Evaluation of Existing Data
Eighteenmile Creek Superfund Site
Operable Unit 3
City of Lockport, Niagara County
New York

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Prepared for:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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1 Overview

Introduction

This work is being performed under U.S. Environmental Protection Agency (EPA) RAC2 Contract Number EP-W-10-007. The Original Work Assignment Form (WAF) for the Remedial Investigation/Feasibility Study (RI/FS) to be performed by Los Alamos Technical Associates (LATA) for the Eighteen Mile Creek Site – Operable Unit 3 (OU 3) (Site) was issued on September 23, 2013. Ecology and Environment, Inc. (E & E) is a Team Subcontractor to LATA on this contract and has the lead technical role in this project. WAF Amendment 001 was issued on December 27, 2013, to revise the project schedule based on the results of the December 18, 2013, Scoping Meeting. The information in this memorandum will be included in the Draft Work Plan for this Work Assignment.

Site Overview

Eighteenmile Creek Superfund Site is a National Priorities List (NPL) hazardous waste site under investigation pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund.

Eighteenmile Creek Superfund Site (Site) is located in Niagara County, New York, on the south side of Lake Ontario (see Figure 1). The main branch of Eighteenmile Creek (the Creek) flows north for approximately 15 miles and discharges into Lake Ontario in Olcott, New York. Much of the flow in the main branch of Eighteenmile Creek comes from water diverted from the New York State Barge Canal (Canal). Eighteenmile Creek watershed also includes the two main tributaries, the east branch and the Gulf Creek, and minor tributaries. The Site consists of contaminated sediments, soil and groundwater in and around the Creek.

To address the cleanup of this Site, EPA has divided the Site into three separate operable units (OUs). OU1 will address contaminated soil at the residential properties on Water Street in Lockport, New York, and also address conditions of a building located on the former Flintkote Plant property (former Flintkote Building). EPA completed a Record of Decision (ROD) for OU1 on September 30, 2013. OU2 is part of the Eighteenmile Creek corridor (the Creek Corridor), which extends from the Creek's headwaters at the Canal to Harwood Street in Lockport (see Figure 2). OU2 will address contaminated sediments and soil in other areas of the Creek Corridor including the banks of the Residential Properties

of OU1. OU3 will address contaminated sediment in the Creek from the north end of the Creek Corridor in Lockport to the mouth of the Creek in Olcott, New York, where the Creek discharges into Lake Ontario (see Figure 2).

For OU1 and OU2 as defined by EPA, the New York State Department of Environmental Conservation (NYSDEC) completed a RI/FS and ROD for the Flintkote property and separate RI/FS and ROD for the remainder of the Creek Corridor. For OU3, EPA completed an RI under the Great Lakes Legacy Act (GLLA) program for contaminated sediment in the Creek channel (CH2MHill and EEEPC 2012). The EPA GLLA RI for contaminated sediment also compiled historical sediment data some which included some of the NYSDEC sediment data from OU2. Past studies, site information and existing analytical data from these studies and others were evaluated to determine whether additional data are needed to develop a complete conceptual model for OU3, understand fate and transport of sediment in the Creek, and assess risk to human and ecological receptors. The results of the evaluation are presented in this technical memorandum.

2 OU3 Background

This section includes a description of OU3 and a summary of existing conditions and previous investigations. All of the reports reviewed for this technical memorandum are listed in Appendix A.

2.1 Site OU3 Description

OU3 is defined as the portion of Eighteenmile Creek channel downstream of OU2, or the Creek channel north of Harwood Street. A sediment thickness survey was conducted in November 2010 as part of the EPA GLLA RI. The survey was conducted for shallow portions of the Creek up to the Burt Dam impoundment and included taking measurements of bank-to-bank (bankfull) width (i.e., the width that water begins to leave the channel and discharge onto the floodplain), water depths, and sediment thickness. The width of OU3 is defined as the Creek channel within the bankfull width.

Downstream of the Harwood Street, the creek drops down the Niagara Escarpment and winds through approximately 12 miles of rural Niagara County to Burt Dam. This portion of Eighteenmile Creek passes through the towns of Lockport and Newfane. The land use within this portion of Eighteenmile Creek watershed consists primarily of cropland and orchards, with residential, commercial, and small industrial areas located closer to the city of Lockport and around Newfane. (Newfane includes the hamlet of Newfane on Route 78, centrally located in the town and on the east bank of Eighteenmile Creek [see Figure 2]). Several other industrial facilities and inactive hazardous waste sites are located along or in the vicinity of Eighteenmile Creek, including the City of Lockport Wastewater Treatment Plant, VanDemark Chemical, Inc., and the Old Upper Mountain Road Landfill site on Gulf Creek.

Several dams were also constructed to provide power in the more level areas near Newfane, two of which two remain today. Newfane Dam was built in the 1830s near the end of McKee Street and Ewings Road to provide power for the Newfane mill district. Burt Dam was built farther north of Newfane in 1924, creating a 95-acre reservoir within the creek gorge; the reservoir extends approximately 2 miles upstream of the dam. The original dam generated power until the 1950s; it was restored in 1988 and still operates.

Two major tributaries flow into the main channel of Eighteenmile Creek: the stream that drains the northwestern part of Lockport and flows through a ravine

known as the Gulf (hereinafter referred to as Gulf Creek) and the East Branch of Eighteenmile Creek. Gulf Creek enters the main channel just north of the Lockport Wastewater Treatment Plant. The East Branch of Eighteenmile Creek enters the main channel just north of Ridge Road.

Eighteenmile Creek was divided into smaller investigation areas, or reaches, based on the physical characteristics of the Creek observed during previous investigations (see Figure 2). The Creek length was determined by digitizing a center line based on review of aerial photographs. The center line was used to establish distance markers along the length of the creek, with zero starting at the headwaters of the Creek at the Erie Canal (using the Headwaters West Branch) and ending at the mouth of the creek at Lake Ontario.

- **Reach 1** consists of the Creek channel from Burt Dam to the discharge point of the Creek into Lake Ontario. Fisherman's Park is located immediately below the dam and extends through the shallow areas of the channel. The channel deepens and flows approximately 2 miles into Olcott Harbor. The area is also deemed to have "Archeological Sensitivity" by SHPO (accessed at http://pwa.parks.ny.gov/nr/). Olcott Harbor has two parallel foot piers at the entrance with a 12-foot-deep and 140-foot-wide federally maintained navigation channel.
- **Reach 2** consists of the impoundment immediately upstream of Burt Dam. A bathymetric survey conducted by EPA in 2009 reported shorelines with steep to near vertical slopes and water depths ranging up to about 37 feet. The historic creek channel is still evident throughout most of the survey area. Measurements along transects at the upstream end of the impoundment found sediment thicknesses averaging about 13 feet. The area is similar to other deep lake environments.
- **Reach 3** is characterized by the historic stream channel that was flooded after installation of the dam. The delineation between Reaches 2 and 3 was an estimated boundary marking the separation of the deeper water from the portion of the Creek where the impounded water meets the upstream creek flow. Large sediment deposition areas have formed where the swiftly moving upstream creek flows into the impoundment area and the flow velocities drop quickly. The reach has surrounding marsh and forested wetland areas that were historically flooded.
- **Reach 4** is relatively swift moving and includes comparatively few sediment depositional areas of shallower depths. Sampling locations include areas where sediment was deposited due to obstructions or decrease in flow velocities, near the marshes and old floodplains, and near outfalls. The reach has surrounding marsh and forested wetland areas near Ide Road that were historically flooded.
- **Reach 5** consists of the impoundment area behind Newfane Dam and includes deep water and thick sediment. The dam is privately owned but non-functional and there is the potential for the dam to be removed in the

future. The deep water impoundment extends approximately 0.7 miles upstream.

- **Reach 6** is characterized by limited access, relatively shallow sediment deposition areas, and higher flow velocities. There are two isolated creek oxbow channels and one forested wetland where contaminated sediment may have been deposited during historical overbank flooding. Several outfalls from the Newfane area and agricultural drainage areas may have also contributed contaminants to the Creek. The reach is generally defined by the confluence of the main channel and East Branch of Eighteenmile Creek. The added flow from the East Branch generally increases the flow velocity and reduces the potential for sediment deposition.
- **Reach 7** is characterized by limited access and large stretches of slowly moving water and high sediment deposition. Reach 7 begins at the bottom of the Niagara escarpment and continues downstream for almost 5 miles to the East Branch confluence. There are several floodplains and drainage areas along the Creek.

2.2 OU3 Summary of Existing Site Conditions

Detailed descriptions of the existing site conditions are provided in previous study reports as listed in Table 1. A summary of key points is provided below.

- The most prominent topographic feature in Eighteenmile Creek watershed is the Niagara Escarpment. The watershed is located within both the Ontario and Huron plains, two relatively flat plains that are separated by the escarpment, which runs generally east-west along the northern portion of the city of Lockport. OU3 lies within the Ontario Plain (from Lake Ontario to the Niagara Escarpment), elevations range from 245 feet above mean sea level (AMSL) at the shoreline to approximately 400 feet AMSL at the toe of the escarpment.
- OU3 is also influenced by man-made structures on the creek, including two dams. Burt Dam is a 600-kilowatt hydro-generating facility currently owned by the Algonquin Power and Utilities Corporation. This run-of-river facility consists of a dam with an integrated intake structure, powerhouse, and tailrace. The facility was reconstructed in 1987 from an old hydroelectric generating plant at the site of an existing dam. Under terms of an agreement with the Federal Energy Regulatory Commission (FERC), the New York State Department of Transportation (NYSDOT) issued a permit in which they agreed to provide a diversion of excess water from the Erie Canal to augment the natural flow of Eighteenmile Creek to maintain a flow of 400 cubic feet per second (cfs) at the dam. The maintenance of this flow to the dam will need to be considered during the development of any remedial alternative. The height of the dam at the crest elevation is 49 feet which raises the water elevation up to 49 feet above the natural elevation of the Creek. The bathymetry survey behind the dam indicates the current water depth is 30 to 35 feet (CH2MHill and EEEPC, 2012). New-

fane Dam is privately owned and not operational, but the dam does restrict flow and retain water and sediment behind it.

- Sediment contaminated with PCBs and metals has been identified along the entire 15-mile length of the main branch of Eighteenmile Creek. The Creek Corridor (OU2) has been identified as the source area for PCBs and metals for the entire 15-mile length.
- As part of the Phase 1 reconnaissance conducted for the EPA GLLA, 36 drainage areas and eight outfalls were identified and mapped along Reaches 3 to 7. The potential for these outfalls as sources of contamination were investigated by locating sampling points downstream of the outfalls. Results indicated that the outfalls could be potential sources of lead and PAHs.
- Eighteenmile Creek provides important fish and wildlife habitat. A portion of Eighteenmile Creek 1.5 miles downstream of Burt Dam is designated by the New York State Department of State (NYSDOS) as a Significant Coastal Fish and Wildlife Habitat (SCFWH), and the Creek's estimated 65 acres of emergent and submerged aquatic vegetation comprise one of the largest coastal wetlands along the southwestern shore of Lake Ontario (NYSDOS 1987). The portion of Eighteenmile Creek downstream of Burt Dam is considered a significant recreational resource due to the large numbers of coho and chinook salmon and brown trout that migrate into the creek from Lake Ontario each fall, when these fish ascend the stream to spawn. Because of the fish habitat, Eighteenmile Creek is the second most visited fishing destination in the Lake Ontario basin, attracting up to 15,000 anglers annually (NYSDEC 2007a). The Creek habitat in most of the upstream reaches has not been characterized, and the potential impacts of remediation on habitat have not been addressed.

2.3 OU3 Summary of Existing Data

Detailed descriptions of existing data are provided in the previous study reports listed in Table 1. The usability of data for evaluating fate and transport and assessing risk is summarized on Table 1 and discussed in Section 3. A general understanding of contaminant fate and transport in Eighteenmile Creek is presented below:

- Data generated within the last 10 years is considered potentially usable and representative of current site conditions. Data is considered usable if the results were generated under acceptable quality practices and methods. Not all of the data has been formally validated, but if supporting analytical reports are available to perform validation, it is expected that the data would be found to be usable for risk assessment purposes.
- Many of the early investigations in the 1990s focused on the evaluation of sediment and water quality to address impacts to the creek below Burt Dam within Eighteenmile Creek Area of Concern. A limited number of older studies were conducted between Burt Dam and Lockport, New York.

These investigations were completed under standard, state-wide monitoring protocols implemented by the New York State Department of Health (NYSDOH). The data are useful for understanding the fate and transport of contaminants of concern through the watershed. The earlier studies demonstrated the link between the Canal and a broad list of contaminants transported in water that could originated as far away saLake Erie and the Niagara River, and migrated to Eighteenmile Creek via the Canal. The early studies also identified potential sources of specific contamination for PCBs and metals in the Creek Corridor. The subsequent studies completed in the Creek Corridor focused on the nature and extent of these specific contaminants. Other contaminants, such as volatile organic compounds (VOCs), pesticides, and polychlorinated dibenzodioxins and dibenzofurans (dioxins/furans), were not found at levels determined to be significant by NYSDEC in the Creek Corridor site investigations and, therefore, were not considered contaminants of concern for the main Creek and, thus, were not analyzed in many samples.

- Previous investigations have focused on PCBs and select metals as the primary site-related contaminants. More limited data are available for semivolatile organic compounds (SVOCs), other metals, and pesticides. Very limited data are available for dioxins/furans and VOCs. SVOC analyses were often limited to a list of 16 polynuclear aromatic hydrocarbons (PAHs).

3 Data Evaluation

The usability of data for evaluating fate and transport and assessing risk is summarized on Table 1. If the data were considered usable, the number and type of samples and the type of analysis were counted for each reach as described in Section 2. The total number of samples is summarized on Table 2. The sufficiency of the data for evaluating fate and transport of contaminants and assessing risk is described below. Data gaps identified as part of the data evaluation process are summarized in Section 5.

3.1 Fate and Transport of Contaminants

3.1.1 Groundwater

There is no information on groundwater aquifers or the interaction of groundwater with the Creek in OU3 and it has not been evaluated as potential route of contaminant transport. Groundwater was not evaluated in OU3 because OU3 is focused on the Creek channel as a receptor of contaminated sediment from OU2. The primary contaminants at OU2 were PCBs and lead, and the groundwater at OU2 had not been impacted by these contaminants (except for an isolated elevated level of PCBs in 198-F).

3.1.2 Surface Water

Surface water has not been extensively sampled as part of previous investigations. As part of regional studies, EPA has conducted semiannual monitoring of surface water discharge from Eighteenmile Creek and several other tributaries (EPA 2011). The current analytical program includes PCBs, mercury, and total suspended solids (TSS). Earlier monitoring events included DDT metabolites (2002 to 2006) and dioxins (2002 to 2003). NYSDEC evaluated the monitoring data from 2002 to 2008 to provide estimates of loading of synthetic chemicals into Lake Ontario from several New York tributaries with special emphasis on dioxins (NYSDEC 2009a). The data indicate that since 2002, Eighteenmile Creek had the highest PCB concentrations in surface water relative to other major tributaries to Lake Ontario. Further discussion of PCBs is provided in Section 4.

3.1.3 Sediment

Sediment has been extensively sampled as part of previous investigations and is discussed further as part of the human and health and ecological risk evaluation. There are no current data for the Town of Newfane marina for sediment chemistry at depth in the sediments. The subsurface sediments in Olcott Harbor were sampled by NYSDEC in 1994 and no PCBs were detected and metals concentrations

in the subsurface sediments were not higher than surface sediment concentrations of metals, and, therefore, none of the subsequent studies evaluated subsurface sediments in this area. Surface sediments were sampled and analyzed for PCBs by USACE in 2010 and sediments in the federal navigational channel were sampled in 2013. The surface sediment concentrations were lowest in the Newfane area in 2010. In 2013, the USACE determined the sediment in the federal navigation channel at the mouth of the Creek was suitable for open lake disposal. The specific sample results were not obtained. The results are consistent with other surface sediment data that indicate lower concentrations in Reach 1 and in the harbor compared with upstream areas. However the depth and levels of contamination in buried sediments is unknown. Sediment transport and erosion are discussed in Section 4.

3.1.4 Soils

To determine if contaminated sediment were deposited on the banks during flooding events, historical creek channels and wetlands were sampled during the EPA GLLA project (see Table 2). Concentrations of the chemicals of potential concern (COPCs) in the soil samples are comparable to or lower than sediments in the main channel. The EPA GLLA RI concluded that the limited soil data suggest that bank soils have not been extensively impacted by contaminated sediments.

3.2 Human Health Risk Assessment

In previous studies, Eighteenmile Creek OU3 was divided into seven reaches for investigation and characterization purposes, as described in Section 2. The reaches were numbered beginning at the north end of the Creek where it empties into Lake Ontario. A Human Health Risk Assessment (HHRA) was not completed for OU3.

Numerous studies have been conducted of the sediment and biota in various reaches of OU3 as listed in Table 1. In general terms, contaminants that have been found in the area that may pose health risks to humans that come into contact with sediment include PCBs, metals, PAHs, and pesticides. Biota have been primarily sampled for PCBs and high concentrations in biota tissue have been identified in all reaches sampled (i.e. Reaches 1, 2, and 5)

Potential exposure pathways and receptors are summarized in Table 7. Potential receptors include recreational users of the Creek – swimmers, waders, boaters, and anglers and their families and friends who might eat their catch. All of these receptors could be exposed to site contaminants through dermal contact with and incidental ingestion of surface water and sediment. Anglers and their families and friends who might eat their catch could also ingest contaminants in the fish tissue. These activities appear likely to occur in different ways and to different degrees in the various reaches of the Creek. Wading is most likely to occur in the shallower Reaches, 1, 3, 4, 6, and 7; swimming in the deeper impoundments behind the Burt and Newfane dams, and possibly in the harbor area of Reach 1 where the creek discharges to Lake Ontario. Boating could occur in any of the reaches but access above Burt Dam is limited to small boats. Fishing is most popular in the shallow

area downstream of Burt Dam but could occur anywhere in Reaches 1 through 7. Significant sediment contact is most likely to occur in the shallow reaches and along the banks of the creek. Significant contact with bottom sediment is unlikely to occur in the deeper water in the impoundments – Reaches 2 and 5. Therefore, from a human exposure standpoint, the lower creek can be divided into five relatively homogeneous exposure areas:

- Reach 1 – Mouth of the creek to Burt Dam;
- Reach 2 – the Burt Dam impoundment;
- Reaches 3 and 4 – upstream of the Burt Dam impoundment to the Newfane Dam;
- Reach 5 – the Newfane Dam impoundment; and
- Reaches 6 and 7 – upstream of the Newfane Dam impoundment to the bottom of the escarpment. Physical access to Reach 7 may be more difficult due to the woody debris present.

Assessing potential exposures to site contaminants requires that sufficient data be available to make reliable estimates of contaminant concentrations in the various potential exposure areas. EPA estimates potential exposures based on a conservative estimate, typically the 95% upper confidence limit (95% UCL) on the average contaminant concentrations within an exposure area. EPA has developed the ProUCL statistical software package to evaluate the analytical data and perform the appropriate statistical calculations. The ProUCL Technical Guidance document recommends that at least eight to 10 detected values be available in order to calculate reliable estimates of the 95% UCL values.

3.2.1 Available Data for the Human Health Risk Assessment

The sediment in the stream bed has been sampled and analyzed extensively throughout most of OU3. There are much greater than 10 detected values for PCB Aroclors and metals in all of the homogenous exposure areas described in the previous section. There are fewer analyses for PAHs and pesticides, but greater than 10 positive detect values in most of the exposure areas except for PAH in Reach 1. Most of the available historical PCB data are for the various Aroclor mixtures. There are some PCB congener results available for sediment samples and fish tissue collected downstream of the Newfane Dam to the mouth of the Creek at Olcott.

3.2.2 Additional Analytical Parameters

In order to comply with EPA risk assessment guidance, full Hazardous Substance List analyses are needed for at least some fraction of the samples to provide assurance that no significant COPCs are missed in the RI/remedial assessment process. Some analytical parameters have limited data as described below. In addition, there are limited data for PAH in Reach 1, as noted on Table 2.

Dioxins/furans have been detected in fish collected near the northern end of the Creek at concentrations higher than Oak Orchard Creek, a reference creek to the east. Environmental media in the Creek were not analyzed for dioxins/furans as part of the GLLA RI, because that study evaluated transport of contamination from OU2. Earlier NYSDEC studies of the Canal and Creek channel indicate that dioxins/furans are present in sediments in OU3 and, therefore, could contribute to cumulative risks.

Total chromium concentrations appear to be elevated in environmental media in Eighteenmile Creek. Chromium can exist in two valence states, Cr(III), and Cr(VI). The Cr(VI) is generally much less common in environmental media, but it is much more toxic than Cr(III), therefore, it is important to know the chemical form of the chromium present. In the HHRA for the residential properties comprising OU1, the form of the chromium was unknown so it was conservatively assumed to be the more toxic Cr(VI) for the risk estimates prepared for OU1 properties and as a result Cr(VI) completely dominated the risk estimates for those properties.

3.2.3 Additional Environmental Media

Some of the potential exposure scenarios that may occur in OU3 involve contact with surface water (i.e., swimming, wading and fishing), and consumption of fish and/or crayfish caught from the creek. Analytical data is available for surface water or fish or crayfish tissue, but primarily for PCBs.

The potential for contaminated sediments to impact floodplains has only been assessed at a few locations where historical Creek areas were visible. Sediment transport and the potential for flooding has not been documented in OU3.

3.2.4 Background and Reference Areas

A number of the contaminants found in OU3 are naturally occurring (e.g., most metals such as iron, lead, copper, zinc, and aluminum), or are ubiquitous in environmental media (PAHs and dioxin/furan) as a result of natural processes like combustion or other regional or global human activities. Consequently it is important to collect analytical data for environmental media in nearby reference or background areas in order to distinguish site-specific concentrations, exposures, and risks from those found in the other Lake Ontario watersheds. Some tissue samples were collected from Oak Orchard creek in 2007 (E & E 2009). Basin-wide monitoring programs also can be used as references for surface water and historical sediment data.

3.3 Ecological Risk Assessment

Data available to support the Baseline Ecological Risk Assessment (BERA) for OU3 is presented in this section. A Screening Level Ecological Risk Assessment (SLERA) has not yet been conducted for OU3; however, it seems likely that an unacceptable screening level risk will be identified in OU3 when a SLERA is conducted, for at least two reasons:

1. Elevated levels of PCBs, copper, lead, zinc, and other contaminants in sediment and fish tissue have been reported in OU3 in several recent investigations (e.g., CH2M Hill 2012; E & E 2009, 2012a, 2012b); and

2. Fish, wildlife, and other ecological receptors are abundant in and along the creek in OU3 given the diversity of natural habitats present (E & E 2009).

The information presented in this memorandum is intended to assist EPA with understanding the potential data needs to conduct a BERA for OU3, should EPA decide to do so.

E & E's evaluation of the sufficiency of the available data to support a BERA for OU3 was based on the following:

1. The preliminary ecological CSM for OU3 (see Figure 3);

2. The preliminary list of assessment endpoints, risk questions, and measures (see Table 4); and

3. A review of the available data for OU3 as presented in recent site investigation reports, including the GLLA RI (CH2MHill and EEEPC 2012), Beneficial Use Impairment Investigation Report for Eighteenmile Creek (E & E 2009), and other recent site reports as described in Table 1.

As the risk assessment process for OU3 advances, it is expected that refinements will be made to the CSM and assessment and measurement endpoints. The following summarizes available data for OU3. Recommendations to fill identified data gaps are presented in Section 5.

3.3.1 Available Data for Ecological Risk Assessment

Table 2 provides a summary of existing data. The following points are noteworthy regarding the sufficiency of the available data to support a BERA for OU3:

- Existing sediment chemistry data appear to be adequate for determining the extent of contamination;
- There are no sediment toxicity data and the available bioaccumulation test data are limited to PCBs, except for downstream of Burt Dam (Reach 1);
- Surface water sample data are available for PCB congeners, mercury, pesticides, and dioxins/furans. No data are available for metals, PAHs, and surface water toxicity;
- Fish tissue and other biological data are available for Reach 1 and behind both impoundments; and
- Benthic community and other wildlife surveys have only been completed for Reach 1.

3.3.2 Additional Analytical Parameters

PCB congener data have been collected for Eighteenmile Creek system in several investigations. Recently, all 209 PCB congeners were measured in fish and sediment samples collected to support a Trophic-Trace model for Eighteenmile Creek (E. Risk Sciences 2012). PCB congener data is useful for assessing exposure instances when PCB patterns from Aroclors are weathered or degraded.

3.3.3 Background and Reference Areas

As described for the HHRA, a number of the COPCs found in OU3 are naturally occurring (metals), or are ubiquitous in environmental media (PAHs and dioxin/furan) as a result of natural processes like combustion or other regional or global human activities. Consequently, it is important to collect analytical data for environmental media in nearby reference or background areas in order to distinguish site-specific concentrations, exposures and risks from those found in the general Lake Ontario watersheds. One possible reference area for OU3 is Oak Orchard Creek, which was used as a reference area for Eighteenmile Creek AOC Beneficial Use Impairment Investigation conducted in 2007 (E & E 2009). Oak Orchard Creek has many similarities with Eighteenmile Creek. Both creeks are tributaries of Lake Ontario, are of similar size and surrounding geography, and are subject to water level fluctuations due to changes in lake water levels. In addition, each creek has a hydro-electric dam located some distance from their confluences with the lake. Oak Orchard Creek is not a Great Lakes AOC and was recommended as a suitable reference location by NYSDEC. Finally, the BUI investigation demonstrated that PCBs and dioxin/furans in brown bullheads (whole-body samples) collected from Eighteenmile Creek were an order of magnitude greater than in brown bullheads collected from Oak Orchard Creek

4 Sediment Erosion and Deposition Analysis (SEDA)

Migration of the PCBs and lead contamination from the Creek Corridor downstream to Lake Ontario is well documented. The highest lead contamination in sediments in OU3 is detected at depths of 2 to 8 feet in the reservoir behind Burt Dam. Radiochemical dating of the sediment cores indicate the sediment at this depth was deposited prior to 1954. The highest PCB contamination in sediments is shallower and the sediment was deposited in the mid-1960s. Persistent higher concentrations of both PCBs and lead in shallow sediments throughout the creek indicate continued migration of contamination downstream of the Corridor. Therefore, understanding sediment transport is of primary concern for determining remedial alternatives in OU3. The source of contaminated sediment is believed to be primarily located in OU2 and that contaminated sediment is migrated downstream through deposition, re-suspension due to scour and settling; however, these processes have not been modeled.

The sediment thickness, water depth, and area were modeled for OU3 and sediment volume was estimated based on the model as part of the GLNPO RI; however, the data for Reach 1 were limited. The average sediment thickness and water depths in the depositional areas behind the dams increase from upstream to downstream. The average sediment thickness and water depths in rest of the main channel decrease from upstream to downstream.

The model can be used to evaluate sediment deposition. Current bathymetry of the reservoir behind Burt Dam shows a significant sediment deposition area where main channel Creek flow discharges into the impoundment. As the water depth increases closer to the dam, the sediment scour appears to decrease. Sediment capping in this area is a potential remedial alternative and sediment transport in this area needs to be evaluated. Sediment deposition also is present behind Newfane Dam, but the varying concentration profiles at depth indicated sediment contaminant movement after deposition.

Olcott Harbor also is a depositional area but the water and sediment depths in the marina are unknown. Water depth in the harbor is monitored and maintained by the USACE as a federal navigational channel. The USACE is scheduled to dredge the navigation channel to the project depth of 12 feet below low water datum (LWD) in 2014.

Sediment depositional areas were identified in shallower areas of the Creek with higher concentrations of PCBs and lead at the bottom of the cores. However, the extents of the isolated PCB and lead "hot spots" have not been delineated and the results from subsequent confirmatory samples have shown inconsistent results. The findings suggest that the distribution of PCB and lead contamination in sediments varies significantly and conditions change over time. Deposition in the shallow areas is also caused by the significant amount of woody debris obstructing the water flow throughout these portions the Creek.

Sediment transport off the creek bank due to flooding is not well documented, but limited sampling of the historical creek channels and wetlands indicate minimal impacts based on the low concentrations of contamination.

Two major tributaries, East Branch of Eighteenmile Creek and Gulf Creek, contribute significant flow to the main channel. Many smaller tributaries and drainage areas throughout the flat agricultural portion of the Creek from the escarpment to Newfane have been documented to contribute intermittent flow to the main channel. The impact of the tributaries on sediment transport has not been established. However, a preliminary model of hydrology and sediment transport within the watershed was developed for the USACE in 2005 using the Soil and Water Assessment Tool (BSGLC 2005). The model estimated the annual total surface water runoff to the Creek and sub basins to be 412 millimeters (mm), while the annual runoff ratio (i.e., total surface water runoff divided by precipitation amounts) was 0.45 mm. The sub-basins with the largest proportion of urban development produced the greatest amounts of runoff. Across all sub-basins, the annual average runoff ranged from 369 to 461 mm (BSGLC 2005). The model is limited because United States Geological Service (USGS) stream flow gage data is not available for Eighteenmile Creek watershed and the artificially controlled flow from the Canal presents unique challenges to modeling the hydrology within Eighteenmile Creek watershed.

EPA semiannual monitoring of Lake Ontario tributaries indicate that since 2002 the highest PCB concentrations in surface water were observed in Eighteenmile Creek. In 2008 PCB concentrations in Eighteenmile Creek were more than 40 times greater than observed in any tributary and two to three orders of magnitude higher than observed in any other tributary in 2009 to 2010 . Both the EPA and NYSDEC estimated loadings for Eighteenmile Creek based on estimated flow rates because the creek is not gauged by the USGS. The EPA estimated the PCB loadings to be 10 to 20 grams per day. Limited NYSDEC surface water sampling for dissolved PCBs in the Creek Corridor indicate the highest concentration of dissolved PCBs are present downstream of the Flintkote property. The relationship between the dissolved PCBs in the surface water and sediment transport of contamination is not understood in OU3.

5 Data Gaps and Recommendations

The following data gaps and recommendations are based on the data evaluation presented in Section 3. The data gaps and sampling recommendations to address them are in this section and on Table 5.

5.1 Fate and Transport

PCBs, lead, and other contaminants were detected at the Creek in all reaches and media sampled. The following are recommendations to fill data gaps by media:

5.1.1 Groundwater

Groundwater below escarpment is not considered to be part of OU3 because OU3 is limited to contaminated sediments moving downstream from OU2. Therefore, we do not recommend groundwater investigated as part of OU3.

5.1.2 Surface Water

Lake-wide monitoring studies of dissolved PCBs in water indicates that there is a source of PCBs to the surface water within OU2 and the Creek is significant source of PCBs to Lake Ontario. Until the source area in OU2 is found and investigated and this source can be eliminated, additional evaluation of surface water is not recommended. The existing surface water data can be used to estimate human exposure in the HHRA. Some additional sampling is recommended as part of the ecological risk evaluation. This data can be used for both the HHRA and BERA.

5.1.3 Sediment

Sediment has been extensively sampled as part of previous investigations. There are no current sample data to assess the depth and level of contamination in sediments in Town of Newfane Marina, but results from the 1994 NYSDEC study did not find high concentrations. The USACE is planning to dredge the federal navigational channel in 2014. Their data indicate the sediment contamination at the surface in Reach 1 is significantly lower than above Burt Dam and it is not clear if contaminated sediment from OU2 and upstream in OU3 impacts the area near the lake entrance or if shoaling from Lake Ontario contributes to sediments in the area. Historical studies suggest that most of the contaminated sediment was deposited behind Burt Dam and was not transported farther into Reach 1. Additional sampling of sediments at depth is not recommended in the Town of Newfane Marina unless a more complete understanding of sediment transport through modeling indicates this area to be a potential depositional zone. The Town of Newfane

also may dredge the marina are in the future if funding can be obtained due to low water levels in Lake Ontario.

No other additional sampling is needed to evaluate fate and transport; however, some additional sampling is recommended as part of the risk evaluation. Sediment sampling to evaluate the extent of "hot spots" in the shallower reaches has not been effective in delineating the extent of contamination because concentrations changed between sampling events. Additional sampling to identify hotspots is not recommended until risk assessment and sediment transport modeling is completed. The existing data can be used to estimate volumes of contaminated sediment within the margin of error acceptable for evaluation of remedial alternatives in the FS.

5.1.4 Soils

Minimal sampling of floodplain soils has been completed and the initial results do not indicate a larger flooding concern. No additional sampling is recommended until risk assessment and sediment transport modeling is complete.

5.2 Human Health Risk Assessment

As stated in Section 3, the data available for soil and sediment in the stream bed and banks generally appears to be sufficient for most COPCs. However the additional sample parameters, sample locations, and environmental media listed in the following subsections are recommended to complete the HHRA.

5.2.1 Additional Samples

Data gaps for specific analytical parameters in specific reaches were identified as shown in Table 2. No samples have been collected for PAH analyses in Reach 1 below Burt Dam. However, there are sufficient samples for PAH in the other reaches. For other measured parameters, the concentrations in the sediment in Reach 1 are significantly lower. If PAH data from upstream are used to assess risks for Reach 1, then risks may be overestimated in this area. For dioxin/furan, historical data from previous studies in 1994, 1998, and 2003 can be used for screening level risk assessment. Sediments also were not analyzed for hexavalent chromium, which may be a risk driver if total chromium concentrations are used to estimate risks from hexavalent chromium. Because most of the available PCB data are for Aroclors, PCB Aroclor data can used in the HHRA except possibly for evaluation of the fish ingestion pathway for which the congener data may be useful.

Sediment and surface water data collected for BERA toxicity evaluation can also be used for the HHRA to fill data gaps on the lack of full-scan analysis. Sampling at depth is not required for the HHRA. We do not recommend additional sampling in Reach 1 only to collect data on PAH concentrations in sediment. The upstream data can be used to estimate risk for this parameter in Reach 1.

5.2.2 Additional Environmental Media

Additional samples to assess exposure pathways from fish consumption are not recommended for PCBs; however, there are no fish tissue data to assess exposure pathways for additional parameters. PCBs are expected to be the primary risk driver in fish consumption, but some additional limited fish tissue data are recommended for additional parameters..

5.2.3 Additional Sampling Locations

Suitable comparison or background areas need to be identified, sampled, and analyzed to establish general area concentrations of chemicals that might be site-related COPCs. Background data collected for OU2 also can be used for OU3.

5.3 Ecological Risk Assessment

5.3.1 Additional Samples

As presented in Section 3, most reaches have sufficient samples to assess ecological exposures for the majority of analytical parameters, but there is insufficient data for all parameters. Previous sample investigations have not assessed the toxicity of contaminated water or sediment to aquatic organisms. Additional sampling is recommended as summarized below and noted on Table 5.

The recommendations are summarized below.

- Sufficient sediment samples were collected throughout the creek to determine the nature and extent of contamination and for risk assessment purposes, except samples for sediment toxicity, which is recommended for the BERA. Sediment toxicity is at three locations between Burt and Newfane Dams and three locations above Newfane Dam. Sediment chemistry samples should be collected at locations where sediment toxicity is evaluated to help understand the causative agents of toxicity, if any.
- Surface water toxicity testing is recommended along with collocated surface water chemistry samples to help evaluate the causative agents of toxicity, if any. Sampling for metals should include total and dissolved forms.
- A benthic community survey is also recommended to be conducted at selected riffle and pool locations within OU3 following NYSDEC (2009) protocols to determine the level of impairment, or lack thereof, as done for the area below Burt Dam (E & E 2012b). The survey locations should be collocated with sediment toxicity and chemistry sampling (see above).

5.2.2 Additional Sampling Locations

Suitable comparison or background areas need to be identified, sampled and analyzed to establish general area concentrations of chemicals that might be site-related COPCs. One possible reference area is the Oak Orchard Creek. Background data collected for OU2 also can be used for OU3.

5.4 SEDA

The transport mechanisms for the PCB contamination downstream are not fully understood. PCBs strongly adsorb to sediment particles, have low water solubility, are persistent in the environment (do not readily break down), and thus do not typically show much migration in a given environment. The adsorption of PCBs onto solids is greatest in solids containing high organic matter and clay, similar to the sediment encountered in portions of Eighteenmile Creek. The adsorbed PCBs will be transported downstream with the sediments they are sorbed to. The PCB concentrations in the water discharging into Lake Ontario indicate that PCBs are being mobilized in the water column throughout Eighteenmile Creek. PCB concentrations in the surface sediments below Burt Dam are relatively low but site-specific bioaccumulation testing indicates PCBs in surface sediments are highly bioavailable. High concentrations of PCBs in fish collected below Burt Dam support this conclusion. If PCBs contamination transport mechanism was primarily on sediment particles, then higher concentrations of PCBs would be expected in sediment depositional areas. Higher PCBs concentrations were found in sediment deposits in Reaches 2, 3, 6, and 7, but PCB concentration in subsurface sediments deposited behind Newfane Dam in Reach 5 are relatively low. The findings indicate additional evaluation of the sediment transport downstream of PCBs is warranted.

Tables

Table 1

Summary and Evaluation of Historical Data

Eighteenmile Creek Superfund Site - Operable Unit 3

Investigations	Reference Key	Area	Data Summary	Data Evaluation	Data Availability and Status	Data Use
NYSDEC 1998. Eighteenmile Creek and Olcott Harbor Sediment Study.	NYSDEC 1998	OU 2 and 3	Sediment sampling at 8 sites on Eighteenmile Creek, tributaries, and Barge Canal. Sampling was completed in 1994.	The report provides detailed description of data collection and data validation procedures. Laboratory results are attached in the appendix. The data is only source of dioxin data for the sediment and therefore can be used for screening purposes. Surface contamination and toxicity results are greater than 10 years old and not representative of current conditions.	A partial data set is available electronically for PCBs, Dioxin and Furan and PCB Congener data from Trophic Trace Model. The available sediment data were imported into GLNPO RI database. Additional data was entered from the original report for missing COPCs. Only total concentrations were entered for PCBs, PAHs, and DDT metabolites. Additional data entry is needed for other parameters and individual compounds.	Dioxin data will be used for risk assessment. Subsurface sediment will be used for nature and extent.
NYSDEC. 2001a. Final Report, Eighteenmile Creek Sediment Study, Summary of August 17-20 and November 3, 1998 Results.	NYSDEC 2001	OU 2 and 3	Sediment sampling at 12 sites on Eighteenmile Creek, tributaries, and Barge Canal, water column sampling to evaluate sediment transport from Barge Canal to Eighteenmile Creek. Sampling was completed in 1998. Some of the sampling sites were the same location as the NYSDEC 1998. Provides a detailed description of dioxin and furan data. Report includes radiodating of cores behind Newfane and Burt Dam.	The report provides detailed description of data collection and data validation procedures. Laboratory results are attached in the appendix. The data is only source of dioxin data for the sediment and therefore can be used for screening purposes. Surface contamination and toxicity results are greater than 10 years old and not representative of current conditions.	A partial data set is available electronically for PCBs and metals as well as Dioxin/Furan and PCB Congener data from Trophic Trace Model. The available sediment data were imported into GLNPO RI database. Additional data was entered from the original report for missing COPCs. Only total concentrations were entered for PCBs, PAHs, and DDT metabolites. Additional data entry is needed for dioxins and individual compounds.	Dioxin data will be used for risk assessment. Subsurface sediment will be used for nature and extent. Radiodating will be used to evaluate historical deposition.
USACE 2004a. Volume I, Project Report Overview, Sediment Sampling, Biological Analyses, and Chemical Analyses for Eighteenmile Creek AOC.	USACE 2004		2004a: Sediment and tissue testing for Reach 1 sediments including PCB congener, dioxin, TOC, PCB Aroclors, metals, mercury and pesticide analysis.	Summary of sediment and tissue sampling and results. Detailed analytical results included in volume II.	A partial data set is available electronically for PCBs, Dioxin and Furan and PCB Congener data from Trophic Trace Model. The available sediment data were imported into GLNPO RI database. Additional data was entered from the original report for missing COPCs. Only total concentrations were entered for PCBs, PAHs, and DDT metabolites. Additional data entry is needed for other parameters and individual compounds.	Data are considered usable for nature and extent of contamination.
USACE 2004b. Volume II, Laboratory Reports, Sediment Sampling, Biological Analyses, and Chemical Analyses for Eighteenmile Creek AOC.	USACE 2004		2004b: Laboratory reports of sediment and tissue analysis in Reach 1 Sediments. Sediment results include PCB, pesticide, metals, mercury, TOC, dioxin, and particle sizing analysis. Tissue results include PCB, pesticide, metals and mercury analysis. Bioaccumulation results include final biomass, total lipid content, chlorinated pesticides, PCB congener and heavy metals analysis.	Data were not formally validated and no data validation memos are available. Laboratory data and associated QC results are available in the appendix of the report.	A partial data set is available electronically for PCBs, Dioxin and Furan and PCB Congener data from Trophic Trace Model. The available sediment data were imported into GLNPO RI database. Additional data was entered from the original report for missing COPCs. Only total concentrations were entered for PCBs, PAHs, and DDT metabolites. Additional data entry is needed for other parameters and individual compounds.	Data are considered usable for evaluating nature and extent of contamination.

Table 1

Summary and Evaluation of Historical Data

Eighteenmile Creek Superfund Site - Operable Unit 3

Investigations	Reference Key	Area	Data Summary	Data Evaluation	Data Availability and Status	Data Use
NYSDEC 2010c. Results From The Sampling Of Erie Canal Suspended Sediments And Creek Waters For PCBs. Eighteen Mile Creek Corridor Site.	NYSDEC 2010	OU2	Additional suspended sediment and water column above sediment sampling for PCB Aroclors in Erie Canal, creek, millrace, and offsite locations.	Data are used to evaluate fate and transport of sediment from Barge Canal. A limited set of pisces samples are available. Data may be useful for evaluation of alternatives.	Data could be usable for PCB comparison in the water column. Suspended sediment sampling was unsuccessful. Filter media used for sediment collection were cut submitted for PCB analysis (extracted, analyzed and reported similar to a “wipe” type samples). There were no positive detections found in these samples. Data were not available electronically and not directly related to nature and extent.	Data are usable for evaluating fateand transport.
Ecology and Environment, Inc. 2007. Final Report for the Eighteenmile Creek PCB Source Trackdown Project. Prepared for NCSWCD.	NCSWCD 2007	OU2	Presents sediment data from Reach 7 and tributaries. PCB and metals results from sediment cores and PCB screening results from sediment grab samples are available electronically.	Data was validated and data review memos are available. Sediment data from the cores are considered usable for the RI.	Sediment data are included in the GLNPO RI database.	Data are usable for risk assessment and fate and transport.

Table 2

RI/FS OU3 -- Summary of Sampling Data for RI/FS

Eighteenmile Creek Superfund Site - Operable Unit 3

Sample Location	Reach	Number of Studies	Sample Date Range		Number of Samples										
					PCB Aroclors	PCB Congeners	Metals	Mercury	PAH	Pesticides	Dioxins/ Furans	Total Organic Carbon	Toxicity	AVS/SEM	Other[A]
Sediment															
Creek	01	4	5/25/94	10/26/10	32	36	47	47	--	50	42	59			--
Creek	02	3	10/11/94	5/25/10	127	34	127	127	124	14	13	105			--
Creek	03	2	8/18/98	5/27/10	80	28	80	80	80	7	9	59			--
Creek	04	1	11/16/09	6/23/10	25	3	22	22	15	4	--	22			--
Creek	05	3	10/12/94	7/2/10	82	15	83	82	81	13	13	59			--
Creek	06	1	11/17/09	7/2/10	62	6	62	62	51	6	--	62			--
Creek	07	2	8/23/06	7/1/10	121	19	101	101	67	15	--	101			--
Totals	**Subtotals**				**529**	**141**	**522**	**521**	**418**	**109**	**77**	**467**			**0**
Tributary	04, 07	2	8/17/98	6/29/10	20	2	22	22	22	11	2	20			--
Surface Soils															
Historic Creek	04 - 07	1	11/16/09	12/2/09	9	1	9	9	3	3	--	9			--
Wetland	03 - 07	1	11/16/09	12/2/09	12	2	12	12	4	4	--	12			--
Totals					**41**	**5**	**43**	**43**	**29**	**18**	**2**	**41**			**0**
Surface Water/ PISCES															
Creek	01	1	4/16/02	10/16/08	--	11	--	13	--	9	5	--			13
Creek	06	1	5/1/07	6/10/08	--	7	--	7	--	7	7	--			7
Totals					**0**	**18**	**0**	**20**	**0**	**16**	**12**	**0**			**20**
Biological															
Fish Tissue	01	3	5/1/07	9/13/10	19	39	--	--	--	--	2	--			--
Fish Tissue	02	2	9/13/10	8/20/12	10	41	--	--	--	--	--	--			--
Fish Tissue	05	1		8/20/12	15	15	--	--	--	--	--	--			--
Toxicity	01	1	8/21/12	8/22/12	4	--	4	4	--	4	--	--	6	4	4
Benthic Community	01	1	11/16/09	8/20/12	--	--	--	--	--	--	--	--			5
Bird and Mammal Surveys	01	1		5/1/07	--	--	--	--	--	--	--	--			1
Crayfish	01	1		8/20/12	3	--	--	--	--	--	--	--			--
Crayfish	02	1		8/20/12	3	--	--	--	--	--	--	--			--
Crayfish	05	1		8/20/12	2	--	--	--	--	--	--	--			--

Key:

SVOCs = Semivolatile organic compounds
PAHs = Polycyclic aromatic hydrocarbons
PCBs = Polychlorinated biphenyls
TCL = Toxic compound list
TOC = Total organic carbon
TSS = Total suspended solids

Notes:

A = For sediment, TOC and water content. For surface water, TOC and water quality parameters (field measured). For biota, lipids and moisture content.

Table 3

Preliminary Selection of Exposure Pathways

Eighteenmile Creek - Operable Unit 3

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current and Future	Sediment	Sediment	Eighteenmile Creek Bed	Anglers and other Site Visitors	All ages	Ingestion, Dermal Contact, Inhalation	Quantitative	Anglers and other Site Visitors may wade in the creek; contaminants are known to be present.
				Swimmers, Waders and Boaters	All ages	Ingestion and Dermal Contact	Quantitative	Swimmers, waders and boaters may wade in the creek; contaminants are known to be present.
	Fish and Crayfish Tissue	Fish and Crayfish Tissue	Eighteenmile Creek	Anglers and their familes	Children and Adults	Ingestion	Quantitative	Anglers and their families may consume fish caught from the creek. Fish caught from the creek are known to be contaminated

Table 4

Preliminary List of Candidate Assessment Endpoints, Risk Questions, and Measures for the Baseline Ecological Risk Assessment

Eighteenmile Creek Superfund Site - Operable Unit 3

Assessment Endpoint	Representative Species	Risk Question	Measure	Analysis Approach
Herbivorous, Insectivorous, and Carnivorous Aquatic-Dependent Mammals (OU2 [creek] and OU3)				
Survival, growth, and reproduction or aquatic mammals	Muskrat, Raccoon, Mink, Bat	Does the daily dose of contaminants received from ingestion of sediment, water, and prey exceed TRVs for survival, growth, or reproduction of mammals?	Contaminant concentrations in sediment, surface water, and prey	Modeled dose from ingestion of sediment, surface water, and prey compared with literature-based TRVs.
Herbivorous, Insectivorous, and Carnivorous Aquatic-Dependent Birds (OU2 [creek] and OU3)				
Survival, growth, and reproduction or aquatic birds	Mallard, Swallow, Heron	Does the daily dose of contaminants received from ingestion of sediment, water, and prey exceed TRVs for survival, growth, or reproduction of birds?	Contaminant concentrations in sediment, surface water, and prey	Modeled dose from ingestion of soil or sediment, surface water, and prey compared with literature-based TRVs.
Benthic Macroinvertebrates (OU2 [creek] and OU3)				
Survival, growth, and reproduction of benthic macroinvertebrates	All freshwater benthic macroinvertebrates	Are contaminant concentrations in sediment greater than screening levels for effects on survival, growth, or reproduction of benthos?	Contaminant concentrations in sediment.	Compare sediment contaminant concentrations with literature-based sediment screening levels for effects on benthic macroinvertebrates.
		Is the survival and growth of lab-reared benthic organisms in site sediment less than their survival and growth in clean control sediment?	Sediment toxicity test results	Compare survival and growth in site sediment with survival and growth in clean control sediment as described in EPA protocols.
		Is the composition of the benthic macroinvertebrate community in Eighteenmile Creek impaired based on NYSDEC protocols and, if so, what is the level of impairment?	Benthic community survey	Quantify composition and abundance of benthic macroinvertebrates and calculate impairment score (e.g. BAP) as per NYSDEC protocols.

Table 4

Preliminary List of Candidate Assessment Endpoints, Risk Questions, and Measures for the Baseline Ecological Risk Assessment

Eighteenmile Creek Superfund Site - Operable Unit 3

Assessment Endpoint	Representative Species	Risk Question	Measure	Analysis Approach
Aquatic Biota Exposed to Surface Water (OU2 [creek] and OU3)				
Survival, growth, and reproduction of aquatic organisms exposed to surface water	Fish, invertebrates, amphibians, and plants	Are contaminant concentrations in surface water greater than water quality criteria for protection of aquatic organisms?	Surface-water contaminant concentrations.	Compare surface-water contaminant concentrations with water quality criteria and standards.
		Is survival and growth of laboratory-reared organisms in site surface water less than survival and growth in clean control water?	Surface water toxicity test results	Compare survival and growth in site surface water with survival and growth in clean control water as described in EPA testing protocol.

Key:

BAP = Biological Assessment Profile (of index values, NYSDEC 2009, page 62).

EPA = Environmental Protection Agency

NYSDEC = New York State Department of Environmental Conservation

OU2 = Operational Unit 2 (Corridor Site)

OU3 = Operational Unit 3 (Rest of Creek)

TRV = Toxicity Reference Value

Table 5

RI/FS OU3 -- Summary of Data Gaps and Recommended Additional Sampling.

Eighteenmile Creek Superfund Site - Operable Unit 3

Matrix and Data Gap	Data Need	Note	Number of Samples												Remarks
			PCB Aroclors	PCB Congeners	Metals	Mercury	Cr(III) and Cr(IV)	PAH	Pesticides	Dioxins/ Furans	Total Organic Carbon	Toxicity	AVS/SEM	Other	
Sediment		***Sufficient samples were collected throughout the creek to determine the nature and extent of contamination, for the FS, and for risk assessment purposes, except for Olcott Harbor in Reach 1 and sediment toxicity, which is recommended for the BERA. Sediment chemistry samples (Full TCL scan) should be collected at locations were sediment toxicity is evaluated.***													
Sediment Chemistry	Data Gap and HHRA	There is limited sediment data in Reach 1 for select parameters and no recent samples in Olcott Harbor. There is limited data on select parameters that may be HHRA drivers.	--	--	--	--	6	--	--	--	--	--	--	--	Samples from BERA toxicity will be analyzed for additional parameters. No other sediment sampling is recommended until screening HHRA and BERA and sediment transport modeling are completed.
Sediment Toxicity	BERA	Sediment toxicity tests with benthic macroinvertebrates have not been conducted upstream from Burt Dam and Newfane Dam. The tests provide direct evidence of sediment toxicity, or lack thereof, and are a critical element of the sediment quality triad approach. Standardized tests based on EPA protocols are available.	--	--	--	--	--	--	--	--	--	12	--	--	Six *Chironomus* (midge) tests and six *Hyalella* (amphipod) tests for a total of 12 toxicity tests.
Sediment Chemistry	BERA and HHRA	Needed at locations were sediment toxicity is assessed. Sediment chemistry is another element of the sediment quality triad approach. AVS/SEM is recommended to help evaluate metals bioavailability. Full TCL scan typically needed for Superfund.	6	6	6	6	--	6	6	6	6	--	6	--	Three locations between Burt and Newfane Dams and three locations upstream from Newfane Dam.
Surface Soils		***Floodplain contamination has not been fully evaluated but the few samples that were collected do not ~~to~~ indicate any immediate concerns. Biota Soil Accumulation Factors (BSAFs) deveoloped for terrestrial habitats in OU2 should be appropriate for the OU3 floodplain, thereby minimizing the types of sampling required for the OU3 floodplain, should EPA decide to evaluate the floodplain .***													
			--	--	--	--		--	--	--	--	--	--	--	
Surface Water		***Surface water has been evaluated as part of the longterm EPA and NYSDEC tributary monitoring studies, but these studies do not provide all of the data types needed for a baseline ecological risk assessment.***													
Surface Water Toxicity	BERA	Surface water bioassays with laboratory-reared organisms have not been conducted in Eighteenmile Creek. The tests provide direct evidence of surface water toxicity, or lack thereof. Standard EPA tests with the fathead minnow and *Ceriodaphnia* (water flea) are available.	--	--	--	--	--	--	--	--	--	12	--	--	Three locations between Burt and Newfane Dams and three locations above Newfane Dam with two tests (fathead minnow and *Ceriodaphnia*) at each location.
Surface Water Chemistry	HHRA and BERA	All aquatic organisms are exposed to surface water and wildlife consume water from the creek. Surface water chemistry recommended at locations were toxicity is evaluated. Full TLC scan recommended for Superfund. Dissolved and total metals should be measured. Other includes TSS, TOC, and water-quality parameters (field measured).	6	6	6	6	--	6	6	6	--	--	--	6	
Biological		***Biological and habitat assessment data have been collected primarily below Burt Dam. More limited data are available in the Burt Dam and Newfane Dam impoundments. No data are available above Newfane Dam. Limited additional data are recommended to support the baseline ecological risk assessment.***													
Forage Fish	BERA	No data for metals and other organics in forage fish (e.g., juvenile sunfish) from the creek channel are available. The data are needed to develop reliable exposure estimate for piscivorous wildlife to site-related contaminants.	--	--	10	10	--	--	10	10	--	--	--	10	Metals to be analyzed for may be limited to those that are highly elevated in creek sediment in the Creek (lead, zinc, copper). Additional sampling may not be needed following SERA.
Sport Fish (Fillet)	HHRA	No data for metals and other organics in edible fish (e.g., largemouth bass, bullhead) from the creek channel are available. The data are needed to develop reliable exposure estimate for human health to site-related contaminants.	--	--	10	10	--	--	10	10	--	--	--	10	Metals to be analyzed for may be limited to those that are highly elevated in creek sediment in the Creek (lead, zinc, copper). Additional sampling may not be needed following screening level HHRA.
Benthic Community Survey	BERA	No studies have directly evaluated the condition of the resident benthic community upstream from Burt Dam. Such studies provide a direct measure of benthic community health and are a critical element of the sediment quality triad approach. Standardized sampling and analysis methods are available based on EPA and NYSDEC protocols.	--	--	--	--	--	--	--	--	--	--	--	12	Six riffle/run locations and six pool locations for a total of 12 survey stations. Pool survey locations should be collocated with sediment toxicity and chemistry sampling (see above).

Key:

AVS/SEM = Acid Volatile Sulfur / Simultaneously Extracted Metals
BERA = Baseline ecological risk assessment
BSAF = Biota soil (or sediment) accumulation factor
ERA = Ecological risk assessment
SLERA = Screening level ecological risk assessment
SVOCs = Semivolatile organic compounds
PAHs = Polycyclic aromatic hydrocarbons
PCBs = Polychlorinated biphenyls
TCL = Toxic compound list
TOC = Total organic carbon
TSS = Total suspended solids

Figures

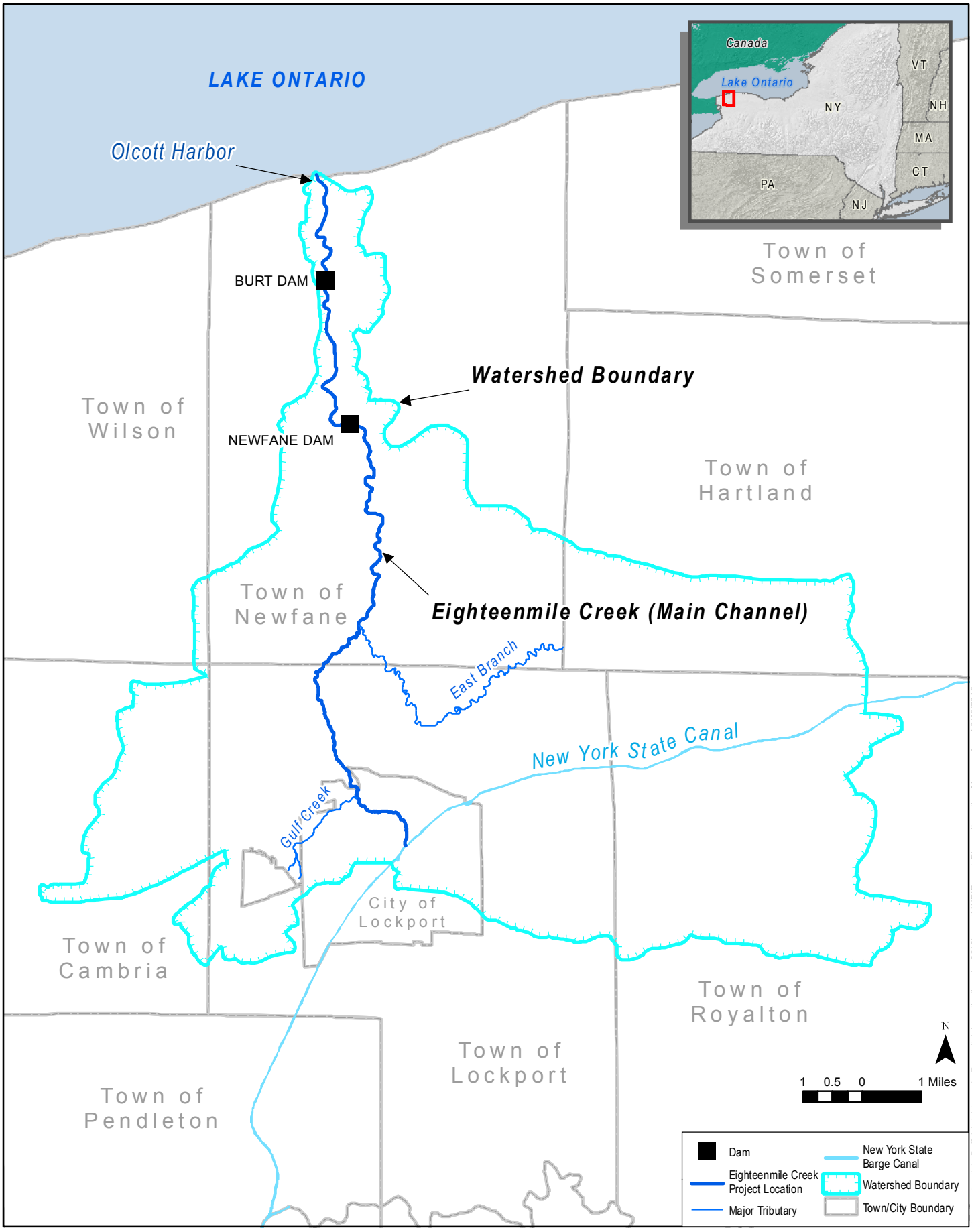

Figure 1 Eighteenmile Creek Site Location

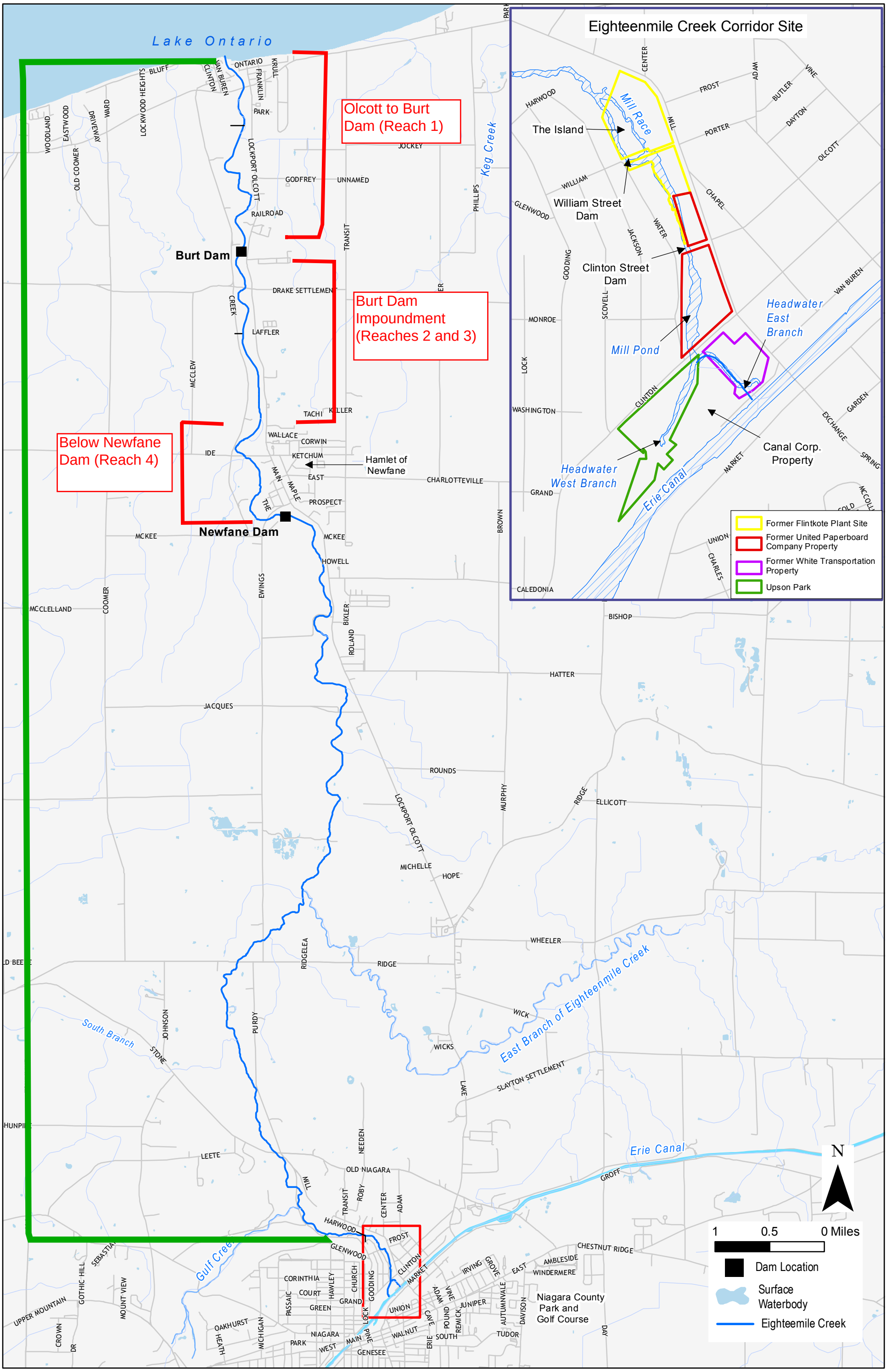

Figure 2 Eighteenmile Creek Site Areas

© Ecology & Environment, Inc. GIS Department Project #
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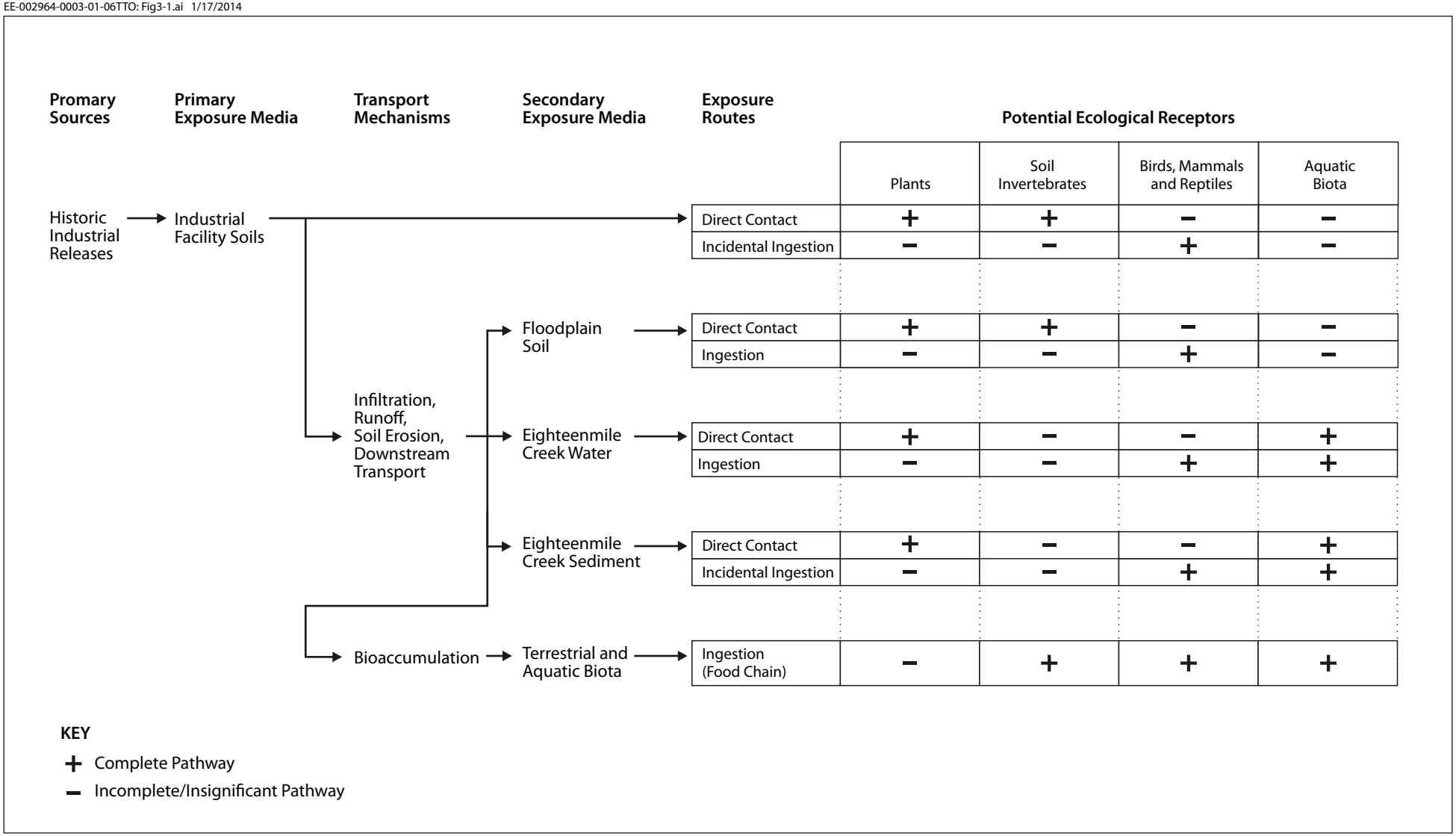
EE-002964-0003-01-06TTO: Fig3-1.ai 1/17/2014



SOURCE: Ecology and Environment, Inc., 2014

Figure 3 Preliminary Ecological Conceptual Site Model, Eighteenmile Creek Corridor Site (OU2) and Downstream Areas (OU3)

A Reports Reviewed

Table A

List of Previous Studies and Guidance Reviewed

Eighteenmile Creek Superfund Site - Operable Unit 2 and 3

Reference Key	Area	Year	Reference
	OU2 and OU3	2005	Buffalo State Great Lakes Center (BSGLC). 2005. *Sediment Modeling for the Eighteenmile Creek Watershed, Niagara County.* Final project report. Prepared by Shreeram Inamdar, Ph.D., Great Lakes Center and Department of Geography, SUNY Buffalo State College, for the U.S. Army Corps of Engineers Buffalo District. December 2005.
	OU3	1983	Burt Dam Associates. 1983. *Application for Exemption for Licensing for the Burt Dam Hydroelectric Project*. Submitted to the Federal Energy Regulatory Commission.
	OU3	2009	CH2M HILL, Inc. and EEEPC. 2009a. *Phase 1 Reconnaissance Survey Eighteenmile Creek Area of Concern, Niagara County, New York, for the Remedial Investigation/Feasibility Study*. Prepared for the United States Environmental Protection Agency.
	OU3	2009	CH2M HILL, Inc. and EEEPC. 2009b. *Field Sampling Plan for the Eighteenmile Creek AOC Site Characterization, Niagara County, New York*.
	OU3	2011	CH2M HILL, Inc. and EEEPC. 2011. *Data Summary Report, Site Characterization Eighteenmile Creek Area of Concern, Niagara County, New York.*
USEPA GLNPO	OU2 and OU3	2012	CH2M HILL, Inc. and EEEPC. 2012. *Draft Remedial Investigation Report, Eighteenmile Creek, Remedial Investigation / Feasibility Study, Niagara County, New York.* Prepared for USEPA Region 5 RAC2 by CH2M HILL, E & E, and others. WA No. 139-RICO-1527/Contract No. EP-S5-06-01.
	OU1 and OU2	2011	City of Lockport. 2011. CSO Longterm Control Plan - Draft, Niagara County, New York. Prepared by the Clough Harbor and Associates, September 16, 2011.
	OU1 and OU2	2006	City of Lockport. 2006. City of Lockport Zoning Map, Niagara County, New York. Prepared by the City of Lockport Engineering Department, February 2006.
	OU2 and OU3	2007	E & E. 2007a. Eighteenmile Creek State of the Basin Report. Prepared for the U.S. Army Corps of Engineers.
NCSWCD 2007	OU2 and OU3	2007	E & E. 2007b. *Final Report for the Eighteenmile Creek PCB Source Trackdown Project*. Niagara County, New York.
	OU2	2007	E & E. 2007C. *Phase 1 Environmental Site Assessments, Eighteenmile Creek Corridor Sites: Upson Park, United Paperboard Company, and White Transportation. City of Lockport, New York*. Prepared for the New York State Department of Environmental Conservation.
	OU3	2009	E & E. 2009. *Eighteenmile Creek Beneficial Use Impairment Assessment*. Niagara County, New York. Prepared for the Niagara County Soil and Water Conservation District.
	OU2	2009	E & E. 2009. *Final Feasibility Study Report for the Eighteenmile Creek Corridor Sit (Site 932121) and Adjacent Upland Properties (Water Street Residential Properties, Former United Paperboard Company, White Transportation, and Upson Park)*. City of Lockport, New York. Prepared for New York State Department of Environmental Conservation, Albany, NY by E & E, Lancaster, NY.
	OU3	2011	E & E. 2011. *Interim Eighteenmile Creek Area of Concern (AOC) Strategic Plan for Beneficial Use Impairment (BUI) Delisting, Contract Number W912P4-10-D-0002.* Prepared for the United States Army Corps of Engineers.
	OU3	2012	E & E. 2012a. Draft Eighteenmile Creek Baseline Fish Sampling Report. Prepared for Niagara County Soil and Water Conservation District, Lockport, NY by E & E, Lancaster, NY.
	OU3	2012	E & E. 2012b. Draft Eighteenmile Creek Baseline Benthic Community Sampling Report. Prepared for New York State Department of Environmental Conservation, Albany, NY by E & E, Lancaster, NY.
USACE 2010	OU3	2012	E Risk Sciences, LLP (ERS) and USACE. 2012. *Final Bioaccumulation Modeling and Ecological Risk Assessment, Eighteenmile Creek Great Lakes Area of Concern (AOC), Niagara County, New York.* Prepared by E Risk Sciences, LLP, Allston , Massachusetts, and U.S. Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, Mississippi.
	OU3	2011	EA Engineering P.C. and EA Science and Technology (EA Engineering). 2011. *Final Remedial Investigation Report Old Upper Mountain Road (932112) Lockport, New York, Site Number 932029, Town of Lockport, Niagara County*. Prepared for NYSDEC Region 9.
NYSDEC SRI	OU2	2009	EEEPC. 2009a. *Final Supplemental Remedial Investigation Report for the Eighteenmile Creek Corridor Site (Site No. 932121), City of Lockport, New York*. Prepared for the New York State Department of Environmental Conservation.
NYSDEC SRI-A	OU2	2009	EEEPC. 2009b. *Final Additional Investigation Addendum to the Supplemental Remedial Investigation Report for the Eighteenmile Creek Corridor Site (Site No. 932121), City of Lockport, New York*. Prepared for the New York State Department of Environmental Conservation.

Table A

List of Previous Studies and Guidance Reviewed

Eighteenmile Creek Superfund Site - Operable Unit 2 and 3

Reference Key	Area	Year	Reference
	OU3	2011	Environment Canada et al. 2011. Lake Ontario Lakewide Management Plan, Annual Report 2011. Prepared by a binational partnership of Environment Canada, Fisheries and Oceans Canada, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, Ontario Ministry of Environment, Ontario Ministry of Natural Resources and New York State Department of Environmental Conservation. Available online at: http://binational.net/lamp/lo_ar_2011_en.pdf.
	OU3	2007	NCSWCD. 2007. *Eighteenmile Creek Remedial Action Plan, 2006 Status Report*. Prepared with funding provided by the U.S. Environmental Protection Agency. March 2007.
	OU3	2011	NCSWCD. 2011. *Eighteenmile Creek Remedial Action Plan, Stage II - Update*. Prepared with funding provided by the U.S. Environmental Protection Agency. Final Draft, December 2011.
	OU3	2011	New York State Department of Health (NYSDOH). 2011. *Health Advice on Eating Fish You Catch for Erie, Niagara, Cattaraugus, Genesee, Orleans, Wyoming, and Chautauqua Counties.*
	OU3	1987	New York State Department of State (NYSDOS). 1987. Coastal Fish and Wildlife Habitat Rating Form for Eighteenmile Creek – Lake Ontario.
	OU2	1998	Nutter Associates. 1998. *City of Lockport Comprehensive Plan.* Prepared for City of Lockport, Niagara County, New York. May 1998.
	Reference Data	2009	NYS GIS Clearinghouse. 2009. GIS Metadata from NYS Cyber Security. "NIAGARA_County_Ortho_4bed_1ft." Remote sensing image. NYS Digital Ortho-Imagery Program 2008 imagery in Niagara County. NYSCSCIC, Albany, NY. Accessed online at http://gis.ny.gov/gateway/mg/2008/niagara/.
	OU2	2000	NYS Canal Corporation. 2000. Evaluation of Sediment Quality of the Erie Canal between the Niagara River and Rochester, NY.
	OU3	1996	NYSDEC. 1996. *Trackdown of Chemical Contaminants to Lake Ontario from New York State Tributaries.*
	OU3	1997	NYSDEC. 1997. Eighteenmile Creek Remedial Action Plan. Prepared by the Division of Water.
NYSDEC 1998	OU 2 and 3	1998	NYSDEC. 1998. Eighteenmile Creek and Olcott Harbor Sediment Study, Niagara County, New York.
	Guidance	1999	NYSDEC. 1999. Technical Guidance for Screening Contaminated Sediments. Prepared by the Division of Fish, Wildlife and Marine Resources, Albany, New York.
NYSDEC 2000	OU 2 Flintkote	2000	NYSDEC. 2000. Site Investigation Report, Former Flintkote Plant Site, 198 & 300 Mill Street, City of Lockport, Niagara County, New York. Prepared by the Division of Environmental Remediation. September 2000.
NYSDEC 2001	OU 2 and 3	2001	NYSDEC. 2001a. Final Report, Eighteenmile Creek Sediment Study, Summary of August 17-20 and November 3, 1998 Results. Prepared by the Division of Water.
	OU2	2001	NYSDEC. 2001b. City of Lockport Sewer System, PCB Trackdown Project, 1998-2000, Draft Summary Report. Prepared by NYSDEC Division of Water. October 2001.
	OU 2 Flintkote	2002	NYSDEC. 2002. Sampling Report, Former Flintkote Plant Site, 143 Water Street, City of Lockport, Niagara County, New York. Prepared by the Division of Environmental Remediation.
	OU1	2003	NYSDEC. 2003. Sampling Report, Water Street Properties, City of Lockport, Niagara County, New York. Prepared by the Division of Environmental Remediation.
NYSDEC 2004	OU1 and 2	2004	NYSDEC. 2004. Site Investigation Scope of Work. Eighteenmile Creek Corridor: New York State Barge Canal to North Transit Road. August 2003, revised February 2004.
	Guidance	2005	NYSDEC. 2005. New York State Comprehensive Wildlife Conservation Strategy. Available online at: http://www.dec.ny.gov/docs/wildlife_pdf/ontarioswtxt.pdf
NYSDEC RI	OU1 and 2	2006	NYSDEC. 2006a. Remedial Investigation Report, Eighteenmile Creek Corridor, Lockport, Niagara County, New York, Site Number 932121. Prepared by the Division of Environmental Remediation.
	OU 2 Flintkote	2006	NYSDEC. 2006b. Record of Decision for the Former Flintkote Plant Site.
	OU3	2007	NYSDEC. 2007a. Lake Ontario Annual Report 2007. Lake Ontario Tributary Creel Survey, Fall 2005 - Spring 2006, Fall 2006 - Spring 2007. Prepared by Scott Prindle and Daniel Bishop, Region 7 Fisheries, Cortland, New York.
	OU2	2007	NYSDEC. 2007b. PCB Sources - Flintkote. Internal Memorandum. Prepared by Glenn May August 2007.
	OU2 and OU3	2009	NYSDEC. 2009a. Toxic Chemicals in NYS Tributaries to Lake Ontario: A Report on Sampling Undertaken in 2007 and 2008 with Special Emphasis on the Polychlorinated Dibenzodioxins and Furans. Prepared for the U.S. Environmental Protection Agency.
	Guidance	2010	NYSDEC. 2010a. CP-51: Soil Cleanup Guidance Policy.

Table A

List of Previous Studies and Guidance Reviewed

Eighteenmile Creek Superfund Site - Operable Unit 2 and 3

Reference Key	Area	Year	Reference
	OU1 and OU2	2010	NYSDEC. 2010b. Record of Decision for the Eighteenmile Creek Corridor Site Operable Unit Nos. 1,3,4,5 and 6, State Superfund Project Lockport, Niagara County, New York Site No. 932121.
NYSDEC 2010	OU2	2010	NYSDEC. 2010c. Results from the Sampling of Erie Canal Suspended Sediments and Creek Waters for PCBs, Eighteenmile Creek Corridor Site, Site No. 932123, City of Lockport, Niagara County, New York.
	OU3	2012	NYSDEC. 2012. Personal communication, letter dated January 17, 2012, from Jean Pietrusiak, NYSDEC Information Services, to Marcy Werth, E & E, Inc., in response to a data request regarding rare and state-listed animal and plant species.
	OU 2 Flintkote	2005	TVGA. 2005a. Site Investigation Report: Site Investigation/Remedial Alternatives Report (SI/RAR) Former Flintkote Site.
	OU 2 Flintkote	2005	TVGA. 2005b. Final Remedial Alternatives Report Former Flintkote Site.
	OU2	2006	URS Corporation. 2006. Summary Report for PCBs Detected in NYS Barge Canal Sediments During the Investigation of NYSEG's Transit Street and State road Former MGP Sites, Sites #9-32-098 and #9-32-109, Lockport, NY. New York State Electric and Gas, Binghamton, New York.
USACE 2004	OU3	2004	USACE. 2004a. *Volume I (Project Report Overview): Sediment Sampling, Biological Analyses, and Chemical Analyses for Eighteenmile Creek OAC, Olcott, New York.* Prepared for USACE Buffalo District, by USACE Engineer Research and Development Center, Vicksburg, MS.
	OU3	2004	USACE. 2004b. Volume II (Laboratory Reports): Sediment Sampling, Biological Analyses, and Chemical Analyses for Eighteenmile Creek AOC, Olcott, New York. Prepared for USACE Buffalo District, Buffalo, NY by USACE Engineer Research and Development Center, Vicksburg, MS.
USEPA 2008	OU3	2008	USACE. 2008. Eighteenmile Creek, Great Lakes Area of Concern (AOC), Niagara County, New York: Concentrations, Bioaccumulation and Bioavailability of Contaminants in Surface Sediments.
	OU3	2010	USACE. 2010. Memo from Karl Gustavson, Ph.D., and Sara Hendrix, U.S. Army Engineer Research and Development Center, and Katherine von Stackelberg, Sc.D., E Risk Sciences, LLP, to Bryan Hinterberger, and Scott Pickard, USACE, Buffalo District, and Victor DiGiacomo, Jr., Niagara County Soil & Water Conservation District, regarding Eighteenmile Creek Area of Concern Food Web Modeling: Final Data Gaps. August 3, 2010.
	OU3	2011	USACE. 2011. Memo from Katherine von Stackelberg, Sc.D., E Risk Sciences, LLP, and Karl Gustavson, Ph.D., U.S. Army Engineer Research and Development Center, to Bryan Hinterberger, USACE, Buffalo District, and Victor F. DiGiacomo, Jr., Eighteenmile Creek Remedial Action Plan Coordinator, Niagara County Soil & Water Conservation District, regarding Eighteenmile Creek Area of Concern: Final Conceptual Site Model (CSM). January 21, 2011.
	OU3	2013	USACE. 2013. Public Notice. Operationa and Maintenance Dredging and Dredged Material Placement. FY 14 Disaster Relief Appropriations Act (Hurricane Sandy) Supplemental Lake Ontario Harbor Maintenance Dredging. Notice No: LOHD-14
	Guidance	1989	USEPA. 1989. *Risk Assessment Guidance for Superfund, Volume I Human Health Evaluation Manual (Part A),* Office of Emergency and Remedial Response, EPA/540/1-89/002, Washington, D.C., December 1989
	OU3	2008	USEPA. 2008. *Field Data Report, Eighteenmile Creek Sediment* .
	OU3	2011	USEPA. 2011. *Field Data Report, Lake Ontario Tributaries 2009-2010.* USEPA Monitoring and Assessment Branch

Key:

EEEPC	Ecology and Environment Engineering, P.C.
USEPA	U.S. Environmental Protection Agency
USACE	U.S. Army Corps of Engineers
E & E	Ecology and Environment, Inc.
NYSDEC	New York State Department of Environmental Conservation
NCSWCD	Niagara County Soil and Water Conservation District