FIRST FIVE-YEAR REVIEW REPORT
GEDDES BROOK/NINEMILE CREEK SITE
OPERABLE UNIT OF ONONDAGA LAKE BOTTOM SUBSITE
ONONDAGA LAKE SITE
ONONDAGA COUNTY, NEW YORK

Prepared by

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September 7, 2017
Date

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APPENDIX C – FIGURES

LIST OF ABBREVIATIONS & ACRONYMS

AMSL	Above Mean Sea Level
BERA	Baseline Ecological Risk Assessment
CCR	Construction Completion Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
cm	centimeters
cy	Cubic Yards
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FYR	Five-Year Review
HHRA	Human Health Risk Assessment
ICs	Institutional Controls
IRM	Interim Remedial Measure
LEL	Lowest Effects Level
LOAEL	Lowest-observed-adverse-effect-level
LCP	Linden Chemicals and Plastics
NOAEL	No-observed-adverse-effect-level
µg/kg	Micrograms per Kilogram
mg/kg	Milligrams per Kilogram
ng/kg	Nanograms per Kilogram
ng/L	Nanograms per Liter
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OM&M	Operation, Monitoring and Maintenance
OU	Operable Unit
PCBs	Polychlorinated Biphenyls
PCDD/PCDFs	Polychlorinated Dibenzodioxins/Polychlorinated Dibenzofurans
PRP	Potentially Responsible Party
RAO	Remedial Action Objectives
RECP	Rolled Erosion Control Product
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RPM	Remedial Project Manager
TEQ	Toxicity Equivalent
UU/UE	Unlimited Use/Unrestricted Exposure
ww	Wet Weight

EXECUTIVE SUMMARY

This is the first five-year review for the Geddes Brook/Ninemile Creek site (Site), an operable unit of the Onondaga Lake Bottom Subsite of the Onondaga Lake Superfund Site. The Site is located in the Town of Geddes, Onondaga County, New York. The purpose of this five-year review is to assess current information to determine if the remedy is and will continue to be protective of human health and the environment. The triggering action for this statutory five-year review was the on-site construction start date of the remedial action for the Ninemile Creek portion of the Site.

Remediation activities at the Site were conducted from 2011 through 2014 consistent with a 2009 Response Action Document, two 2009 Records of Decision (RODs) and a 2013 Explanation of Significant Difference (ESD). Remediation included excavation of mercury-contaminated channel sediments and floodplain soils/sediments, transport via dump truck of excavated materials to the LCP Bridge Street Operable Unit (OU)1 Final Cover Area, placement of clean imported material with appropriate substrate types and thickness, and performing site restoration in accordance with approved designs.

Following remediation, levels of dissolved mercury in Geddes Brook and Ninemile Creek surface water samples were below the ROD Remediation Goal (RG) of 2.6 nanograms/liter (ng/L) for protection of wildlife. Average levels of dissolved mercury were also below the RG of 0.7 ng/L for protection of human health via fish consumption in three of four sampling events in Geddes Brook and during low flow conditions in Ninemile Creek. While average levels of dissolved mercury were above the 0.7 ng/L criterion in Ninemile Creek during high flow conditions in the downstream area of the Site, the levels were consistent with levels of dissolved mercury in Ninemile Creek at the upstream location. A summary of the post-remediation results and RGs for dissolved mercury in surface water is provided in Table ES-1.

Table ES-1
Surface Water GB and NMC Downstream Average Levels/NMC Upstream Levels and RGs - Dissolved Mercury (ng/L)

Area	2013	2014	2015	2016	Remediation Goals	
Geddes Brook	0.25	0.96	0.37	0.28	2.6	0.7
Ninemile Creek (Downstream - Low Flow)	-	-	0.18	0.19		
Ninemile Creek (Upstream - Low Flow)	-	-	0.19	0.16		
Ninemile Creek (Downstream - High Flow)	-	-	1.21	1.2		
Ninemile Creek (Upstream - High Flow)	-	-	1.09	1.21		

While no RGs are specified in the ROD for unfiltered mercury and methylmercury in surface water, post-remediation levels of unfiltered mercury and methylmercury in surface water are below

baseline levels in Geddes Brook, and are below baseline and/or upstream levels in lower Ninemile Creek, except for unfiltered mercury under low flow conditions.

ROD remediation goals for mercury in soil/sediment include NYSDEC's sediment criterion of 0.15 milligrams per kilogram (mg/kg), NYSDEC's unrestricted use soil cleanup objective of 0.18 mg/kg, and site-specific mercury bioaccumulation-based soil/sediment quality values (BSQVs) of 0.6 mg/kg and 0.8 mg/kg for floodplain soil and sediment, respectively. Post-remediation levels of total mercury in Geddes Brook, Ninemile Creek wetland and channel sediment, and Ninemile Creek (Reach CD) floodplain soil are below RGs. In the SYW-10 forested wetland area, average total mercury levels in soil/sediment in the combined remediated and unremediated areas are above the BSQV of 0.6 mg/kg; however, this is not unanticipated, given that a sizeable area within the SYW-10 area was excluded from remediation so as to continue to provide forested wetland functions, consistent with the remedial objective, conceptual approach, and design for SYW-10. Average total mercury levels in soil/sediment in the remediated area within SYW-10 are below the mercury BSQV of 0.6 mg/kg for floodplain soil. A summary of the post-remediation results for mercury in sediment/floodplain soil and sediment/soil RGs is provided in Table ES-2.

Table ES-2
Sediment/Soil Average Levels and RGs - Mercury (mg/kg)

Area/Media	2013	2014	2015	2016	Remediation Goals			
Geddes Brook Soil/Sediment	0.044	0.052	0.063	0.028	0.15	0.18	0.6	0.8
SYW-10 Soil/Sediment Remediated Area	-	-	0.07	0.06				
SYW-10 Soil/Sediment Combined Remediated + Unremediated Area	-	-	1.47	1.90				
Ninemile Creek Channel Sediment	-	-	-	0.07	0.15	-	-	0.8
Ninemile Creek Reach CD Soil	-	-	-	0.033	-	0.18	0.6	-

While no RGs are specified in the ROD for methylmercury in sediment, post-remediation levels of methylmercury in Geddes Brook and Ninemile Creek wetland and channel sediment are below baseline levels. Based on the variability in some of the species available for collection during the baseline and post-remediation construction periods, and the limited data available, potential trends associated with benthic macroinvertebrates in Geddes Brook and Ninemile Creek cannot be ascertained at this time.

In the Geddes Brook floodplain area, average post-remediation levels of mercury and methylmercury in earthworm composite samples and small mammals were below average baseline levels. Detected levels of total mercury and methylmercury in collocated Ninemile Creek

floodplain soil and earthworms are well below levels detected during baseline sampling. Total mercury was not detected in small mammals in the Ninemile Creek (Reach CD) floodplain area. Average total mercury levels in small mammals in both the remediated and unremediated areas in SYW-10 are below baseline levels. In addition, total mercury was not detected in small mammals in the remediated area in 2016.

Average concentrations of total mercury in Geddes Brook prey fish and Ninemile Creek prey and sport fish in the downstream (remediated) locations are below the ROD RGs. The RGs are based on protection of ecological receptors and protection of human health due to consumption of fish. It should also be noted that with respect to fish tissue results, statistical metrics which may be used to demonstrate whether the concentrations of adult sport fish and prey fish are statistically below the stated goals have not been determined. The metrics to assess achievement of fish tissue goals and the statistical methods, which are currently under development, will be incorporated into the Ninemile Creek Operation, Monitoring, and Maintenance (OM&M) Plan and/or Onondaga Lake Monitoring and Maintenance Plan, and may be utilized in subsequent Geddes Brook/Ninemile Creek Five Year Reviews (FYRs). A summary of the post-remediation results and RGs for mercury in fish tissue is provided in Table ES-3.

Table ES-3
Fish Average Levels and RGs - Mercury (mg/kg wet weight)

Area/Biota	2013	2014	2015	2016	Remediation Goals
Geddes Brook Prey Fish	0.083	0.072	-	0.058	0.1
Ninemile Creek Prey Fish (Downstream)	-	-	0.065	0.051	
Ninemile Creek Sport Fish (Downstream)	-	-	0.099	0.106	0.3

Detected levels of polychlorinated biphenyls (PCBs) and the average level of polychlorinated dibenzodioxins/polychlorinated dibenzofurans (PCDD/PCDFs) (TEQ as 2,3,7,8-TCDD) in sport fish collected from downstream locations in Ninemile Creek are within the acceptable risk range of one in one million to one in ten thousand for cancer effects. Average levels of PCBs in Ninemile Creek sport fish are below the noncancer target for adults and were below and marginally above the noncancer target for children in 2015 and 2016, respectively. The targets are based on protection of human health due to consumption of fish. A summary of the post-remediation results for PCBs and PCDD/PCDFs in sport fish along with fish tissue targets is provided in Table ES-4.

Table ES-4 Ninemile Creek Downstream Sport Fish Average Levels and Targets for PCBs (micrograms/kg wet weight) and PCDD/PCDFs (ng/kg wet weight)					
Contaminant	2015	2016	Fish Tissue Targets		
			1 in 10,000 Excess Adult Cancer Risk	Noncancer Adult	Noncancer Child
PCBs	117	146	1,100	190	120
PCDDs/PCDFs	3.998	-	10	-	-

Based on Site inspections, and review of post-remediation operation, maintenance and monitoring results obtained to date, all construction-related components of the remedy have been implemented consistent with the decision documents cited above and approved designs, and are functioning as intended. It is anticipated that operating procedures, monitoring, and maintenance, as currently being implemented, will maintain the effectiveness of the remedy.

The implemented actions at the Site are protective of human health and the environment in the short-term. In order for the implemented actions to be protective in the long-term, institutional controls in the form of environmental easements need to be implemented to restrict dredging/excavating in the areas where residual contamination remains beneath clean cover material at levels above that which would allow for unlimited use and unrestricted exposure.

I. INTRODUCTION

The purpose of a FYR is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP) (40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

The Onondaga Lake Superfund site currently includes eleven subsites (subsites are defined as any site that is situated on Onondaga Lake's shores or tributaries that has contributed contamination to or threatens to contribute contamination to Onondaga Lake). Each subsite consists of one or more operable units (OUs). This FYR report evaluates the Geddes Brook/Ninemile Creek Site (Site), designated by the New York State Department of Environmental Conservation (NYSDEC) as an OU of the Onondaga Lake Bottom Subsite, Onondaga Lake Superfund Site.

The Site is separated into OU1 and OU2. OU1 includes the channel sediments, surface water, and floodplain soils/sediments of lower Geddes Brook downstream from the discharge point of the West Flume, which is part of Honeywell's Linden Chemicals and Plastics (LCP) Bridge Street subsite, and lower Ninemile Creek from approximately 600 feet upstream of the discharge point of Geddes Brook to just downstream of the I-690 overpass near the Wastebeds 1 through 8 site. OU2 includes the channel sediments, surface water, and floodplain soils/sediments of the section of lower Ninemile Creek from the downstream end of OU1 to Onondaga Lake. For purposes of consistency with site documents, activities will be discussed in the context of OU1 and OU2. However, to support tracking in EPA's SEMS data system, protectiveness determinations will be based on OU20 and OU24 of the Onondaga Lake Site.[1]

This is the first FYR for the Site. The triggering action for this statutory review is the start of the Geddes Brook/Ninemile Creek OU1 remedial action which commenced in 2012. The FYR has been prepared due to the fact that hazardous substances, pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Geddes Brook/Ninemile Creek FYR was led by the EPA remedial project manager (RPM) and lead author, Robert Nunes. Participants included NYSDEC project managers Timothy Larson and Tracy Smith, EPA hydrogeologist Edward Modica, EPA human health risk assessor, Michael Sivak, EPA ecological risk assessor Mindy Pensak, and EPA community involvement coordinator Larisa Romanowski. The potential responsible party, Honeywell International Inc. (Honeywell), was notified of the initiation of the FYR. The FYR began on December 15, 2016.

[1] The Site is being tracked in EPA's SEMS database as OU20 and OU24 of the Onondaga Lake National Priorities List site. OU20 is the original designation for the Site and represents all Site areas. OU24, which includes OU2 of the Site, was added to EPA tracking systems in 2008 when the Site was separated into two OUs.

Site Background

Geddes Brook and Ninemile Creek are located southwest of Onondaga Lake (Figure 1). Geddes Brook, a Class C stream below the Old Erie Canal and Class C trout upstream, originates in the Town of Camillus (located southwest of Syracuse, New York) and flows approximately 3 miles northeast to its confluence with the West Flume, a drainage ditch that passes through Honeywell's LCP Bridge Street subsite of the Onondaga Lake site, and an additional 0.3 miles north to Ninemile Creek on the perimeter of the New York State Fairgrounds in Syracuse, New York (Figure 2).

Ninemile Creek, a Class C stream below the former Honeywell water intake and a Class C trout stream upstream, originates at Otisco Lake and flows approximately 16 miles northeast to its mouth at Onondaga Lake. Ninemile Creek receives surface inflow from Beaver Meadow Brook and Geddes Brook at approximately 2.8 miles and 1.3 miles, respectively, upstream from Onondaga Lake (Figure 2). Between Amboy Dam and Onondaga Lake, Ninemile Creek flows adjacent to Solvay Wastebeds 1 through 8, 9 through 11, and 12 through 15. During the time that Honeywell utilized the Solvay process for the production of soda ash (1881 to 1986), wastes from this process were disposed of in numerous wastebeds along the lake and Ninemile Creek. Wastebeds 1 through 8 were used until 1944 and Wastebeds 9 through 15 were used from 1944 until 1986. Upstream of the dam, Ninemile Creek flows through woodlands, farmlands, and some light industrial/commercial areas. Ground surface elevations range from approximately 400 feet above mean sea level (AMSL) at the most upstream section of Ninemile Creek addressed in this study, to approximately 363 feet AMSL where the stream enters Onondaga Lake (NYSDEC and EPA, 2009b and NYSDEC and EPA, 2009c).

The Site is defined as the channel sediments, floodplain soils/sediments, and surface water of Geddes Brook and Ninemile Creek that were impacted or had the potential to be impacted by the disposal of hazardous and industrial wastes by Honeywell. This definition was based on the understanding at the time of the remedial investigation and feasibility study (RI/FS) work plan (1998) that contaminants from Honeywell sites (*e.g.,* LCP Bridge Street, Solvay Wastebeds) were discharged (directly or indirectly) to Geddes Brook and Ninemile Creek, where they settled into the stream beds, banks, and floodplains.

The stretch of Ninemile Creek downstream of the area just above the confluence with Geddes Brook has been designated as "lower Ninemile Creek," which has been further subdivided into three reaches (AB, BC, and CD). Major physical features within and near the Site, the approximate limits of the respective operable units, and the approximate limits of lower Ninemile Creek Reaches AB, BC, and CD are shown in the aerial photographs presented in Figures 2 and 3.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Geddes Brook/Ninemile Creek/Onondaga Lake		
EPA ID: NYD986913580		
Region: 2	**State:** NY	**City/County:** Town of Geddes, Onondaga County

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** No

REVIEW STATUS
Lead agency: State ***[If "Other Federal Agency", enter Agency name]*:**
Author name (Federal or State Project Manager): Robert Nunes
Author affiliation: EPA
Review period: 6/11/2012 - 6/12/2017
Date of site inspection: 5/25/2017
Type of review: Statutory
Review number: 1
Triggering action date: 6/11/2012
Due date *(five years after triggering action date)*: 6/12/2017

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

As part of the RI process, a baseline risk assessment was conducted for the Site to estimate the risks to human health and the environment. The baseline risk assessment, consisting of a human health risk assessment (HHRA), which evaluated risks to people, and a baseline ecological risk assessment (BERA), which evaluated risks to the environment, analyzed the potential for adverse effects, both under current conditions, and if no actions are taken to control or reduce exposure to hazardous substances at the Site.

The HHRA concluded that contamination at the Site presented risks to human health that were above EPA guidelines, particularly as a result of fish consumption. The primary sources of these cancer risks and noncancer health hazards were methylmercury, PCBs, and PCDD/PCDFs.

The BERA concluded that comparisons of tissue concentrations and modeled doses of chemicals to toxicity reference values showed exceedances of hazard quotients for Site-related chemicals. Many of the contaminants at the Site were persistent and, therefore, the risks associated with these contaminants were unlikely to decrease significantly in the absence of remediation. On the basis of these comparisons, it was determined through the BERA that all receptors of concern were at risk. Contaminants and stressors at the Site either impacted or potentially impacted every trophic level examined in the BERA.

Based upon the results of the RI and the HHRA and BERA, NYSDEC and EPA determined that active remediation was necessary to protect public health or welfare and the environment from actual and threatened releases of hazardous substances into the environment. In addition, the control of contamination migrating from Geddes Brook and Ninemile Creek into Onondaga Lake is an integral part of the overall remediation of Onondaga Lake.

Response Actions

Honeywell entered into a consent order with NYSDEC (Index No. D7-0003-01-09), effective April 16, 2002, to perform an interim remedial measure (IRM) to address contaminated channel sediments and floodplain soils/sediments associated with lower Geddes Brook. The scope of the IRM included full bank-to-bank removal (estimated to be 4,200 cubic yards [cy]) from lower Geddes Brook, beginning at the confluence with the West Flume and ending at the confluence with Ninemile Creek. In addition to sediment removal, impacted floodplain soils/sediments associated with lower Geddes Brook (estimated to be 63,000 cy) were also remediated. In 2009, NYSDEC and EPA selected the LCP Bridge Street subsite containment system as the disposal location for contaminated channel sediment and floodplain soil/sediment that were removed under the IRM (NYSDEC and EPA, 2009a). Pursuant to the IRM, which was performed from May 2011 through February 2013, approximately 102,400 cy of contaminated sediments and floodplain soils/sediments over approximately 16 acres were removed from the Geddes Brook channel and adjoining floodplains, the Geddes Brook culverts, and the Outfall 019 drainage ditch and associated floodplains (Parsons, 2014a). Following removal, approximately one foot of vegetated cover was placed in areas where soil/sediment had been excavated, resulting in a lower overall elevation with the intent to establish an emergent wetland. Restoration of the Geddes Brook channel downstream of the culverts included its relocation westward to provide increased buffer from the State Fair Landfill and to provide increased channel length and better connectivity with the emergent wetland/floodplain.

NYSDEC/EPA RODs were issued for OU1 and OU2 in April 2009 and October 2009, respectively.

The RAOs, which were the same for both Site OUs, are:

- RAO 1: To eliminate or reduce, to the extent practicable, further transport of sediments and soils, containing mercury and other chemical parameters of interest (CPOIs), from the channel and floodplain of lower Geddes Brook and lower Ninemile Creek to Geddes Brook, Ninemile Creek, and, ultimately, Onondaga Lake.

- RAO 2: To eliminate or reduce, to the extent practicable, existing and potential future adverse ecological effects on fish and wildlife resources, as well as potential risks to humans.
- RAO 3: To eliminate or reduce, to the extent practicable, levels of mercury and other CPOIs in surface water in order to meet surface water quality standards.

To achieve the RAOs, remedial goals (RGs) were developed to provide specific goals to address the four primary affected media within the Site: channel sediments, floodplain soils/sediments, biological tissue, and surface water.

The RODs present the following RGs for the Site:

- RG 1: Reduce, contain, or control, to the extent practicable, mercury and other CPOI concentrations in erodible channel sediments and in erodible floodplain soils/sediments within the Site.
- RG 2: Achieve CPOI concentrations, to the extent practicable, in channel sediments and floodplain soils/sediments that are protective of human health and fish and wildlife resources. This RG covers a range of risk levels for mercury and other CPOIs.
- RG 3: Achieve CPOI concentrations, to the extent practicable, in fish tissue that are protective of humans and wildlife that consume fish.
- RG 4: Achieve, to the extent practicable, aqueous CPOI concentrations to meet surface water quality standards.

The remedies for Ninemile Creek included the dredging/excavation and removal of an estimated 117,000 cy of contaminated channel sediments and floodplain soils/sediments covering approximately 30 acres. The remedies also included restoration of the streambed and banks, wetlands, and habitats of Ninemile Creek following sediment and soil removal and placement of an isolation cap or backfill, where needed. This included the placement of a habitat layer with appropriate substrate types and thickness, as well as planting of appropriate species of wetlands and uplands vegetation. The major components of the OU1 and OU2 remedies are illustrated on Figures 4a and 4b, respectively.

The selected remedies were to address all areas of the Site (with the exception of a portion of the forested wetland in Reach AB, as further discussed below), such that concentrations of mercury and other CPOIs following remediation were expected to be below NYSDEC's sediment criteria (including the lowest effects level [LEL] of 0.15 mg/kg for mercury) in the top two feet of channel sediments and 6 NYCRR Part 375 unrestricted use soil cleanup objectives (including the objective of 0.18 mg/kg for mercury) in the top two feet in floodplain areas. The selected remedies were also to attain a 0.8 mg/kg site-specific BSQV for mercury in sediments for protection of wildlife consumption of fish and a 0.6 mg/kg site-specific BSQV for mercury in floodplain soils for protection of wildlife consumption of terrestrial invertebrates. The selected remedies were also intended to achieve fish tissue mercury concentrations ranging from 0.1 mg/kg wet weight (ww), which is for protection of ecological receptors, to 0.3 mg/kg ww, which is based on EPA's methylmercury National Recommended Water Quality criterion for the protection of human health from the consumption of organisms.

In addition to the remediation goals for mercury in fish tissue cited above, ecological target tissue concentrations for mercury based on the no-observed-adverse-effect levels (NOAELs), as well as target tissue concentrations for PCBs and PCDD/PCDFs, corresponding to both the 10^{-4} and 10^{-5} cancer risk levels for human health exposure were developed in the FS report, based on exposure parameters from the Geddes Brook/Ninemile Creek HHRA and BERA, and were included in the RODs. Although these targets were not cited as remediation goals in the descriptions of the selected remedies, they may be considered points of reference for evaluations of reduction of risk for human and wildlife consumers of fish.

The RODs indicated that PCBs and PCDD/PCDFs were not widespread in Geddes Brook and Ninemile Creek sediments and that the areas where these contaminants were elevated were generally located within the areas addressed under the selected remedies. The reduction in PCB and PCDD/PCDF concentrations in sediment as a result of the implementation of the remedies were expected to result in reduced fish tissue concentrations over time, to the extent that Geddes Brook/Ninemile Creek sediments contribute to the body burden of these contaminants in fish tissue. The exposures to these compounds would be reduced to the same or greater extent as that of mercury. It was therefore expected that if the remediation goals for mercury in fish tissue are met in the future, that the future fish tissue concentrations for PCBs and PCDD/PCDFs would fall within the target tissue concentration ranges for each contaminant and receptor. If this assumption is proven not to be the case in the future, based on ongoing fish tissue monitoring, then an evaluation will take place to determine why this assumption may no longer be valid. Remediation goals and target concentrations for fish are further presented in Table 1.

The remedy for OU2 included the performance of a focused study during the design phase on the forested wetland portion of SYW-10, a 27.2-acre Class I wetland, to identify areas that would require remediation and areas that could be excluded from remediation in order to preserve valuable habitat. A conceptual approach for this area was developed and incorporated into the Remedial Design for Reaches BC and AB.[2] The remedial approach for this area is shown on Figure 5. It was expected that remediation of the indicated area, in conjunction with remediation of the immediately adjacent areas, including the adjacent forested uplands and spit, would result in lower mercury concentrations in soil on a Site-wide average basis (especially in the biologically-active zone), reduced mercury concentrations in biota from remediated areas, and reduced exposure to higher level receptors such as the red-tailed hawk.

The selected remedies also include institutional controls (ICs) in the form of environmental easements to restrict dredging/excavating in the areas where residual contamination would remain beneath the habitat layer at levels above that which would allow for unlimited use or unrestricted exposure. In accordance with the selected remedies, it will be certified on an annual basis that the ICs are in place and that remedy-related OM&M is being performed. In addition, the New York

[2] The lower 300 feet of the Ninemile Creek channel, as well as the adjacent SYW-10 wetland spits (see Figure 4b) which were included in the selected remedy in the OU2 ROD, were incorporated in the remedial design for the Onondaga Lake site. Remediation and restoration of the lower 300 feet of the channel and the wetland spits have been completed under the Onondaga Lake remedy and long-term monitoring and maintenance of these areas is being performed under the lake monitoring program.

State Department of Health (NYSDOH) fish consumption advisories for Onondaga Lake and its tributaries, including Geddes Brook and Ninemile Creek, remain in effect.

The remedy for Reach BC included the removal of channel sediment to allow for the installation of an isolation cap and habitat layer and the removal of soil overlying structural stone on the adjoining banks and backfill/restoration with approximately one foot of vegetated habitat layer. In 2013, an ESD was issued for a 240-foot long stretch of the Reach BC channel and adjoining banks in the vicinity of railroad and roadway bridges, an overpass abutment for NYS 695, and an Onondaga County sewage force main. (See Figures 3 and 7.) Based on an evaluation of construction implementability and safety conducted as part of the remedial design, it was determined that sediment excavation in this area posed hazards (worker safety and structural stability) due to its proximity to the bridge supports and low clearances under bridges and utility conduits. In addition, supplemental sediment characterization data gathered during the remedial design indicated that the concentrations of contaminants in channel sediments and stream bank soils in this area are relatively low. Because of the noted hazards, in combination with the low levels of contaminants in this area, the remedy for this area was modified such that there would be no channel removal or backfilling. Material would only be removed from a portion of the bank and floodplain that is accessible. The excavated areas would be backfilled and revegetated in a manner consistent with other areas being remediated on the Site, while taking into consideration existing infrastructure so as to avoid potential structural impacts and hazards to workers (NYSDEC and EPA, 2013).

Status of Implementation

As noted above, under the IRM, approximately 102,400 cy of mercury-contaminated sediments and floodplain soils/sediments were removed from the Geddes Brook channel and adjoining floodplains, the Geddes Brook culverts, and the Outfall 019 drainage ditch and associated floodplains from May 2011 through February 2013. Following the excavations, clean material was placed over the area, and the area was subsequently restored. As the excavations effectively removed nearly 100% of the mercury mass in floodplain soil and sediment, the IRM is the final action for the Geddes Brook area and further remedial action is not necessary. Excavation/dredging of the mercury-contaminated soil/sediment began in Reach CD of Ninemile Creek in June 2012. In accordance with the Reach CD design, a portion of Reach CD was relocated to facilitate remedial construction and to create a buffer between Ninemile Creek and Wastebeds 9 and 10. Work for this phase of construction was completed in August 2012 (Parsons, 2016a). In coordination with construction of an Onondaga Lake Canalways Trail extension, excavations in SYW-10 began in October 2012 in the southern corner where the Trail Extension footprint overlapped the SYW-10 removal limits. Excavations in the remainder of SYW-10 began in October 2013 and were completed in November 2013. Remedial work in Reaches BC and AB was performed from June 2013 to October 2014 (Parsons, 2016d).

Channel sediment and floodplain soil removals in Ninemile Creek Reaches CD, BC and AB were conducted to the lines and grades in the design report and approved by NYSDEC. In addition to the IRM volume of 102,400 cy, a total of 127,250 cy of contaminated soil/sediment were removed from these areas and transported via dump truck to the LCP Bridge Street OU1 Final Cover Area

(another Onondaga Lake subsite). If excavated material was unsuitable for transport upon removal, a solidification agent (pelletized quicklime) was added to the material prior to transport. Construction water generated during the effort was treated at a temporary water treatment plant located adjacent to the LCP Bridge Street OU1 Final Cover Area. Treated construction water was initially discharged to the West Flume, but beginning in June 2012, treated water was conveyed to the Metropolitan Syracuse Sewage Treatment Plant. The excavated areas were backfilled with clean imported fill. Site restoration features, which included crib walls, woody debris, rock features, live stakes, gabion baskets, downed trees, stone with joint plantings, large flat stone piles, rock lunker structures, small trees and shrubs, were installed consistent with the designs. A July 2016 Construction Completion Report (CCR) for Reach CD was approved by NYSDEC on August 4, 2016. A September 2016 CCR for Reaches BC/AB was approved by NYSDEC on September 29, 2016. Operation, maintenance and monitoring activities at the Site commenced following completion of construction.

Institutional Controls

As noted above, ICs are included in the selected remedies. Table A, below, summarizes the status of the ICs.

Table A: Summary of Implemented and Planned Institutional Controls

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Soil, sediment	Yes	Yes	Site-wide	Restrict dredging/excavating in the areas where residual contamination remains beneath the habitat layer at levels above that which would allow for unlimited use or unrestricted exposure.	Environmental Easements Planned (Planned 8/31/18)
Fish[3]	Yes	No	Lower Geddes Brook, Lower Ninemile Creek	Provide an advisory regarding consumption of fish	NYSDOH fish consumption advisory for Onondaga Lake and its tributaries (Implemented)

[3] From 1970 to 1985, fishing on Onondaga Lake was banned due to contamination. A NYSDOH fish consumption advisory for the lake and its tributaries has been in place since 1986, with modifications, as appropriate.

Systems Operations/Operation & Maintenance

This Site has ongoing OM&M activities as part of the remedy. Maintenance and restoration activities in wetland areas include invasive vegetation control, carp (*Cyprinus carpio*) mitigation, large tree protection, and planting/seeding in areas of sparse vegetation. Monitoring of restored wetlands is to be conducted for five years after restoration (restoration was completed in Geddes Brook and Reach CD in 2012, SYW-10 in 2013, and Reaches BC/AB in 2014); monitoring of wetland areas may extend longer than the five-year monitoring period due to the time needed for woody material (trees and shrubs) to develop (Parsons, 2016c). After five years, the monitoring results are to be evaluated to determine if the restoration has been successful and if hydrologic conditions can be maintained in the future. Monitoring activities also include periodic monitoring of the streambed elevation and bank stability along the length of lower Geddes Brook and lower Ninemile Creek, and monitoring of surface water, sediment, fish and other biota. These activities are further discussed below.

Vegetation monitoring at the Site includes quantitative vegetation sampling at 48 plot locations. Twenty seven plot locations are in the Geddes Brook area, including two in Outfall 019, and 21 plot locations are in the Ninemile Creek area, including three in SYW-10 (Parsons, 2016e). (See Figures 6a, 6b, 6c, and 6d.) At each station, 100- and 400-square foot sample plots were established to evaluate herbaceous and woody vegetation, respectively. Overall plant cover at the site is calculated using data from the sample plots. Annual goals for percent cover of seeded areas and survival of trees/shrubs and invasive species are provided in the OM&M plans. Invasive species have been below the target maximum value of five percent cover in all areas, except at SYW-10 in 2016, where they were slightly higher than the five percent target value. Invasive species control throughout the site included pulling invasive species by hand, digging out rhizomes, and, in locations with no standing water, treatment with herbicides. Control efforts were also increased at SYW-10 during the fall of 2016 due to the higher percentage of invasive species present there (Parsons, 2017).

In 2013, high water levels allowed carp to maintain a continual presence in the channel grade wetlands in Geddes Brook and the emergent and forested wetlands connected to Ninemile Creek. Their presence appeared to have negatively affected emergent plant establishment in these areas by increasing turbidity and physically uprooting plants. In 2014 and 2015, over 450 carp were removed using large bag seines (Parsons, 2016f and Parsons, 2016b). Fencing was installed in several wetlands in Geddes Brook and Ninemile Creek Reach CD to help protect vegetation from carp. In Geddes Brook, fencing was placed around the perimeter of channel grade wetlands and in the west basin south pond approximately two to five feet from the shoreline to prevent carp from entering so as to allow a fringe of emergent vegetation to become established. Fencing was also installed across the mouth of each channel grade wetland in Ninemile Creek Reach CD, to prevent carp from entering.

In order to protect trees from beavers (*Castor canadensis*), the trunks of all of the large trees in the Geddes Brook and Ninemile Creek Reach CD areas, excluding Northern white cedars (*Thuja occidentalis*), were initially wrapped with a 3-foot-high corrugated plastic protector and, subsequently, with a 4-foot-high fence with a greater diameter than the trees to allow large trees to continue to grow without being restricted. Five-foot-high fencing was installed and maintained around the perimeter of the northern white cedars in 2013, 2014, and newly installed trees in 2015

to protect them from deer browsing. Additionally, light pruning was conducted in July 2015 on several large trees in the Geddes Brook area. Water bags were also installed (and routinely filled throughout the summer) around all large trees that were installed in 2015 and 2016, and at trees located in dryer portions of the site such as the top of the utility berm in Geddes Brook (Parsons, 2016b, Parsons, 2017). In 2015, the 25 large trees that were to be installed as part of the original restoration or subsequent maintenance activities were replaced with several native species, including swamp white oak (*Quercus bicolor*), red maple (*Acer rubrum*), American sycamore (*Platanus occidentalis*), sugar maple (*Acer saccharum*), northern red oak (*Quercus rubra*), and Northern white cedar (Parsons, 2016b).

In spring 2014, National Grid removed the above-grade portion of two utility poles in the far northwest corner of the Geddes Brook west floodplain. The poles had prevented the excavation of adjacent and underlying soils during site construction. With the utility poles removed, excavation and restoration took place in mid-July 2014 following NYSDEC approval of the proposed work (Parsons, 2016f). The removal area (see Figure 8) was excavated down to the clay layer and three feet into restored material on the sidewalls. A total of 135 cy was excavated and hauled to the LCP Bridge Street OU1 Final Cover area. After the excavation was completed, five grab samples were collected from the bottom of the excavation, composited into one representative sample, and analyzed for total mercury by a New York State-certified laboratory. The soil sample result was 0.018 mg/kg mercury (the 6 NYCRR Part 375 unrestricted use soil cleanup objective for mercury is 0.18 mg/kg). No additional excavation was necessary, as approved by NYSDEC. The area was then backfilled with one foot of topsoil (32 cy total) and was graded to blend into the surrounding topography. The area was then seeded with conservation seed mix and covered with rolled erosion control product (RECP). Additional herbaceous and woody plantings were placed in 2015 to complete the restoration of this area.

Approximately 13,500 native salt tolerant herbaceous plugs and 290 native trees and shrubs were installed in sparsely-vegetated areas in the backflow channels on the eastern bank of Ninemile Creek Reach CD containing saline groundwater seeps during 2015 in an effort to restore the area (Parsons, 2016b). Species of note include widgeongrass (*Ruppia maritima*), which was transplanted in cooperation with Onondaga County Parks from the remnant salt marsh on the southeast shore of Onondaga Lake, and common glasswort (*Salicornia virginica*), which was obtained as seed by the State University of New York College of Environmental Science and Forestry and grown at its greenhouse prior to transplanting.

The elevations of the east floodplain channel grade wetlands of Geddes Brook are to be surveyed annually for five years or until the realigned channel and connected wetlands have reached a dynamic equilibrium based on the hydrology of the restored site, whichever is earlier (Parsons, 2011). This monitoring is being conducted to ensure that the wetland connections perform as intended by allowing the free flow of water between the channel grade wetlands and Geddes Brook when creek levels are high, and by allowing the wetlands to retain water during lower water periods. In 2013, water levels within the Geddes Brook site remained high throughout the summer and fall, resulting in a continual connection between the wetlands and Geddes Brook. In June 2014 and August 2015, the elevation of the sill logs in the wetland connections were surveyed during low water periods to verify that the connection was being maintained (Parsons, 2016f and Parsons, 2016b). Differences between 2014 and 2015 elevations and the as-built elevations were minor

(between +/- 0.8 inch and +/- 1 inch). However, some minor areas of erosion and slumping caused by high water levels in the spring of 2014 were noted in Geddes Brook and Outfall 019. After consultation with NYSDEC, these areas were repaired later that year and in 2015 with either light stone fill, or RECP and topsoil. Additional plantings were installed and seeds placed in these areas to increase soil protection against potential future erosion.

Select transects across Ninemile Creek were surveyed for elevation and composition of surface material to determine if bed loss has occurred. It is not anticipated that repairs would be required if bed losses at these transects are measured to be within an acceptable tolerance level (e.g., 12 inches or less compared to the original constructed bed elevation). Flows in Ninemile Creek reached 2,280 cubic feet per second (cfs) on March 30, 2014, exceeding the flows associated with the 10-year return interval (2,000 cfs). Four stations were surveyed in August 2014 and a fifth station was surveyed in 2015. All of the 2014 surveyed stations were within 12 inches of the original constructed bed elevation. The 2015 survey elevations indicate that no bed loss has occurred when compared to the original constructed bed elevation. All of these stations were resurveyed in 2016. Also, five additional stations were surveyed for elevation and composition in 2016 upon the request of NYSDEC. The 2016 survey elevations verify that no substantial bed loss has occurred. Furthermore, the 2014, 2015, and 2016 surveys determined the surface composition to be consistent with the material used during construction. In some areas, the recorded bed elevations were slightly higher than the original constructed bed elevations. This was likely attributable to deposition, micro-topography of the channel bottom and/or small shifts in survey points. (Parsons, 2016f; Parsons, 2016b and Parsons, 2017).

Potential site impacts from climate change have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the Site.

III. PROGRESS SINCE THE LAST REVIEW

This is the first FYR for the Site.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On November 14, 2016, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at 38 Superfund sites in New York and New Jersey, including the Geddes Brook/Ninemile Creek site. The announcement can be found at the following web address:

https://www.epa.gov/sites/production/files/2016-11/documents/five_year_reviews_fy2017_final.pdf.

In addition to this notification, a notice of the commencement of the FYR was sent to local public officials. The notice was provided to the Town of Geddes by email on March 20, 2017 with a

request that the notice be posted in the respective municipal offices and on the Town of Geddes webpage. In addition, the notice was distributed via the NYSDEC's Onondaga Lake News email listserv, which includes approximately 14,000 subscribers. The purpose of the public notice was to inform the community that EPA would be conducting a FYR to ensure that the remedy implemented at the Site remains protective of public health and is functioning as designed. In addition, the notice included contact information, including addresses and telephone numbers, for questions related to the FYR process or the Site.

Once the FYR is completed, the results will be made available at the Site information repositories. The information repositories are maintained at the NYSDEC Region 7 Office, 615 Erie Boulevard West, Syracuse, New York; NYSDEC Central Office, 625 Broadway, Albany, New York; Onondaga County Public Library, Syracuse Branch at the Galleries, 447 South Salina Street, Syracuse, New York; and the Atlantic States Legal Foundation, 658 West Onondaga Street, Syracuse, New York. In addition, efforts will be made to reach out to local public officials to inform them of the results.

No interviews were conducted for this FYR.

Data Review

Monitoring of surface water, channel sediment, floodplain soil/sediment, and fish tissue has been conducted in order to provide sufficient data to assess progress toward achieving the RGs and the RAOs established in the RODs. In addition, monitoring of biota other than fish, including benthic macroinvertebrates, earthworms, and small mammals, has been conducted to help evaluate remedy effectiveness. Following the completion of construction, monitoring commenced in 2013 and 2015 in Geddes Brook and Ninemile Creek (including SYW-10), respectively, consistent with the Geddes Brook OM&M Plan, the draft Ninemile Creek OM&M Plan, and direction from NYSDEC.

A discussion of the post-construction monitoring results for the period between 2013 and 2016 is provided below. A summary of the sampling that has been completed since 2013 in Geddes Brook, Ninemile Creek, and SYW-10 is presented in Table 2. Sample locations and data results are presented in Figures 5, and 9 through 26. Non-detect values are represented as ½ of the detection limit. For locations where duplicate samples were collected, the mean of the original and duplicate sample results at the location was used in the calculations. As the data sets are relatively small, the presentation of the data in the text below and in the graphs is generally focused on the range (i.e., minimum, maximum) and mean of the numerical values, and does not include other statistical measures (e.g., standard deviation, 95% confidence interval). It should also be noted that with respect to fish tissue results, statistical metrics which may be used to demonstrate whether the concentrations of adult sport fish and prey fish are statistically below the stated goals have not been determined. The metrics to assess achievement of fish tissue goals and the statistical methods, which are currently under development, will be incorporated into the Ninemile Creek OM&M Plan and/or Onondaga Lake Monitoring and Maintenance Plan, and may be utilized in subsequent Geddes Brook/Ninemile Creek FYRs.

Geddes Brook Surface Water

The Geddes Brook OM&M Plan established a total of six surface water monitoring locations in Geddes Brook and Outfall 019 that have been sampled annually for filtered (dissolved) mercury, unfiltered (total) mercury, and methylmercury. The Geddes Brook surface water (and sediment) sample locations, which included both channel and emergent wetland areas, are provided on Figure 9. The results for dissolved mercury, total mercury, and methylmercury are presented in Figures 10a, 10b, and 10c, respectively.

Dissolved mercury concentrations at the Geddes Brook and Outfall 019 sampling stations averaged 0.25 ng/L (range 0.15 to 0.38 ng/L), 0.96 ng/L (range 0.66 to 2.0 ng/L), 0.37 ng/L (range 0.19 to 0.77 ng/L), and 0.28 ng/L (range 0.25 to 0.44 ng/L) in 2013, 2014, 2015, and 2016, respectively. The average concentrations are below the ROD goals of 2.6 ng/L for protection of wildlife and 0.7 ng/L for protection of human health via fish consumption, except for the 2014 mean concentration, which exceeded the more stringent goal. The post-remediation average levels of dissolved mercury are lower than the average 2010/2011 baseline sampling dissolved mercury level of 1.59 ng/L (range 0.6 to 2.88 ng/L).

Unfiltered mercury in Geddes Brook surface water averaged 0.96 ng/L (range 0.15 to 1.79 ng/L), 1.37 ng/L (range 0.73 to 2.30 ng/L), 1.71 ng/L (range 0.38 to 3.77 ng/L), and 1.08 ng/L (range 0.25 to 3.91 ng/L) in 2013, 2014, 2015, and 2016, respectively. Methylmercury levels averaged 0.074 ng/L (range 0.01 to 0.17 ng/L), 0.13 ng/L (range 0.05 to 0.33 ng/L), 0.16 ng/L (range 0.01 to 0.50 ng/L), and 0.07 ng/L (range 0.01 to 0.26 ng/L) in 2013, 2014, 2015, and 2016, respectively. These post-remediation levels are notably lower than the average total mercury level of 23.86 ng/L (range 2.7 to 89.4 ng/L) documented during 2010/2011 baseline sampling conducted at low flow and high flow conditions, and the 1992 baseline average for methylmercury of 0.62 ng/L (range 0.08 to 1.83 ng/L).[4] No goals are specified in the ROD for total mercury or methylmercury in surface water.

Geddes Brook Sediment

The Geddes Brook OM&M Plan established six sediment monitoring locations that were co-located with the surface water sample locations (Figure 9) and have been analyzed annually for total mercury and methylmercury. Samples were collected annually between 2013 and 2016, and the results for total mercury and methylmercury are presented in Figures 11a and 11b, respectively, and are summarized below.

Sediment concentrations for total mercury in Geddes Brook (and adjacent wetland areas) and the Outfall 019 area averaged 0.044 mg/kg (range 0.028 to 0.067 mg/kg), 0.052 mg/kg (range 0.025 to 0.095 mg/kg), 0.063 mg/kg (range 0.040 to 0.095 mg/kg), and 0.028 mg/kg (range 0.014 to 0.045 mg/kg) in 2013, 2014, 2015, and 2016, respectively. These levels are lower than the LEL for mercury in sediment (0.15 mg/kg), the Part 375 unrestricted use soil cleanup objective of 0.18

[4] Baseline sampling in 2010/2011 did not include analyses for methylmercury in surface water, however, methylmercury (unfiltered) baseline sampling was conducted in lower Geddes Brook and lower Ninemile Creek in 1992.

mg/kg for mercury, and the site-specific mercury BSQVs for floodplain soil and sediment of 0.6 and 0.8 mg/kg, respectively. These levels are also lower than the average total mercury levels in Geddes Brook sediment of 5.35 mg/kg (range 0.81 to 14.2 mg/kg) in baseline samples (0-15 centimeters [cm]) collected in 2010.

Goals are not specified in the ROD for methylmercury in sediment; however, concentrations documented between 2013 and 2016 were, like total mercury levels in sediment, notably lower than during the baseline period. Methylmercury averaged 0.326 micrograms per kilogram (µg/kg) (range 0.027 to 0.953 µg/kg), 0.364 µg/kg (range 0.025 to 0.710 µg/kg), 0.401 µg/kg (range 0.010 to 0.912 µg/kg), and 0.405 µg/kg (range 0.030 to 1.440 µg/kg) in 2013, 2014, 2015, and 2016, respectively. The averages are below the average of 4.72 µg/kg (range 0.34 to 8.65 µg/kg) in lower Geddes Brook sediment baseline samples (0-15 cm) collected in 2010.

Geddes Brook Biota

Baseline sampling was conducted in 2010 at the Geddes Brook site to establish mercury concentrations in biota prior to remediation. Prey (forage) fish, benthic macroinvertebrates, small mammals, and earthworms were sampled for mercury in 2013, 2014, and 2016 at the locations shown on Figure 12. Among these biota, prey fish are the only biota collected that have RGs. Prey fish species collected included Longnose Dace (*Rhinichthys cataractae*), Sunfish (*Lepomis* spp.), Round Goby (*Neogobius melanostomus*), Shorthead Redhorse (*Moxostoma macrolepidotum*), White Suckers (*Catostomus commersoni*), Pumpkinseed (*Lepomis gibbosus*), Creek Chub (*Semotilus atromaculatus*), Brook Stickleback (*Culaea inconstans*), and Bluntnose Minnow (*Pimephales notatus*). It is assumed that all mercury in fish is methylmercury, making methylmercury analysis unnecessary in prey fish.

The average total mercury concentrations in prey fish collected during 2013, 2014 and 2016 were 0.083 mg/kg ww (range 0.042 to 0.165 mg/kg ww), 0.072 mg/kg ww (range 0.015 to 0.175 mg/kg ww), and 0.058 mg/kg ww (range 0.015 to 0.190 mg/kg ww), respectively. The averages were below the baseline average of 0.135 mg/kg ww (range 0.088 to 0.190 mg/kg ww) and the RG of 0.1 mg/kg ww for protection of ecological receptors specified in the ROD. As shown in Figure 13, the number of fish that exceeded the goal have declined each year since 2013, with only two of 15 prey fish samples in lower Geddes Brook exceeding the goal in 2016.

Total mercury and methylmercury results for Geddes Brook biota other than fish are presented in Figures 14a and 14b, respectively. For the benthic macroinvertebrates, species have varied with each sampling event depending on availability. Species collected in post-remediation samples included the dragonfly nymph (*Anisoptera*), crayfish (*Astacoidea*), amphipod (*Amphipoda*), and damselfly (*Zygoptera*). Total mercury concentrations in macroinvertebrates averaged 0.030 mg/kg ww (range 0.015 to 0.056 mg/kg ww), 0.128 mg/kg ww (range 0.030 to 0.360 mg/kg ww), and 0.016 mg/kg ww (range 0.005 to 0.028 mg/kg ww) in 2013, 2014, and 2016 respectively. Methylmercury concentrations in macroinvertebrates averaged 46.7 µg/kg ww (range 21.1 to 78.5 µg/kg ww), 76.4 µg/kg ww (range 24.1 to 148.0 µg/kg ww), and 15.6 µg/kg ww (range 4.4 to 28.3 µg/kg ww) in 2013, 2014, and 2016 respectively. Average total mercury levels in invertebrates in 2013 and 2016 were lower than the average baseline level (0.038 mg/kg ww) in 2010, whereas, in 2014, they were higher relative to baseline levels. For methylmercury, the averages for

invertebrates were higher in 2013 and 2014 relative to the average baseline level (16.17 µg/kg ww) in 2010, and the average in 2016 was approximately equal to the average baseline level. Benthic macroinvertebrates collected in Geddes Brook during baseline sampling were limited to crayfish and amphipods. Total mercury and methylmercury levels in crayfish were lower in post-remediation samples relative to baseline. In amphipods, total mercury levels were lower in post-remediation samples relative to baseline, but methylmercury levels were higher in post-remediation samples relative to baseline. Only dragonfly nymphs and crayfish were available in each of the three years of post-remediation samples. Levels of mercury and methylmercury in these species were higher in 2014 than in 2013 or 2016. Based on the variability in species available for collection during the baseline and post-remediation periods, and the limited number of data points, potential trends associated with these data cannot be determined at this time.

Total mercury concentrations in earthworms collected in the Geddes Brook area averaged 0.025 mg/kg ww (range 0.010 to 0.050 mg/kg ww), 0.173 mg/kg ww (range 0.080 to 0.230 mg/kg ww), and 0.039 mg/kg ww (range 0.030 to 0.047 mg/kg ww) in 2013, 2014, and 2016, respectively. The averages are below the average baseline concentration (2010) for total mercury of 0.196 mg/kg ww (range 0.036 to 0.380 mg/kg ww).[5] Methylmercury concentrations in earthworms averaged 20 µg/kg ww (range 16.0 to 23.7 µg/kg ww) and 1.6 µg/kg ww (range 0.8 to 2.1 µg/kg ww) in 2013 and 2016, respectively. These levels were below the average baseline concentration for methylmercury of 59 µg/kg ww. Methylmercury was not detected in the 2014 earthworm samples.

Total mercury concentrations in small mammals collected in the Geddes Brook area averaged 0.016 mg/kg ww (range 0.005 to 0.025 mg/kg ww), 0.012 mg/kg ww (range 0.010 to 0.020 mg/kg ww), and 0.039 mg/kg ww (range 0.005 to 0.106 mg/kg ww) in 2013, 2014, and 2016, respectively. The averages are below the average baseline (2010) concentration for total mercury of 0.109 mg/kg ww (range 0.011 to 0.400 mg/kg ww). Methylmercury concentrations in Geddes Brook area small mammals averaged 9.4 µg/kg ww (range 3.4 to 14.0 µg/kg ww), 7.2 µg/kg ww (range 4.8 to 16.4 µg/kg ww), and 19.7 µg/kg ww (range 0.2 to 53.2 µg/kg ww) in 2013, 2014, and 2016, respectively. The averages are below the average baseline (2010) concentration for methylmercury of 72.2 µg/kg ww (range 11.5 to 225.0 µg/kg ww). Small mammals collected in the Geddes Brook area included the white-footed mouse (*Peromyscus leucopus*), the meadow vole (*Microtus pennnsylvanicus*), the Northern Short-tailed Shrew (*Blarina brevicauda*).

Ninemile Creek Surface Water

Sampling of surface water was conducted in Ninemile Creek in 2015 and 2016 at one location upstream of the Site and four locations downstream of the confluence with Geddes Brook (one in Reach CD, one in Reach BC, and two in Reach AB); once during high flow and once during low flow conditions. The sample locations are provided on Figure 15. Samples were analyzed for

[5] Baseline sampling of earthworms in Geddes Brook and Ninemile Creek included a depuration (purging in a clean environment) step prior to analysis. Earthworms in SYW-10 during baseline were not depurated. Contaminant levels in baseline samples would likely be lower if the sampling procedure includes a depuration step relative to contaminant levels in samples that do not undergo depuration. Post-remediation earthworm samples from Geddes Brook in 2013 and 2014 and SYW-10 in 2015 were depurated. In 2016, at NYSDEC's request, none of the samples in Geddes Brook, Ninemile Creek, or SYW-10 included a depuration step.

dissolved mercury, unfiltered mercury, and methylmercury; the results are presented in Figures 16a, 16b, and 16c, respectively.

Dissolved mercury concentrations at the four downstream Ninemile Creek sampling stations averaged 0.18 ng/L (range 0.17 to 0.19 ng/L) and 0.19 ng/L (range 0.16 to 0.24 ng/L) during low flow conditions in 2015 and 2016, respectively, which are below the ROD goals of 2.6 ng/L for the protection of wildlife and 0.7 ng/L for the protection of human health due to fish consumption. The dissolved mercury concentrations in the upstream location in 2015 and 2016 were 0.19 ng/L and 0.16 ng/L, respectively. Dissolved mercury concentrations at the four downstream stations during high flow conditions averaged 1.21 ng/L (range 1.04 to 1.37 ng/L) and 1.20 ng/L (range 1.10 to 1.38 ng/L) in 2015 and 2016, respectively. These levels are below the ROD goal of 2.6 ng/L, but above the 0.7 ng/L New York State surface water quality standard. This is not contrary to what might be anticipated since the dissolved mercury concentrations at the upstream location during high flow were 1.09 ng/L and 1.21 ng/L in 2015 and 2016, respectively.

During high flow conditions, unfiltered mercury at the four downstream Ninemile Creek surface water stations averaged 42.78 ng/L (range 15.70 to 55.40 ng/L) and 66.46 ng/L (range 61.70 to 69.25 ng/L) in 2015 and 2016, respectively. The average detected levels during high flow conditions are significantly higher than the average detected level of 14.93 ng/L (range 8.35 to 18.70 ng/L) during 2011 high flow baseline sampling in Ninemile Creek. It should be noted, however, that unfiltered mercury levels were also elevated in the upstream sampling location in Ninemile Creek during the high flow sampling events in 2015 (50.10 ng/L) and 2016 (78.40 ng/L) relative to the high flow baseline sampling results for unfiltered mercury and were higher than the average levels at the downstream locations for the corresponding years. The elevated unfiltered mercury levels in 2015 and 2016 during high flow relative to baseline conditions at high flow may be attributable to higher average flow rates at the time of sampling in 2015 (630 cfs) and 2016 (809 cfs) as compared to the average flow rate at the time of high flow baseline sampling (340 cfs). At the four downstream sampling stations during low flow conditions, unfiltered mercury in Ninemile Creek surface water averaged 2.50 ng/L (range 0.82 to 5.10 ng/L) and 2.67 ng/L (range 1.39 to 4.60 ng/L) in 2015 and 2016, respectively. The average detected levels of unfiltered mercury during low flow conditions at the downstream locations are higher than the average unfiltered mercury levels of 1.26 ng/L (range 1.05 to 1.48 ng/L) documented during 2010 low flow baseline sampling, and the unfiltered mercury levels of 1.09 ng/L and 1.20 ng/L for the 2015 and 2016 upstream samples, respectively, at low flow conditions.

At the four downstream sampling stations during low flow conditions, methylmercury levels in Ninemile Creek surface water averaged 0.07 ng/L (range 0.05 to 0.10 ng/L) and 0.12 ng/L (range 0.04 to 0.29 ng/L) in 2015 and 2016, respectively. The averages for methylmercury at the upstream and downstream locations under low flow conditions are below the 1992 baseline average of 0.15 ng/L (range 0.11 to 0.20 ng/L) during low flow. During high flow conditions, methylmercury in Ninemile Creek surface water at the downstream sampling locations averaged 0.58 ng/L (range 0.40 to 0.70 ng/L) and 1.32 ng/L (range 1.17 to 1.53 ng/L) in 2015 and 2016, respectively. The 1992 baseline average for methylmercury in Ninemile Creek was 0.45 ng/L (range 0.13 to 1.44 ng/L) during high flow. During both the 2015 and 2016 high flow sampling events in Ninemile Creek, methylmercury levels were higher at the upstream sampling location relative to any of the

downstream locations. As noted above, no goals are specified in the ROD for total mercury or methylmercury in surface water.

Ninemile Creek Sediment and Macroinvertebrates

Four channel surface sediment samples (0-15 cm) were collected in the downstream reaches of Ninemile Creek in 2016 (one in Reach CD, two in Reach BC, and one in Reach AB) and analyzed for total mercury and methylmercury. Sediment sample locations are shown on Figure 17 and results for total mercury and methylmercury are shown on Figures 18a and 18b, respectively. Channel sediment concentrations for total mercury averaged 0.07 mg/kg (range 0.04 to 0.15 mg/kg). These levels did not exceed the LEL for mercury in sediment (0.15 mg/kg) and were lower than the site-specific mercury BSQV for sediment of 0.8 mg/kg. The average concentration for total mercury in Ninemile Creek channel sediment was also lower than the average baseline (2010) level of 0.5 mg/kg for lower Ninemile Creek channel sediment (range 0.04 to 1.1 mg/kg). Goals are not specified in the ROD for methylmercury in sediment; however, the average methylmercury level of 0.43 µg/kg (range 0.22 to 0.69 µg/kg) in Ninemile Creek channel sediment is lower than the average baseline level of 0.657 µg/kg (range 0.304 to 1.35 µg/kg).

Three macroinvertebrate samples were collected in Ninemile Creek in 2016; the samples were co-located with three of the four channel sediment samples (Figure 17). The samples (crayfish) were analyzed for total mercury and methylmercury, and the results are presented in Figures 23a and 23b, respectively. Macroinvertebrate concentrations for total mercury and methylmercury averaged 0.021 mg/kg ww (range 0.016 to 0.026 mg/kg ww) and 21.9 µg/kg ww (range 13.4 to 33.6 µg/kg ww), respectively. The 2010 baseline level of 0.029 mg/kg ww for total mercury in benthic macroinvertebrates was higher than the 2016 total mercury average, whereas the 2010 average baseline level of 4.4 µg/kg ww (range 2.4 to 6.1 µg/kg ww) for methylmercury was lower than the 2016 methylmercury average. The invertebrates collected in Ninemile Creek during baseline sampling were limited to amphipods and chironomids (*Chironomidae*); crayfish were not collected in Ninemile Creek during the 2010 baseline sampling. Based on the variability in species available for collection during the baseline and post-remediation periods, and the limited number of data points, potential trends associated with these data cannot be determined at this time.

Ninemile Creek Fish

The Ninemile Creek 2015 OM&M Sampling Work Plan established protocols for monitoring prey fish (as whole body samples) and sport fish (as fillets) in Ninemile Creek Reaches AB, BC, and CD, as well as upstream of the Site. Prey fish and sport fish tissue data are evaluated for comparison to RGs, which are intended to be protective of ecological receptors and of human health due to consumption of fish, respectively.

Prey fish were targeted for collection at four sampling locations in Ninemile Creek in 2015 and 2016. Three locations were in the remediation areas, while a fourth was located upstream. (See Figure 19 for sample locations.) All prey fish samples were composited and analyzed for total mercury and percent moisture. A subset of the 2015 and 2016 prey fish samples was analyzed for PCBs and lipid content and a subset of the 2015 samples was analyzed for PCDD/PCDFs. Prey fish species collected included Creek Chub, Round Goby, Banded Killifish (*Fundulus diaphanus*),

and White Suckers. The prey fish results for total mercury, PCBs, and PCDD/PCDFs are presented in Figures 20a, 20b, and 20c, respectively.

For total mercury, downstream prey fish samples from the remediation areas averaged 0.065 mg/kg ww (range 0.013 to 0.168 mg/kg ww) and 0.051 mg/kg ww (range 0.018 to 0.137 mg/kg ww) in 2015 and 2016, respectively. The average concentrations are below the ROD goal of 0.1 mg/kg ww for prey fish. As shown in Figure 20a, the number of samples that exceeded the goal in 2016 (one of 15 samples in the downstream reach) was less than in 2015 (four of 15 samples). Upstream total mercury prey fish samples averaged 0.043 mg/kg ww (range 0.028 to 0.059 mg/kg ww) and 0.059 mg/kg ww (range 0.046 to 0.069 mg/kg ww) in 2015 and 2016, respectively. At the downstream locations, PCBs detected in prey fish averaged 217 µg/kg ww (range 52 to 1,100 µg/kg ww) and 85 µg/kg ww (range 51 to 157 µg/kg ww), in 2015 and 2016, respectively. At the upstream locations, PCBs detected in prey fish averaged 169 µg/kg ww (range 143 to 194 µg/kg ww) and 157 µg/kg ww (range 46 to 267 µg/kg ww), in 2015 and 2016, respectively. The average levels of PCBs for prey fish at both the upstream and downstream locations in Ninemile Creek were below the 2002 baseline average of 278 µg/kg ww (range 250 to 300 µg/kg ww). The average levels of PCDD/PCDFs (TEQ as 2,3,7,8-TCDD) in 2015 prey fish were 2.012 nanograms per kilogram (ng/kg) ww (range 1.234 to 3.868 ng/kg ww) and 0.561 ng/kg ww (range 0.448 to 0.674 ng/kg ww) for downstream and upstream samples, respectively. These levels are below the 2002 baseline average of 5.777 ng/kg ww (range 4.200 to 9.040 ng/kg ww) for PCDD/PCDFs (TEQ as 2,3,7,8-TCDD) for prey fish.

Sport fish were targeted for collection from two locations in Ninemile Creek in 2015 and 2016. One location encompassed all of the downstream reaches, while the other represented the upstream location. (See Figure 19 for sample locations.) All samples were analyzed for mercury and percent moisture. As noted above, it is assumed that all mercury in fish is methylmercury, making methylmercury analysis unnecessary in sport fish. Sport fish species collected included Brown Trout (*Salmo trutta*), Brown Bullhead (*Ameiurus nebulosus*), Rock Bass (*Ambloplites rupestris*), and Sunfish. Mercury results for sport fish are presented in Figures 21a and 21b. Total mercury levels in downstream sport fish averaged 0.099 mg/kg ww (range 0.039 to 0.442 mg/kg ww) and 0.106 mg/kg ww (range 0.029 to 0.400 mg/kg ww), in 2015 and 2016, respectively. The average concentrations are below the ROD goal of 0.3 mg/kg ww for human consumption of sport fish. As shown on Figure 21a, total mercury levels exceeded the ROD goal in only one of the 11 downstream sport fish samples in 2015 and one of the 17 downstream sport fish samples in 2016. Total mercury in upstream samples averaged 0.06 mg/kg ww (range 0.04 to 0.07 mg/kg ww) and 0.041 mg/kg ww (range 0.020 to 0.050 mg/kg ww) in 2015 and 2016, respectively.

As in the case for the prey fish, a subset of the 2015 and 2016 sport fish samples was analyzed for PCBs and lipid content and a subset of the 2015 samples was analyzed for PCDD/PCDFs. The results for PCBs and PCDD/PCDFs in sport fish are presented in Figures 21c and 21d, respectively. From the downstream location in Ninemile Creek, PCB levels in sport fish averaged 117 µg/kg ww (range 34 to 183 µg/kg ww) and 146 µg/kg ww (range 97 to 210 µg/kg ww), in 2015 and 2016, respectively. At the upstream location, PCB levels in sport fish averaged 132 µg/kg ww (range 112 to 151 µg/kg ww) and 187 µg/kg ww (range 150 to 223 µg/kg ww), in 2015 and 2016, respectively. The average levels of PCBs in sport fish collected from the downstream location are below the fish tissue target concentration of 1,100 µg/kg ww based on a reasonable maximum exposure

(RME) excess cancer risk of one in 10,000, but marginally above the target of 110 µg/kg ww based on an RME excess cancer risk of one in 100,000. The average levels of PCBs in sport fish collected from both downstream and upstream locations in 2015 and 2016 were below the target of 190 µg/kg ww based on non-cancer effects for adults. The average level of PCBs in sport fish collected from the downstream location in 2015 was below the target of 120 µg/kg ww based on non-cancer effects for children, whereas the average level of PCBs in sport fish collected from the 2016 downstream location and the 2015 and 2016 upstream location were above the 120 µg/kg ww target. The average levels of PCDD/PCDFs (TEQ as 2,3,7,8-TCDD) in sport fish in 2015 were 3.998 ng/kg ww (range 0.473 to 11.684 ng/kg ww) and 2.44 ng/kg ww (range 0.57 to 4.31 ng/kg ww) for downstream and upstream samples, respectively. The averages are below the target of 10 ng/kg ww based on an RME excess cancer risk of one in 10,000 for adults, but above the target of 1 ng/kg ww based on an RME excess cancer risk of one in 100,000. The 2002 baseline average for PCDD/PCDFs (TEQ as 2,3,7,8-TCDD) was 3.62 ng/kg ww (range 3.39 to 4.07 ng/kg ww). The PCB and PCDD/PCDF targets are based on protection of human health due to fish consumption.

Ninemile Creek Floodplain Soil and Biota

Four Ninemile Creek floodplain soil samples were collected from three locations in 2016 in the Reach CD area (see Figure 17) and analyzed for total mercury and methylmercury. The average detected concentrations of these samples for total mercury and methylmercury were 0.033 mg/kg (range 0.031 to 0.034 mg/kg) and 0.42 µg/kg (range 0.39 to 0.46 µg/kg), respectively. The total mercury levels are lower than the Part 375 unrestricted use soil cleanup objective of 0.18 mg/kg for mercury and the site-specific mercury BSQV for floodplain soil of 0.6 mg/kg. The detected levels of total mercury and methylmercury are also significantly below concentrations detected in the Ninemile Creek floodplain during baseline sampling in 2010. The average detected concentrations of the floodplain soil samples for total mercury and methylmercury during baseline sampling were 0.50 mg/kg (range 0.13 to 0.71 mg/kg) and 2.07 µg/kg (range 1.57 to 2.34 µg/kg), respectively. The total mercury and methylmercury results for Ninemile Creek floodplain soil are provided in Figures 22a and 22b, respectively.

Earthworm composite samples co-located with the floodplain soil samples in 2016 were analyzed for total mercury and methylmercury, and the results are provided in Figures 23a and 23b, respectively. The average concentrations of the earthworm samples for total mercury and methylmercury were 0.025 mg/kg ww (range 0.024 to 0.026 mg/kg ww) and 1.53 µg/kg ww (range 0.40 to 3.30 µg/kg ww), respectively. These levels are well below Ninemile Creek earthworm concentrations detected during baseline sampling in 2010. The average concentrations of the earthworm samples for total mercury and methylmercury during baseline sampling were 0.70 mg/kg ww (range 0.34 to 0.97 mg/kg ww) and 31.5 µg/kg ww (range 21 to 43.2 µg/kg ww), respectively.[6]

Two white-footed mice, two meadow voles, and one deer mouse were collected in the Reach CD area in 2016 (see Figure 17). Although baseline mammal sampling adjacent to Ninemile Creek included methylmercury as well as total mercury, it was assumed that all total mercury would be in the form of methylmercury for the 2016 Ninemile Creek mammal samples. For this reason, the

[6] Also, see Footnote 3 regarding depuration of earthworm samples.

2016 Ninemile Creek small mammal samples were analyzed for total mercury only. In these five samples, total mercury was not detected. In the Ninemile Creek baseline samples (2010), average total mercury in the deer mice was 0.038 mg/kg ww and total mercury was 0.048 mg/kg ww in the one white-footed mouse collected. The total mercury results for Ninemile Creek small mammals are provided in Figure 23a.

SYW-10 Soil/Sediment and Biota

As noted above, some areas of SYW-10 were not remediated to preserve a valuable habitat not found on other areas of the lakeshore. Soil/sediment and earthworm samples were collected in SYW-10 in 2015 and 2016, and analyzed for total mercury and methylmercury consistent with the established monitoring protocols in the Ninemile Creek 2015 OM&M Sampling Work Plan. Small mammal samples were also collected in SYW-10 in 2015 and 2016, and analyzed for total mercury consistent with the Work Plan. Sample locations for soil/sediment and biota are provided on Figure 5.

Post-remediation soil/sediment samples (composite samples from the top six inches) were collected from ten stations in SYW-10 consistent with baseline monitoring locations in both remediated (six stations) and unremediated (four stations) areas. Total mercury and methylmercury results for the SYW-10 soil/sediment samples are provided in Figures 24a and 24b, respectively. In the remediated areas, total mercury in soil/sediment averaged 0.07 mg/kg (range 0.03 to 0.13 mg/kg) and 0.06 mg/kg (range 0.03 to 0.11 mg/kg) in 2015 and 2016, respectively. These levels are below the LEL of 0.15 mg/kg, the Part 375 unrestricted use mercury soil cleanup objective of 0.18 mg/kg, and the site specific mercury BSQVs of 0.6 mg/kg and 0.8 mg/kg for soil and sediment, respectively. Soil/sediment total mercury concentrations for the combined remediated and unremediated areas averaged 1.47 mg/kg (range 0.03 to 4.09 mg/kg) and 1.90 mg/kg (range 0.03 to 7.87 mg/kg) in 2015 and 2016, respectively. While the mean concentrations exceed the mercury BSQVs, this is not unanticipated given that a sizeable area within the SYW-10 area was excluded from remediation so as to continue to provide forested wetland functions, consistent with the remedial objective, and the conceptual approach and design for SYW-10. In the remediated areas, methylmercury in soil/sediment averaged 1.96 µg/kg (range 0.71 to 3.70 µg/kg) and 1.29 µg/kg (range 0.35 to 2.30 µg/kg) in 2015 and 2016, respectively. Soil/sediment methylmercury concentrations for the combined remediated and unremediated areas averaged 6.16 µg/kg (range 0.71 to 17.60 µg/kg) and 6.65 µg/kg (range 0.35 to 22.80 µg/kg) in 2015 and 2016, respectively. Goals for methylmercury in sediment or floodplain soil are not specified in the ROD.

Earthworm samples in SYW-10 were collected in 2015 and 2016 and were co-located with the soil/sediment samples. Total mercury and methylmercury results for the SYW-10 earthworm samples are provided in Figures 25a and 25b, respectively. Earthworm concentrations for total mercury in SYW-10 for the combined remediated and unremediated areas averaged 0.20 mg/kg ww (range 0.04 to 0.49 mg/kg ww) and 0.33 mg/kg ww (range 0.08 to 1.25 mg/kg ww) in 2015 and 2016, respectively. Earthworm methylmercury concentrations for the combined remediated and unremediated areas averaged 157.5 µg/kg ww (range 14.3 to 515.0 µg/kg ww) and 127.1 µg/kg ww (range 22.8 to 506.0 µg/kg ww) in 2015 and 2016, respectively. In SYW-10 remediated areas, total mercury averaged 0.13 mg/kg ww (range 0.04 to 0.19 mg/kg ww) and 0.13 mg/kg ww (range 0.08 to 0.19 mg/kg ww) in the 2015 and 2016 earthworm samples, respectively. In SYW-10

remediated areas, methylmercury earthworm samples averaged 111.3 µg/kg ww (range 26.8 to 181.0 µg/kg ww) and 39.6 µg/kg ww (range 22.8 to 61.1 µg/kg ww) in 2015 and 2016, respectively. As anticipated, earthworm total mercury and methylmercury levels were generally higher in unremediated areas relative to the remediated areas. Goals for total mercury and methylmercury in earthworms are not specified in the ROD.[7]

Small mammal (meadow vole, white-footed mouse, deer mouse) samples were collected in 2015 and 2016 from the large contiguous areas of the remediated and unremediated zones of SYW-10 and analyzed for total mercury. Small mammal total mercury concentrations in SYW-10 for the combined remediated and unremediated areas averaged 0.027 mg/kg ww (range 0.010 to 0.063 mg/kg ww) and 0.022 mg/kg ww (range 0.005 to 0.088 mg/kg ww) in 2015 and 2016, respectively. (See Figure 26.) Total mercury in 2010 baseline small mammal samples (white-footed mouse, Northern Short-Tailed Shrew) collected in SYW-10 averaged 0.29 mg/kg ww (range non-detect to 1.60 mg/kg ww). Goals for total mercury in small mammals are not specified in the ROD. The average total mercury concentrations in small mammals from the combined remediated and unremediated areas of SYW-10 in 2015 and 2016 were approximately one order-of-magnitude lower than the average baseline concentration in 2010. It is also worth noting that, while total mercury was detected in all of the SYW-10 small mammal samples collected in 2015, all five of the small mammal samples (deer mouse) collected in the SYW-10 remediated area in 2016 were non-detect for total mercury. The detection limits for the 2016 samples in the remediated area ranged from 0.0093 to 0.01 mg/kg. The 2016 small mammal total mercury results for the remediated area are similar to the results for samples collected in a reference area within the Three Mile Bay Wildlife Management Area adjacent to Oneida Lake during baseline sampling in 2010. Mercury results for small mammals (white-footed mouse) collected in the reference area were non detect with the detection limits ranging from 0.0086 to 0.0092 mg/kg.

Site Inspection

An inspection of the Site was conducted on May 25, 2017. In attendance were Mr. Nunes; Mr. Larson, Mr. Smith, Rebecca Quail, and Corbin Gosier of NYSDEC; Lindsay Speer and Curtis Waterman representing the Onondaga Nation; Mark Arrigo and Natalia Cagide-Elmer of Parsons (Honeywell contractor); Craig Milburn of Brown and Sanford (Honeywell consultant); and John McAuliffe and Mike Savage of Honeywell.

During the inspection, although not affecting the remediation, stormwater runoff from the NYS 695 overpass (it was raining during the inspection) was observed cascading directly into the section of Geddes Brook upstream of the culverted section. No significant areas of erosion or slumping in the channel areas were observed. Vegetative cover, including native plants, shrubs, and trees, were observed to be generally well established throughout the site. A seep flowing into the eastern Geddes Brook wetland area from the utility berm was observed. Subsequent water surface elevation and water quality readings (i.e., temperature, conductivity, salinity, pH) indicate that the seep is attributable to natural groundwater runoff from the adjacent south pond. Also, an area impacted by an orange-colored discharge in the vicinity of the saline groundwater seeps in the

[7] Also, see Footnote 3 regarding depuration of earthworm samples.

Ninemile Creek Reach CD area was observed. The coloration appears to be the result of oxidized iron in spring water and is unrelated to the remedy.

V. TECHNICAL ASSESSMENT

QUESTION A: *Is the remedy functioning as intended by the decision documents?*

Remediation activities in the Geddes Brook and Ninemile Creek areas were conducted from 2011 through 2014. Following remediation, levels of dissolved mercury in Geddes Brook and Ninemile Creek surface water samples were below the ROD goal of 2.6 ng/L for protection of wildlife. Average levels of dissolved mercury were also below the ROD goal of 0.7 ng/L for protection of human health via fish consumption in Geddes Brook in three of four sampling events and during low flow conditions in Ninemile Creek. While levels of dissolved mercury were above the 0.7 ng/L criterion in Ninemile Creek during high flow conditions, the levels were consistent with levels of dissolved mercury in Ninemile Creek upstream of the Site. While no RGs are specified in the ROD for unfiltered mercury and methylmercury in surface water, post-remediation levels of unfiltered mercury and methylmercury in surface water are below baseline levels in Geddes Brook, and are below baseline and/or upstream levels in lower Ninemile Creek, except for unfiltered mercury under low flow conditions.

Post-remediation levels of total mercury in Geddes Brook and Ninemile Creek wetland and channel sediment are below ROD RGs and below baseline levels. While no RGs are specified in the ROD for methylmercury in sediment, post-remediation levels of methylmercury in Geddes Brook and Ninemile Creek wetland and channel sediment are below baseline levels. Based on the variability in some of the species available for collection during the baseline and post-remediation construction periods, and the limited data available, potential trends associated with benthic macroinvertebrates in Geddes Brook and Ninemile Creek cannot be ascertained at this time.

Average concentrations of total mercury in Geddes Brook prey fish and Ninemile Creek prey and sport fish in the downstream (remediated) locations are below the ROD RGs. Although some individual fish samples have exceeded the RGs, the number of exceedances has decreased each year. Detected levels of PCBs and PCDD/PCDFs in sport fish collected from both downstream and upstream locations in Ninemile Creek are within the acceptable risk range of one in one million to one in ten thousand for cancer effects. Average levels of PCBs in Ninemile Creek sport fish are below the noncancer target for adults and were below and marginally above the noncancer target for children in 2015 and 2016, respectively. The RGs and targets are based on protection of ecological receptors and protection of human health due to consumption of fish.

In the Geddes Brook floodplain area, average post-remediation levels of mercury and methylmercury in earthworm composite samples and small mammals were below average baseline levels. In Ninemile Creek (Reach CD) floodplain soil, levels of total mercury are well below the Part 375 unrestricted use soil cleanup objective of 0.18 mg/kg and the BSQV of 0.6 mg/kg. Detected levels of total mercury and methylmercury in collocated Ninemile Creek floodplain soil and earthworms are well below levels detected during baseline sampling. Total mercury was not detected in small mammals in the Ninemile Creek (Reach CD) floodplain area. In the SYW-10

area, total mercury levels in soil/sediment in the combined remediated and unremediated areas are above the Site-specific mercury BSQV of 0.6 mg/kg; however, this is not unanticipated, given that a sizeable area within the SYW-10 area was excluded from remediation so as to continue to provide forested wetland functions, consistent with the remedial objective, conceptual approach, and design for SYW-10. Average total mercury levels in soil/sediment in the remediated area within SYW-10 are below the mercury BSQV of 0.6 mg/kg for soil. Average total mercury levels in small mammals in both the remediated and unremediated areas in SYW-10 are below baseline levels. In addition, total mercury was not detected in small mammals in the remediated area in 2016.

Based on the above, all construction-related components of the remedy have been implemented consistent with the RODs, ESD, and Remedial Designs, and are functioning as intended. It is anticipated that operating procedures, monitoring, and maintenance as currently being implemented, will maintain the effectiveness of the remedy.

Post-remediation maintenance of the stream bed and banks, wetlands, and habitats and planting of appropriate species of wetlands and uplands vegetation is being conducted in accordance with the Site OM&M Plans. ICs in the form of environmental easements are needed to restrict dredging/excavating in the areas where residual contamination remains beneath the habitat layer at levels above that which would allow for unlimited use or unrestricted exposure.

QUESTION B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?*

Land use assumptions, exposure assumptions and pathways, RAOs, and clean-up levels considered in the decision document followed Agency guidance and policy and they remain valid. Although specific parameters may have changed since the time the risk assessment was completed, the process remains valid. Additionally, there have been no physical changes to the Site that would adversely affect the protectiveness of the remedy.

The HHRA concluded that exposure to contaminants in fish tissue, primarily methylmercury and PCBs, would result in noncarcinogenic hazards that exceeded EPA's benchmarks. However, there is currently a fish advisory for consumption of fish caught from Onondaga Lake and its tributaries.

The current Site and surrounding land use is, primarily, commercial and industrial and is not expected to change in the future. Potential exposure to channel sediments and floodplain soil has been mitigated through excavation, placement of clean material and restoration.

Although the ecological risk assessment screening and toxicity values used to support the 2009 RODs may not necessarily reflect the current studies and values, the selected cleanup levels and screening values are still appropriate and protective of ecological receptors. Furthermore, where RGs were not established, monitoring studies comparing baseline and post-remediation conditions for media and biota were conducted to determine the protectiveness of the remedy, which is a valid method of measuring protectiveness in this system.

The data collected post-remediation show that concentrations in biota are generally lower than baseline conditions. The trend will continue to be evaluated.

QUESTION C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

There is no new information that calls into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations				
OU(s) without Issues/Recommendations Identified in the Five-Year Review:				
None				
Issues and Recommendations Identified in the Five-Year Review:				
OU(s): 20 & 24	**Issue Category: Institutional Controls**			
	Issue: The selected remedies include ICs in the form of environmental easements to restrict dredging/excavating in the areas where residual contamination would remain beneath the habitat layer at levels above that which would allow for unlimited use or unrestricted exposure.			
	Recommendation: The required ICs need to be implemented.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	State	8/31/2018

OTHER FINDINGS

In addition, the following are recommendations that were identified during the FYR and may improve management of O&M but do not affect current and/or future protectiveness:

- The available post-construction data for soil/sediment and biota other than fish are limited and additional monitoring of these media is not currently scheduled in the Ninemile Creek and SYW-10 areas, or in the Geddes Brook area beyond 2017. It is recommended that monitoring of surface water, soil/sediment, and biota should continue pursuant to the Geddes Brook and Ninemile Creek OM&M Plans until it is determined by NYSDEC and EPA that the RGs have been achieved and to fully evaluate remedy effectiveness.
- The extent of any public outreach that may have been performed in regard to increasing awareness of the NYSDOH fish consumption advisory for Onondaga Lake and its tributaries specific to the Site is not clear. It is recommended that New York State provide EPA with information on any Site-related outreach activities that have been performed to date relating to the Onondaga Lake fish consumption advisory and any future planned activities to enhance outreach and increase public awareness of the advisory.

- It was noted during the site inspection that stormwater runoff from the NYS 695 overpass was cascading directly onto Geddes Brook. It may be appropriate to contact the New York State Department of Transportation to determine if stormwater flow can be redirected or otherwise modified so as to minimize its potential impact on the brook.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)		
*Operable Units:*20 and 24	*Protectiveness Determination:* Short-term Protective	*Planned Addendum Completion Date:* 12/29/2017
Protectiveness Statement: The implemented actions at the Site are protective of human health and the environment in the short-term because sediment and floodplain soils have been excavated and remediated areas have been restored to reduce potential exposure to Site contaminants. In addition, post-remediation monitoring indicates that the cover system remains in place and that contaminant levels in surface soil and sediment in remediated areas have decreased relative to pre-remediation conditions. In order for the implemented actions to be protective in the long-term, ICs need to be implemented.		

VIII. NEXT REVIEW

The next FYR report for the Geddes Brook/Ninemile Creek Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

References

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APPENDIX B - TABLES

Table 1: Target Tissue Concentrations for Fish (all concentrations in mg/kg wet weight)		
Contaminants of Concern	**Target Tissue Concentrations**	
Human Health – Fish Fillets	**Reasonable Maximum Exposure**	
Mercury (as MeHg)[3]	0.3	
Total PCBs[4]	0.11 to 1.1	
PCDD/PCDFs (TEQ as 2,3,7,8-TCDD)[5]	1×10^{-6} to 1×10^{-5}	
Ecological Exposure **Small Fish (3-18 cm) - Whole Fish [1,2]**	**NOAEL**	**LOAEL**
Mercury (as MeHg)	0.009	0.187
Ecological Exposure **Large Fish (18-60 cm) - Whole Fish [1,2]**	**NOAEL**	**LOAEL**
Mercury (as MeHg)	0.014	0.345

Table 1 Notes:

1. NOAEL = no-observed-adverse-effect-level; LOAEL = lowest-observed-adverse-effect-level.
2. NOAELs and LOAELs for small (3 to 18 cm) fish are based on the belted kingfisher and mink. NOAELs and LOAELs for large (18 to 60 cm) fish are based on the great blue heron and river otter.
3. The human health target tissue concentration for mercury (0.3 mg/kg ww) is based on EPA's National Recommended Water Quality Criterion for methylmercury, as measured in fish tissue. Under the Reasonable Maximum Exposure scenario, human health mercury target fish tissue concentrations range from 0.6 to 0.9 mg/kg ww with the lower end of the range based on young children and the upper end of the range based on adults.
4. The human health target tissue concentrations for total PCBs are based on RME carcinogenic risks at risk targets ranging from 1E-05 (0.11 mg/kg ww) to 1E-04 (1.1 mg/kg ww) for adults. The RME targets based on non-cancer effects of PCBs (0.12 mg/kg ww and 0.19 mg/kg ww for children and adults, respectively), fall within the range based on carcinogenic risks. As noted in the 2009 RODs, a target concentration based on the 1E-06 risk level (0.011 mg/kg ww) may not be achievable since it is much lower than mean background concentration (0.04 mg/kg ww) in U.S. waters.
5. TEQ = toxicity equivalent (toxicity-weighted mass of dioxin mixtures). The human health target tissue concentrations for PCDD/PCDFs are based on RME carcinogenic risks at risk targets ranging from 1E-05 (1E-06 mg/kg ww) to 1E-04 (1E-05 mg/kg ww) for adults. Non-carcinogenic targets could not be developed for PCDD/PCDFs. As noted in the 2009 RODs, a target concentration based on the 1E-06 risk level (1E-07 mg/kg ww) is much lower than mean background concentration (8E-07 mg/kg ww) in US waters and may not be achievable.

Table 2: Summary of GB/NMC Post-Remedy Sampling

Matrix	Parameter		2013			2014			2015			2016		
			GB	NMC	SYW 10	GB	NMC	SYW 10	GB	NMC	SYW 10	GB	NMC	SYW 10
Sport Fish	Total Hg PCBs and PCDD/Fs PCBs	(♦) (●) (*)								♦ ●			♦ *	
Prey Fish	Total Hg PCBs and PCDD/Fs PCBs	(♦) (●) (*)	♦			♦				♦ ●		♦	♦ *	
Benthic Invertebrates	Total Hg and MeHg	(■)	■			■						■	■	
Earthworms	Total Hg and MeHg	(■)	■			■					■	■	■	■
Small Mammals	Total Hg Total Hg and MeHg	(♦) (■)	■			■					♦	■	♦	♦
Surface Water	Dissolved Hg Total Hg and MeHg	(◊) (■)	■ ◊			■ ◊			■ ◊	■ ◊		■ ◊	■ ◊	
Soil/Sediment Sampling	Total Hg and MeHg	(■)	■			■			■		■	■	■	■

Notes:

1. Post-remedy sampling completed to date is based on the final GB OM&M Plan (February 2011), final NMC 2015 Sampling Work Plan (September 2015), revised draft NMC OM&M Plan (August 2016), and NMC 2016 Sampling Scope (NYSDEC 9/17/16 and Parsons 9/23/16 emails).

2. GB IRM remedial construction completed in 2012. SYW-10 remedial construction completed in 2013 and restoration in 2014. NMC remedial construction completed in 2014 and restoration in 2015.

3. For fish samples, PCBs, dioxins/furans (PCDD/PCDFs), and lipids are a subset of the mercury samples.

4. For GB post-remedy sampling, surface water was sampled in one low-flow event each year. For NMC post-remedy sampling, surface water was sampled in two events each year (one low flow and one high flow).

APPENDIX C – FIGURES

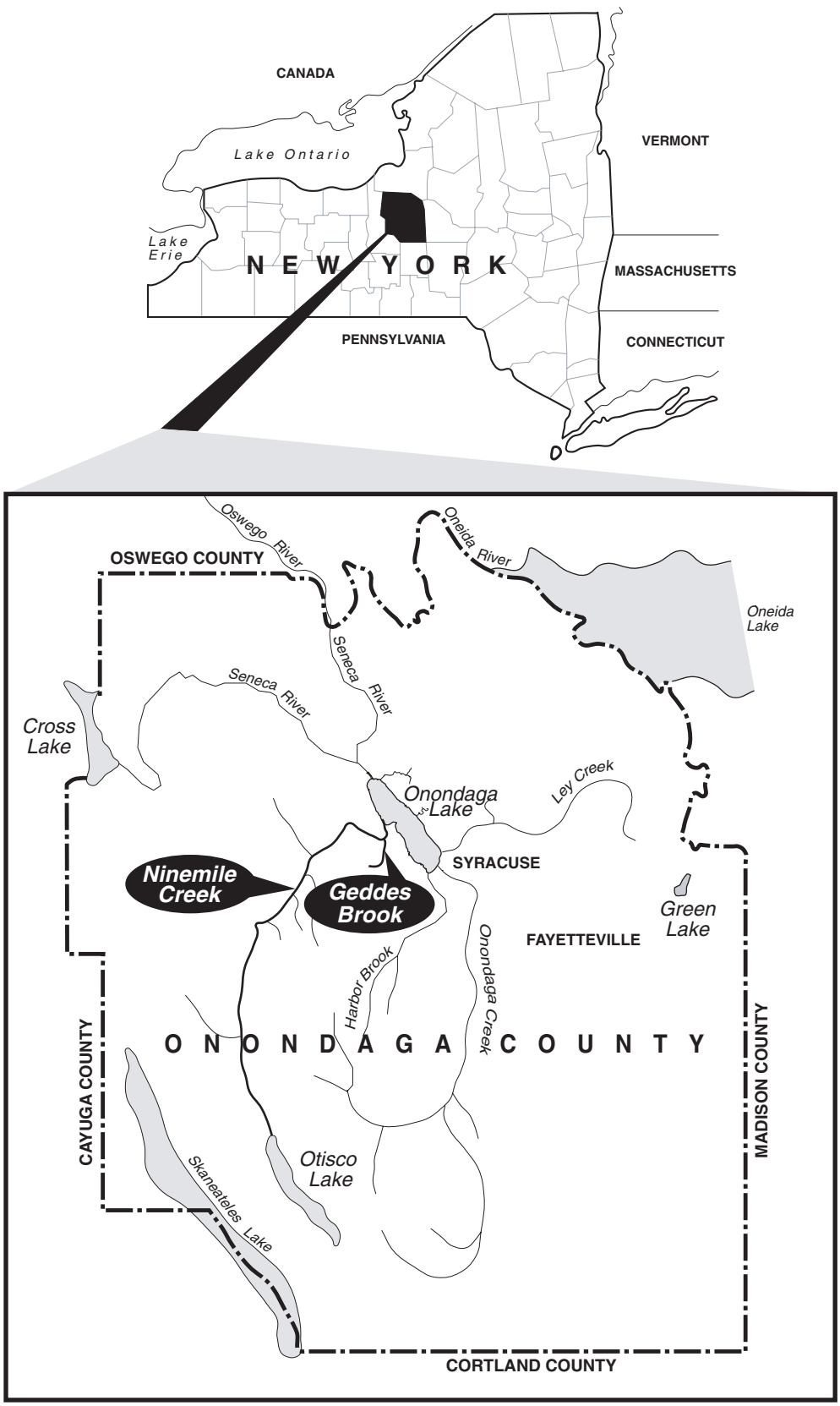
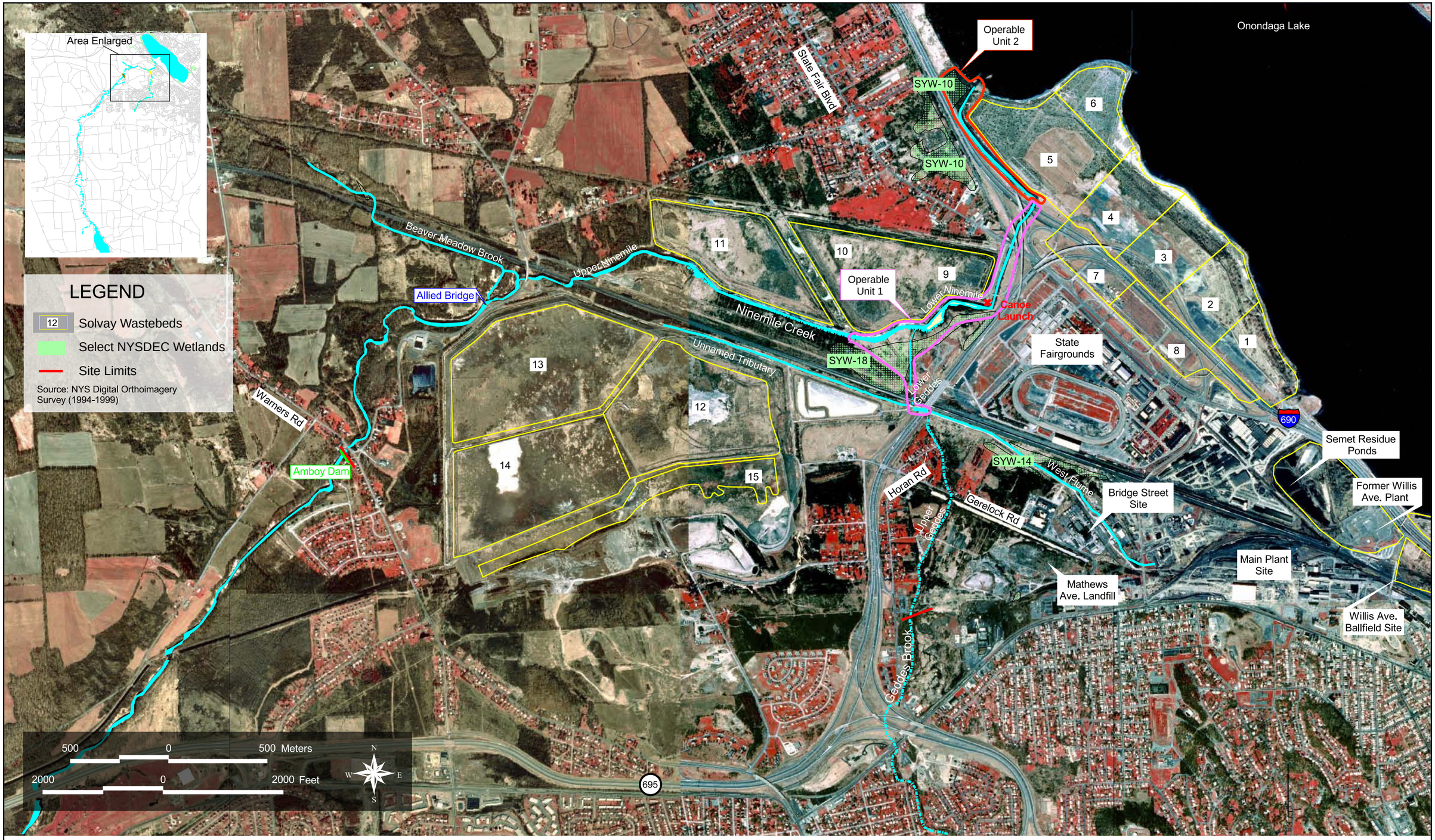


Figure 1. Location of Geddes Brook, Ninemile Creek, and Onondaga Lake

Source: FS Figure 1-1 (Parsons, 2005)



Source: Modified from RI Figure 1-2 (TAMS/Earth Tech, 2003c)

Figure 2.
Geddes Brook/Ninemile Creek and Vicinity

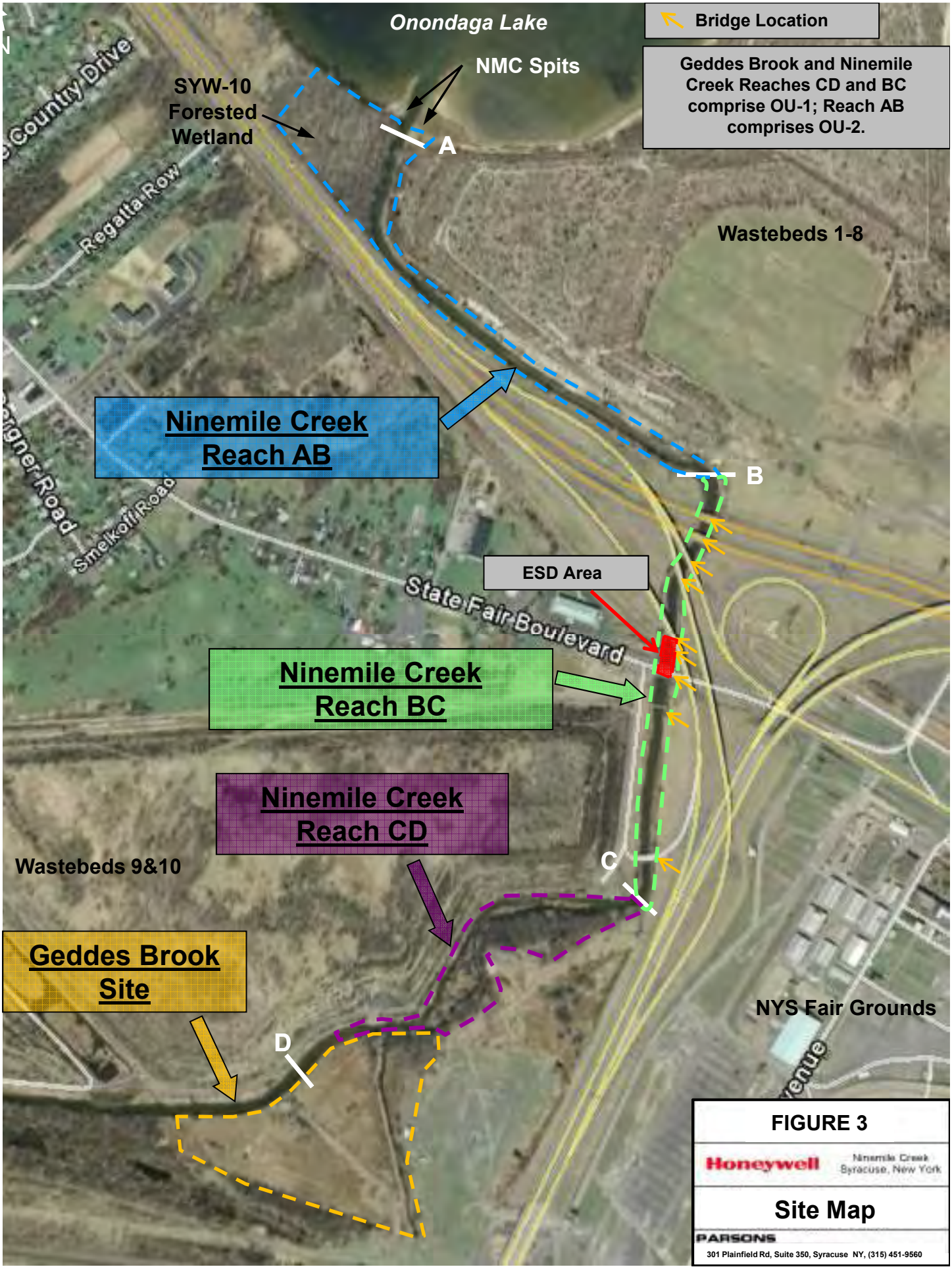


FIGURE 3

Honeywell — Ninemile Creek, Syracuse, New York

Site Map

PARSONS

301 Plainfield Rd, Suite 350, Syracuse NY, (315) 451-9560

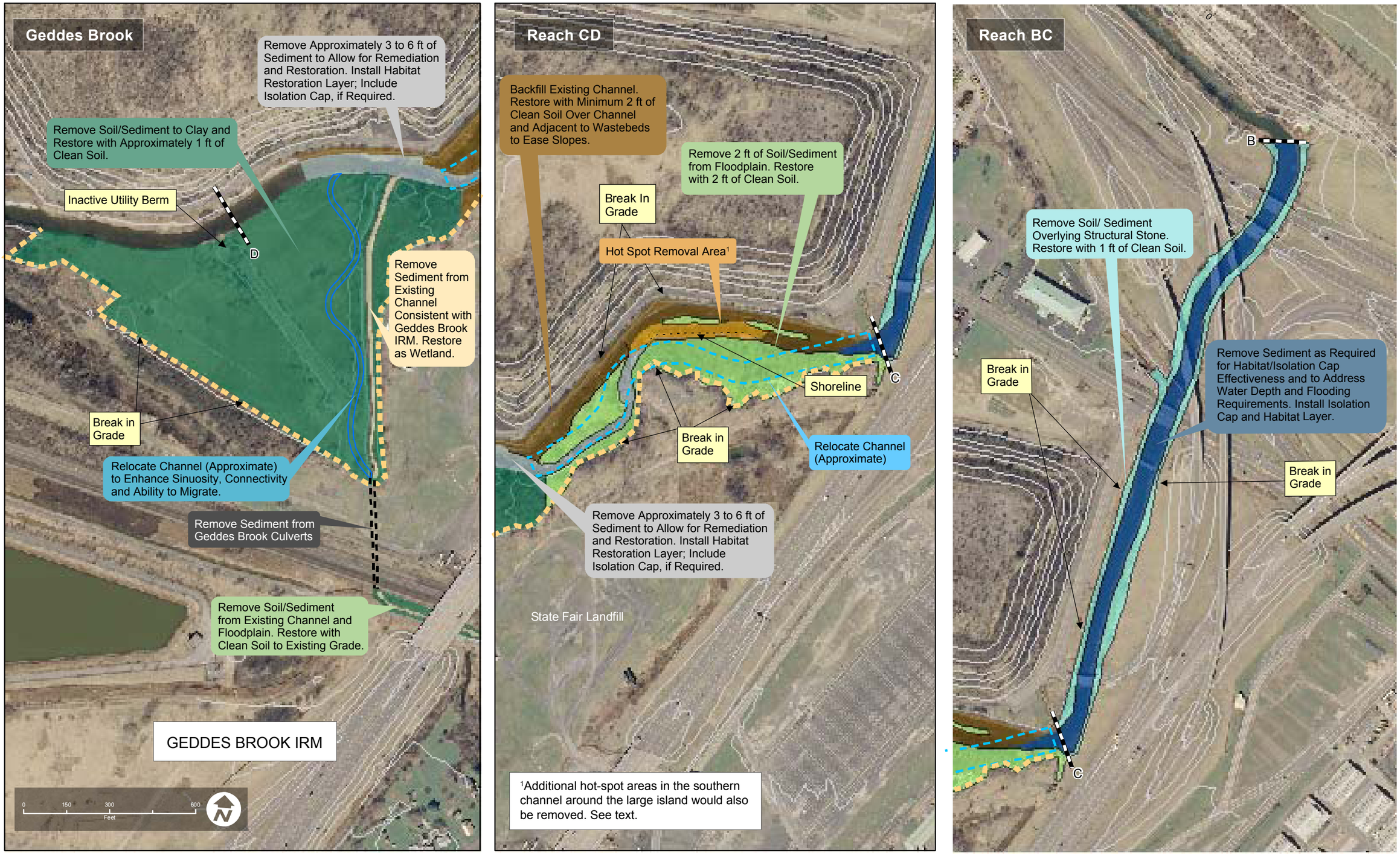
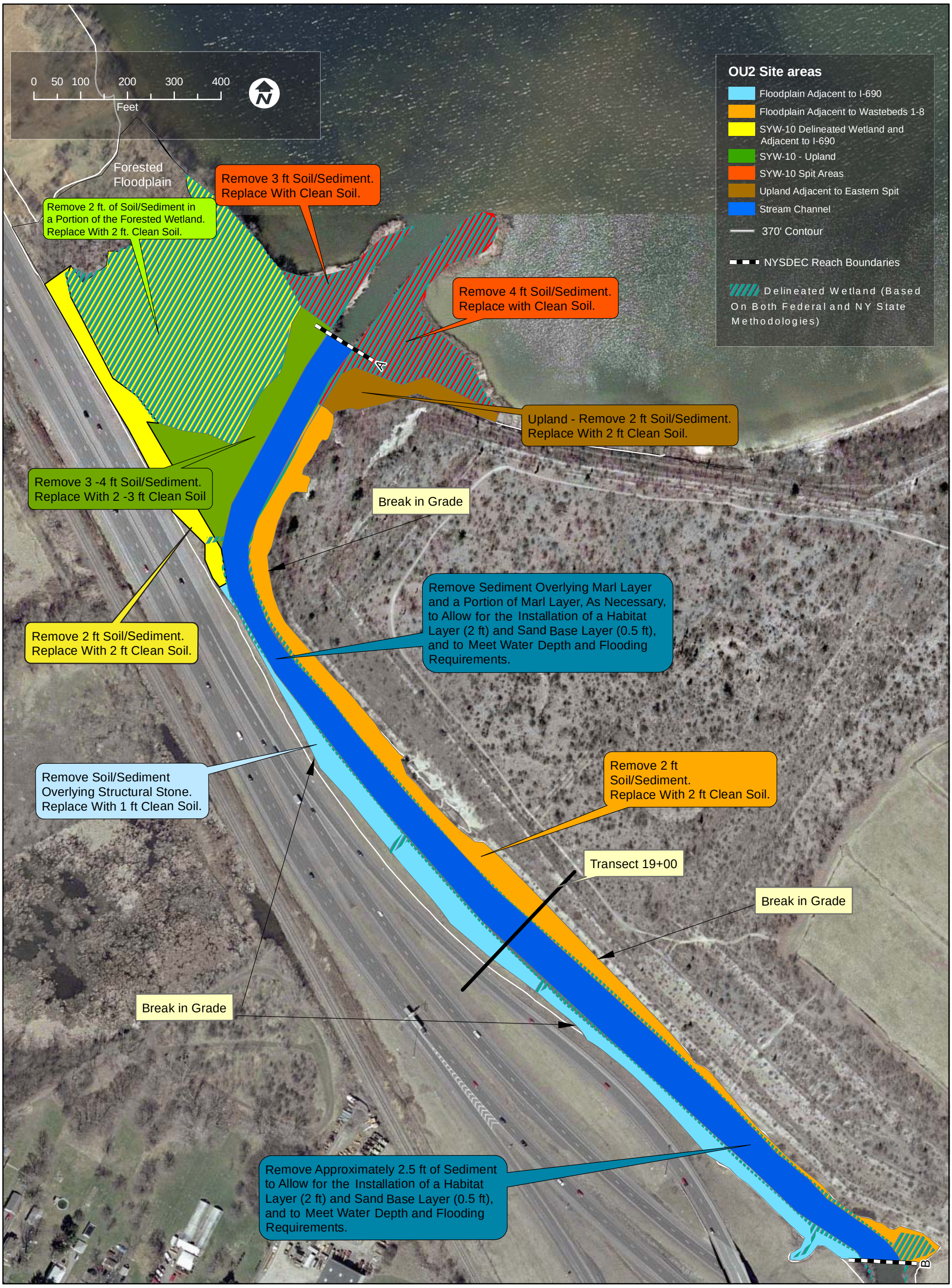


Figure 4a.
OU1 Alternative 3 (Selected Remedy) Remedial Approach and Geddes Brook IRM

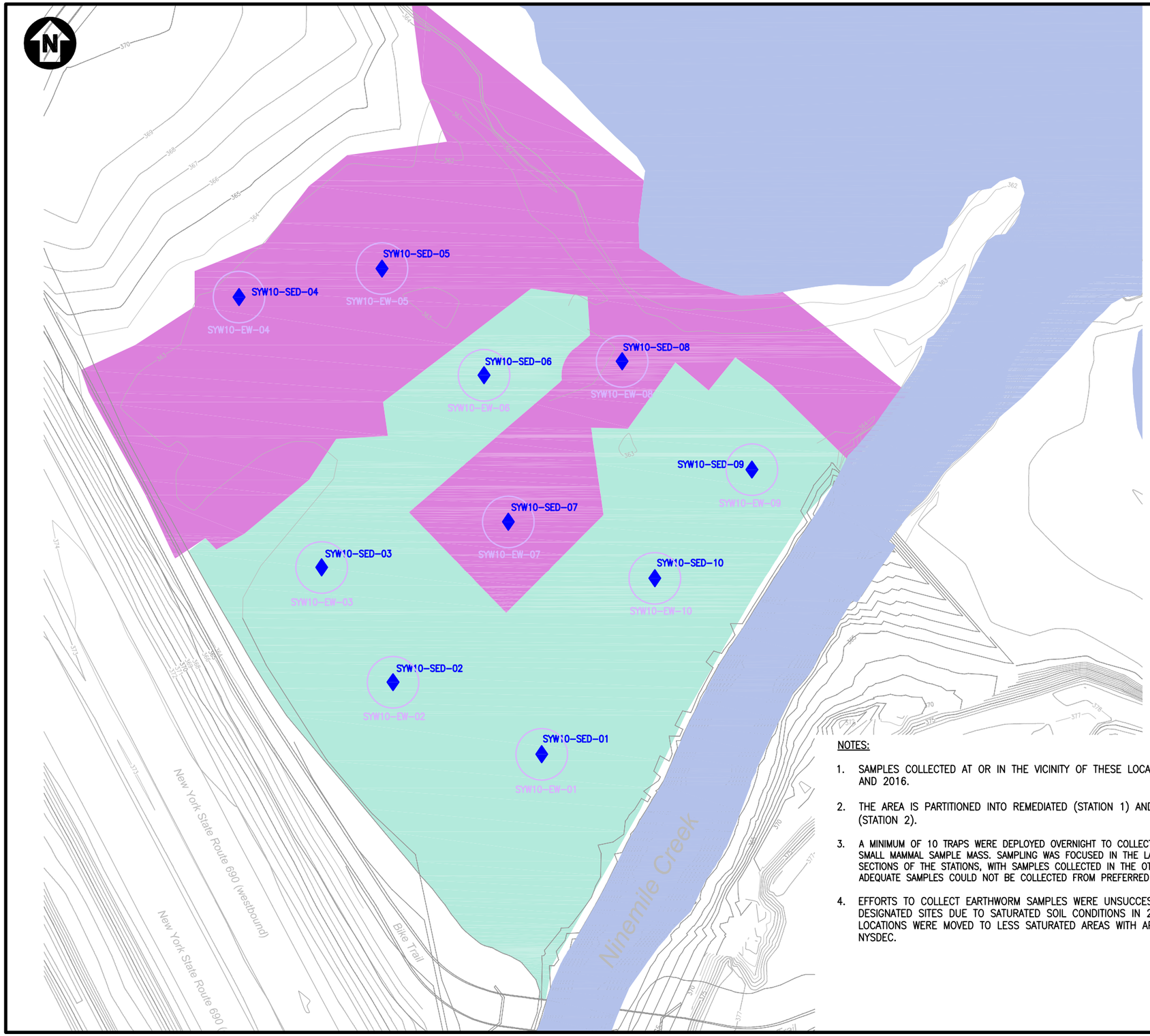
Source: Modified from Supplemental FS (Parsons, 2008a)

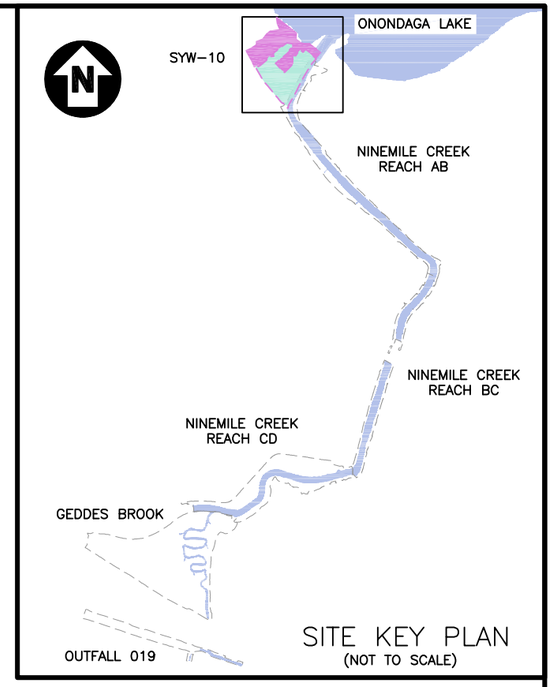


Note: Removal depths noted above are preliminary and would be finalized during remedial design.

Source: Modified from OU2 Supplemental FS (Parsons, 2009)

Figure 4b
OU2 Alternative 3 (Selected Remedy) Remedial Approach





LEGEND:

- RESTORATION AREA
- EXISTING ELEVATION CONTOUR
- STREAM BED
- SMALL MAMMAL REMEDIATED AREA, STATION 1
- SMALL MAMMAL UNREMEDIATED AREA, STATION 2
- SEDIMENT SAMPLING LOCATION
- EARTHWORM SAMPLING AREA STATION

NOTES:

1. SAMPLES COLLECTED AT OR IN THE VICINITY OF THESE LOCATIONS IN 2015 AND 2016.
2. THE AREA IS PARTITIONED INTO REMEDIATED (STATION 1) AND UNREMEDIATED (STATION 2).
3. A MINIMUM OF 10 TRAPS WERE DEPLOYED OVERNIGHT TO COLLECT SUFFICIENT SMALL MAMMAL SAMPLE MASS. SAMPLING WAS FOCUSED IN THE LARGE CONTIGUOUS SECTIONS OF THE STATIONS, WITH SAMPLES COLLECTED IN THE OTHER AREAS WHEN ADEQUATE SAMPLES COULD NOT BE COLLECTED FROM PREFERRED AREAS.
4. EFFORTS TO COLLECT EARTHWORM SAMPLES WERE UNSUCCESSFUL AT THE DESIGNATED SITES DUE TO SATURATED SOIL CONDITIONS IN 2015. SAMPLE LOCATIONS WERE MOVED TO LESS SATURATED AREAS WITH APPROVAL FROM NYSDEC.

80 40 0 80 160

SCALE: 1"=80'

FIGURE 5

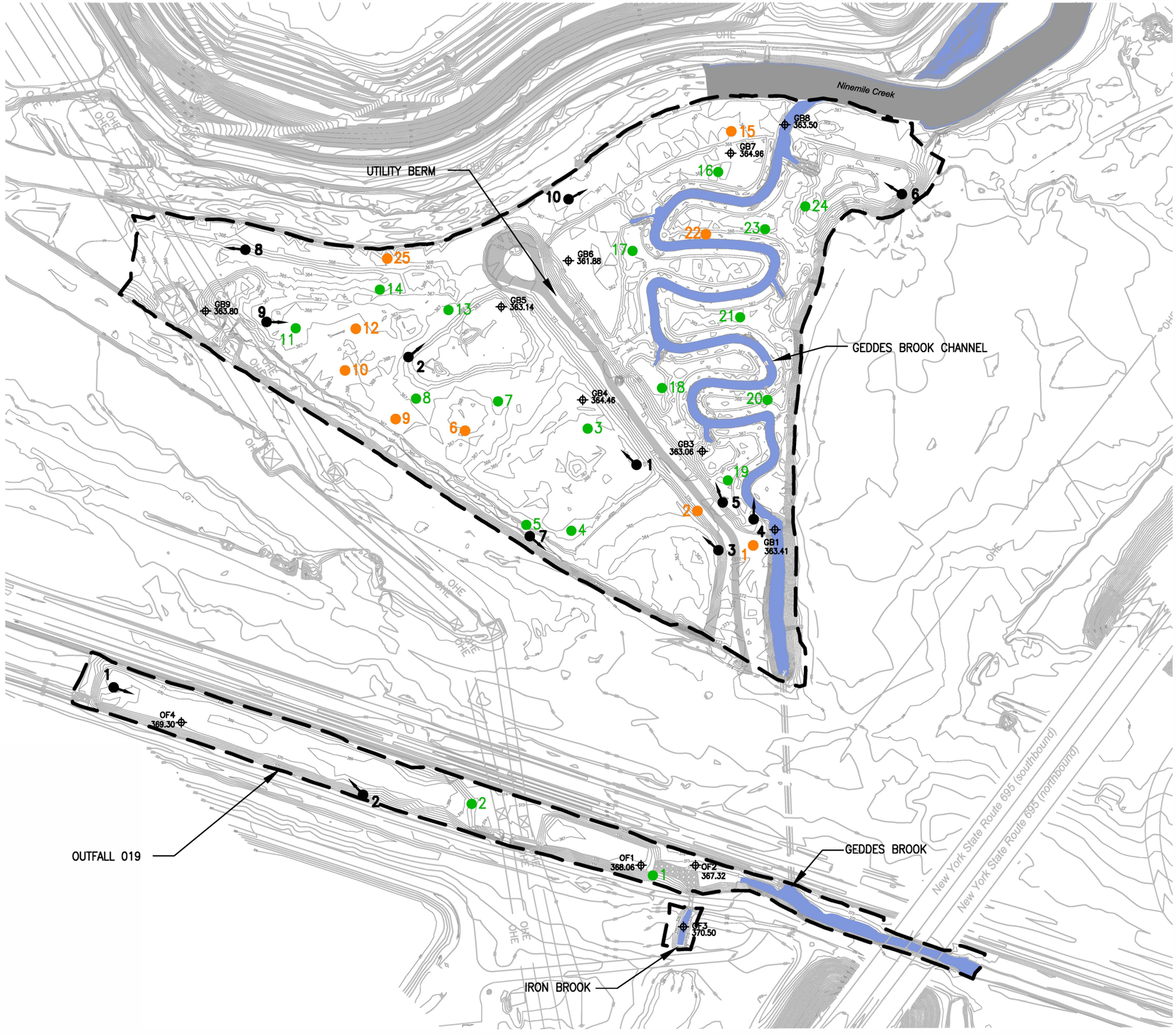
Honeywell

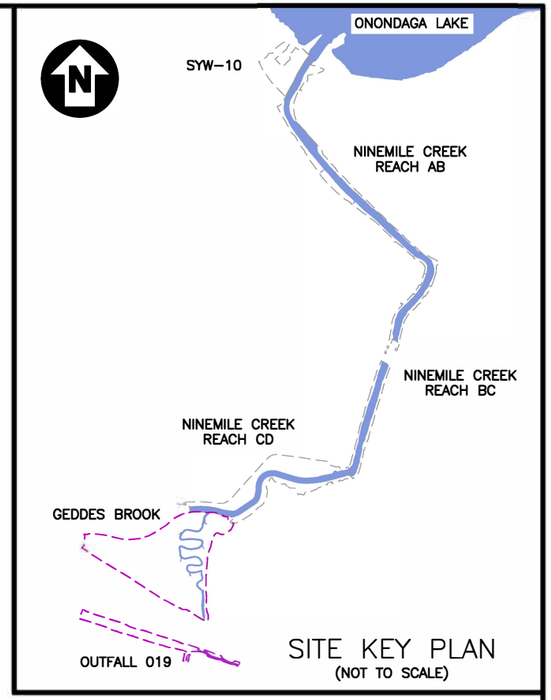
NINEMILE CREEK/GEDDES BROOK OM&M

SYW-10 BIOTA AND SOIL/SEDIMENT SAMPLING LOCATIONS

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 * 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\449463 - GB-NMC OM&M 2015-2016\10.0 TECHNICAL CATEGORIES\10.1 CAD\DEC-5-YEAR REVIEW\449463-SYW-10-2015-BIOTA SAMPLING LOC SK-006A.DWG
PLOT DATE: 5/17/2017 10:25 AM PLOTTED BY: SIVALIA, JACK





SITE KEY PLAN
(NOT TO SCALE)

LEGEND:

- RESTORATION AREA
- EXISTING ELEVATION CONTOUR
- STREAM BED
- VEGETATED TRAFFICABLE LANE
- RIPARIAN LOCATIONS
- WETLAND LOCATIONS
- PHOTO LOCATIONS AND DIRECTION
- STAFF GAUGES

NOTES:

1. LOCATION DESIGNATIONS ARE BASED ON FINAL DESIGN (PARSONS, 2011).

200 100 0 200 400

SCALE: 1"=200'

FIGURE 6a

Honeywell

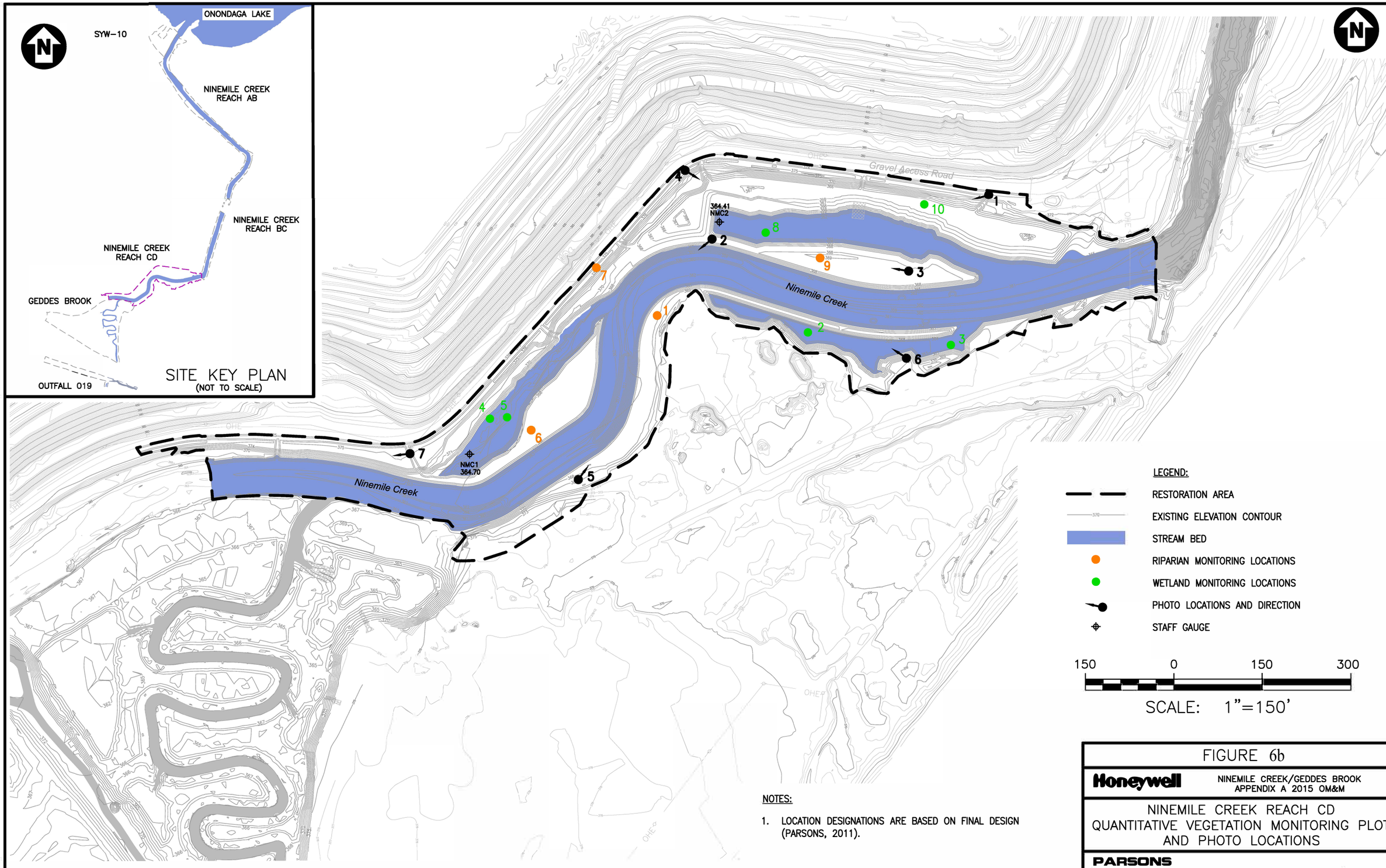
NINEMILE CREEK/GEDDES BROOK
APPENDIX A 2015 OM&M

GEDDES BROOK AND OUTFALL 019
QUANTITATIVE VEGETATION MONITORING PLOT AND PHOTO LOCATIONS

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 * 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\448443 GB-NMC OMM\10.0 TECHNICAL CATEGORIES\10.2 CAD\2015 FIGURES\APPENDIX A\448443-GB-2015-VEGPLOT.DWG
PLOT DATE: 5/3/2016 9:19 AM PLOTTED BY: RUSSO, JILL

SITE KEY PLAN
(NOT TO SCALE)



LEGEND:

- RESTORATION AREA
- EXISTING ELEVATION CONTOUR
- STREAM BED
- RIPARIAN MONITORING LOCATIONS
- WETLAND MONITORING LOCATIONS
- PHOTO LOCATIONS AND DIRECTION
- STAFF GAUGE

150 0 150 300

SCALE: 1"=150'

NOTES:

1. LOCATION DESIGNATIONS ARE BASED ON FINAL DESIGN (PARSONS, 2011).

FIGURE 6b

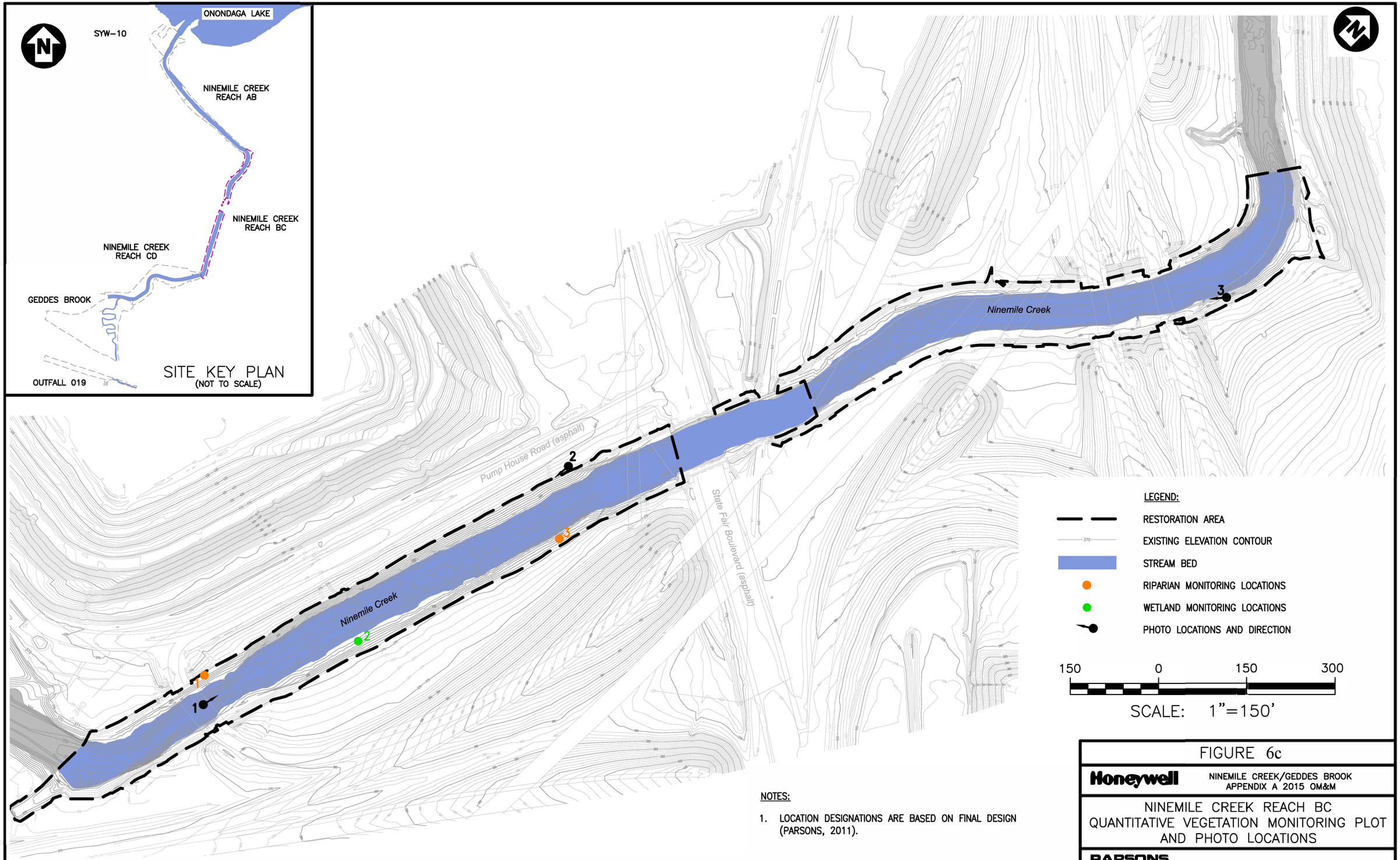
Honeywell

NINEMILE CREEK/GEDDES BROOK
APPENDIX A 2015 OM&M

NINEMILE CREEK REACH CD
QUANTITATIVE VEGETATION MONITORING PLOT AND PHOTO LOCATIONS

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 * 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\448443 GB-NMC OMM\10.0 TECHNICAL CATEGORIES\10.2 CAD\2015 FIGURES\APPENDIX A\448443-NMC-2015-VEGPLOT.DWG
PLOT DATE: 5/5/2016 12:58 PM PLOTTED BY: RUSSO, JILL



LEGEND:

- RESTORATION AREA
- EXISTING ELEVATION CONTOUR
- STREAM BED
- RIPARIAN MONITORING LOCATIONS
- WETLAND MONITORING LOCATIONS
- PHOTO LOCATIONS AND DIRECTION

150 0 150 300

SCALE: 1"=150'

NOTES:

1. LOCATION DESIGNATIONS ARE BASED ON FINAL DESIGN (PARSONS, 2011).

FIGURE 6c

Honeywell

NINEMILE CREEK/GEDDES BROOK
APPENDIX A 2015 OM&M

NINEMILE CREEK REACH BC
QUANTITATIVE VEGETATION MONITORING PLOT AND PHOTO LOCATIONS

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 * 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\448443 GB-NMC OMM\10.0 TECHNICAL CATEGORIES\10.2 CAD\2015 FIGURES\APPENDIX A\448443-NMC-2015-VEGPLOT.DWG
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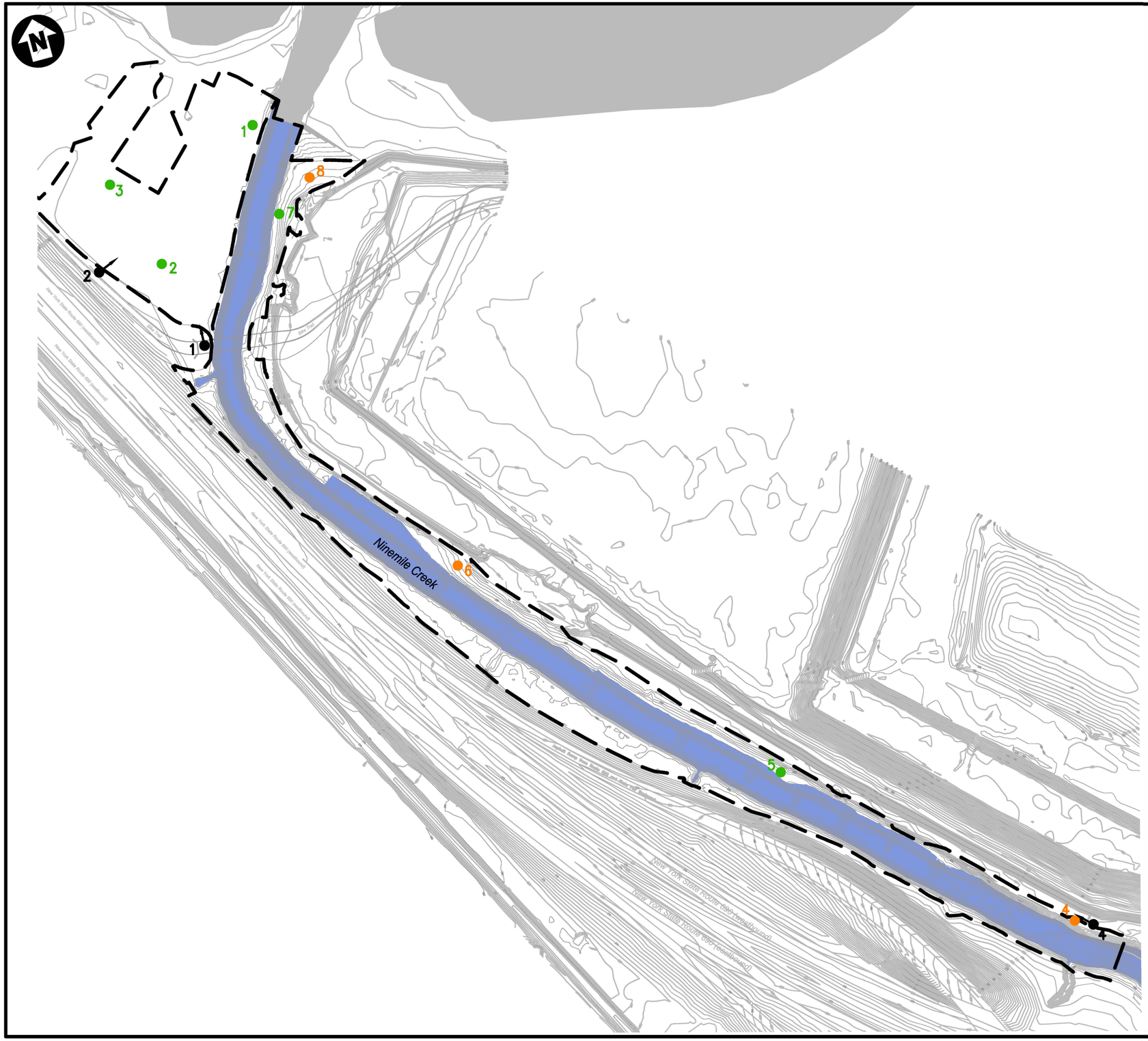
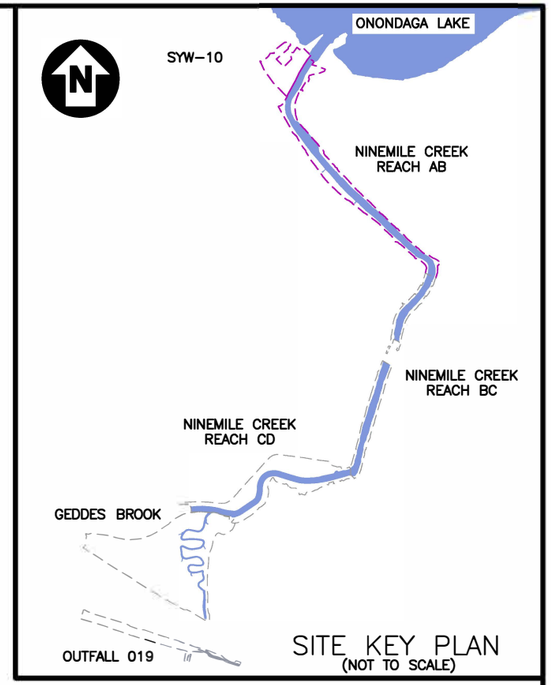




LEGEND:

- RESTORATION AREA
- EXISTING ELEVATION CONTOUR
- STREAM BED
- RIPARIAN MONITORING LOCATIONS
- WETLAND MONITORING LOCATIONS
- PHOTO LOCATIONS AND DIRECTION

200 100 0 200 400

SCALE: 1"=200'

FIGURE 6d

Honeywell

NINEMILE CREEK/GEDDES BROOK
APPENDIX A 2015 OM&M

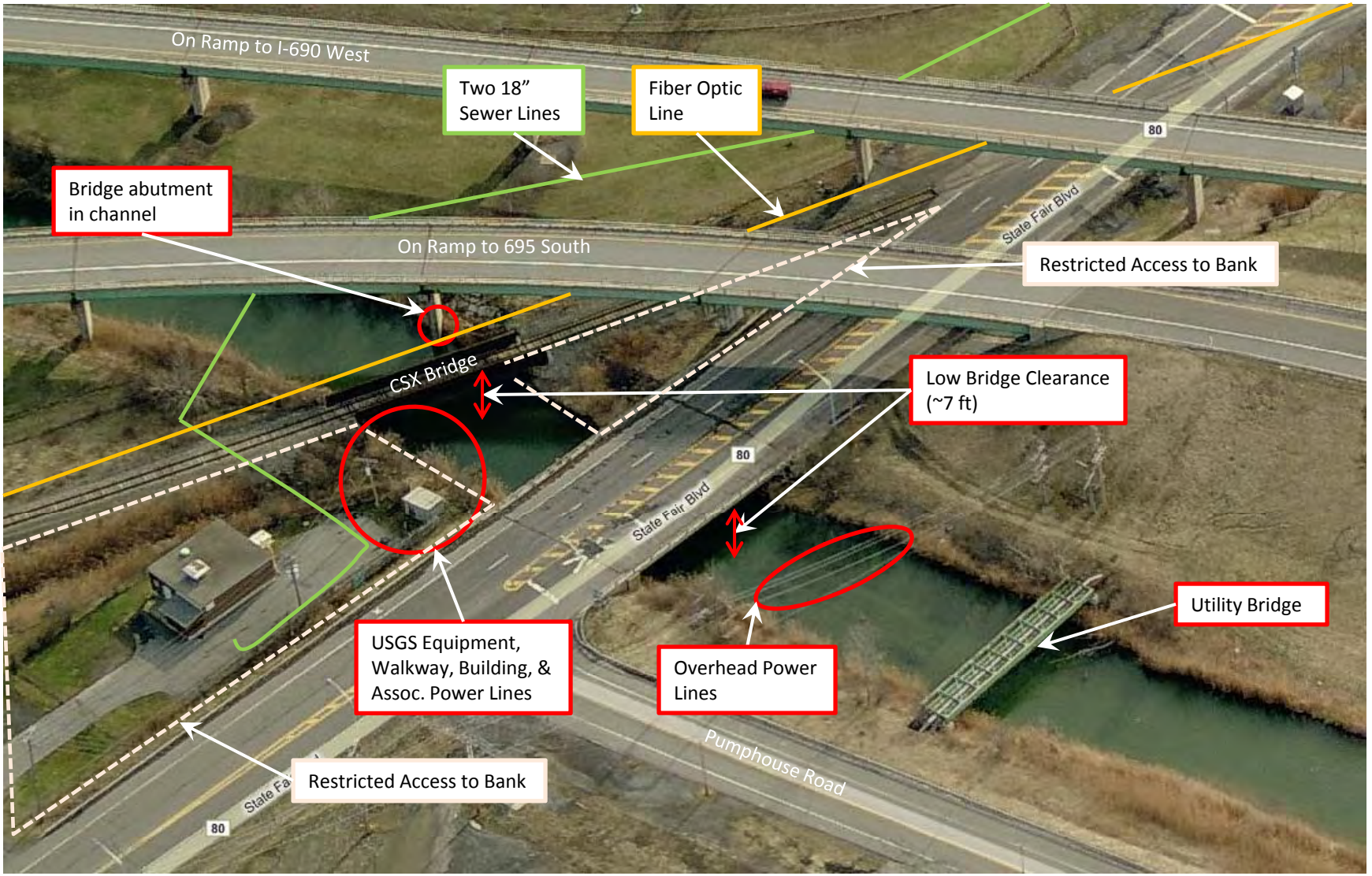
SYW-10 AND NINEMILE CREEK REACH AB
QUANTITATIVE VEGETATION MONITORING
PLOT AND PHOTO LOCATIONS

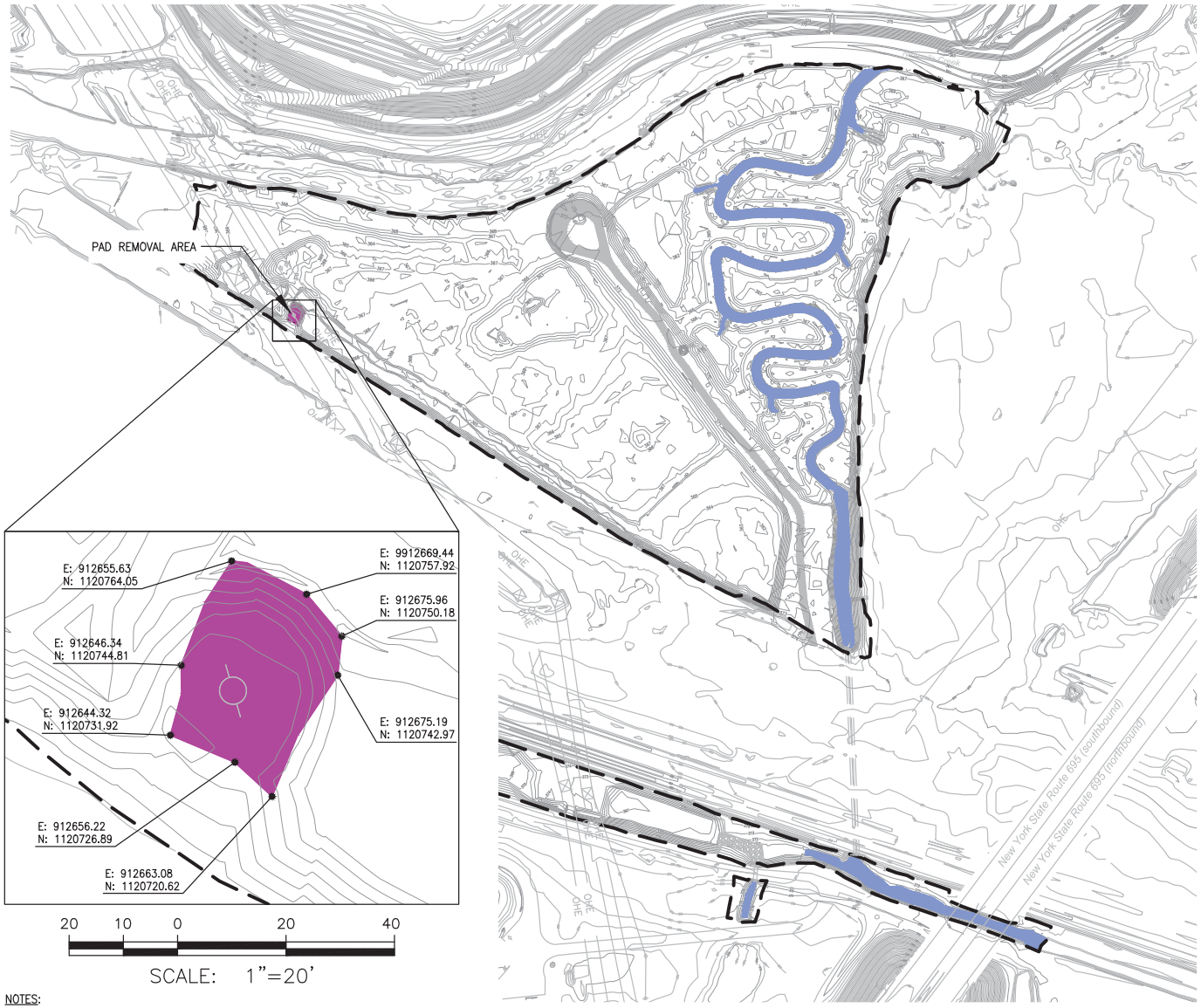
PARSONS

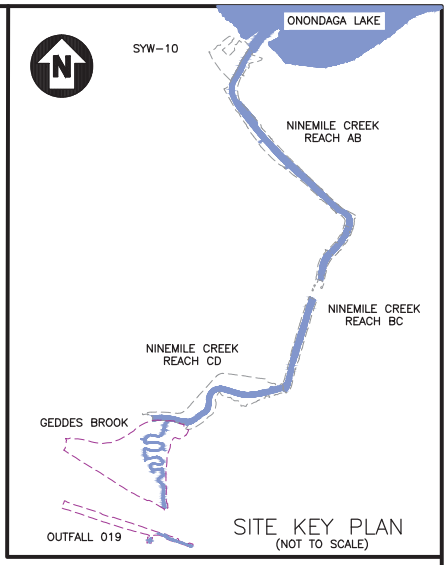
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 * 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\448443 GB-NMC OMM\10.0 TECHNICAL CATEGORIES\10.2 CAD\2015 FIGURES\APPENDIX A\448443-SYW-10-2015-VEGPLOT.DWG
PLOT DATE: 5/3/2016 11:00 AM PLOTTED BY: RUSSO, JILL

Figure 7 – Aerial View of ESD Area (Utility Bridge to Sewer Lines)







LEGEND:

- RESTORATION AREA
- EXISTING ELEVATION CONTOUR
- STREAM BED
- VEGETATED TRAFFICABLE LANE
- PAD REMOVAL AREA

200 100 0 200 400

SCALE: 1"=200'

NOTES:

1. AREA HIGHLIGHTED AS PAD REMOVAL AREA REPRESENTS LIMITS OF REMOVAL.
2. REMOVAL VOLUME: 135 CUBIC YARDS
   REMOVAL ACREAGE: 841 SQUARE FEET

Figure 8

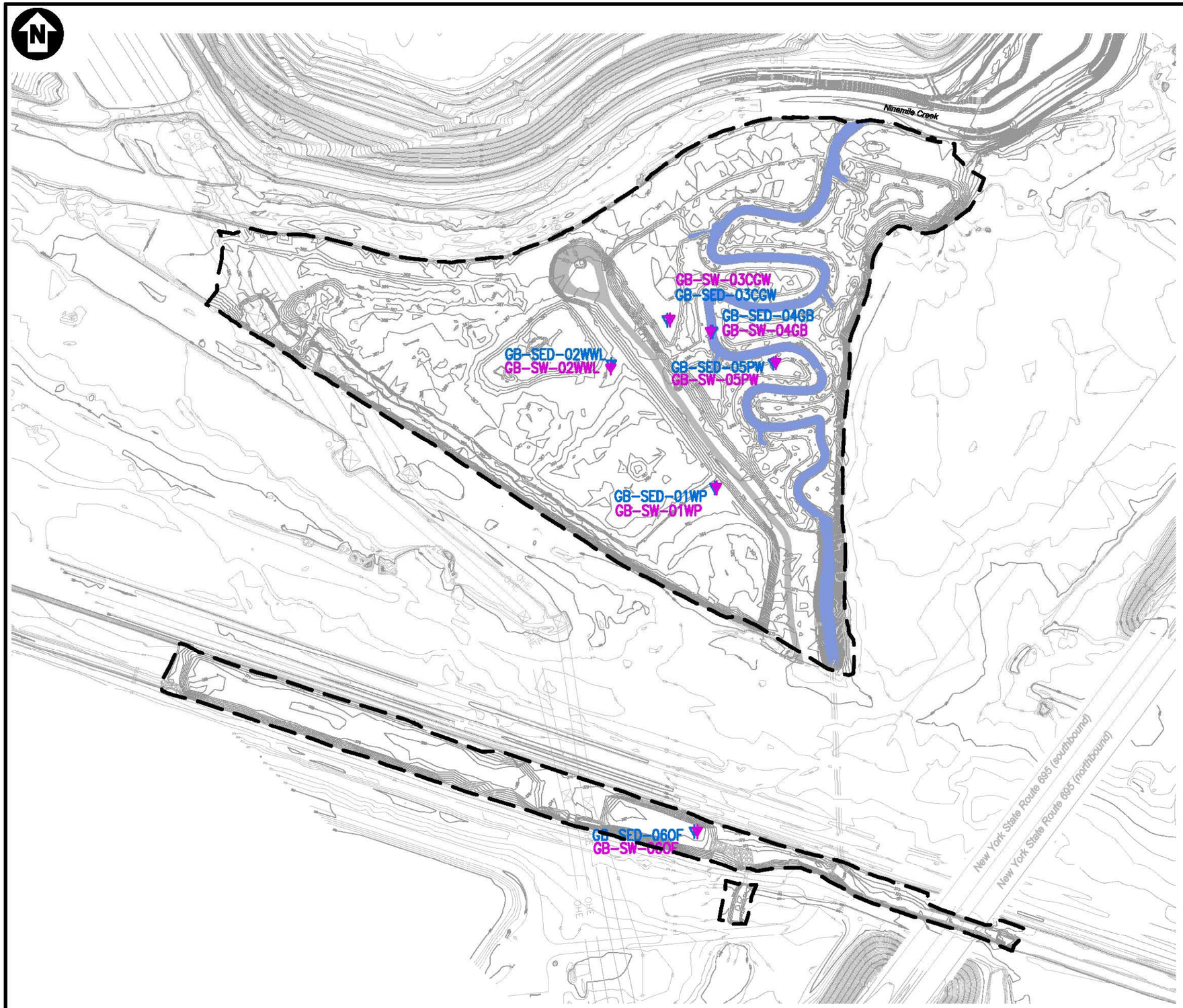
Honeywell

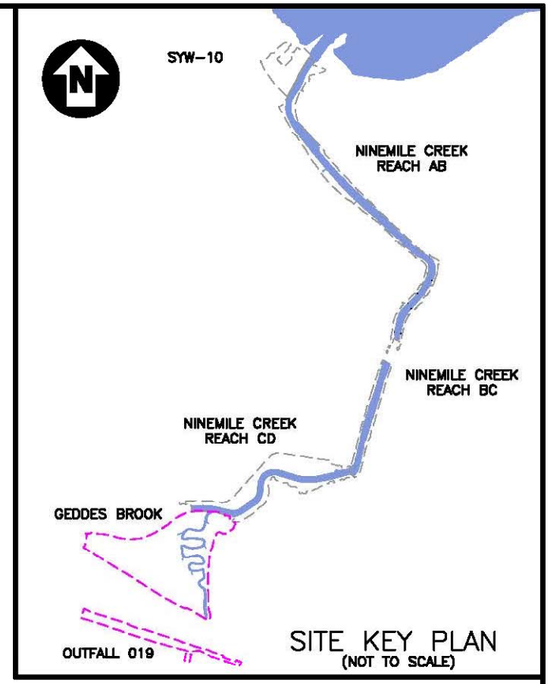
GB/OF19
2014 OM&M

GEDDES BROOK PAD REMOVAL DETAIL VIEW

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 * 315-451-9560

FILE NAME: P:\HONEYWELL - SYR\448443 GB-NMC OMM\10.0 TECHNICAL CATEGORIES\10.2 CAD\2014 FIGURES\448443-GB-2014-REMOVALS AREA.DWG
PLOT DATE: 7/18/2015 6:00 PM PLOTTED BY: CASIDE-ELMER, NATALIA





NOTE:

1. SAMPLES COLLECTED AT OR IN THE VICINITY OF THESE LOCATIONS IN 2013, 2014, 2015, AND 2016.

LEGEND:

- RESTORATION AREA
- SEDIMENT SAMPLING LOCATIONS
- SURFACE WATER SAMPLE LOCATIONS

200 100 0 200 400

SCALE: 1"=200'

FIGURE 9

Honeywell

NINEMILE CREEK/GEDDES BROOK OM&M

GEDDES BROOK SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 • 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\449463 - GB-NMC OM&M 2015-2016\10.0 TECHNICAL CATEGORIES\10.1 CAD\DEC-5-YEAR REVIEW\449463-GB-SED AND SW SK-001.DWG
PLOT DATE: 5/12/2017 10:52 AM PLOTTED BY: RUSSO, JILL

Figure 10a. Geddes Brook 2013 through 2016 Dissolved Mercury Concentrations in Surface Water

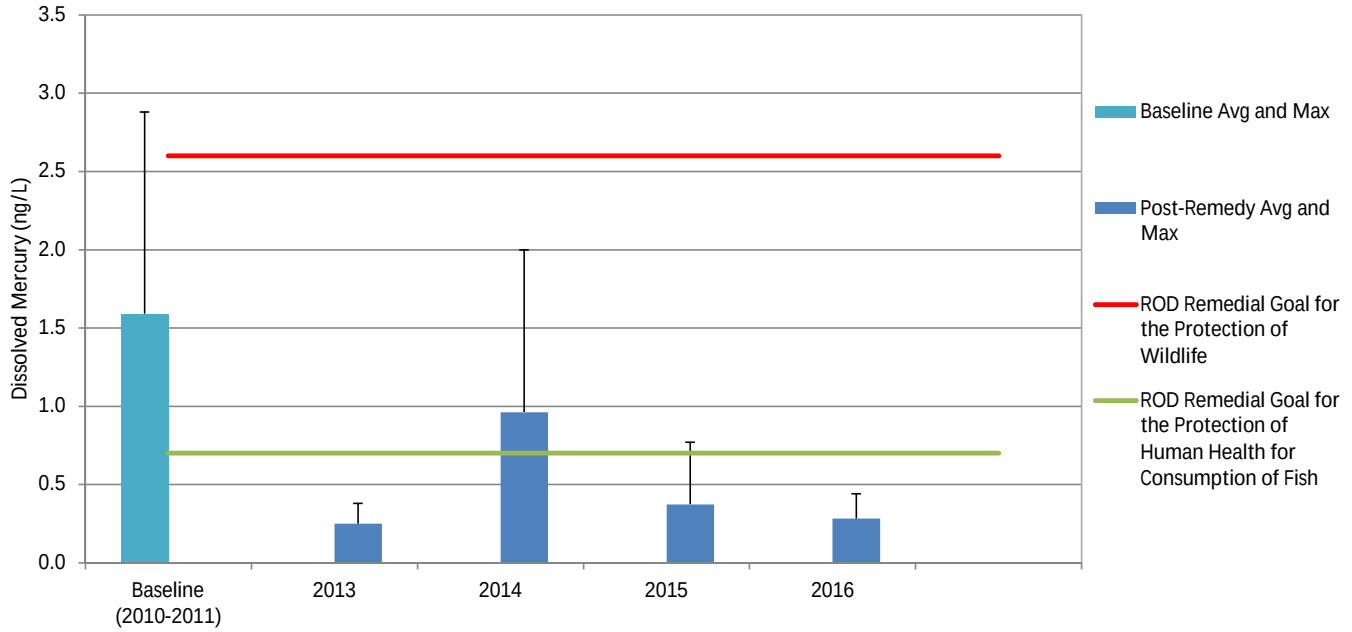
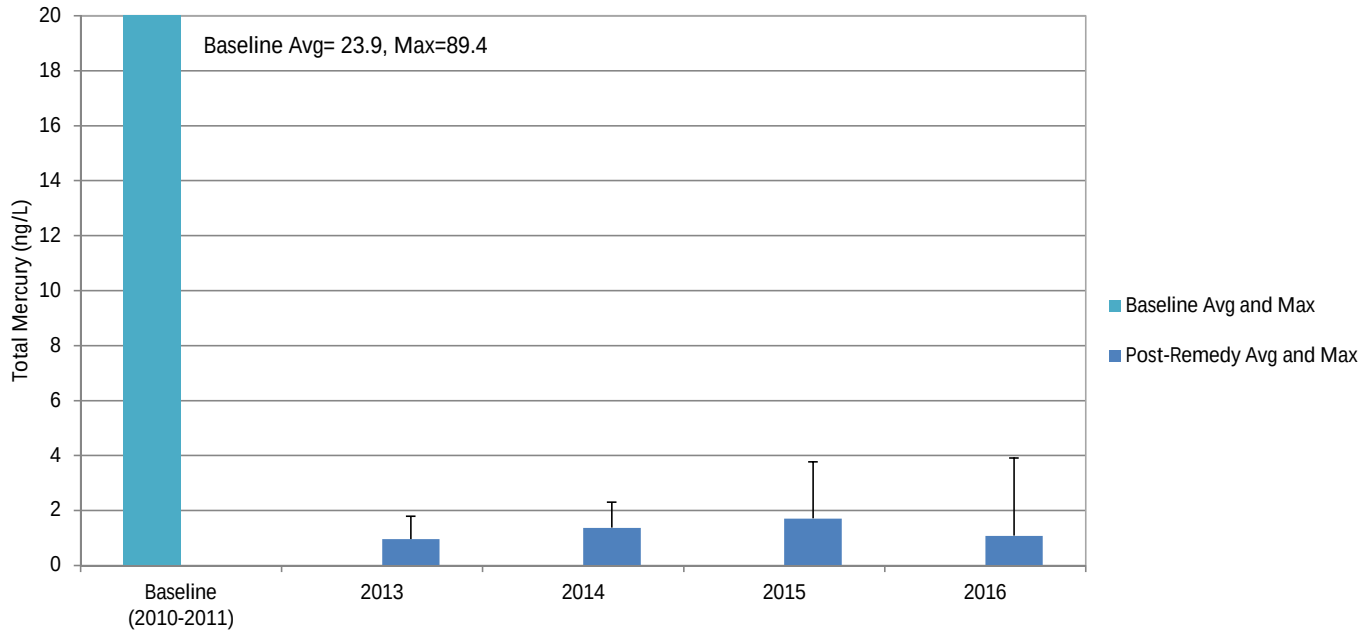


Figure 10b. Geddes Brook 2013 through 2016 Total (Unfiltered) Mercury Concentrations in Surface Water



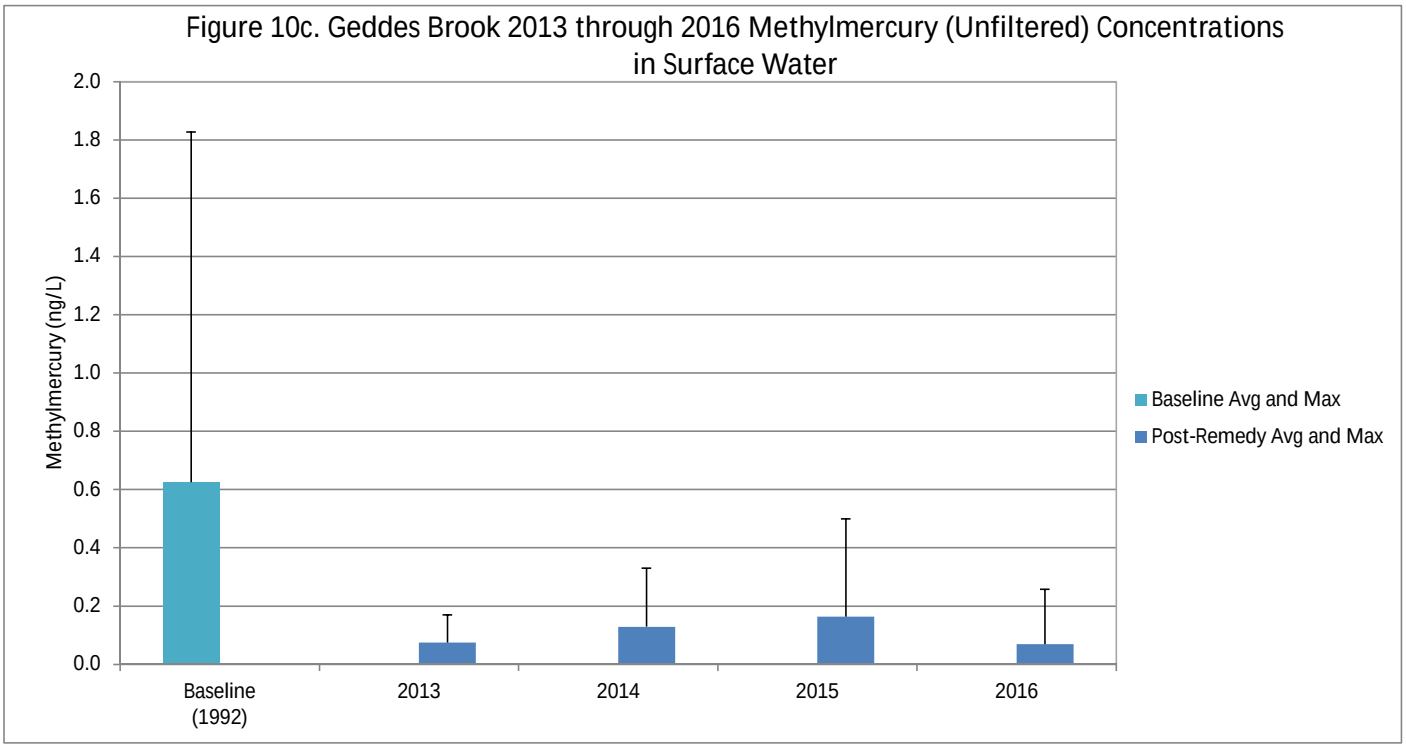


Figure 10c. Geddes Brook 2013 through 2016 Methylmercury (Unfiltered) Concentrations in Surface Water
Methylmercury (ng/L)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Baseline (1992)
2013
2014
2015
2016
Baseline Avg and Max
Post-Remedy Avg and Max

Figure 11a. Geddes Brook 2013 through 2016 Mercury Concentrations in Channel and Wetland Surface Sediment

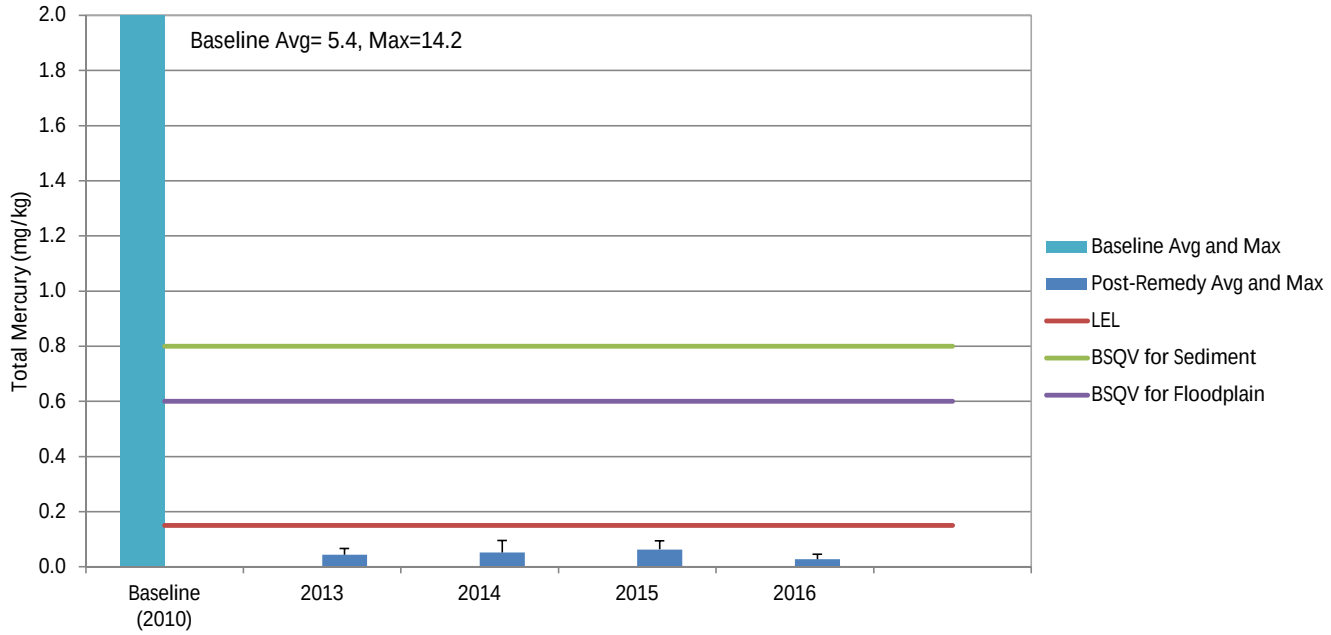
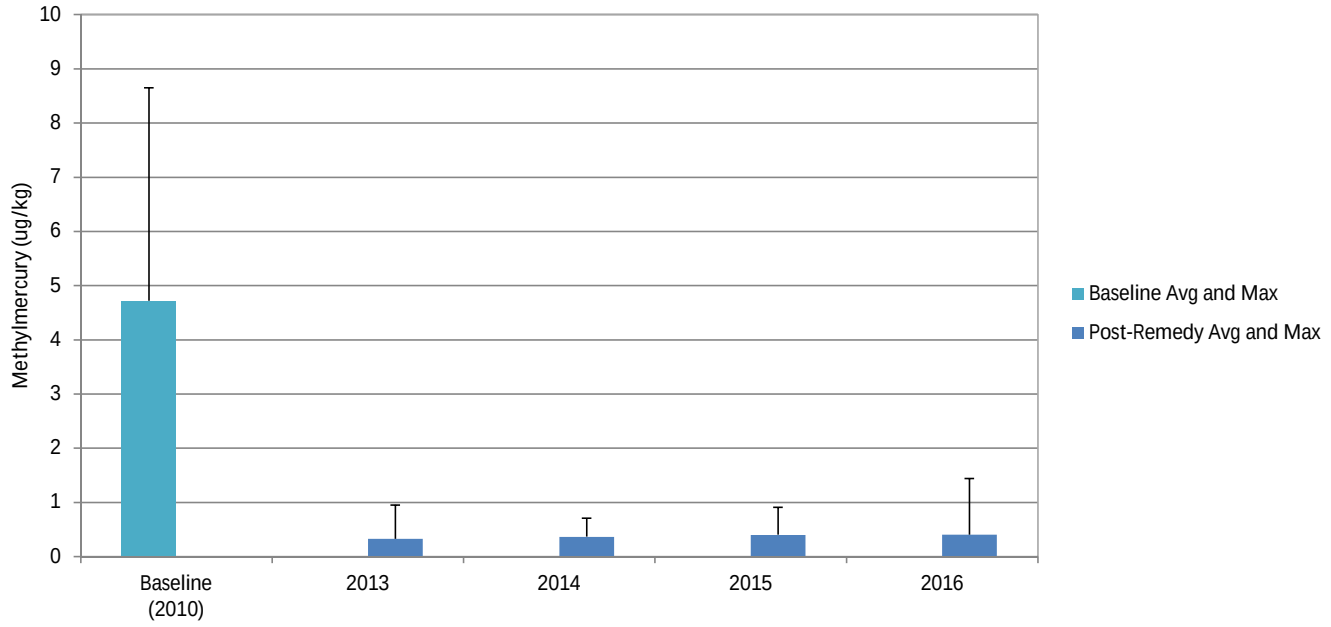
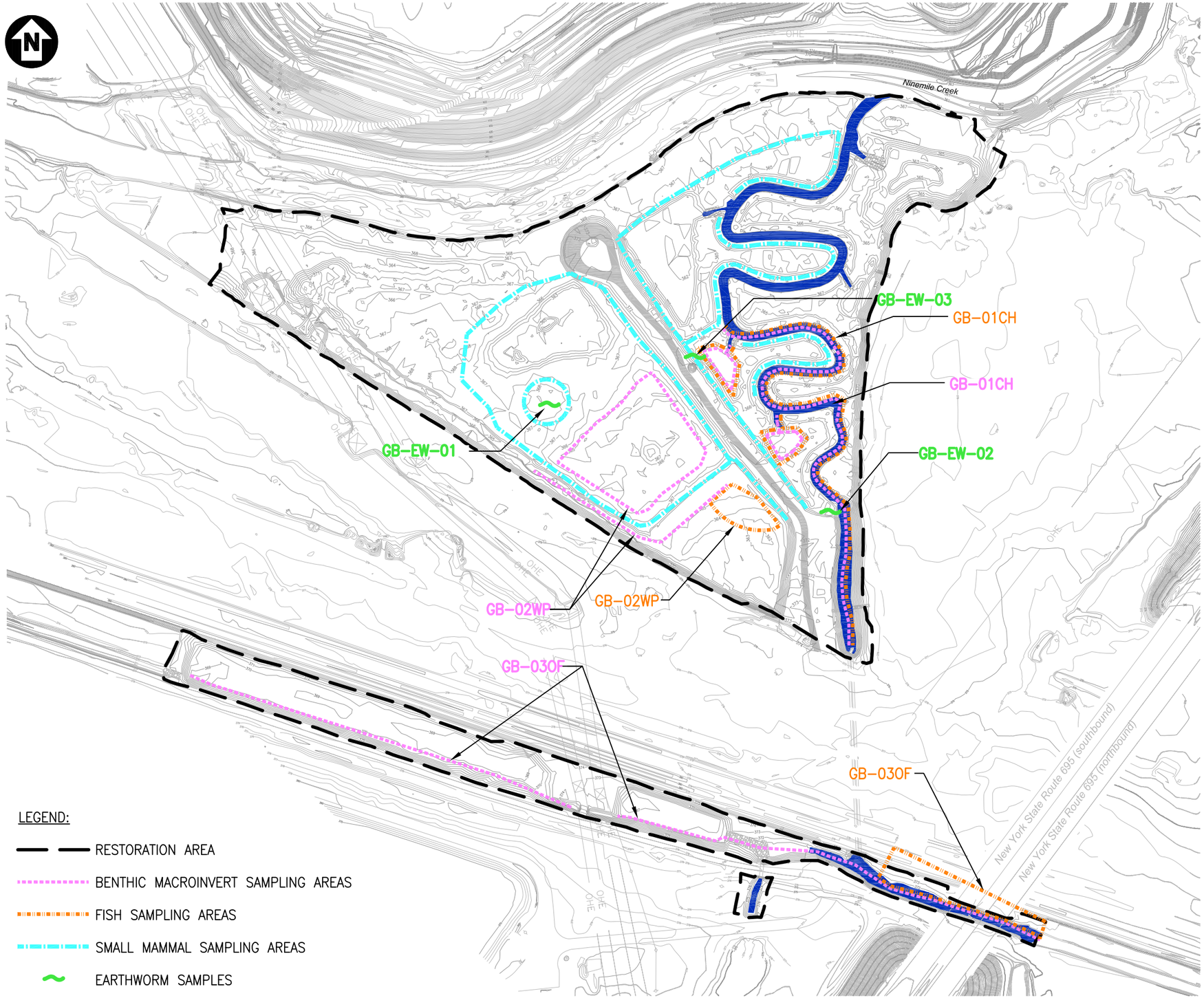


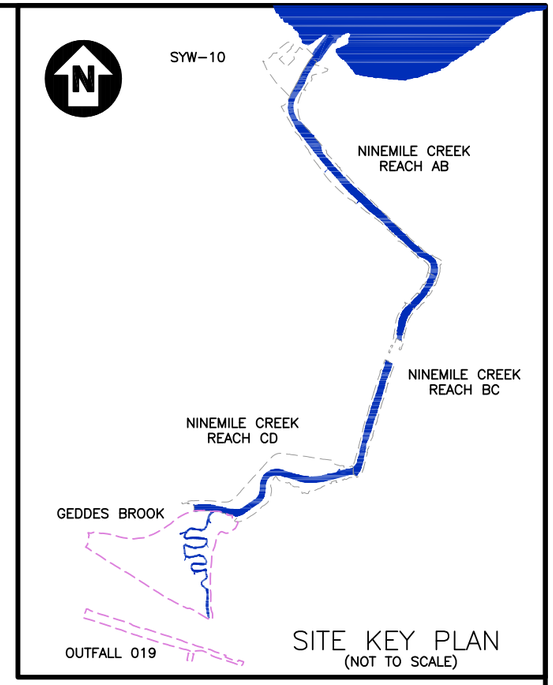
Figure 11b. Geddes Brook 2013 through 2016 Methylmercury Concentrations in Channel and Wetland Surface Sediment





LEGEND:

- RESTORATION AREA
- BENTHIC MACROINVERT SAMPLING AREAS
- FISH SAMPLING AREAS
- SMALL MAMMAL SAMPLING AREAS
- EARTHWORM SAMPLES



SITE KEY PLAN
(NOT TO SCALE)

NOTES:

1. SAMPLES COLLECTED AT OR IN THE VICINITY OF THESE LOCATIONS IN 2013, 2014, AND 2016.
2. A MINIMUM OF 15 TRAPS WERE DEPLOYED OVERNIGHT FOR UP TO FIVE NIGHTS TO COLLECT SUFFICIENT SMALL MAMMAL SAMPLE MASS.
3. UP TO THREE SAMPLE ATTEMPTS (IE. FIELD DAYS) WERE MADE TO COLLECT FISH AND MACROINVERTEBRATE SAMPLE MASS.
4. SAMPLE AREAS FOR FISH, MACROINVERTEBRATES AND SMALL MAMMALS DEPICT THE RANGE WHERE SAMPLING OCCURED.
5. FISH SAMPLING AREAS IN THE EAST FLOODPLAIN WERE INTENDED TO MINIMIZE THE CHANCE THAT FISH FROM NINEMILE CREEK WERE INADVERTENTLY COLLECTED.
6. SMALL MAMMAL SAMPLING AREAS FOCUSED ON INTERIOR PORTIONS OF THE SITE TO MINIMIZE THE CHANCE THAT MIGRANTS FROM OFF SITE WERE COLLECTED.

FIGURE 12

Honeywell

NINEMILE CREEK/GEDDES BROOK OM&M

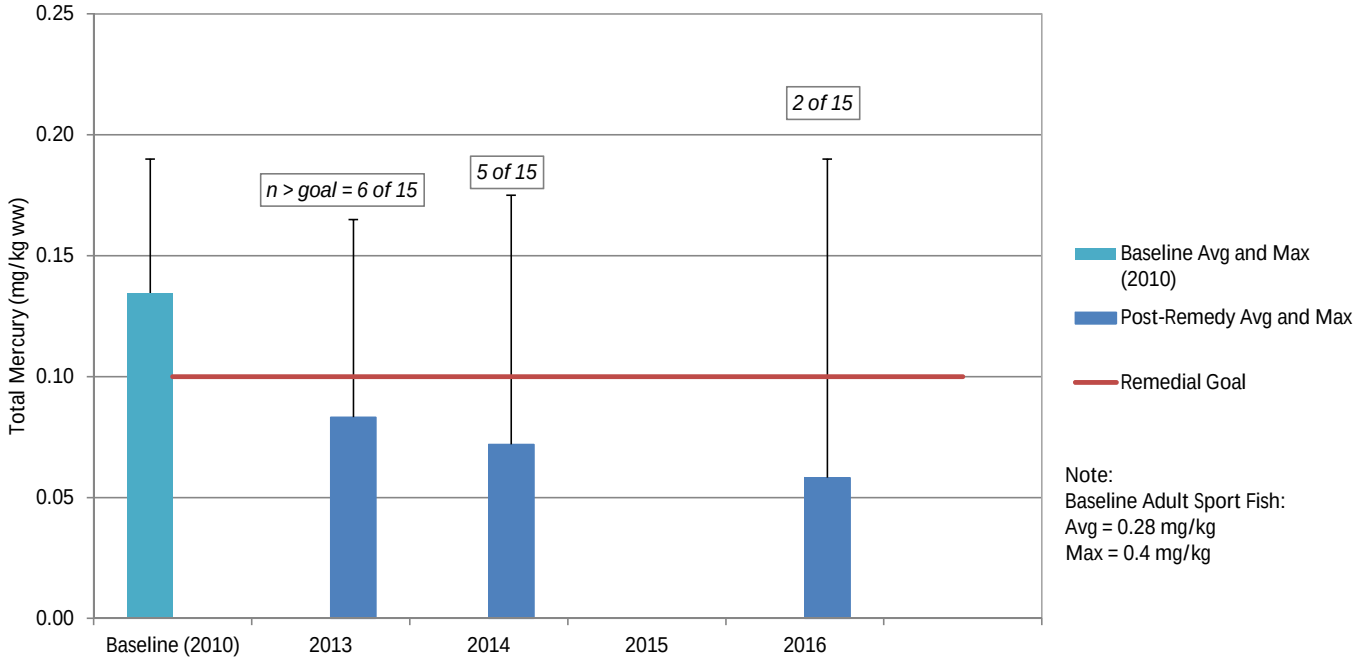
GEDDES BROOK BIOTA MONITORING SAMPLE LOCATIONS

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 * 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\449463 - GB-NMC OM&M 2015-2016\10.0 TECHNICAL CATEGORIES\10.1 CAD\DEC-5-YEAR REVIEW\449463-GB-BIOTA-MONIT SK-002.DWG
PLOT DATE: 6/5/2017 12:35 PM PLOTTED BY: RUSSO, JILL

Figure 13. Geddes Brook 2013 through 2016 Mercury Concentrations in Prey Fish



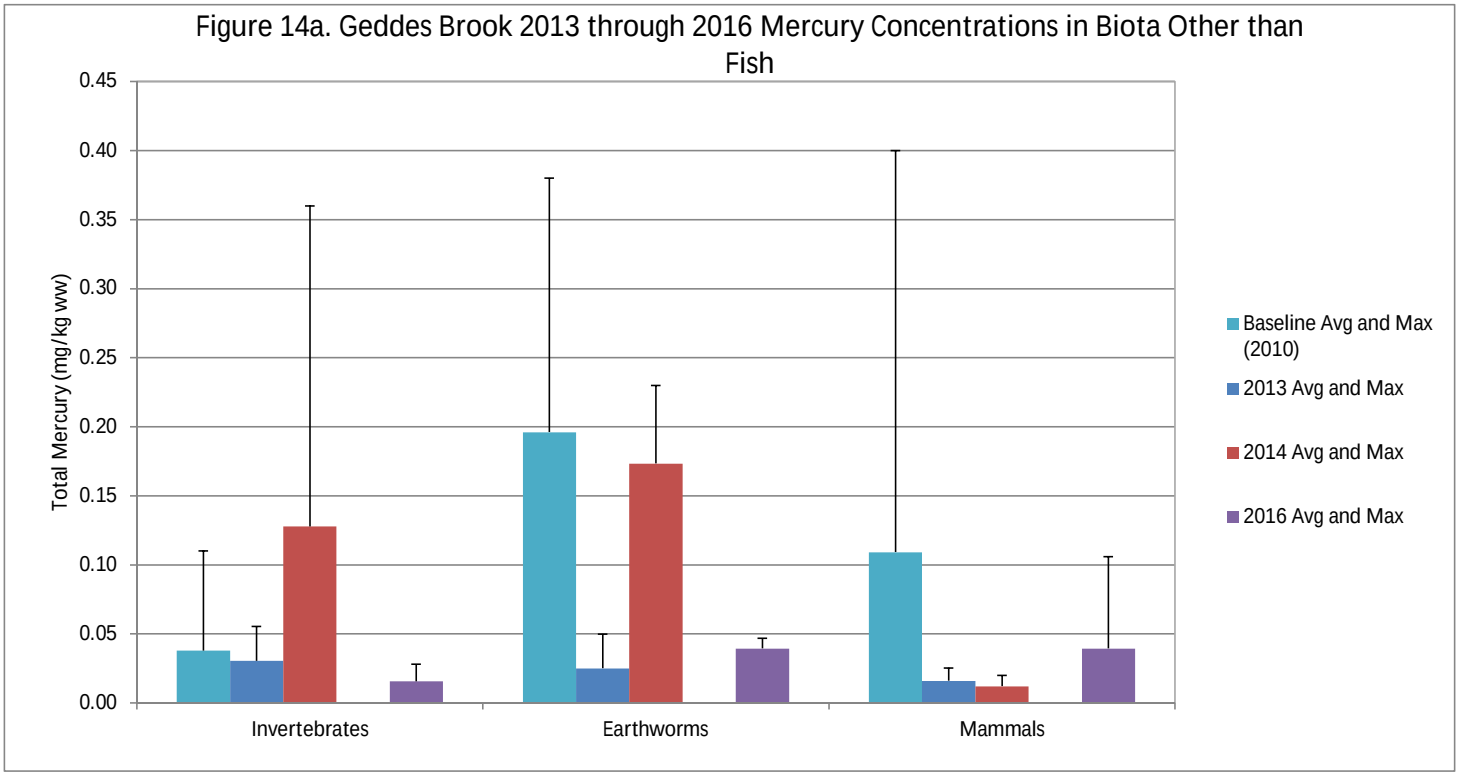


Figure 14a. Geddes Brook 2013 through 2016 Mercury Concentrations in Biota Other than Fish
Total Mercury (mg/kg ww)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Invertebrates
Earthworms
Mammals
Baseline Avg and Max (2010)
2013 Avg and Max
2014 Avg and Max
2016 Avg and Max

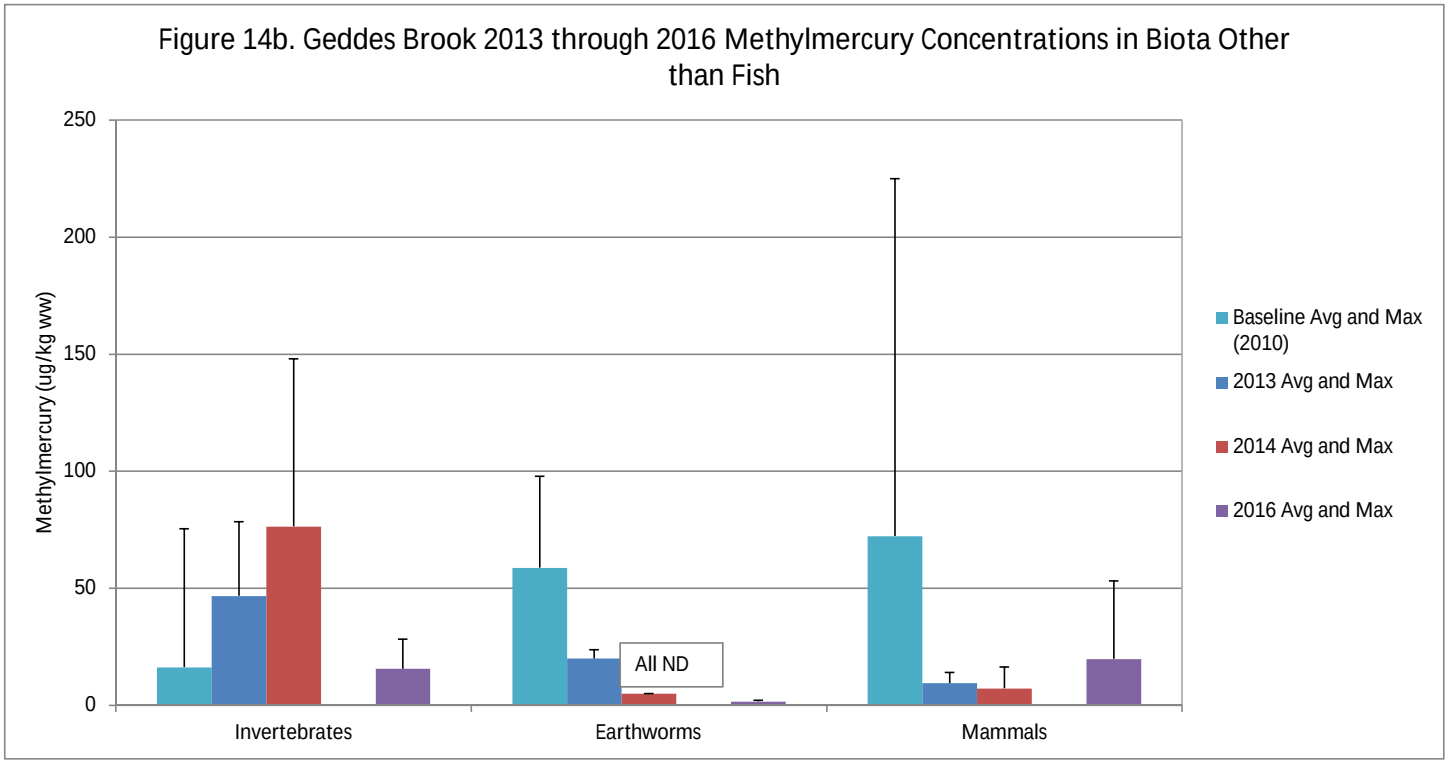
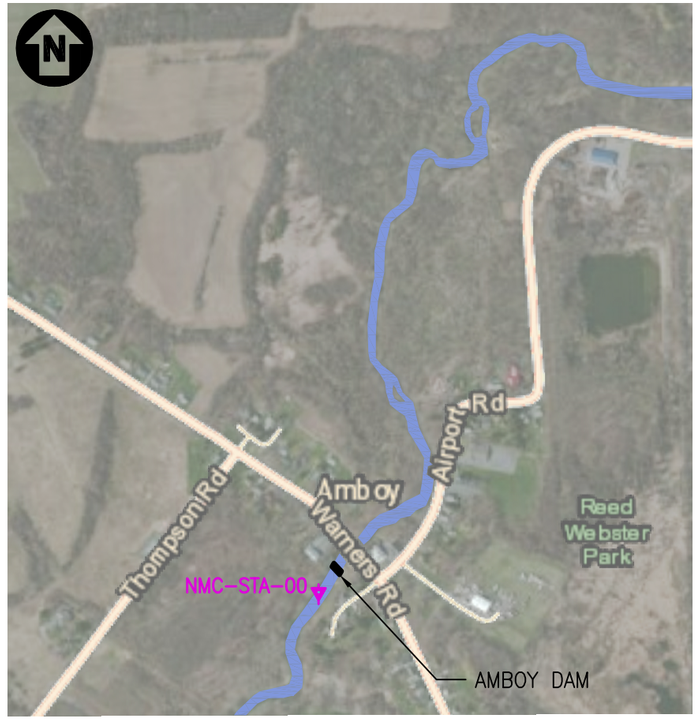


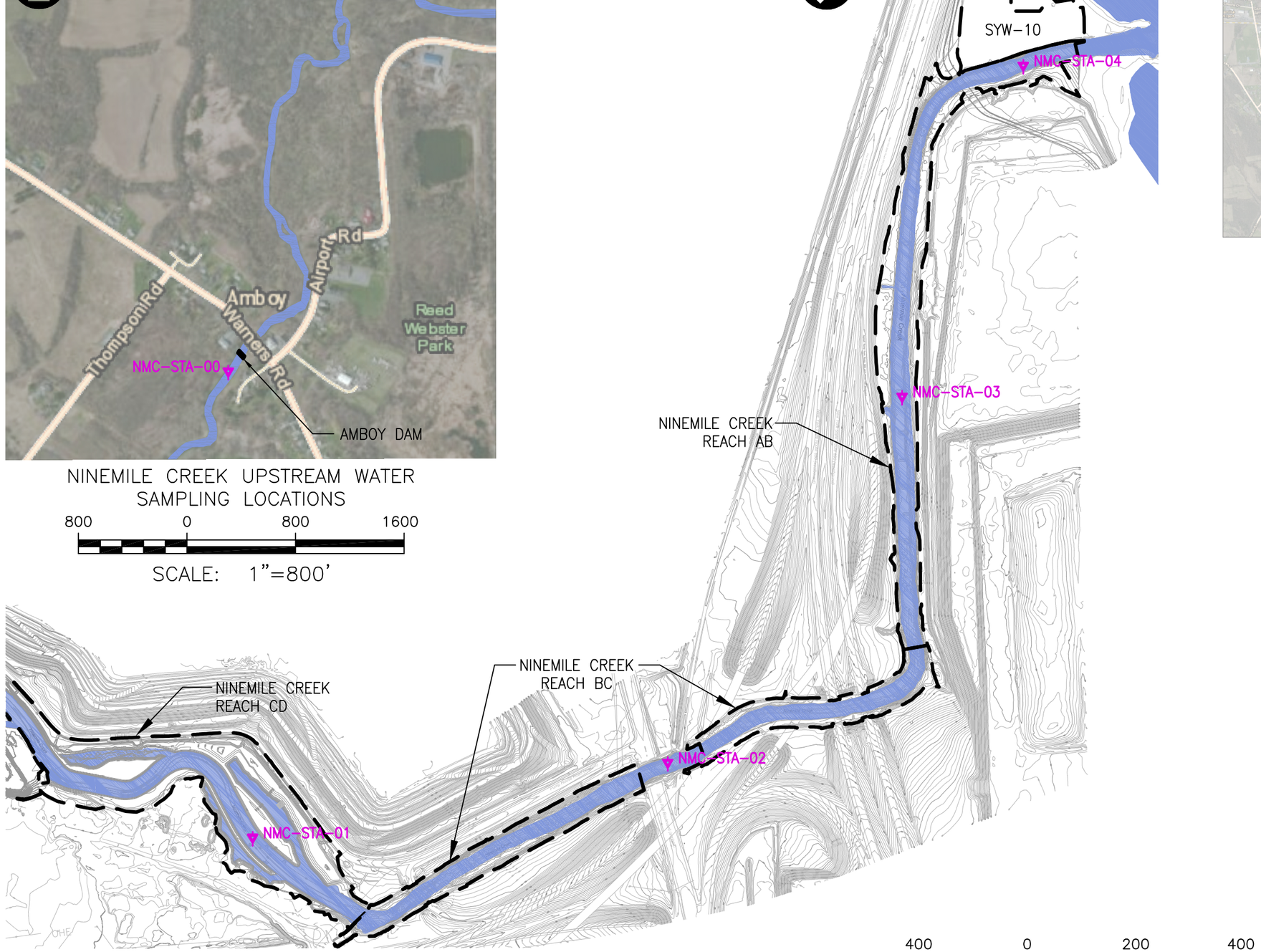
Figure 14b. Geddes Brook 2013 through 2016 Methylmercury Concentrations in Biota Other than Fish
Methylmercury (ug/kg ww)
250
200
150
100
50
0
All ND
Invertebrates
Earthworms
Mammals
Baseline Avg and Max (2010)
2013 Avg and Max
2014 Avg and Max
2016 Avg and Max



NINEMILE CREEK UPSTREAM WATER SAMPLING LOCATIONS

800 0 800 1600

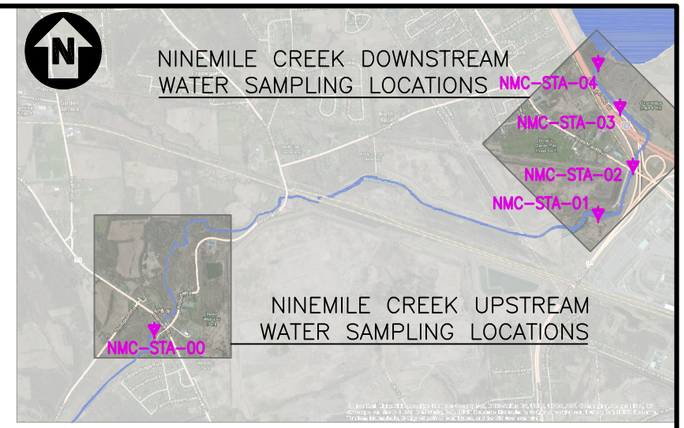
SCALE: 1"=800'



NINEMILE CREEK DOWNSTREAM WATER SAMPLING LOCATIONS

400 0 200 400

SCALE: 1"=400'



NINEMILE CREEK KEY PLAN
(NOT TO SCALE)

LEGEND:

- RESTORATION AREA
- STREAM BED
- NINEMILE CREEK SURFACE WATER SAMPLING LOCATION

NOTES:

1. SURFACE WATER SAMPLING WAS CONDUCTED AT 5 SAMPLING LOCATIONS IN 2015 AND 2016. ONE SAMPLING EVENT OCCURED DURING LOW FLOW CONDITIONS (FLOW <68cfs., USGS STATION 04240300 NINEMILE CREEK LAKELAND, 30TH PERCENTILE FLOW 2010–2014) AND ANOTHER DURING HIGH FLOW CONDITIONS (FLOW >200cfs., USGS STATION 04240300 NINEMILE CREEK LAKELAND, 70th PERCENTILE FLOW 2010–2014). A TOTAL OF 10 SAMPLES WERE COLLECTED DURING EACH YEAR.
2. DOWNSTREAM SURFACE WATER SAMPLING LOCATIONS ARE CONSISTENT WITH BASELINE SURFACE WATER SAMPLING LOCATIONS (GEDDES BROOK/NINEMILE CREEK BASELINE MONITORING DATA SUMMARY REPORT, MARCH 2013).
3. SURFACE WATER SAMPLING INCLUDED RECORDING THE FOLLOWING FIELD PARAMETERS: DO, pH, TEMPERATURE AND CONDUCTIVITY.

FIGURE 15

Honeywell

NINEMILE CREEK/GEDDES BROOK OM&M

NINEMILE CREEK SURFACE WATER SAMPLING LOCATIONS

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 • 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\449463 - GB-NMC OM&M 2015-2016\10.0 TECHNICAL CATEGORIES\10.1 CAD\DEC-5-YEAR REVIEW\449463-NMC-SW & SED SAMPLE LOC-SK-003.DWG
PLOT DATE: 5/17/2017 10:48 AM PLOTTED BY: SIVALIA, JACK

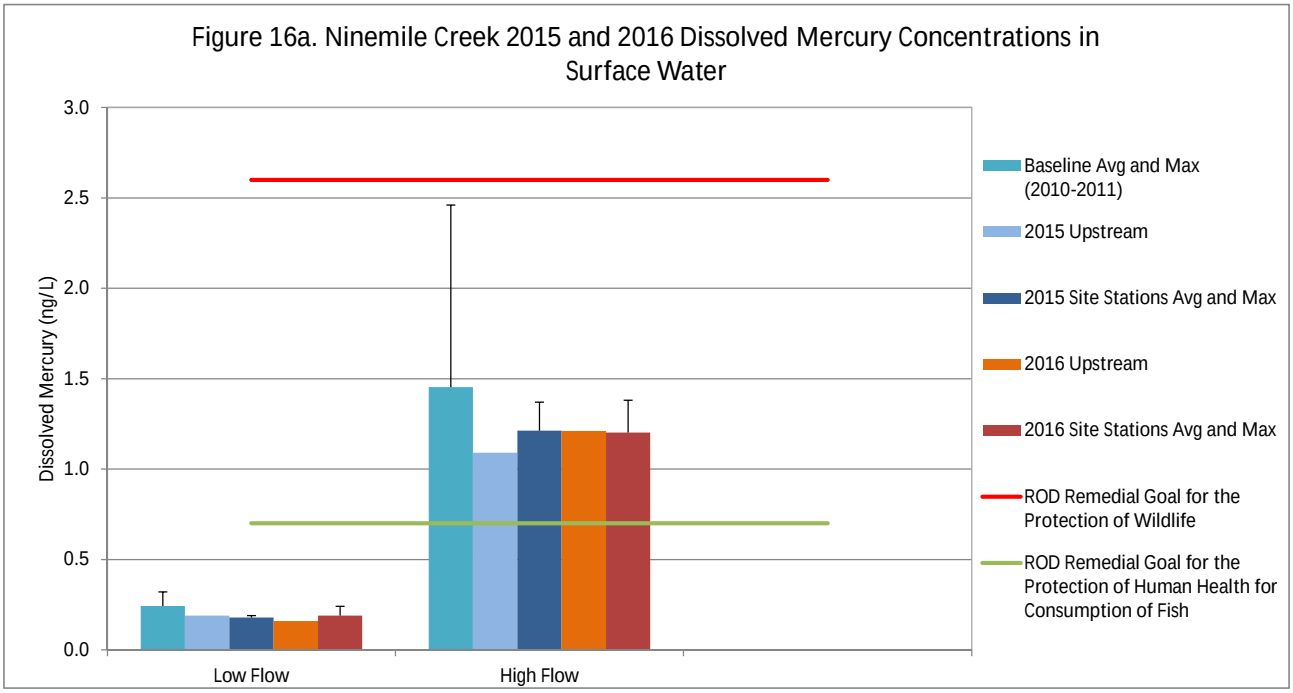


Figure 16a. Ninemile Creek 2015 and 2016 Dissolved Mercury Concentrations in Surface Water
Dissolved Mercury (ng/L)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Low Flow
High Flow
Baseline Avg and Max (2010-2011)
2015 Upstream
2015 Site Stations Avg and Max
2016 Upstream
2016 Site Stations Avg and Max
ROD Remedial Goal for the Protection of Wildlife
ROD Remedial Goal for the Protection of Human Health for Consumption of Fish

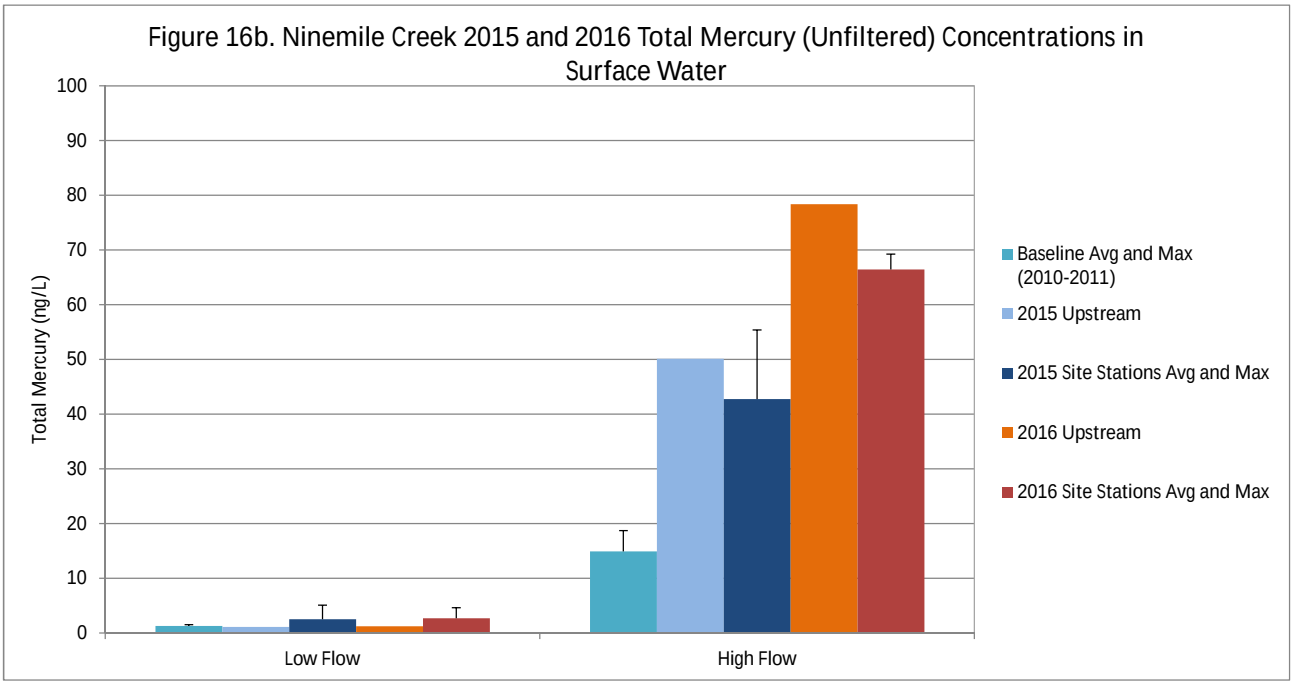


Figure 16b. Ninemile Creek 2015 and 2016 Total Mercury (Unfiltered) Concentrations in Surface Water
Total Mercury (ng/L)
100
90
80
70
60
50
40
30
20
10
0
Low Flow
High Flow
Baseline Avg and Max (2010-2011)
2015 Upstream
2015 Site Stations Avg and Max
2016 Upstream
2016 Site Stations Avg and Max

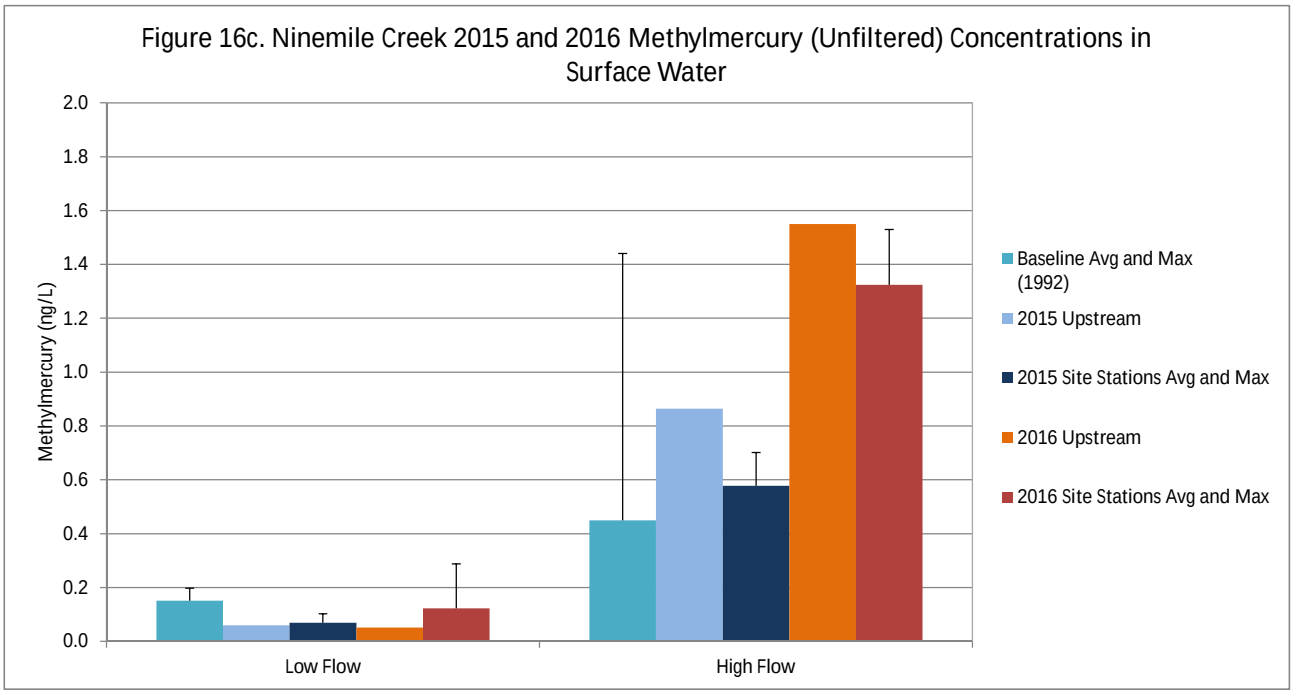
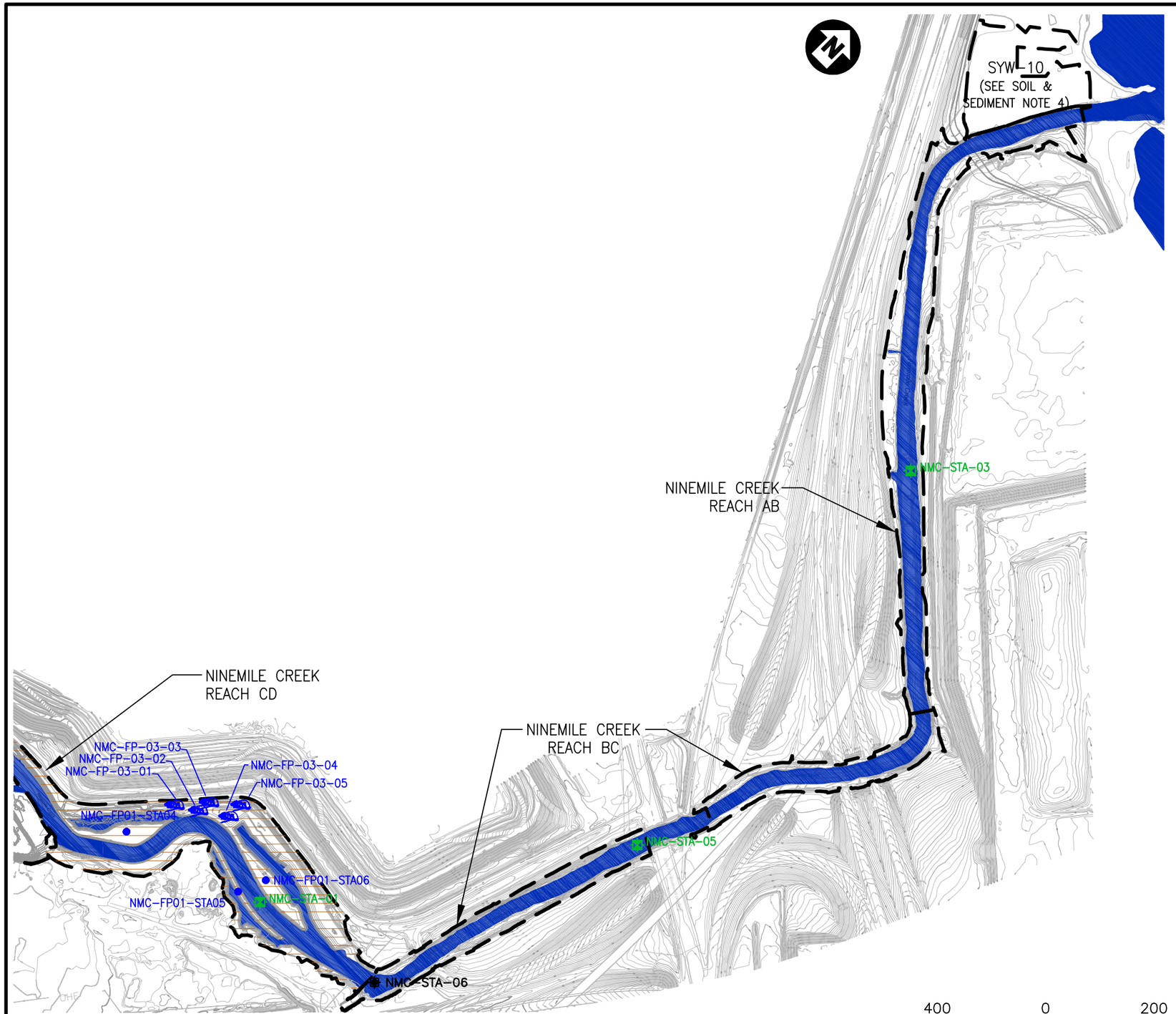
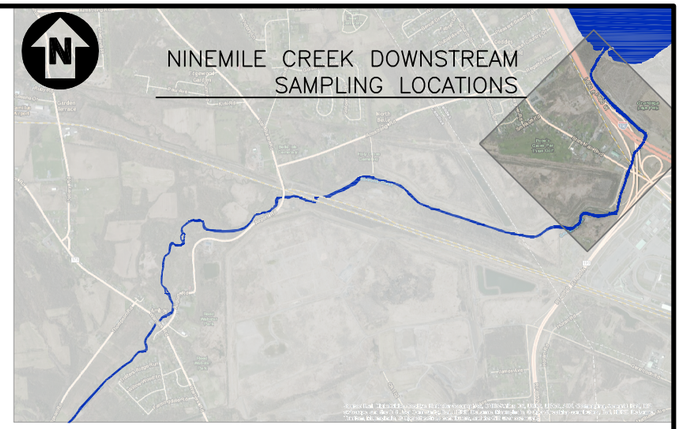


Figure 16c. Ninemile Creek 2015 and 2016 Methylmercury (Unfiltered) Concentrations in Surface Water
Methylmercury (ng/L)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Low Flow
High Flow
Baseline Avg and Max (1992)
2015 Upstream
2015 Site Stations Avg and Max
2016 Upstream
2016 Site Stations Avg and Max





NINEMILE CREEK KEY PLAN
(NOT TO SCALE)

LEGEND:

- RESTORATION AREA
- STREAM BED
- SEDIMENT SAMPLE LOCATION
- CO-LOCATED MACROINVERTEBRATE AND SEDIMENT SAMPLE LOCATION
- CO-LOCATED FLOODPLAIN SOIL/SEDIMENT AND EARTHWORM SAMPLE LOCATION
- SMALL MAMMAL SAMPLING LOCATION
- 2016 SMALL MAMMAL SAMPLES

SOIL AND SEDIMENT NOTES:

1. CHANNEL AND FLOODPLAIN SOIL/SEDIMENT SAMPLING CONDUCTED IN 2016 AS PART OF A POST-REMEDIATION BASELINE EVALUATION.
2. EACH FLOODPLAIN SOIL/SEDIMENT SAMPLE IS A COMPOSITE CONSISTING OF FIVE GRAB SAMPLES FROM THE TOP SIX INCHES OF SOIL/SEDIMENT. GRAB SAMPLES WERE COLLECTED WITHIN A TEN FOOT RADIUS OF THE DESIGNATED SAMPLE LOCATION.
3. CHANNEL SEDIMENT SAMPLES CONSIST OF ONE HOMOGENIZED SAMPLE PER LOCATION.
4. SYW-10 SOIL SAMPLE LOCATIONS ARE SHOWN ON FIGURE 6.

BIOTA NOTES:

1. FIVE SMALL MAMMAL SAMPLES COLLECTED IN 2016 WITHIN THE HIGHLIGHTED STATION.
2. EARTHWORM SAMPLING CARRIED OUT AT 3 STATIONS (SHOWN) IN 2016 WHERE ONE COMPOSITE SAMPLE PER STATION WAS COLLECTED RESULTING IN 3 SAMPLES.
3. MACROINVERTEBRATE SAMPLING CARRIED OUT AT 3 STATIONS (SHOWN) IN 2016 WHERE ONE COMPOSITE SAMPLE PER STATION WAS COLLECTED RESULTING IN 3 SAMPLES.

400 0 200 400

SCALE: 1"=400'

FIGURE 17

Honeywell

NINEMILE CREEK/GEDDES BROOK OM&M

NINEMILE CREEK SOIL/SEDIMENT AND BIOTA (OTHER THAN FISH) SAMPLING LOCATIONS

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 * 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\449463 - GB-NMC OM&M 2015-2016\10.0 TECHNICAL CATEGORIES\10.1 CAD\DEC-5-YEAR REVIEW\449463-NMC-SW & SED SAMPLOCS-SK-005.DWG
PLOT DATE: 5/18/2017 7:59 AM PLOTTED BY: SIVALIA, JACK

Figure 18a. Ninemile Creek 2016 Mercury Concentrations in Surface Sediment
(Reaches AB, BC, and CD)

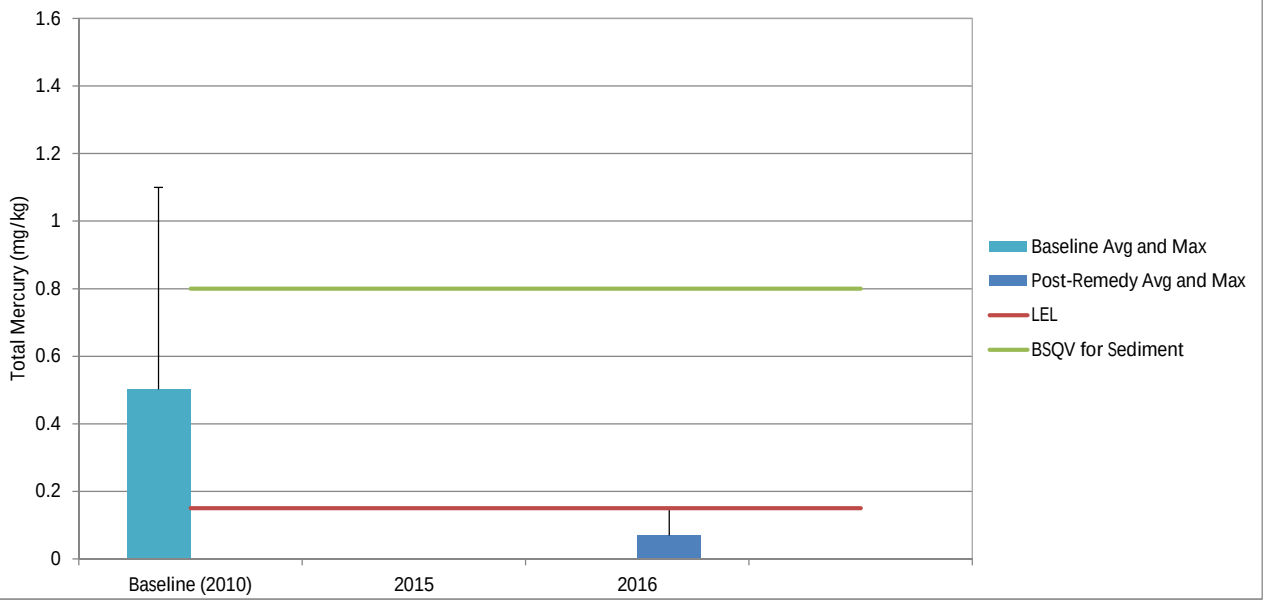
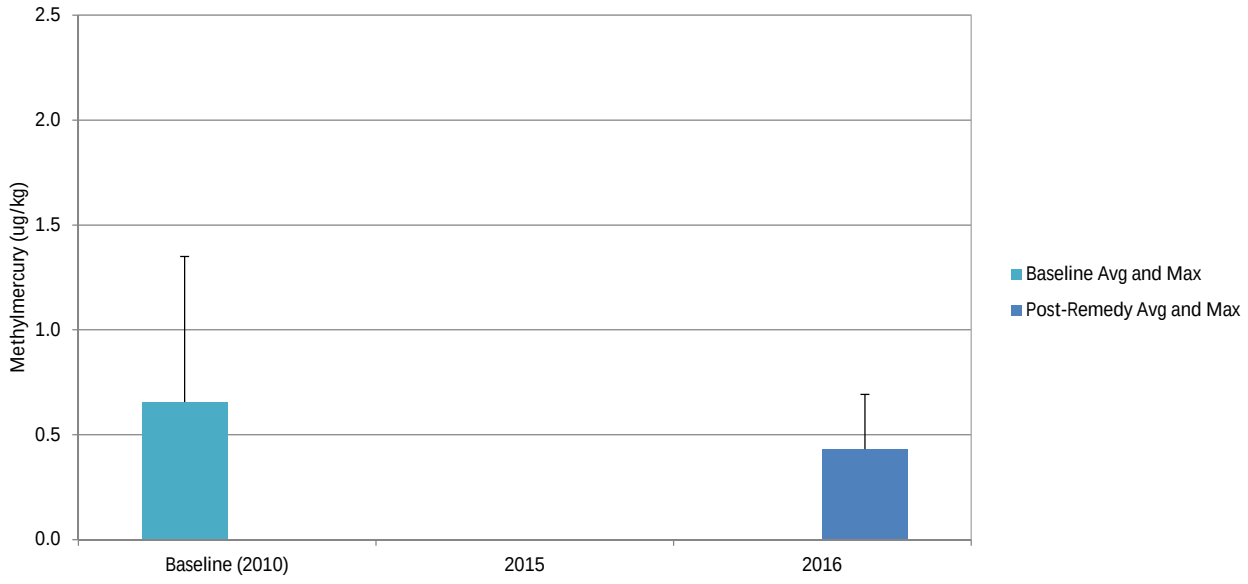


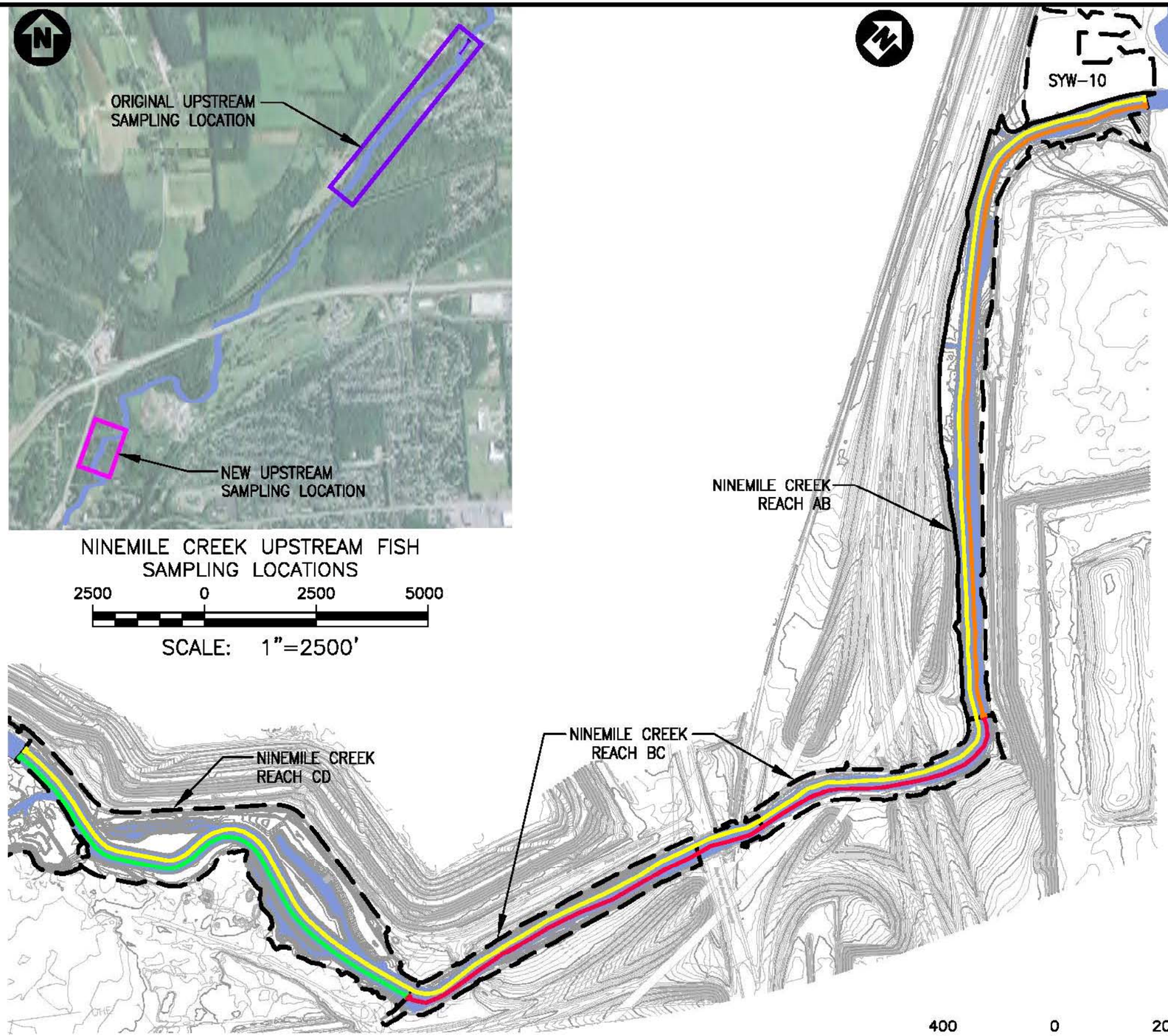
Figure 18b. Ninemile Creek 2016 Methylmercury Concentrations in Surface Sediment
(Reaches AB, BC, and CD)



NINEMILE CREEK UPSTREAM FISH SAMPLING LOCATIONS

2500 0 2500 5000

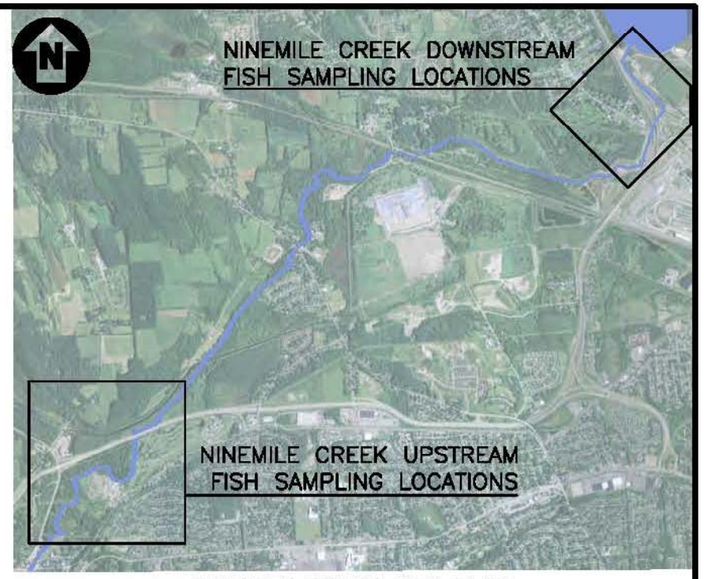
SCALE: 1"=2500'



NINEMILE CREEK DOWNSTREAM FISH SAMPLING LOCATIONS

400 0 200 400

SCALE: 1"=400'



NINEMILE CREEK KEY PLAN
(NOT TO SCALE)

LEGEND:

- RESTORATION AREA
- STREAM BED
- SPORTFISH/PREYFISH STATION 1 – ORIGINAL (UPSTREAM)
- SPORTFISH/PREYFISH STATION 1 – NEW (UPSTREAM)
- SPORTFISH STATION 2 (DOWNSTREAM)
- PREYFISH STATION 2 (REACH CD)
- PREYFISH STATION 3 (REACH BC)
- PREYFISH STATION 4 (REACH AB)

NOTES:

1. SAMPLES COLLECTED WITHIN THESE AREAS IN 2015 AND 2016.
2. DOWNSTREAM SAMPLING STATION LOCATIONS ARE CONSISTENT WITH BASELINE SAMPLING STATION LOCATIONS (GEDDES BROOK/NINEMILE CREEK BASELINE MONITORING DATA SUMMARY REPORT, MARCH 2013).
3. DURING THE 2015 SAMPLING EVENT, FISH WERE NOT ABLE TO BE CAPTURED AT THE UPSTREAM LOCATION SAMPLED DURING BASELINE. AFTER CONSULTING WITH NYSDEC, THE SAMPLED LOCATION WAS MOVED UPSTREAM TO THE TOWN OF CAMILLUS TO COLLECT ADEQUATE SAMPLES. THIS NEW UPSTREAM LOCATION WAS ALSO SAMPLED IN 2016 AND WILL BE SAMPLED DURING ALL FUTURE MONITORING EVENTS.
4. PREYFISH AND SPORTFISH WERE SAMPLED FROM ACCESSIBLE AREAS IN THE DESIGNATED STATIONS WHERE ACCESS AND FLOW CONDITIONS ALLOWED.

FIGURE 19

Honeywell

NINEMILE CREEK/GEDDES BROOK OM&M

NINEMILE CREEK PREY FISH AND SPORT FISH SAMPLING LOCATIONS

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 * 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\449463 - GB-NMC OM&M 2015-2016\10.0 TECHNICAL CATEGORIES\10.1 CAD\DEC-5-YEAR REVIEW\449463-NMC-PREYFISH SAMPLE LOC-SK-004.DWG
PLOT DATE: 5/15/2017 1:41 PM PLOTTED BY: RUSSO, JILL

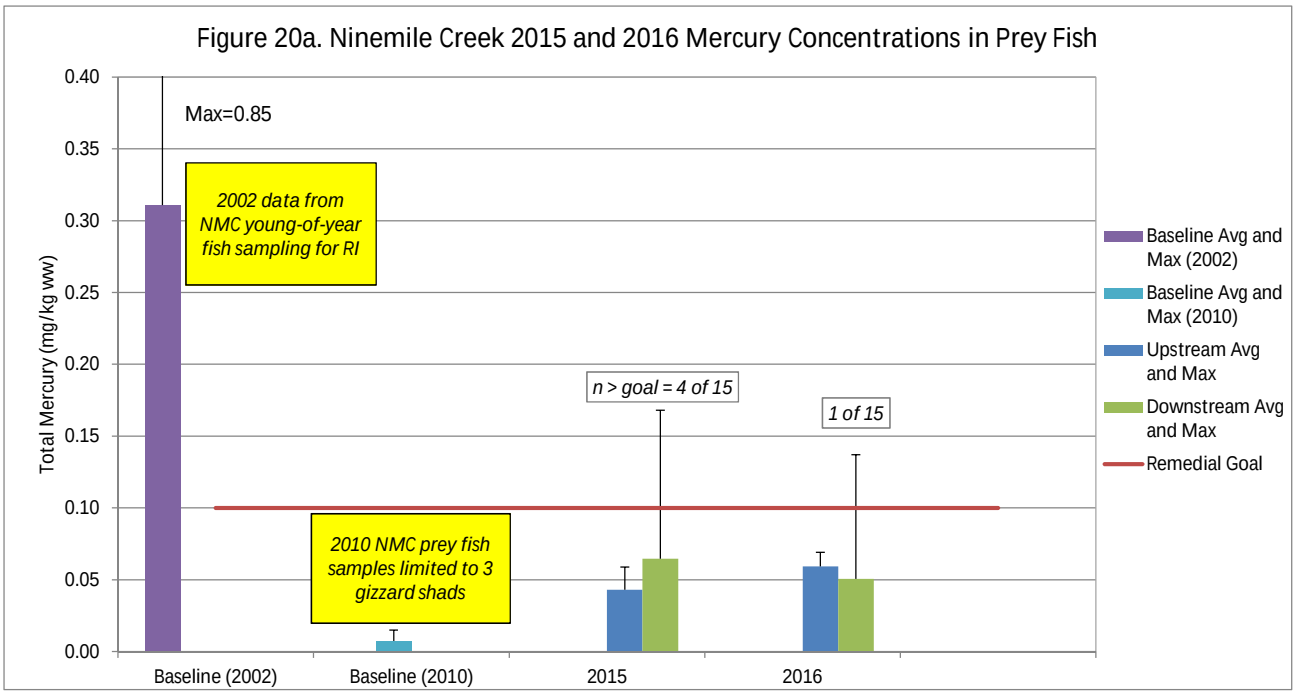


Figure 20a. Ninemile Creek 2015 and 2016 Mercury Concentrations in Prey Fish
Total Mercury (mg/kg ww)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Max=0.85
2002 data from NMC young-of-year fish sampling for RI
2010 NMC prey fish samples limited to 3 gizzard shads
n > goal = 4 of 15
1 of 15
Baseline (2002)
Baseline (2010)
2015
2016
Baseline Avg and Max (2002)
Baseline Avg and Max (2010)
Upstream Avg and Max
Downstream Avg and Max
Remedial Goal

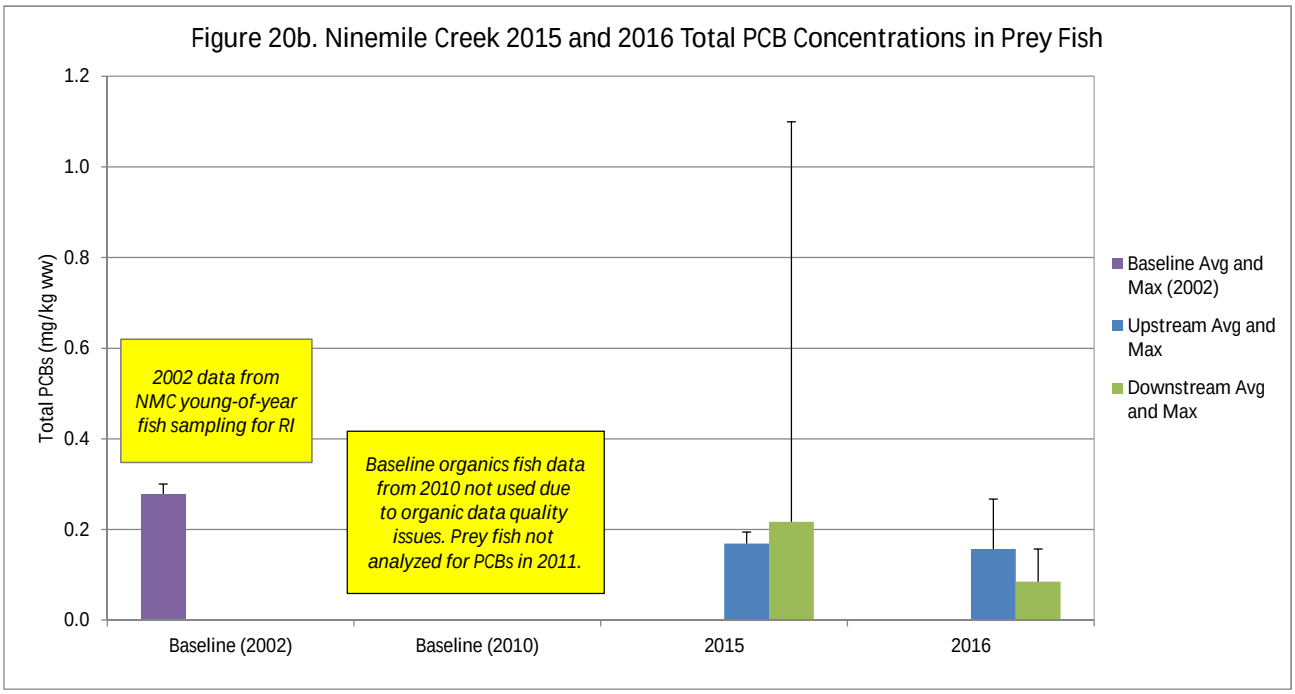


Figure 20b. Ninemile Creek 2015 and 2016 Total PCB Concentrations in Prey Fish
Total PCBs (mg/kg ww)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2002 data from NMC young-of-year fish sampling for RI
Baseline organics fish data from 2010 not used due to organic data quality issues. Prey fish not analyzed for PCBs in 2011.
Baseline (2002)
Baseline (2010)
2015
2016
Baseline Avg and Max (2002)
Upstream Avg and Max
Downstream Avg and Max

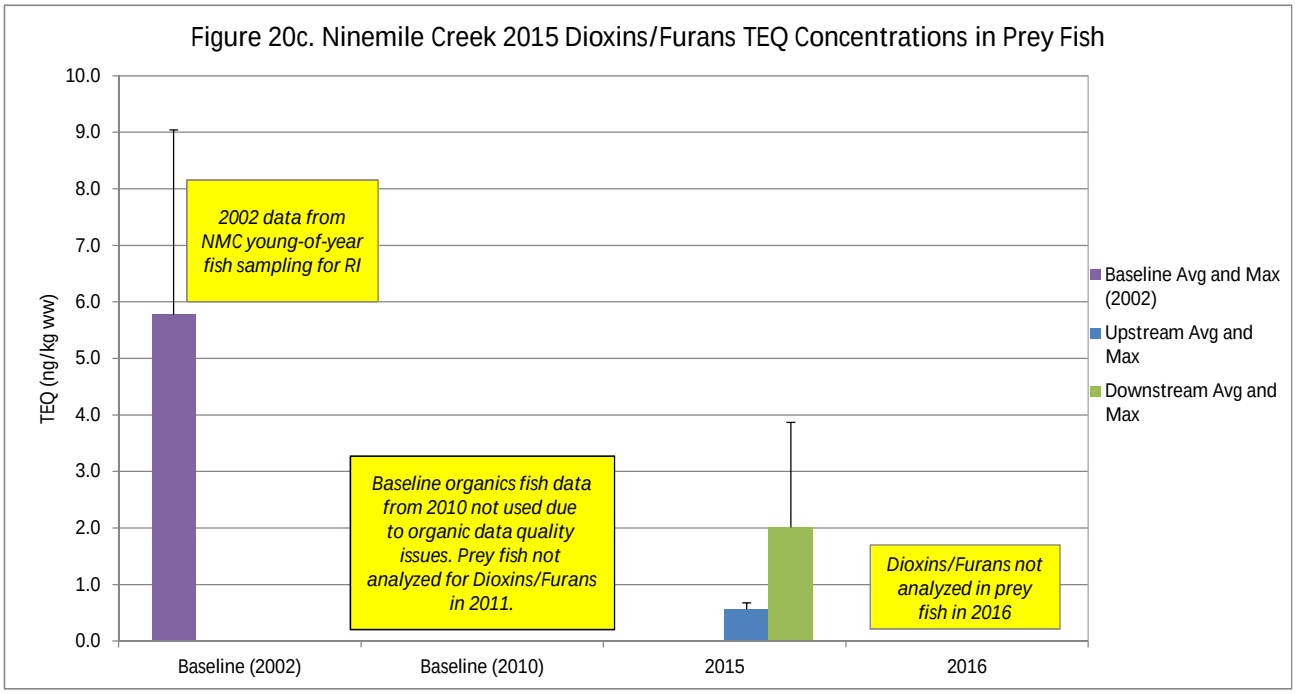


Figure 20c. Ninemile Creek 2015 Dioxins/Furans TEQ Concentrations in Prey Fish
TEQ (ng/kg ww)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2002 data from NMC young-of-year fish sampling for RI
Baseline organics fish data from 2010 not used due to organic data quality issues. Prey fish not analyzed for Dioxins/Furans in 2011.
Dioxins/Furans not analyzed in prey fish in 2016
Baseline (2002)
Baseline (2010)
2015
2016
Baseline Avg and Max (2002)
Upstream Avg and Max
Downstream Avg and Max

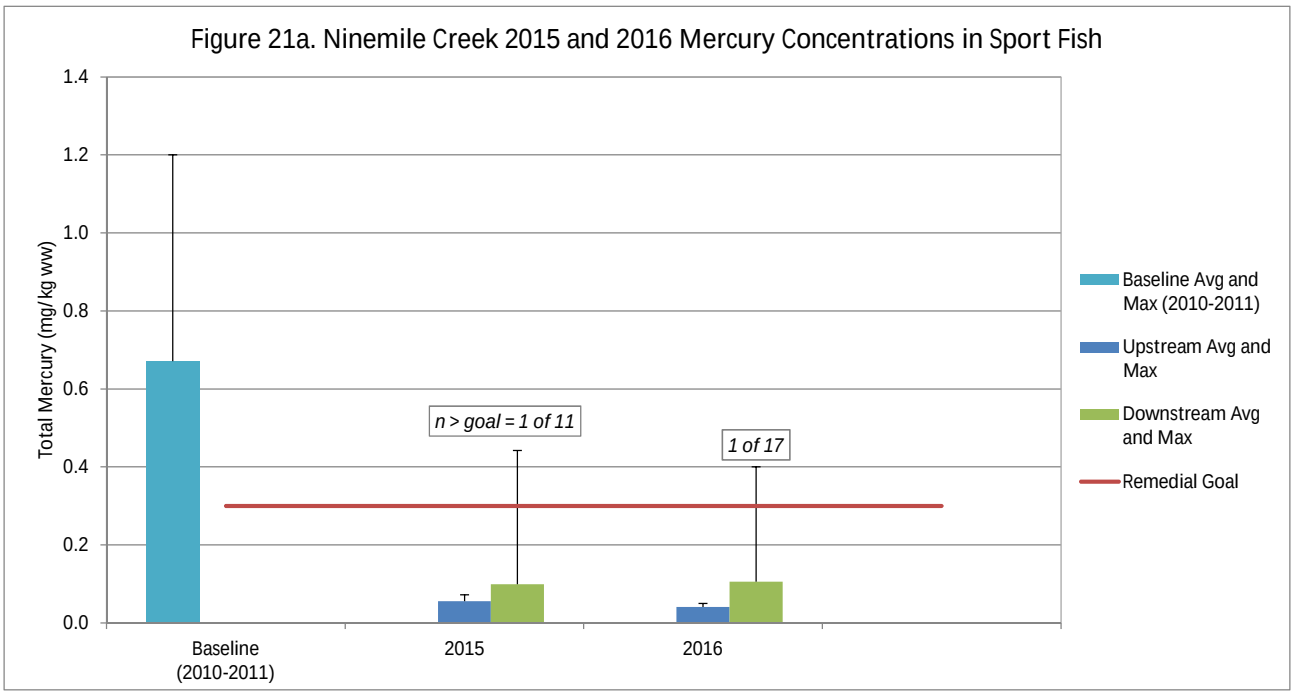


Figure 21a. Ninemile Creek 2015 and 2016 Mercury Concentrations in Sport Fish
Total Mercury (mg/kg ww)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
n > goal = 1 of 11
1 of 17
Baseline (2010-2011)
2015
2016
Baseline Avg and Max (2010-2011)
Upstream Avg and Max
Downstream Avg and Max
Remedial Goal

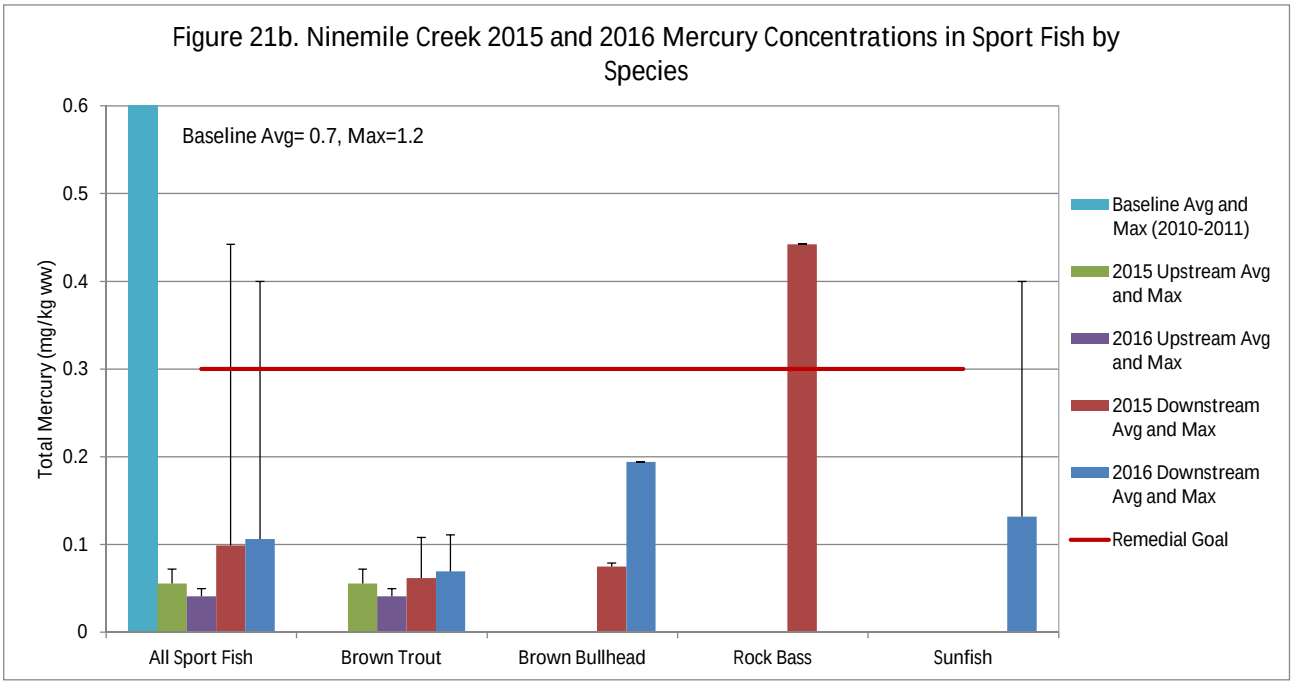


Figure 21b. Ninemile Creek 2015 and 2016 Mercury Concentrations in Sport Fish by Species
Total Mercury (mg/kg ww)
0.6
0.5
0.4
0.3
0.2
0.1
0
Baseline Avg= 0.7, Max=1.2
All Sport Fish
Brown Trout
Brown Bullhead
Rock Bass
Sunfish
Baseline Avg and Max (2010-2011)
2015 Upstream Avg and Max
2016 Upstream Avg and Max
2015 Downstream Avg and Max
2016 Downstream Avg and Max
Remedial Goal

Figure 21c. Ninemile Creek 2015 and 2016 Total PCB Concentrations in Sport Fish

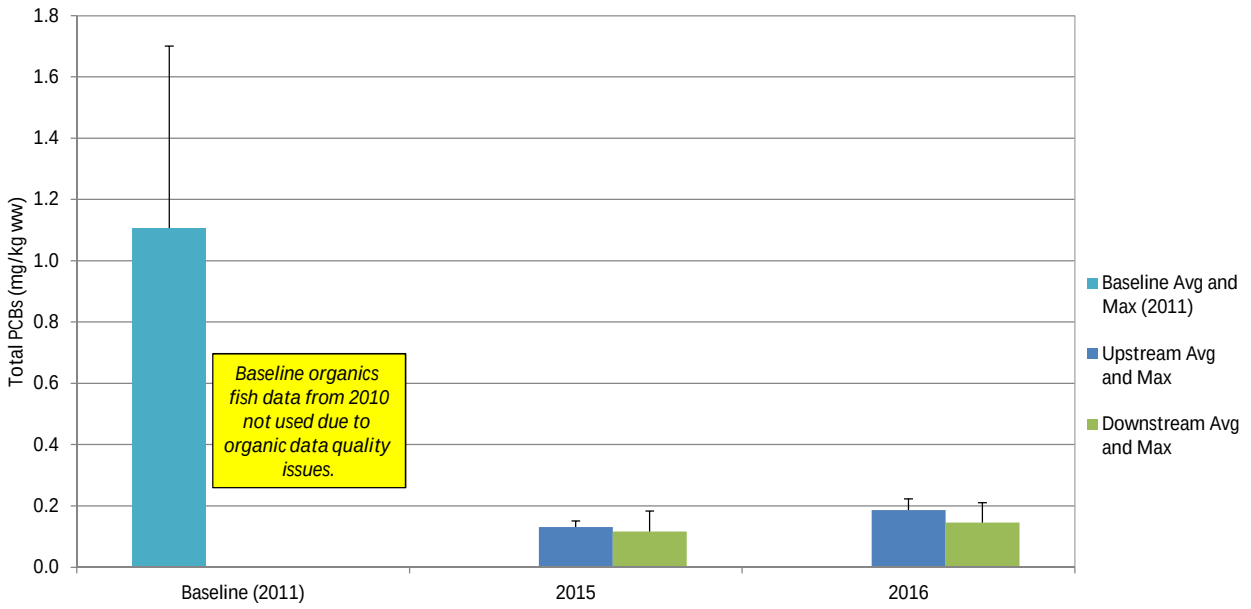


Figure 21d. Ninemile Creek 2015 Dioxins/Furans TEQ Concentrations in Sport Fish

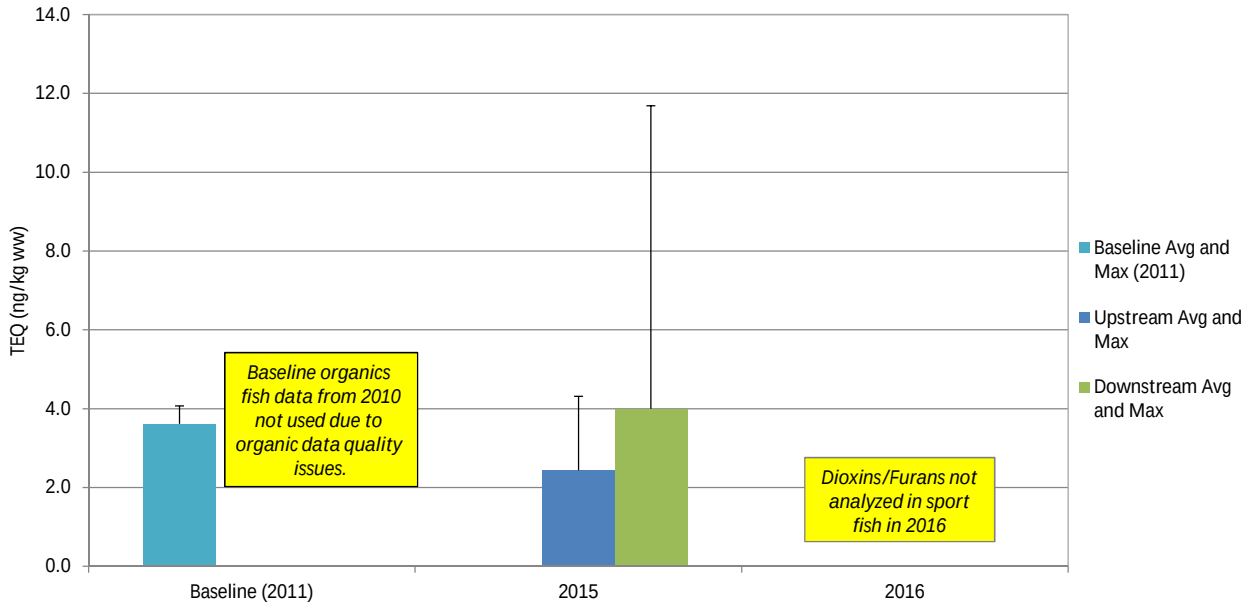


Figure 22a. Ninemile Creek 2016 Mercury Concentrations in Floodplain Soil (Reach CD)

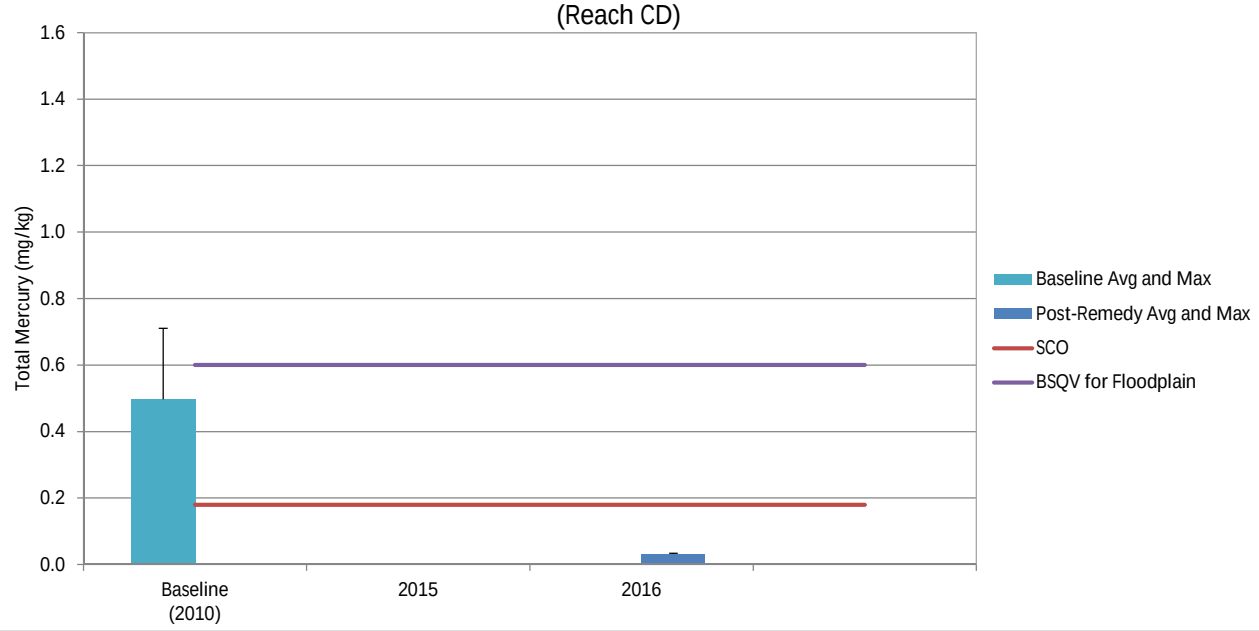


Figure 22b. Ninemile Creek 2016 Methylmercury Concentrations in Floodplain Soil (Reach CD)

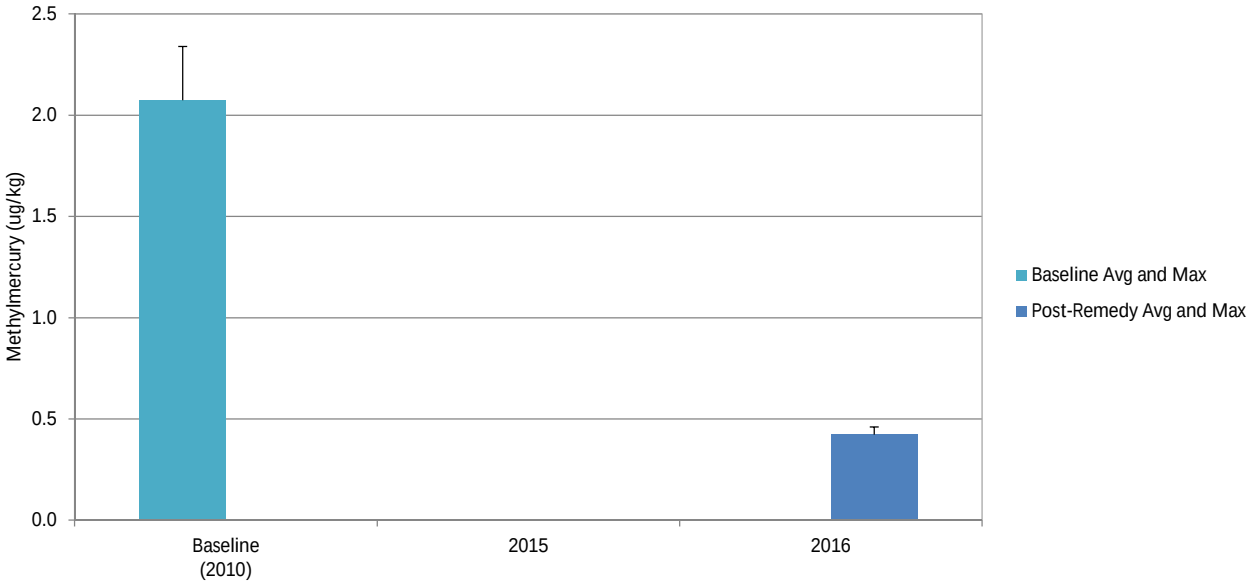


Figure 23a. Ninemile Creek 2016 Mercury Concentrations in Biota Other than Fish

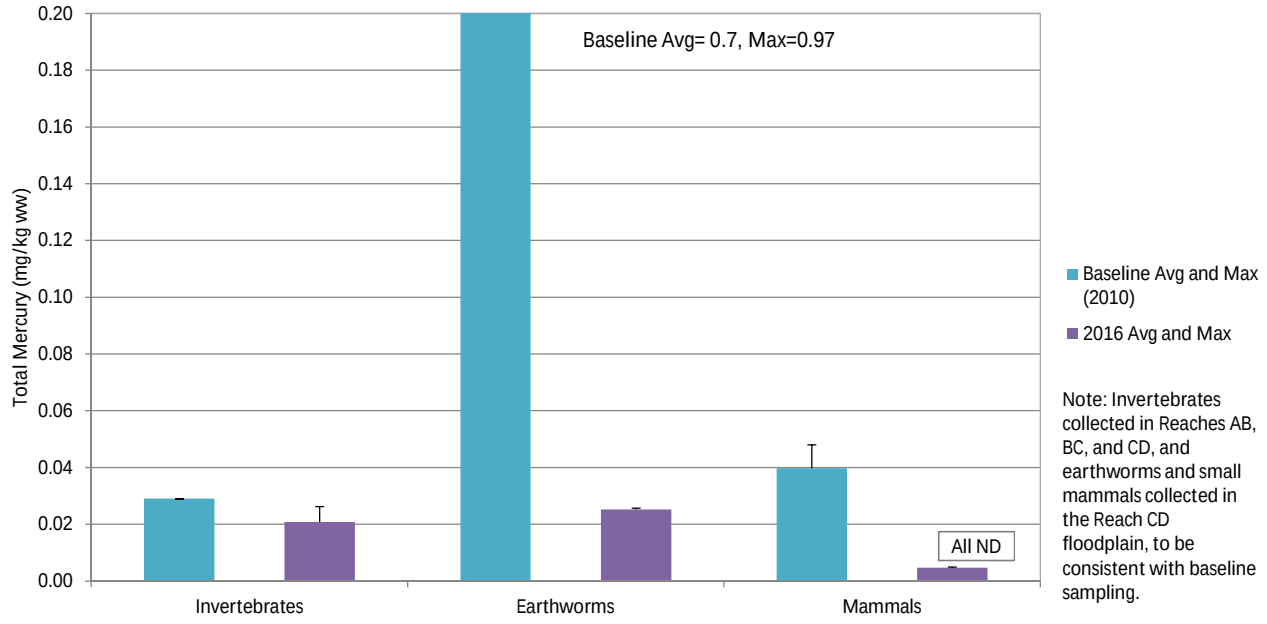
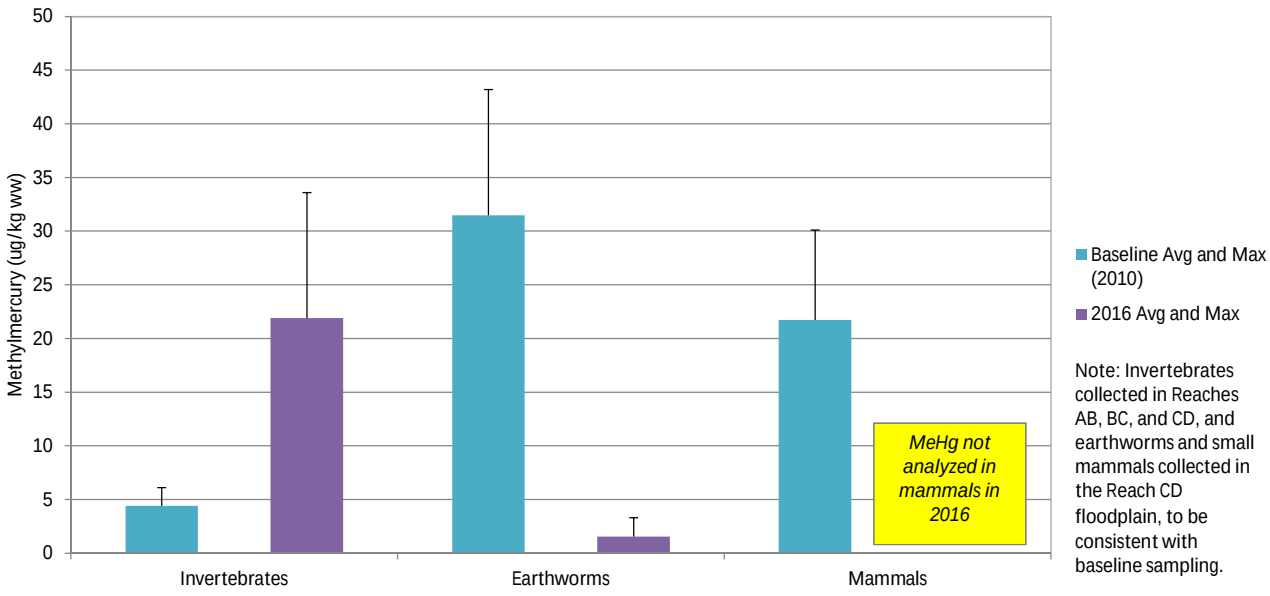


Figure 23b. Ninemile Creek 2016 Methylmercury Concentrations in Biota Other than Fish



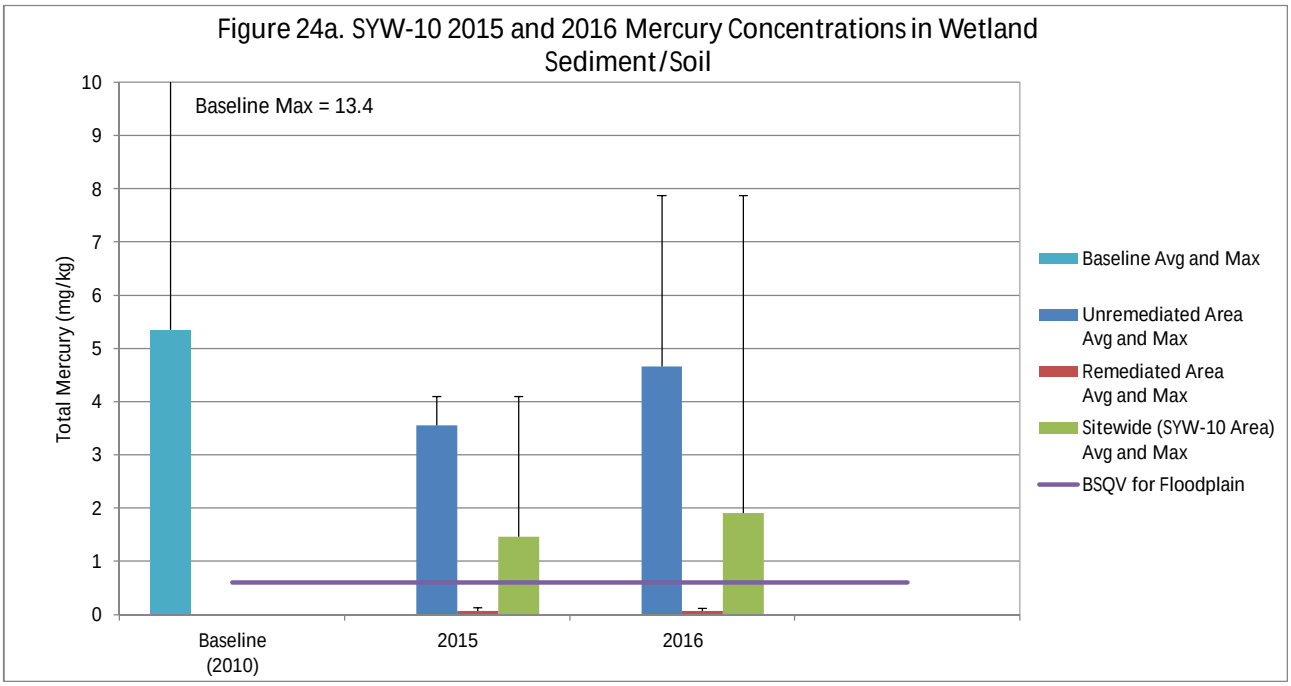


Figure 24a. SYW-10 2015 and 2016 Mercury Concentrations in Wetland Sediment/Soil
Baseline Max = 13.4
Total Mercury (mg/kg)
10
9
8
7
6
5
4
3
2
1
0
Baseline (2010)
2015
2016
Baseline Avg and Max
Unremediated Area Avg and Max
Remediated Area Avg and Max
Sitewide (SYW-10 Area) Avg and Max
BSQV for Floodplain

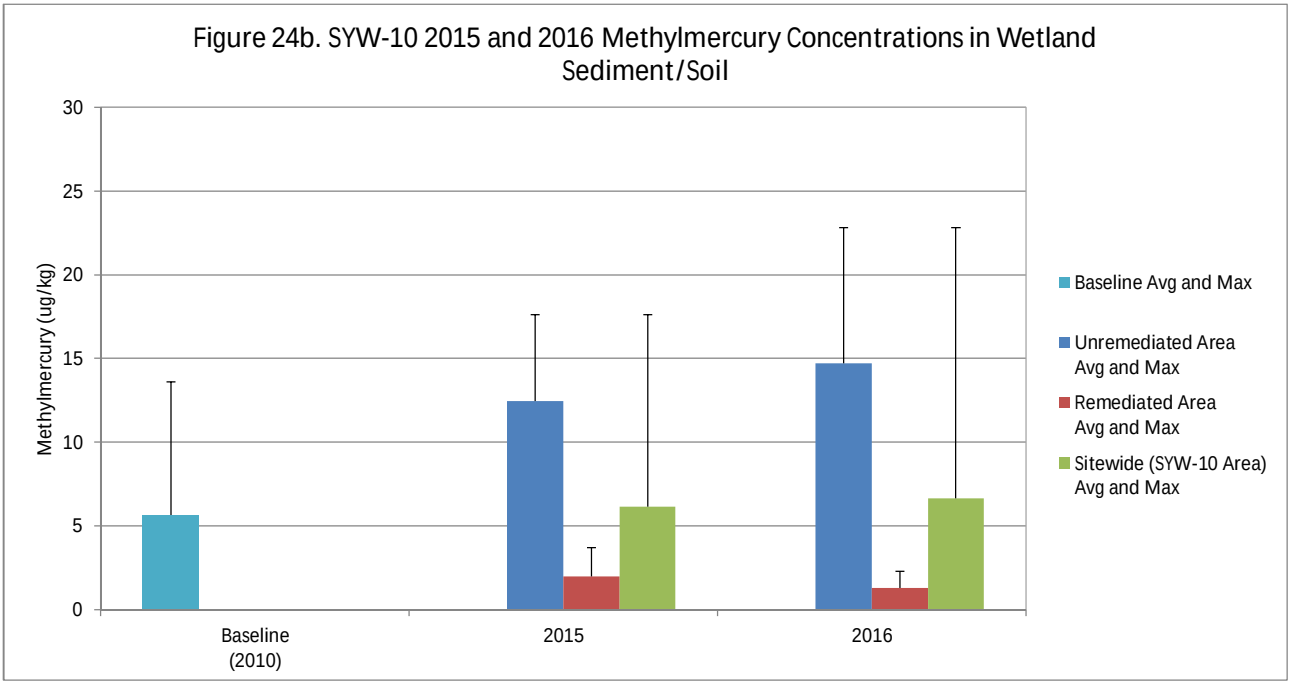


Figure 24b. SYW-10 2015 and 2016 Methylmercury Concentrations in Wetland Sediment/Soil
Methylmercury (ug/kg)
30
25
20
15
10
5
0
Baseline (2010)
2015
2016
Baseline Avg and Max
Unremediated Area Avg and Max
Remediated Area Avg and Max
Sitewide (SYW-10 Area) Avg and Max

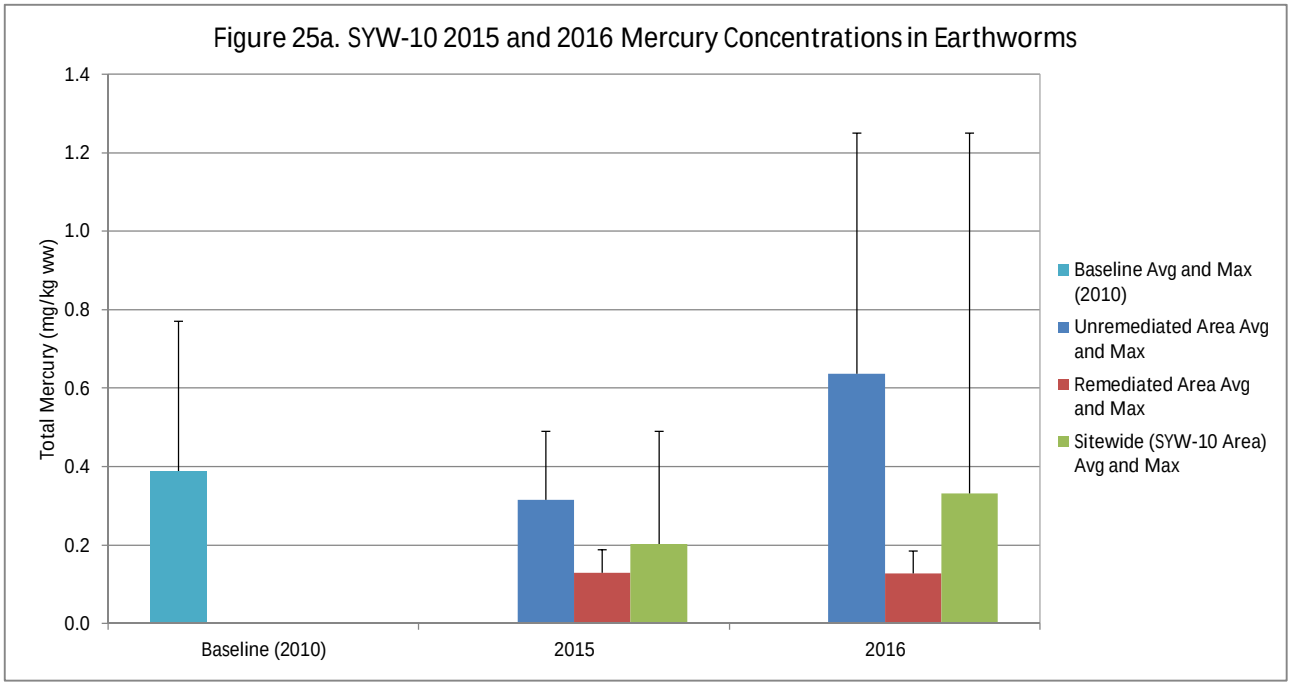


Figure 25a. SYW-10 2015 and 2016 Mercury Concentrations in Earthworms
Total Mercury (mg/kg ww)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Baseline (2010)
2015
2016
Baseline Avg and Max (2010)
Unremediated Area Avg and Max
Remediated Area Avg and Max
Sitewide (SYW-10 Area) Avg and Max

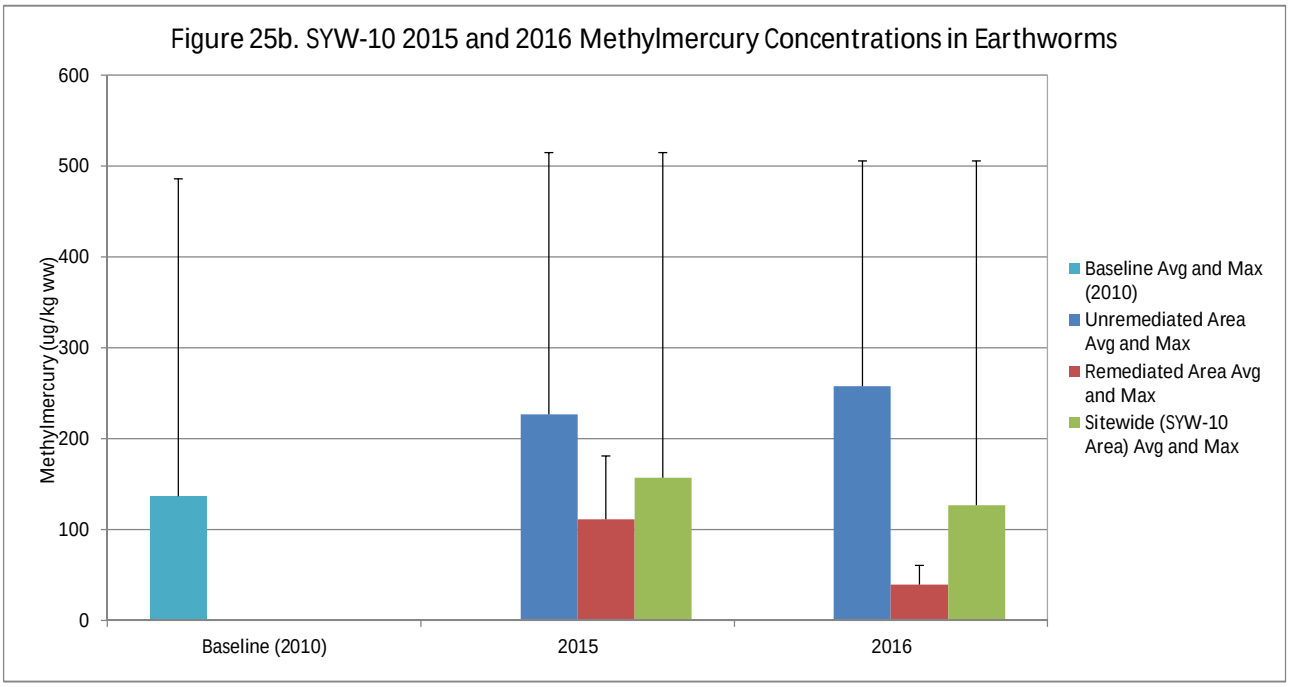


Figure 25b. SYW-10 2015 and 2016 Methylmercury Concentrations in Earthworms
Methylmercury (ug/kg ww)
600
500
400
300
200
100
0
Baseline (2010)
2015
2016
Baseline Avg and Max (2010)
Unremediated Area Avg and Max
Remediated Area Avg and Max
Sitewide (SYW-10 Area) Avg and Max

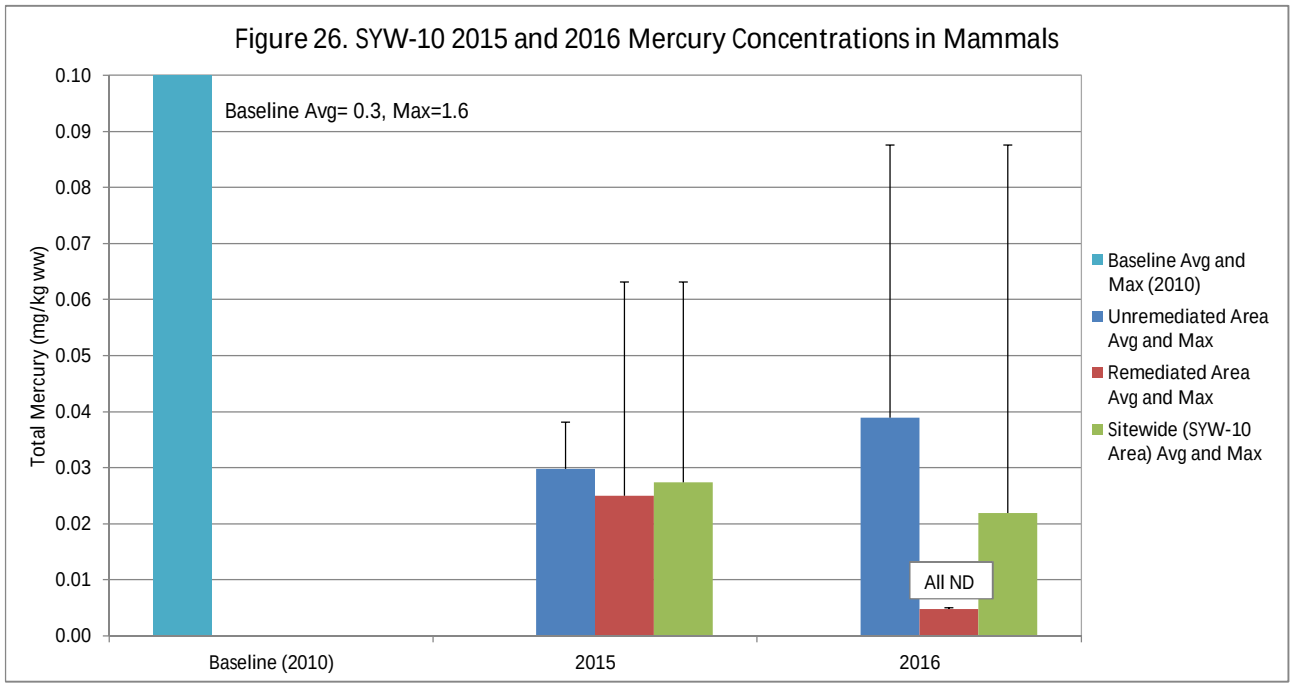


Figure 26. SYW-10 2015 and 2016 Mercury Concentrations in Mammals
Total Mercury (mg/kg ww)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Baseline Avg= 0.3, Max=1.6
All ND
Baseline (2010)
2015
2016
Baseline Avg and Max (2010)
Unremediated Area Avg and Max
Remediated Area Avg and Max
Sitewide (SYW-10 Area) Avg and Max