Raisin	40,000	\$500,000	Corps	Partial	No	Design		2011
Rouge River (Corps 312b, others)	MI	Rouge River			Corps		No			
Lower Rouge River	MI	Rouge River	60,000	\$10,000,000	Legacy		No	Assessment		
St. Marys River, Tannery Bay [Superfund: Cannelton Industries NPL site]	MI	St. Marys River	40,000	\$8,000,000	Legacy	Full	Yes	Remediation Complete		2007
St. Marys River Former MGP Site (Phase 1)	MI	St. Marys River	8,000	\$1,500,000	Legacy	Full	Yes	Remediation Complete	2010	2010
St. Marys River Former MGP Site (Phase 2)	MI	St. Marys River	20,000	\$2,500,000	Legacy	Partial	No	Design	2010	2011
Torch Lake	MI	Torch Lake	4,000,000	\$1,000,000	Superfund		No	Monitoring		
OHIO SITES										
Ashtabula River GLLA Project	OH	Ashtabula	500,000	\$60,000,000	Legacy	Full	Yes	Remediation Complete	2006	2010
Ashtabula River (Corps Fed Channel)	OH	Ashtabula	135,000	\$13,000,000	Corps	Full	Yes	Remediation Complete	2008	2008

Site Name / Location	State	AOC	Estimated Volume of Contaminated Sediments	Estimated Cost (Average)	Responsible Office / Authority	Assessment Status	Remediation Complete?	Current Phase	Start Date (Current Phase)	Expected End Date (Current Phase)
Ashtabula River: (Corps Outer Harbor)	OH	Ashtabula	200,000	\$6,000,000	Corps	Partial	No	Design		2011
Cuyahoga River Old Channel (RM 0.9-1.3 Upper End)	OH	Cuyahoga River	116,000	\$12,000,000	Not Determined	Partial	No	Assessment		2011
Cuyahoga: LaFarge / Mirage Slip (RM 0.1)	OH	Cuyahoga River	15,000	\$1,000,000	Not Determined		No	Assessment		
Cuyahoga - RM 0-5.6, Inside Ship Channel (Corps, others)	OH	Cuyahoga River	350,000	\$35,000,000	Other		No			
Cuyahoga Gorge	OH	Cuyahoga River	100,000	\$15,000,000	Legacy	Partial	No	Assessment	2010	2011
Isolated Hot Spots throughout Cuyahoga AOC	OH	Cuyahoga River	100,000	\$11,500,000	Not Determined		No			
Ottawa River (Lower Reaches: RM 0 - RM 3.2)	OH	Maumee River	250,000	\$25,000,000	Not Determined		No	Assessment		
Ottawa River (Upper Reaches: RM 3.2 - RM 8.8)	OH	Maumee River	250,000	\$49,000,000	Legacy		No	Implementation	2009	2010
Maumee Bay - Ottawa River Connecting Channel	OH	Maumee River	117,333	\$6,453,333	Not Determined		No			
Maumee River Shipping Channel (Corps?)	OH	Maumee River	600,000	\$19,500,000	Other		No			
Maumee River - RM 0-7 (Corps?, inside Ship Channel, mouth to I-75 Bridge)	OH	Maumee River	300,000	\$9,750,000	Other		No			
Maumee River - RM 0-7 (outside Ship Channel, mouth to I-75 Bridge)	OH	Maumee River	800,000	\$63,200,000	Not Determined		No			
Ai Creek/Swan Creek - RM 0-1 (mouth to I-75)	OH	Maumee River	50,000	\$5,000,000	Not Determined		No			
Duck Creek (Lower Reach)	OH	Maumee River	40,000	\$6,000,000	Legacy	Full	No	Assessment		
Otter Creek - Lower Reach	OH	Maumee River	120,000	\$18,000,000	Legacy	Full	No	Assessment		
Isolated Hot Spots throughout Maumee AOC	OH	Maumee River	300,000	\$20,100,000	Not Determined		No			
NEW YORK SITES										
Buffalo River	NY	Buffalo River	600,000	\$40,000,000	Legacy	Full	No	Design	2010	2012
Buffalo River (Corps navigation channel - GLRI)	NY	Buffalo River	400,000	\$8,000,000	Corps	Full	No	Design	2011	2011
Eighteenmile Creek	NY	Eighteenmile Creek	250,000	\$25,000,000	Legacy</					

Table 2. Range of Costs for Completed Great Lakes Sediment Remediation Projects.

Site	Sediment Volume Remediated (cubic yards)	Cost
Baltz Pavilion, WI	5,000	\$2,000,000
St Mary's River, Former MGP Site, MI	8,000	\$1,500,000
Sheboygan River Upper Reach, WI	35,000	\$15,000,000
Hog Island and Newton Creek, WI	40,000	\$6,300,000
St Mary's River, Tannery Bay, MI	40,000	\$8,000,000
Milwaukee Estuary, Moss American Site, WI	64,000	\$18,500,000
Ruddiman Creek, MI	90,000	\$13,000,000
Manistique River and Harbor (non-time critical), MI	111,000	\$40,000,000
Ashtabula River, OH (Corps Federal Channel)	135,000	\$13,000,000
Kinnickinnic River, WI	167,000	\$23,000,000
Ashtabula River, OH (GLLA project)	500,000	\$60,000,000
Fox River OU1, WI	784,000	\$97,000,000

Source: Completed projects only from the U.S. Environmental Protection Agency Great Lakes Legacy Act web page (www.epa.gov/glla/remed/GreatLakesSedimentManagementPlan.pdf).

Appendix B.3
**Rough Cost Estimate for Baseline Sampling and Long-Term, Post-Remedial Monitoring of Fish
from Different Trophic Levels in the Eighteenmile Creek System**

The cost of baseline sampling and one round of post-remedial sampling are estimated to be \$65,950 and \$59,950, respectively. The estimate for post-remedial sampling is less than the estimate for baseline sampling because the Sampling and Analysis Plan (SAP) prepared for baseline sampling is assumed to be useful for post-remedial sampling with little or no modification. The cost estimate for fish monitoring includes four tasks: (1) SAP preparation; (2) field sampling; (3) fish tissue analysis; and (4) reporting. It is expected that SAP development will be a desktop effort requiring approximately one week to complete. Field sampling is expected to be a three day effort by a team of three biologists. The sampling will entail collecting five forage fish composite samples and five game fish samples from each of three reaches of Eighteenmile Creek—below Burt Dam; between Newfane and Burt Dams; and upstream from Newfane Dam—for a total of 30 fish samples. We expect that fish sampling will take one day per reach. The fish samples will be analyzed for PCBs, lipids, and percent moisture. Finally, a report will be drafted and finalized summarizing the findings of fish sampling.

Appendix B.4

Pilot Study on Use of Powdered Activated Carbon to Reduce Bioavailability of Polychlorinated Biphenyls (PCBs) in Eighteenmile Creek Sediment

Introduction

This project will evaluate the effectiveness of using powdered activated carbon (PAC) to reduce bioavailability of polychlorinated biphenyls (PCBs) in Eighteenmile Creek sediment. Up to 90% reduction in PCB bioavailability has been observed at sites where this method has been used (Luthy et al. 2009, Clu-in 2010). The five beneficial use impairments (BUIs) at Eighteenmile Creek are all ultimately linked to high PCBs levels in sediment (see Section 2). If the pilot study proves to be successful (i.e., if PAC is effective in reducing PCB bioavailability in Eighteenmile Creek sediment), then application of this technique *in situ* has the potential to contribute to delisting of these BUIs. If implemented, the results of this study will be incorporated into the Eighteenmile Creek Feasibility Study (FS). Sediment treatment with PAC may be useful in Eighteenmile Creek as a polishing step in areas where sediment dredging is implemented and/or as the principal means of sediment remediation in areas that are difficult or impossible to access for dredging.

Project Specifics

This project will include a laboratory bench-top pilot study with Eighteenmile Creek sediment. Creek sediments representing a range of PCB concentrations will be collected and augmented with a range of PAC concentrations. Bioaccumulation in each treatment will be determined by USEPA (2000) Test Method 100.3 (28-day *Lumbriculus variegates* Bioaccumulation Test for Sediments). For comparison, bioaccumulation in untreated sediment from Eighteenmile Creek also will be evaluated. Upon test completion, the sediment samples will be analyzed for PCBs and total organic carbon and the test organisms will be analyzed for PCBs and percent lipids. Bioaccumulation will be evaluated by comparing PCB levels in test organisms among treatments and by calculating and comparing biota-sediment accumulation factors among treatments. Additional information regarding this recommended action can be found in the Western Lake Ontario (WLO) factsheet project for regional stakeholders entitled *Pilot Study on Use of Powdered Activated Carbon to Reduce Bioavailability of Polychlorinated Biphenyls (PCBs) in Eighteenmile Creek Sediment*. The factsheet provides additional details on sampling locations and study design.

Rough Cost Estimate

\$70,820 total divided as follows: \$6,000 for preparation of plans; \$5,000 for sediment sampling; \$44,800 for bioaccumulation testing and chemical analysis; and \$15,000 reporting.

References

- Clu-in. 2010. *Contaminated Site Clean-Up Information*. Available online at: <http://www.clu-in.org/contaminantfocus/default.focus/sec/Sediments/cat/Overview/>. Accessed January 12, 2011.
- Luthy, Richard G., Yeo-Myoung Cho, Upal Ghosh, Todd S. Bridges, and Alan J. Kennedy. May 2009. *Field Testing of Activated Carbon Mixing and In Situ Stabilization of PCBs in Sediment*.
- United States Environmental Protection Agency (USEPA). 2000. *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition*. USEPA Office of Research and Development, Duluth, Minnesota and Office of Water, Washington, D.C. EPA 600/R-99/064.

Appendix B.5
Rough Cost Estimate for Use of TrophicTrace Model to Establish Site-specific Sediment Remedial Goals for PCBs in Eighteenmile Creek

This appendix contains e-mail correspondence between Karl Gustavson (U.S. Army Engineer Research and Development Center) and Carl Mach (Ecology and Environment, Inc.) regarding the scope and cost of this potential action.

From: Gustavson.Karl@epamail.epa.gov
Sent: Tuesday, March 08, 2011 12:13 PM
To: Mach, Carl
Cc: Katherine von Stackelberg; Hinterberger, Bryan A LRB
Subject: Fw: Eighteenmile Creek TrophicTrace Modeling Project

Attachments: 18MCestimate2-24-2011.xlsx

Carl,

Sorry for the delay on this. I wanted to run it by Bryan first as he is the current project sponsor.

A couple things to note. 1) The list is comprehensive and contains items to satisfy uncertainties at the site that relate directly and indirectly to foodweb modeling. Those uncertainties were identified during review of data and model output for the site. Some efforts may already be planned by others; 2) In that regard, there may be a hierarchy here for what could be supported, depending on your needs. At this point, our intent was to be inclusive; and 3) costs are "back-of-the envelope" estimates to give you a ballpark of what to expect if efforts are pursued.

So, based on where we are at now with modeling, I see two primary efforts.

1) Refine model and impacts to receptors by investigating exposure pathways. (Efforts seek to elucidate potentially unmodeled/unknown dietary source; possible water pathway).

- a. stomach contents of largemouth bass and bullheads during spring and summer timeframe (need to better understand diet during various seasons)
- b. sampling of crayfish contaminant levels (in fall they had a very large crayfish dietary component)
- c. water sampling to define dissolved fraction (we only have one sample of dissolved PCB congeners from 1998)
- d. In fall 2012, duplicate sediment and fish tissue sampling used in model development

2. Use of model to develop remedial goals

- a. evaluate PCB congener vs Aroclor relationship in sediment and biota to define appropriate metric for risk-based remedial goals (there is a large discrepancy between aroclors and congeners; both could be considered "total PCB"; they would give you vastly different results).
- b. use Feb 2011 model to develop risk-based remedial goals; update results based on above studies.
- c. update 2011 model and remedial goals based on Task 1 data
- d. high resolution geochronology and chemistry cores (provide an indication of chemistry changes over time to then predict time to remedial goals under no action, assuming rate continues).

Attached is a very rough cost estimate to give an indication as to the general cost.

Give me a call or email if you'd like to discuss.

(See attached file: 18MCestimate2-24-2011.xlsx)

Karl Gustavson, Ph.D.
US Army Engineer Research and Development Center Duty Station: Contaminated Sediments Team,
USEPA OSRTI
Phone: 703-603-8753
Fax: 703-603-9112

From: "Mach, Carl" <CMach@ene.com>
To: Karl Gustavson/DC/USEPA/US@EPA, "Katherine von Stackelberg"
<kvon@erisksciences.com>
Cc: "Bryan A LRB Hinterberger"
<Bryan.A.Hinterberger@usace.army.mil>, "Erickson, Kris"
<KErickson@ene.com>
Date: 02/18/2011 01:52 PM
Subject: RE: Eighteenmile Creek TrophicTrace Modeling Project

Karl, I would be interested in hearing from you and/or Katherine about the following: (1) how much effort is required to develop a sediment remedial goal for Eighteenmile Creek using the TT model and (2) what additional targeted sampling may be useful to refine the model. Can you provide rough cost estimates for these tasks? I would like to be able to convey in the Eighteenmile Creek AOC Strategic Plan about how much additional funding is needed from GLNPO and/or other sources to move the delisting process forward over the next year or two. Thanks in advance for your reply.

Carl Mach, Ph.D.
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Lancaster, NY 14086
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cmach@ene.com

Table 1. Summary of Tasks and Cost Estimates for Additional TrophicTrace Modeling Work at Eighteenmile Creek from Karl Gustavson.

TASKS	1) Refine model and impacts to receptors by investigating exposure pathways. a. Stomach contents of largemouth bass and bullheads during spring and summer timeframe (\$51,250) b. Sampling of crayfish contaminant levels (\$48,500) c. Water sampling to define dissolved fraction of PCBs (\$79,750) d. In fall 2012, duplicate sediment and fish tissue sampling used in model development (\$102,500) 2) Use of model to develop remedial goals. a. Evaluate PCB congener vs Aroclor relationship in sediment and biota to define appropriate metric for risk-based remedial goals (\$45,000) b. Use Feb 2011 model to develop risk-based remedial goals (\$63,000) c. Update 2011 model and remedial goals based on Task 1 data (\$63,000) d. High resolution cores, chemistry, and geochronology markers (to indicate expected time to reach remedial goals) (\$59,250)
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Appendix B.6

Mink Survey and Exposure Assessment within the Eighteenmile Creek Area of Concern (AOC) and Watershed: Project Description and Cost Estimate

The mink survey and exposure assessment are discussed below in Sections 1 and 2, respectively. The work described in this appendix is a scaled-back version of the work described in the Western Lake Ontario (WLO) factsheet entitled *Survey for Levels of Bioaccumulative Chemicals in Wildlife Prey and Tissues and Wildlife Deformities within Western Lake Ontario and its Tributaries*. If that project is implemented, then the work described in this appendix is unnecessary.

1. Mink Survey

This investigation will take place within the Eighteenmile Creek AOC and watershed and include the following tasks:

- Desktop analysis to identify potential mink habitats within the AOC and watershed and site visits;
- Collection and analysis of video-recorded and field data; and
- Video and field data reporting of pertinent study findings.

1.1 Project Overview and Background

This project is designed to provide data regarding the relative abundance and population structure of mink in the Eighteenmile Creek AOC. This will be done using weather-proof video surveillance equipment as was done by Wellman and Haynes (2006) in and near the Rochester Embayment AOC. This study will be a scaled-down version of the Wellman and Haynes (2006) study, with the objective of determining if mink are present and reproducing in the Eighteenmile Creek AOC. The video surveillance data for Eighteenmile Creek will be compared with similar data collected by Wellman and Haynes (2007) at Iroquois National Wildlife Refuge and Bergen Swamp to qualitatively evaluate whether mink relative abundance at Eighteenmile Creek differs from these reference areas. The data from this study will be useful in determining if BUI #5—Bird or Animal Deformities or Reproductive Problems—is impaired at the Eighteenmile Creek AOC. The mink has been selected as the focus of this investigation for the reasons described below.

American Mink

The American mink (*Neovison vison*) is a medium sized mammal belonging to the *Mustelid* family, which also includes ferrets, weasels, fishers, otters, wolverine and badgers. This species exhibits an elongate body and a long tail with relatively short legs and ears. Mink occur throughout New York and in most areas of the United States (United States Environmental Protection Agency [USEPA] 1993). Mink prefer forested areas within permanent or semipermanent wetlands, riparian areas, lakes and marshes, and generally occupy dens in hollow logs, or those created by other aquatic to semi-aquatic species, such as beavers and muskrats. Within New York, habitat studies conducted by trappers have found mink most often in streams followed by beaver ponds, lakes, and marshes (New York State Department of Environmental Conservation [NYSDEC] 2011).

This species is carnivorous and lives on a diet consisting of animals that occupy riparian to aquatic ecosystems including small to medium-sized mammals, birds, fish, and crayfish (USEPA 1993). Mink are usually solitary animals, however, males and females will begin associating during the late winter, upon initiation of the breeding season (NYSDEC 2011). Between April and June, female mink give birth to between one to eight kits (with an average of four kits; NYSDEC 2011).

Mink have been described as a sentinel species, meaning that their presence/absence may indicate environmental conditions. Environmental contaminants, such as mercury, DDE, DDT, dieldrin, and PCBs have been reported as having negative impacts to mink by causing weight loss and reproductive

issues to captive individuals (NYSDEC 2011). It is for this reason that mink have been chosen as the harbingers of ecosystem health in the Great Lakes AOCs.

1.2 Project Specifics

Proposed Scope of Work for Mink Study in Eighteenmile Creek AOC

The employment of weather-proof video surveillance equipment should help reveal trends in mink relative abundance and population structure within the Eighteenmile Creek AOC and watershed. This information will be used for determining if the BUI for bird or animal deformities or reproductive problems should be designated as impaired or be considered for delisting. The overall scope can be implemented within one field season (February through November) and should be implemented within the next three years (2011, 2012, or 2013).

Task 1 – Desktop Analysis and Site Visit

This proposed project will begin with a brief desktop analysis to locate suitable video surveillance station locations. This task will include use of topographic map and aerial imagery within the Eighteenmile Creek AOC and watershed to locate potential video surveillance stations based on suitable mink habitat (e.g. forested swamps, riparian areas, etc.). Access to public and private land deemed suitable habitat will be coordinated with state and local agencies as well as land owners and any applicable wildlife study permits will be attained from NYSDEC.

A site visit will occur during late winter to field validate potential video station locations. Meetings with local fur trappers, if any—who are aware of local areas harboring mink populations—will also take place during the site visit to aid in video station site selection. Finally, the site visit will also include a time-meander field search. During this time, mink track concentrations that are found will be documented and incorporated as potential video surveillance stations. The two most suitable mink video surveillance sites along Eighteenmile Creek will be selected based on results from the desktop analysis, input from local trappers, and time-meander searches, with the goal of selecting one site above Burt Dam (upper Burt Dam site) and one below the dam (lower Burt Dam site).

Task 2 – Data Collection and Analysis

Eight video surveillance stations (four each at the upper and lower Burt Dam sites) will be set up in mid-May and will continue monitoring until mid-November, which is the post-breeding period, a time when mink families would likely travel together. All video surveillance stations will be visited once per week, during which time batteries and video cassettes will be exchanged, camera lenses will be cleaned and systems checks will be performed. All pertinent information concerning field data will be recorded onto standardized data sheets.

The video data will be analyzed for mink presence; however, other recorded wildlife species will also be noted. Special attention will be paid to the number of recorded mink at any given time, as multiple individuals recorded during the post-breeding season are indicative of family units and mink reproduction. All pertinent information concerning video data will be recorded onto standardized data sheets.

Task 3 – Reporting

A report will be generated outlining key findings and recommendations based on the scope of work within approximately 3 month of completing field work. Also, a presentation of the study findings will be made to the Niagara County Soil and Water Conservation District (NCSWCD), U.S. Army Corps of Engineers (USACE), NYSDEC, and other interested parties.

1.3 Project Goals

To determine if mink are present and reproducing along Eighteenmile Creek above and below Burt Dam.

1.4 Project Outcomes

This project will lead to an understanding of mink presence/absence and population structure in the Eighteenmile Creek AOC and watershed. It will also increase current knowledge of the status of breeding mink within the region. The findings of this study will either support the delisting of BUI #5 at the Eighteenmile Creek AOC due to records of mink breeding (as occurred within the Rochester AOC) or, conversely, provide evidence suggesting that BUI #5 is impaired within the Eighteenmile Creek system.

1.5 Cost

E & E estimates that this task can be accomplished for roughly \$69,400 total (see Table 1 for details). The costs provided are estimates only; final costs could be higher or lower than provided here.

2. Mink Exposure Assessment

E & E (2009) indicated that the status of BUI #3 (Degraded Fish and Wildlife Populations) and BUI #5 (Bird or Animal Deformities or Reproductive Problems) likely are impaired in the Eighteenmile Creek AOC. For both BUIs, our conclusion regarding impairment was based on risk calculations for the mink done with site-specific data on PCB levels in brown bullheads. However, as noted in E & E (2009), mink consume other fish besides bullheads and other prey besides fish, including voles, muskrats, and amphibians, which would be expected to contain different levels of PCBs compared with bullheads. Therefore, assuming that mink consume only bullheads may either under- or overestimate their exposure and risk at the AOC. To better understand PCB exposure for the mink, we recommend that the mink exposure assessment presented in E & E (2009) be updated based on the new data for PCBs in forage and game fish collected from Eighteenmile Creek in 2010 to support the TrophicTrace model (Gustavson et al. 2010). We also recommend examining the importance of fish versus other prey as a source of dietary PCB exposure for mink based on a review of recent relevant literature. Because a large portion of the mink diet may consist of prey other than fish, this exercise will provide information regarding the potential uncertainty in the exposure assessment that may result from the assumption of an all fish diet.

E & E estimates that this task can be accomplished for roughly \$14,000 total (see Table 1 for details).

Table 1: Estimated Cost by Task for Mink Survey and Exposure Assessment

Task No. and Description	Schedule	Cost (\$)
Mink Survey		
1. Desktop analysis and site visit	February	\$ 10,600
2. Data collection and analysis	June – October	\$ 46,000
3. Reporting	November – December	\$ 12,800
SUBTOTAL		\$ 69,400
Mink Exposure Assessment		
1. Update exposure assessment with 2010 forage and game fish data		\$7,000
2. Examine importance of fish versus other prey to PCB exposure		\$7,000
SUBTOTAL		\$ 14,000
TOTAL		\$ 83,400

3. References

Ecology and Environment, Inc. (E & E). 2009. *Beneficial Use Impairment Investigation Report for Eighteenmile Creek, Niagara County, New York*. Prepared for the Niagara County Soil and Water Conservation District, Lockport, NY by E & E, Lancaster, NY.

Gustavson, K., S. Hendrix, and K. von Stackelberg. 2010. *Eighteenmile Creek Area of Concern: Data Gaps for Food Web Modeling*. Prepared for the United States Army Corps of Engineers (USACE) Buffalo District, Buffalo, NY and Niagara County Soil and Water Conservation

District (NCSWCD), Lockport, NY by USACE Engineer Research and Development Center (ERDC), Vicksburg, VA and E Risk Sciences LLP.

New York State Department of Environmental Conservation (NYSDEC). 2011. *Mink Factsheet*. Accessed at <http://www.dec.ny.gov/animals/9356.html> in January 2011.

United States Environmental Protection Agency (EPA). 1993. *Wildlife Exposure Factors Handbook*. U.S. EPA Office of Research and Development, Washington, D.C., EPA/600/r-93/187a and EPA/600/r-93/187b.

Wellman, S. T., and J. M. Haynes. 2006. Are there differences in the relative abundance of lakeshore and inland mink populations in and out of the Rochester Embayment of Lake Ontario Area of Concern? Monitoring populations using video traps. In Hayes, J. M., Wellman, S. T., and J. J. Pagano. 2007. *RAP Process in the Rochester Embayment of Lake Ontario: Population Monitoring, Trophic Relationships, and Levels of Bioaccumulative Chemicals of Concern in Mink, a Sentinel Species*. A final report to the New York Great Lakes Protection Fund, New York State Department of Environmental Conservation (NYSDEC), 270 Michigan Avenue, Buffalo, NY.

Appendix B.7

Cost Estimate for Stocking Eighteenmile Creek with Salmonid Species

The fishery at Eighteenmile Creek in Newfane, New York is renowned for its salmon fishing, with 15,000 angler visits annually. Presently, the stocking of this fishery falls under the jurisdiction of the New York State Department of Environmental Conservation (NYSDEC). There is a chance, however, that funding limitations due to state budget constraints may halt the state-run stocking effort. If this scenario comes to pass, then the future fish stocking will have to be undertaken by private sector fish hatcheries with funding from other sources.

Ecology and Environment, Inc. (E & E) contacted several private fish hatcheries in New York State to see if estimates could be provided for rearing and stocking the salmonid species typically stocked in Eighteenmile Creek. Fish species typically stocked at Eighteenmile Creek include: 3 to 4-inch Chinook salmon, 4-inch Coho salmon, and 4.5- and 6-inch steelhead (<http://www.dec.ny.gov/outdoor/23245.html>). Most of the hatcheries contacted did not provide estimates, as they usually deal with stocking private lakes and ponds, while NYSDEC stocks public streams and rivers with salmonid species. One hatchery owner in Bliss, New York was able to provide an estimate for this scenario; however, it is important to note that this is a very rough per inch estimate based on the cost to rear, deliver, and stock fish (50 cents per inch for all species). See Table 1 for a breakdown of the proposed cost of fish stocking at Eighteenmile Creek using private hatcheries as the source of fish. Additional details are provided in Table 2.

Table 1 Estimated Cost to Rear, Deliver and Stock Three Salmonid Species in Eighteenmile Creek, Newfane, New York

Length and Type of Fish ^a	Cost per Individual (in US Dollars)	Number of Fish per Group ^a	Cost per Fish Group (in US Dollars)
3" Chinook Salmon	1.50	80,370	120,555
4" Chinook Salmon	2.00	50,000	100,000
4" Coho Salmon	2.00	30,000	60,000
4.5" Steelhead	2.25	3,500	7,875
6" Steelhead	3.00	3,500	10,500
Total Estimated Cost			298,930

Notes:

a = Fish size and numbers stocked in 2009 in Eighteenmile Creek at Newfane, New York from <http://www.dec.ny.gov/outdoor/23245.html>.

Table 2 Estimated Costs for Fish Stocking at Eighteenmile Creek, Newfane, New York

Cost per inch (\$)	Total Effort 0.5	Fish Hatchery Effort Only 0.25
Type and length of fish	cost per fish	cost per fish
cost for 3" chinook salmon	1.5	0.75
cost for 4" chinook salmon	2	1
cost for 4" coho salmon	2	1
cost for 4.5" steelhead	2.25	1.125
cost for 6" steelhead	3	1.5
Type and length of fish	number of fish	number of fish
3" chinook salmon	80,370	80,370
4" chinook salmon	50,000	50,000
4" coho salmon	30,000	30,000
4.5" steelhead	3,500	3,500
6" steelhead	3,500	3,500

Table 2 Estimates costs for fish stocking at Eighteenmile Creek, Newfane, New York

Cost per inch (\$)		Total Effort 0.5	Fish Hatchery Effort Only 0.25
Type and length of fish		Cost per fish type	Cost per fish type
3" chinook salmon		120,555	60,278
4" chinook salmon		100,000	50,000
4" coho salmon		60,000	30,000
4.5" steelhead		7,875	3,938
6" steelhead		10,500	5,250
TOTAL COST (this includes supping and rearing fees)		\$298,930	\$149,465

Notes:

Unit cost based on a call with Todd Garrison of Garrison's Smith Creek Fish Farm, Bliss, NY.

Mr. Garrison provided a rough estimate of the effort cost based on the length of fish to be raised.

Appendix B.8
Rough Cost Estimate for Baseline Sampling and Long-Term, Post-Remedial Monitoring of the Benthic Community in the Eighteenmile Creek System

The cost of baseline sampling and one round of post-remedial sampling are estimated to be \$41,570 and \$33,320, respectively. The estimate for post-remedial sampling is less than the estimate for baseline sampling because the Sampling and Analysis Plan (SAP) prepared for baseline sampling is assumed to be useful for post-remedial sampling with little or no modification. The cost estimate for monitoring the benthic community includes four tasks: (1) SAP preparation; (2) field sampling; (3) laboratory analysis; and (4) reporting. It is expected that SAP development will be a desktop effort requiring approximately 1.5 weeks to complete. Field sampling is expected to be a two day effort by a team of two biologists. The sampling will entail collecting sediment and benthic macroinvertebrate samples at three sites in the AOC. Sediment samples will be analyzed for PCBs, selected metals, toxicity, and ancillary parameters (total organic carbon, grain size, etc.). Benthic macroinvertebrate samples will be evaluated for taxonomic diversity and abundance. We expect that the sampling will take two days to implement. Finally, a report will be drafted and finalized summarizing the findings.

C

Timeline of Significant Investigations and Events

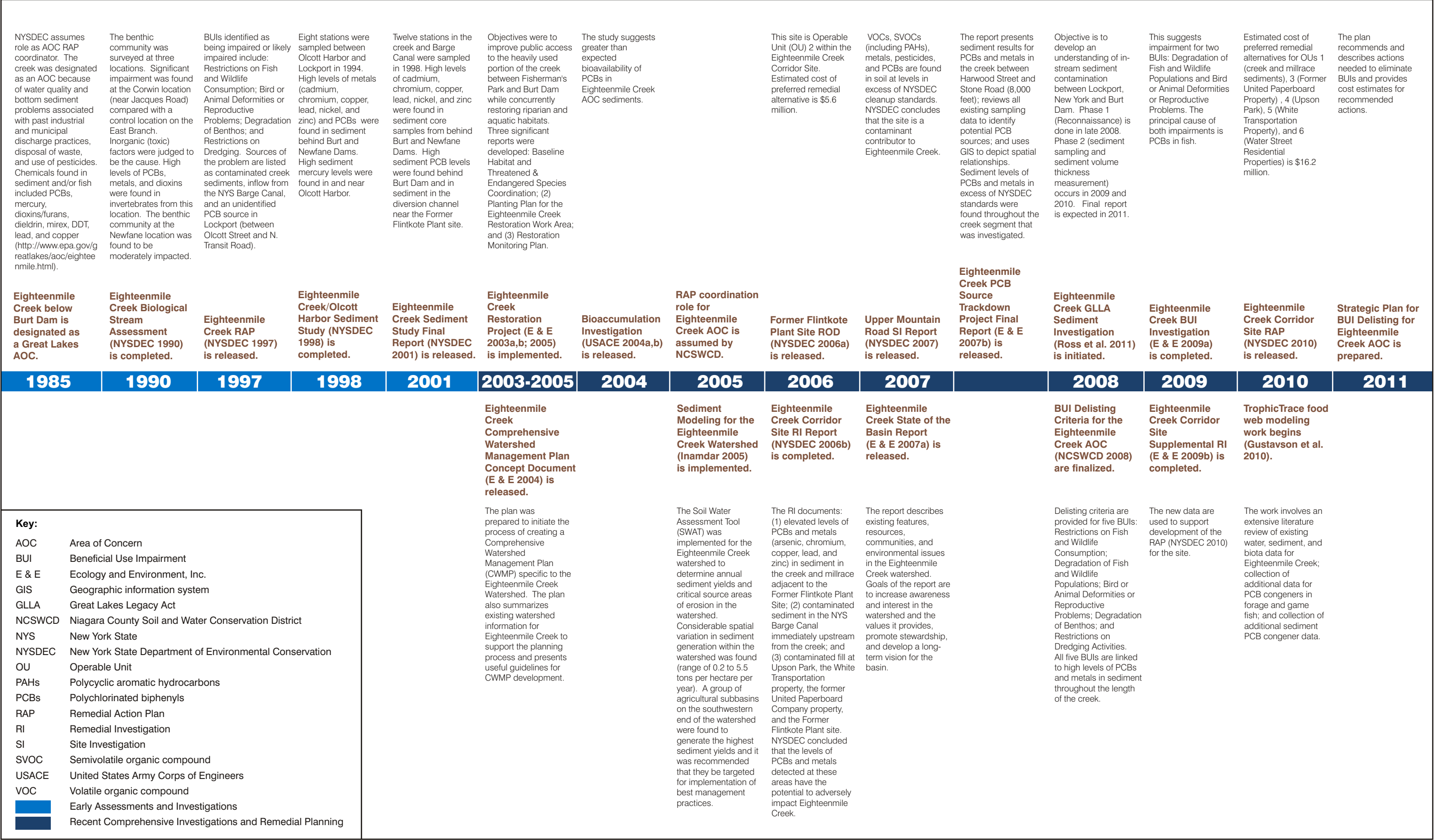


Figure C-1 Timeline of Significant Investigations and Events for the Eighteenmile Creek AOC from 1985 to 2011