BUFFALO RIVER AREA OF CONCERN

Degradation of Benthos

Beneficial Use Impairment Removal Report

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Buffalo River Area Of Concern

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Beneficial Use Impairment (BUI) Removal Report

Prepared by:

New York State Department of Environmental Conservation

This Beneficial Use Impairment (BUI) Removal Report was prepared by the New York State Department of Environmental Conservation (NYSDEC) in cooperation with Buffalo Niagara Waterkeeper (BNW) and Erie County and was substantially funded by the United States Environmental Protection Agency (USEPA) through the Great Lakes Restoration Initiative (GLRI). The NYSDEC and BNW acknowledge the significant efforts of the Remedial Advisory Committee (RAC) in engaging stakeholders and the public throughout the BUI removal process. Additionally, the NYSDEC and BNW acknowledge the pivotal role of U.S. Geological Survey New York Water Science Center in reviewing and improving this document. For more information, please contact either the Remedial Action Plan (RAP) Coordinator at BNW or the AOC Coordinator at NYSDEC.

Contents

List of Abbreviations

AOC	Area of Concern
BAP	Biological Assessment Profile
BNW	Buffalo Niagara Waterkeeper
BUD	Beneficial Use Determination
BUI	Beneficial Use Impairment
BSA	Buffalo Sewer Authority
DO	Dissolved Oxygen
GI	Green Infrastructure
GLLA	Great Lakes Legacy Act
GLNPO	Great Lakes National Program Office
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Agreement
IJC	International Joint Commission
KM	Kilometers
NYSDEC	New York State Department of Environmental Conservation
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCT	Buffalo River Restoration Partnership Coordination Team
Ramboll	Ramboll US Corporation

RAP	Remedial Action Plan
RAC	Remedial Advisory Committee
RG	Remedial Goals
RIBS	Rotating Integrated Basin Studies
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USPC	United States Policy Committee

1. Introduction

This Beneficial Use Impairment (BUI) removal report identifies the background, criteria, supporting data, and rationale to remove the *Degradation of Benthos* BUI from the Buffalo River Area of Concern (AOC). Benthos are organisms that live in the sediment or near the bottom of aquatic ecosystems. Benthos, or benthic macroinvertebrates, are commonly used as indicators of the biological health in a given waterbody due to their sensitivity to pollution and human disturbance (i.e., dredging). Generally, waterbodies in healthy biological condition support a wide variety and high number of macroinvertebrate organisms. Conversely, macroinvertebrate communities composed of pollution-tolerant species, or with low diversity or abundance, can indicate a less healthy waterbody.

The 2011 Stage II Remedial Action Plan (RAP) addendum states this BUI is currently designated as "Impaired" due to contaminated sediments in the river, continued navigational dredging, and low dissolved oxygen. In recent years, significant remedial efforts have been completed to address contamination, including contaminated sediment removal and capping, and upland source control and cleanup at former hazardous waste sites and current industrial facilities along the river. There have also been studies and projects implemented to determine the extent of dissolved oxygen and mitigate causes of low dissolved oxygen to the extent possible.

The New York State Department of Environmental Conservation (NYSDEC) recommends the removal of the *Degradation of Benthos* BUI from the Buffalo River AOC, based on an evaluation of applicable data sets and evidence gathered to address this impairment. This recommendation is made with the full support of the Buffalo River Remedial Advisory Committee (RAC).

2. Background

Under Annex One of the Great Lakes Water Quality Agreement (GLWQA), the International Joint Commission (IJC) identified 43 AOCs in the Great Lakes Basin where pollution from past industrial production and waste disposal practices caused significant ecological degradation. Up to fourteen BUIs, or indicators of environmental degradation, are used to evaluate the condition of an AOC.

The Buffalo River AOC is located in the City of Buffalo, Erie County, in western New York State. The Buffalo River flows from east to west and discharges into Lake Erie near the head of the Niagara River. The AOC extends along the historically industrialized portion of the river, beginning at the mouth of the river and continuing approximately 6 miles upstream to the Bailey Avenue Bridge. The extent of the Buffalo River AOC is depicted in Figure 1. The impact area is 6.2 miles (10 kilometers [km]) in length, and the AOC also includes the entire 1.4 mile (2.3 km) stretch of the City Ship Canal, located adjacent to the river. The drainage area of the Buffalo River is approximately 446 mi^2 (1155 km^2). The primary tributaries which feed the Buffalo River are Buffalo Creek, Cazenovia Creek, and Cayuga Creek. A large extent of the Buffalo River and City Ship Canal within the AOC boundary is designated as a federal navigation channel, which is maintained by the United States Army Corps of Engineers (USACE) to a depth of 22 feet below low water datum.

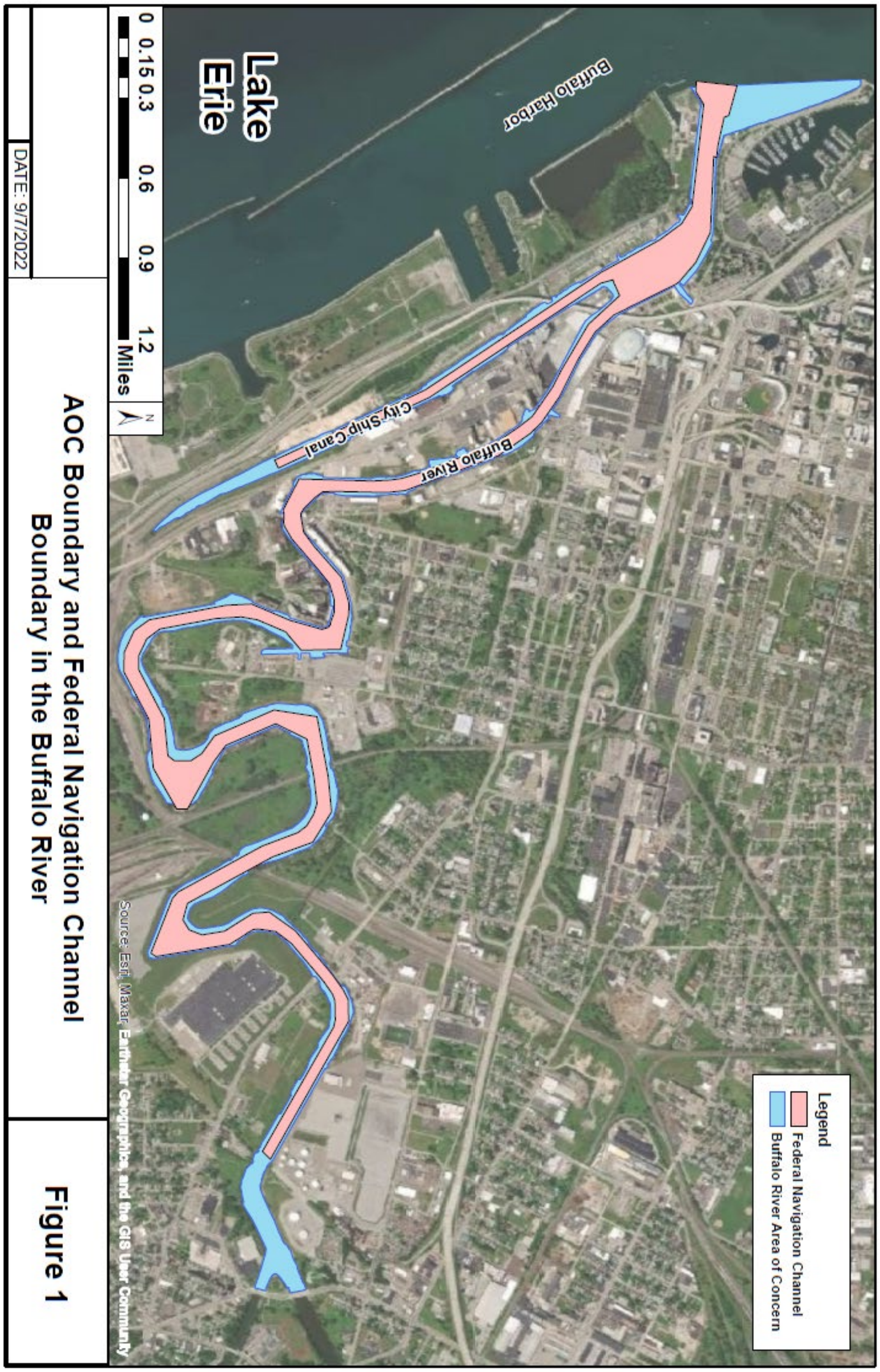


Figure 1: AOC boundary and federal navigation channel boundary in the Buffalo River

Prior to anthropogenic activities, the river was originally a marshy creek that was less than four feet deep. As the City of Buffalo experienced population growth, the Buffalo River was modified to support commercial shipping activities. The river was dredged at the sides and in the center of the channel to accommodate cargo vessels transporting goods to industrial facilities located along its banks. Nearly the entire stretch of the river within the AOC boundary was surrounded by industrial facilities from the late 1800s to 1980s. Over the course of the last century, the Buffalo River became polluted with direct industrial discharges including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), chlorinated organic pesticides, aniline dye byproducts, and heavy metals. Contaminants settled into the sediments or bound with suspended organic matter and settled to the bed of the Buffalo River within the AOC area (Boyer 2010).

Chemical pollutants also found their way into the river indirectly, leaching from upland waste storage areas. Industries along the river disposed of their solid waste by burning, burying, or storing in lagoons on-site. These disposal practices led to chemicals entering the river through rain and snow runoff as well as groundwater leaching (Rossi 1996). Today, many of these waste storage sites have become inactive hazardous waste sites, though some facilities remain and are currently in use. In all cases, efforts continue to eliminate or control future contaminant releases, either through remedial program site cleanups or other environmental regulations that did not exist for most of the industrialized history of the Buffalo River.

The physical modification to the Buffalo River increased the width and depth, thereby reducing flow velocity and promoting sediment deposition. The Buffalo River habitat was altered to a lacustrine, or lake-like environment, which led to low dissolved oxygen levels. Several studies conducted in the mid-90s concluded high sediment oxygen demand, slow flow velocities, and stratification, or lack of mixing, in the river at low flows reduced aeration and were factors causing low dissolved oxygen in the river (Irvine et al. 2005).

Under Annex One of the GLWQA, all AOCs are mandated to develop a Remedial Action Plan (RAP) in three stages:

- Stage I, which collectively identifies specific BUIs and their causes,
- Stage II, which outlines the restoration work needed to address the root problems and restore the identified BUIs, and
- Stage III, which documents the fulfillment of the commitments made in Stage II and recommends the delisting of the AOC.

In 1987, a group of concerned citizens, scientists, and stakeholders, along with NYSDEC, formed the Buffalo River RAC, formerly known as the Buffalo River Citizens' Committee, to identify and address BUIs within the AOC. Collectively, the RAC developed and published the RAP for the Buffalo River AOC in 1989. The goal of the RAP is “to restore and maintain the chemical, physical, and biological integrity of the Buffalo River ecosystem in accordance with the Great Lakes Water Quality Agreement” (NYSDEC 1989). After the RAP was published, NYSDEC determined it met the Stage I and II requirements and was renamed as the Stage I/II RAP. In 2005, Buffalo Niagara Waterkeeper (BNW) published the Buffalo River RAP status report which documented progress that has been made towards delisting, updated delisting criteria and restoration targets for several BUIs and identified data gaps related to BUI assessment.

Through the combined 1989 Stage I and Stage II RAP 2005 RAP status report, and subsequent 2011 RAP addenda, the Buffalo River RAC has designated nine out of the possible fourteen BUIs as being impaired for the Buffalo River AOC. The *Degradation of Benthos* BUI was initially designated as impaired in the 1989 Stage I and Stage II RAP.

2.1 Rationale for BUI Listing

The *Degradation of Benthos* BUI was originally listed as impaired in the 1989 Stage I/II RAP due to low diversity and abundance of the benthic macroinvertebrate community and evidence of sediment toxicity. During the 1960s, pollution and low dissolved oxygen were so severe that the river was largely devoid of benthic macroinvertebrates and fish. Studies conducted in the following decades documented modest increases in benthic macroinvertebrate abundance that coincided with water quality improvements, including increasing dissolved oxygen (Diggins and Snyder 2003; Environ 2009). Macroinvertebrate surveys conducted in the 1980s found that communities were dominated by pollutant tolerant species that can survive in degraded environmental conditions, and contaminated sediments appeared to cause toxicity. The NYSDEC performed acute toxicity testing for *Hyalella azteca* (*H. azteca*), and chronic toxicity for *Ceriodaphnia dubia* (*C. dubia*) in 1985. The amphipod *H. azteca* is a small freshwater crustacean that inhabits the sediment surface and is an ideal sediment toxicity testing organism due to its relative sensitivity and tolerance to contaminants in sediments, short generation time, and ease of culture in the laboratory (USACE 2019, USEPA 2000). The water flea *C. dubia* is an important food item for small and young fish and is an ideal organism for water toxicity testing due to its short generation time, rapid reproduction, and sensitivity to pesticides, heavy metals, and other toxic substances (USACE 2019, USEPA 2002). The results of the toxicity testing concluded sediments from the Buffalo River AOC appeared to cause toxicity to *H. azteca*. In the following decades, limited improvement was observed in the macroinvertebrate community, and surveys conducted after 2000 found no evidence of toxicity in sediment bioassays. Researchers noted that it was unclear if the continued degraded condition of the macroinvertebrate community was attributable to chemical contamination of sediments or the broader influences of an urban watershed (Environ 2009).

The 2005 Stage II RAP status report further identified routine dredging of the Buffalo River as a cause for the impairment. The 2011 addendum to the Stage II RAP added low dissolved oxygen as another factor negatively impacting the benthic community. Modeling was conducted in 2005 to characterize receiving water quality into the Buffalo River AOC and concluded that the major cause of low dissolved oxygen was the hydraulic system of the river (Irvine et al. 2005). Previous dissolved oxygen modeling studies found causes for low dissolved oxygen in the Buffalo River AOC were reduced aeration during low flows, high sediment oxygen demand, and slow flow velocities (Irvine et al. 2005). As mentioned previously, the major modifications of the river via dredging increased the size of the channel which reduced flow velocities and promoted sediment deposition. The Buffalo River is still dredged to a depth of 22 to 23 feet to accommodate cargo vessels.

2.2 BUI Removal Criteria

In December 2001, the *Restoring United States Areas of Concern: Delisting Principles and Guidelines* document developed by the USEPA was adopted by the United States Policy Committee (USPC). This document was intended to “guide the restoration and maintenance of beneficial uses and the subsequent formal delisting in order to achieve a measure of consistency across the basin” (USPC 2001). This document provided the following scenarios under which a BUI can be removed:

A. A delisting target has been met through remedial actions which confirm that the beneficial use as been restored.

B. It can be demonstrated that the beneficial use impairment is due to natural rather than human causes.

C. It can be demonstrated that the impairment is not limited to the local geographic extent but rather is typical of lake-wide, region-wide, or area-wide conditions (under this situation, the beneficial use may not have been originally needed to be recognized as impaired).

D. The impairment is caused by sources outside the AOC. The impairment is not restored but the impairment classification can be removed or changed to "impaired-not due to local sources." Responsibility for addressing "out of AOC" sources is given to another party.

The most comprehensive path to BUI removal is represented by the first option, where specific targets or removal criteria are established and, after implementation of the necessary remedial actions, it can be demonstrated that the beneficial use has been restored.

The Buffalo River RAC published AOC-specific criteria for removing the *Degradation of Benthos* BUI in the 2005 Stage II RAP. The criteria read:

1) Benthic macroinvertebrate communities are non-impacted or slightly impacted according to NYSDEC indices; AND

2) In the absence of conclusive community structure data, the toxicity of sediment-associated contaminants is not statistically higher than controls.

3. Management Actions & Assessments Supporting BUI Removal

Since publication of the Stage II RAP status report in 2005, a significant amount of work has been completed to address the *Degradation of Benthos* BUI and restore sediment quality. This work and a timeline of events are summarized below. Additional information about the sediment remediation can be found in the *Buffalo River AOC Restrictions on Dredging Activities Beneficial Use Impairment Removal Report* (NYSDEC 2022).

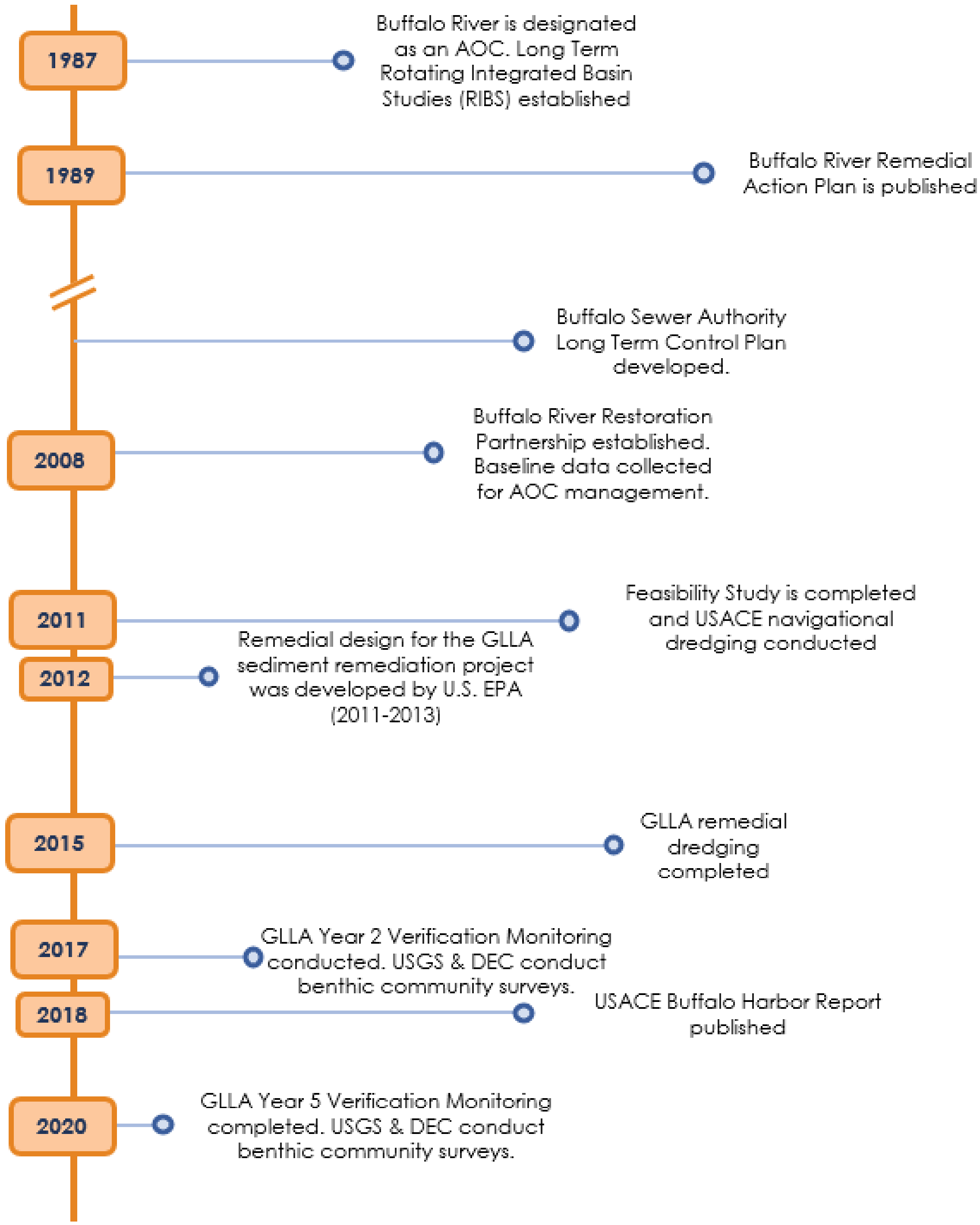


Figure 2: Timeline of AOC Activities

3.1 Inactive Hazardous Waste Site Remediation

Historic industrial waste disposal practices had a negative ecological impact on the Buffalo River AOC (Rossi 1996). Mitigating upland contaminant sources was necessary to reduce and prevent reintroduction of contaminants into the river as the designation of impairment for the *Degradation of Benthos* was contaminated bottom sediments. Historical locations of contaminant inputs along the shoreline of the

Buffalo River AOC have been designated as inactive hazardous waste sites in the last 40 years. NYSDEC issues different classifications for waste sites based on the nature and extent of the site-specific contamination, as well as the potential impacts to human health and the environment. To address contamination at inactive hazardous waste sites, there are numerous programs in New York State which include the state Superfund program, the Brownfields Cleanup Program, and the Voluntary Cleanup Program. Sites identified in the Buffalo River watershed were subsequently entered into appropriate state programs to facilitate remediation of site-specific contamination which included both off-site disposal and onsite containment. One remaining primary historical contributor (PVS Chemicals, Inc) is still an active industrial facility and is required to comply with all applicable regulatory requirements that may exist to control contaminant releases.

Remedial investigations and, where it was determined necessary, remedial actions at all designated inactive hazardous waste sites in the vicinity of the Buffalo River AOC have been completed as of 2021. Not all hazardous waste sites required remedial action. Remedial action is required at a hazardous waste site if samples exceeded threshold criteria for hazardous waste. Remedial actions are documented in site-specific monitoring plans. Sites that required no action, as determined though the remedial investigations, documented no impacts to the Buffalo River and was unlikely to transport off-site. Information about hazardous waste sites, including remedial investigation reports and monitoring plans, within the vicinity of the Buffalo River AOC can be found on NYSDEC's DECinfo Locator. Studies document a reduction in contaminant concentrations within the surface sediments throughout the AOC over time confirming that sediment and water quality is improving (Ramboll 2021).

3.2 Great Lakes Legacy Act

In 2002, the Great Lakes Legacy Act (GLLA) was passed by U.S. Congress for the purpose of accelerating cleanup of contaminated sediment within the Great Lakes AOCs. This boosted additional Buffalo River AOC studies to be conducted to determine the extent of contamination in the sediments and prompted remediation alternatives to be assessed. This section summarizes components of the GLLA project: baseline data collection, development of the remedial feasibility study, selection of the remedial design followed by remediation activities, and lastly, post remedial monitoring to measure the success of the remedial design.

A key sampling effort, led by NYSDEC and U.S EPA Great Lakes National Program Office (GLNPO), was conducted in 2005, 2007, and 2008 to document the extent of chemical contamination and assess baseline ecological conditions for the Buffalo River AOC. The study was intended to collect baseline information that could be used in various future studies and reports to evaluate the effects of sediments on the Buffalo River ecosystem. Baseline data were collected at sites within the AOC and at non-AOC reference areas to characterize existing benthic macroinvertebrate community conditions. Two different sampling methods, Hester-Dendy multiplate samplers and petite Ponar grab samplers were used to collect macroinvertebrates. Hester-Dendy samplers are artificial substrates with multiple plates (hereafter 'multiplates') that are colonized by macroinvertebrates over an extended period of time. These samplers are typically deployed suspended in the water column but in this study, and in the post-remediation monitoring described below, they were deployed just above the bed sediment to more closely approximate benthic conditions. A petite Ponar is a quantitative grab sampler designed to penetrate the substrate by its own weight and capture a portion of the bottom sediments by means of a gravity-activated closing mechanism (Duffy, 2021).

Macroinvertebrates were sampled at 15 locations, 5 of which were in the Buffalo River AOC and 10 of which were in reference areas. The 10 reference locations were distributed as follows: one on Cazenovia Creek (a tributary to the Buffalo River), three in the Buffalo River upstream of the AOC, three in Tonawanda Creek, and three in Cattaraugus Creek. Multiplates were only deployed at 2 of the 3 locations in Cattaraugus Creek due to shallow depths at one location. Tonawanda Creek and Cattaraugus Creek were used as out-of-watershed reference water bodies to compare AOC conditions to similar waterbodies not within the AOC. Figures 6 & 7 show the Ponar and multiplate sample locations in the Buffalo River AOC and reference area upstream of the AOC boundary. A more comprehensive summary of the study design and sampling methods can be found in the Buffalo River Sediment Remedial Investigation Report (Environ 2009).

The 2008 baseline results indicated the macroinvertebrate community was severely to moderately impacted based on analysis of sediment grab samples and moderately to slightly impacted based on analysis of the multiplate samplers (Environ 2009). Differences between the sediment grab and the multiplate method metric results are at least in part due to the fact that depositional areas included in sediment grab samples, are composed primarily of fine silts and sands mixed with organic matter. This type of substrate offers little diversity in benthic community habitat. The report concluded, the urban, industrialized, and channelized nature of the river, the high degree of siltation, and the lack of riparian vegetation at many locations, create an altered physical habitat that likely influenced the structure, abundance, and diversity of benthic macroinvertebrate communities. The 2008 results indicate that benthic habitat is fairly similar between the Buffalo River and the reference sites. The results of the 2008 sampling and the similarity between the Buffalo River and the reference sites give insight into the extent to which habitat quality contributes to the benthic community structure seen in the sediment grab samples (ENVIRON 2009).

3.2.1 Remediation

The Buffalo River Restoration Partnership Coordination Team (PCT), formed in 2007, led coordination and planning efforts to address the contaminated bottom sediments within the AOC. This group consisted of representatives from USEPA, NYSDEC, Buffalo Niagara Waterkeeper (BNW), USACE, the City of Buffalo, and Honeywell, Inc. Each organization was a key partner in progressing the restoration of the Buffalo River. Information collected between 2005 to 2012 led to the development of a feasibility study that would determine the best course of action to effectively reduce potential ecological and human health risks associated with elevated sediment contaminant concentrations. A more complete summary of studies completed between 2005 to 2008 is provided in the *Feasibility Study for the Buffalo River* prepared by environmental consultants for Honeywell, Inc. (Environ 2011).

The Feasibility Study proposed five remedial alternatives, ranging from natural recovery to various approaches using remedial dredging and capping. Remedial Alternative 5, “Enhanced Protectiveness Dredging,” was the study’s recommended alternative and consisted of a combination of strategic sediment removal and engineered capping, as this would meet the GLLA remedial goals (RGs) while minimizing short-term impacts to the ecological community. The project partners made the decision to implement Remedial Alternative 5 for remediating contaminated bottom sediments and in March 2013, USEPA published the Final Basis of Design Report (USEPA 2013), which described the plans of the remedial project.

Under the GLLA program, USEPA and Honeywell funded $48.5 million to remove approximately 453,000 cubic yards of contaminated sediment from areas outside of and below the federal navigation channel within the Buffalo River AOC. Most of the sediment was disposed in the Buffalo Harbor confined disposal facility. A small volume of sediment was classified as hazardous waste due to elevated PCB concentrations and was disposed of in a licensed landfill. The funding also included the capping of a 4.75-acre section of the City Ship Canal with 5.5 feet of clean sediment, isolating the chemical contamination, and subsequent habitat restoration in this area. In addition, the U.S Army Corps of Engineers (USACE) conducted routine dredging in 2011 to address the backlog of contaminated sediments that remained in the federal navigation channel, removing approximately 508,000 cubic yards of sediments. This project was largely funded by Great Lakes Restoration Initiative (GLRI) as well as USACE Operations and Maintenance funds. Additional information about the sediment remediation activities can be found in the *Buffalo River AOC Restrictions on Dredging Activities Beneficial Use Impairment Removal Report* (NYSDEC 2022). Post remedial monitoring has confirmed remedial dredging was successful in removing the majority of contaminated sediments and that project remedial goals were met (NYSDEC 2022).

3.2.2 Post-Remedial Monitoring

Post-remediation monitoring was performed in 2017 (Year 2) and 2020 (Year 5) to assess the effectiveness of remedial actions in restoring beneficial uses after the completion of GLLA remedial dredging. Sampling plans to address AOC impairments were originally developed and documented in the *Monitoring Plan for the Delisting of "Impaired" Beneficial Use Impairments,* including for the *Degradation of Benthos* BUI (BNW 2014). The post-remedial monitoring was conducted in two parallel efforts. The first was led by Ramboll US Corporation (Ramboll) and Anchor QEA, on behalf of Honeywell, Inc., and was published in two reports (Ramboll & Anchor QEA 2018 & 2021) and is summarized below in Section 3.2.3. This effort included bathymetric surveys, surficial sediment chemistry analyses, biological (benthic invertebrate and fish) community surveys, and habitat surveys. For the purposes of this report, only the benthic community portion of the monitoring effort is discussed. The second post-remedial monitoring effort was led by the U.S. Geological Survey (USGS) and NYSDEC, is published in a journal article (George et. al, 2022) and associated USGS data release (George et. al, 2021), and is summarized below in Section 3.3.

Both sampling efforts used bottom-deployed multiplates to sample macroinvertebrates. Additionally, the Ramboll study collected macroinvertebrate samples using petite Ponar grabs. The use of both sampling methods provided a more robust assessment of benthic community condition. The Ponar grab method is more directly comparable to historical datasets and directly samples organisms living in the sediments, while the multiplate method eliminates site-to-site habitat differences that can complicate benthic assessments by providing a standardized artificial habitat at all sites. The USGS/DEC study also conducted sediment toxicity testing which is described in section 3.3. Figure 3 shows each sampling type used in the post-remedial monitoring conducted.

Figure 3: Petite Ponar Grab Sampler (left) and Multiplate Samplers (above).

Macroinvertebrate samples from both studies were shipped to a taxonomy laboratory in Schenectady, New York for organism identification. All macroinvertebrates were identified to the lowest practical taxonomic resolution (usually genus or species) following NYSDEC Standard Operating Procedures (Duffy, 2021). Multiplate samples were processed until the target subsample count of 250 organisms was reached or until the entire sample had been processed while Ponar samples were processed until the target subsample count of 100 organisms was reached or until the entire sample had been processed.

The resulting macroinvertebrate identification data from both studies were used to calculate NYSDEC metrics to determine the state of the benthic community within the Buffalo River AOC and reference locations. Methods used for these evaluations are based on long-established NYSDEC biological monitoring protocols described in NYSDEC SOP 208-21 (Duffy 2021). The Ponar data were used to calculate the *Macroinvertebrate Biological Assessment Profile of Index Values for Ponar Samples from Soft Sediments* and the multiplate data were used to calculate the *Macroinvertebrate Biological Assessment Profile of Index Values for Multiple-Plate Samples from Navigable Waters* (Duffy 2021). Both Biological Assessment Profile (BAP) metrics incorporate multiple component metrics into a single value between 0 and 10 that is interpreted on a four-tiered scale of impact: severe (0.0–2.5); moderate (2.5–5.0); slight (5.0–7.5); or non-impacted (7.5–10.0).

Details on the numbers and locations of sites sampled, and the findings from each study are described in the two sections below.

3.2.3 Ramboll Post-Remedial Monitoring

The Ramboll post-remedial monitoring included multiplate and petite Ponar sampling at 5 sites in the AOC, one within-watershed reference site on Cazenovia Creek, and one out-of-watershed reference site on Tonawanda Creek during both 2017 and 2020. The multiplate samplers were deployed for approximately 4 weeks in August during the 2017 sampling event and in July during the 2020 sampling event. Ponar grabs were collected at the time the multiplate samplers were deployed. Further details of the sampling methods and results are described in the following reports:

- *Year 2 Verification Monitoring Results for the Buffalo River* (Ramboll & Anchor QEA 2018)
- *Year 5 Verification Monitoring Results for the Buffalo River* (Ramboll & Anchor QEA 2021)

The results of these sampling efforts revealed a low quantity of organisms in samples from both the AOC and reference areas which may have depressed BAP scores. For example, the multiplate samples from the AOC in 2020 averaged 48 organisms while the target number for calculating the BAP score with this method is 250 organisms. Similarly, the petite Ponar samples from the AOC in 2020 averaged 8 organisms per sample while the target number for calculating the BAP score with this method is 100 organisms (Ramboll 2021). Similar or slightly lower numbers of organisms were obtained from the reference areas, so this does not appear to be an AOC-specific issue. It is not clear if sampling methods, broad regional stressors affecting both the AOC and reference area alike, or other factors are responsible for the low number of organisms present. Nonetheless, these low counts are problematic for assessing community condition because the BAP score is calibrated to a scale from 0-10 based on the intended subsample counts, and many of the component metrics included in the BAP score are positively correlated with the number of organisms in the sample (e.g., species richness). As a result, the BAP scores presented in this section should be considered underestimates of true community condition.

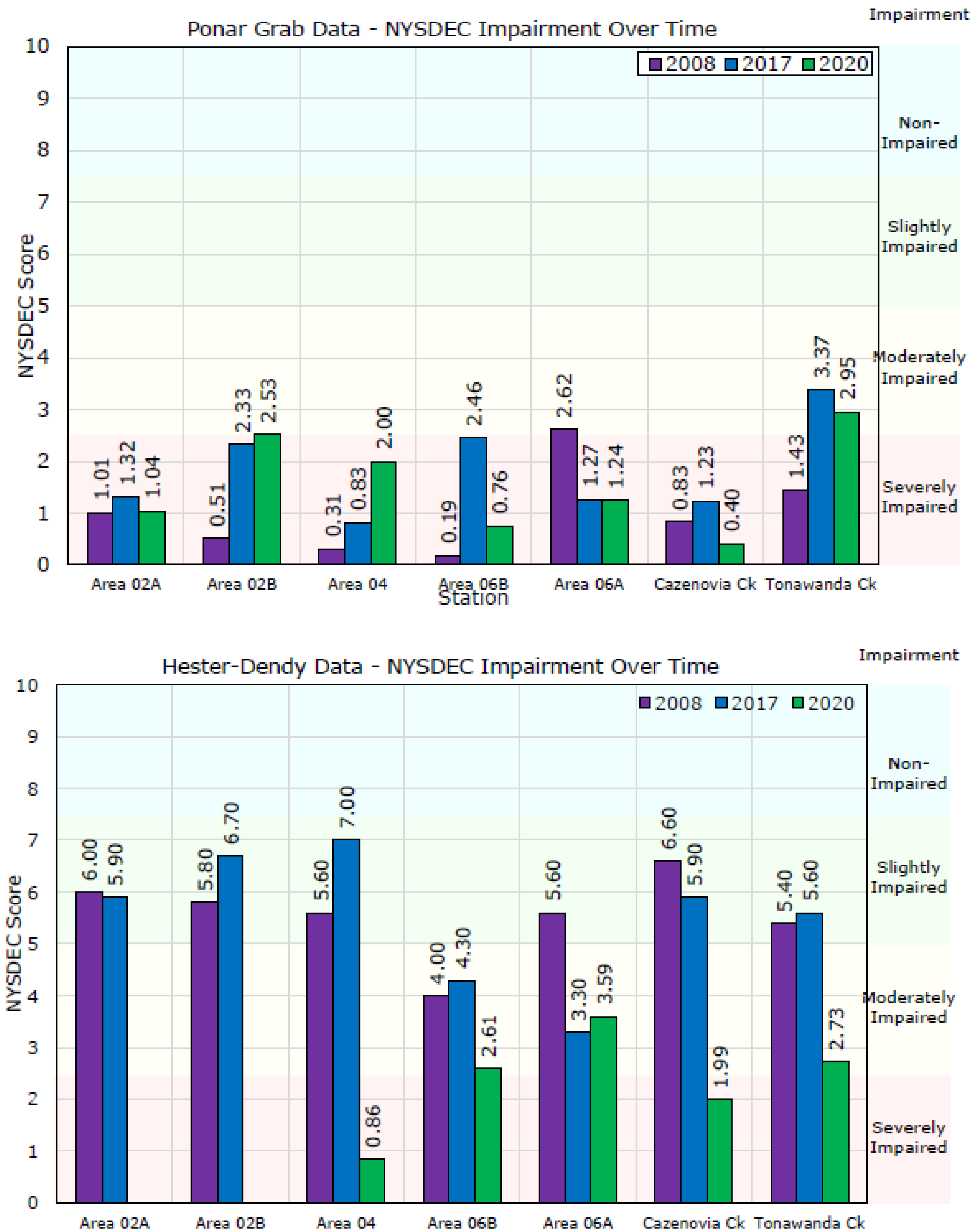
The 2017 and 2020 Ponar data indicated the benthic community in the AOC was severely to moderately impacted. The Ponar BAP ranged from 0.83 to 2.46 (Ramboll & Anchor QEA 2018) in 2017 compared to a range of 0.40 to 2.53 in 2020 (Ramboll & Anchor QEA 2021). Among the reference sites the Ponar BAP at Cazenovia Creek was 1.23 in 2017 and 0.40 in 2020 while comparable values from Tonawanda Creek were 3.37 in 2017 and 2.95 in 2020.

The 2017 multiplate data classify the community as moderately to slightly impacted in the Buffalo River AOC with BAP scores ranging from 3.30 and 7.00. The 2020 sampling results classify the community as severely to moderately impacted with BAP scores ranging from 0.86 to 3.59. Two of the AOC sites were not included in the 2020 assessment as the multiplate samplers were unable to be located so no data were obtained. The Cazenovia Creek reference location had BAP scores of 5.90 in 2017 and 1.99 in 2020. The Tonawanda Creek reference location had BAP scores of 5.60 in 2017 and 2.73.

There was no consistent pattern in BAP scores before and after the remediation when comparing 2008, 2017, and 2020 Ponar grab and multiplate data, which are summarized in Figure 4. However, BAP scores were generally lowest in 2020, especially for the multiplate samples. The reference locations also experienced a decrease in BAP scores in 2020 which may imply that macroinvertebrates were influenced by factors not uniquely associated with the Buffalo River AOC. Several considerations in the *Year 5*

Verification Monitoring Report help clarify why the BAP scores were low (Ramboll and Anchor QEA 2021). The lowest organism counts occurred during the 2020 sampling event, in which the scores for both multiplate and Ponar samples from all sites were low, and potentially inaccurate, because they were generated with fewer than the minimum requirement of 250 and 100 organisms, respectively. Also, the 2020 sampling event was conducted earlier in the year than previous events to avoid conflict with scheduled dredging activities. Additionally, high temperatures and low dissolved oxygen concentrations were observed in 2020 which can adversely affect the health of macroinvertebrate communities (Ramboll & Anchor QEA 2021).

The *Year 5 Verification Monitoring Report* concludes the benthic community in the lower Buffalo River is affected by industrialization of the river and periodic dredging which contributes to lacustrine conditions (Ramboll and Anchor QEA 2021). These environmental conditions provide an advantage to zebra mussels, which have displaced native mussel colonies and dominated resident macroinvertebrate communities most strongly near the mouth at Lake Erie.



In 2020, the area 02A and 02B Hester-Dendy samples were not recovered (see text).

Figure 4: 2008 baseline BAP scores compared to the post-remediation 2017 and 2020 BAP scores for the Buffalo River and reference areas, Cazenovia, and Tonawanda Creeks (Ramboll & Anchor QEA 2021)

3.3 USGS/NYSDEC Post-remedial Monitoring

Benthic community conditions in the Buffalo River AOC and in an upstream reference reach were assessed by NYSDEC and USGS in 2017 and 2020 to determine the status of the Degradation of Benthos BUI after significant remedial measures were implemented. For this assessment, multiplate samplers were used to collect macroinvertebrates and petite Ponar grabs were used to collect sediment for toxicity testing at eight sites in the AOC and at 6 reference sites on the Buffalo River upstream of the AOC during both 2017 and 2020. Sediment toxicity testing involves exposing macroinvertebrates to bed sediment samples and monitoring the survival (acute effect) and growth (chronic effect) of the organisms to infer how sediments affect benthic communities in the wild. Ten-day toxicity tests using two test species, *Chironomus dilutus* and *H. azteca*, were conducted following standard U.S. EPA methods (USEPA 2000). These species were used for toxicity testing because they inhabit wide geographical areas, burrow in sediments, and are known to have sensitivities to common nutrients and toxins (George et al. 2022).

The BAP scores from the AOC sites in 2017 ranged from 3.0 to 6.0 with an average score of 4.8 (George et al. 2022). In 2020, the BAP scores from AOC sites ranged from 2.4 to 5.8 with an average score of 4.2 (George et. al, 2022). These scores classified benthic community condition as moderately to slightly impacted in 2017 and from severely impacted to slightly impacted in 2020 (Figure 5). The BAP scores at upstream reference sites located on the Buffalo River generally had higher BAP scores than the AOC sites, averaging 7.1 in 2017 and 5.7 in 2020.

A statistical model indicated that the primary factors influencing BAP scores were related to the river shifting from a lacustrine environment downstream to a more riverine environment upstream (George et al. 2022). The AOC portion of the river has greater depth due to routine dredging and historical river channel alteration. These conditions lead to finer bed sediments, lower dissolved oxygen levels, and greater relative abundance of zebra mussels at sites in the AOC as compared to sites in the reference area. Zebra mussels are an invasive species that have caused profound changes to ecosystems in the Great Lakes region and elsewhere and are able to effectively colonize the AOC section of the Buffalo River due to the low velocities resulting from historical channel modifications (dredging and widening). The average relative abundance of zebra mussels in macroinvertebrate samples from the AOC was 38.6% in 2017 and 28.3% in 2020, compared to reference sites which averaged 4.4% in 2017 and 0.2% in 2020 (George et al. 2022). This is an important observation because indices of biological integrity like the BAP produce a higher score for balanced communities where many species are present, while the dominance of a single species (i.e., zebra mussels) generates lower scores.

This study also noted that BAP scores were generally higher in the 2017 survey and lower in the 2020 survey and attributed this difference to lower dissolved oxygen and higher water temperatures during the second survey. This was likely related to an extensive period of warm and dry conditions preceding and during the 2020 sampling event which may have adversely impacted local benthic communities in the region (George et al. 2022).

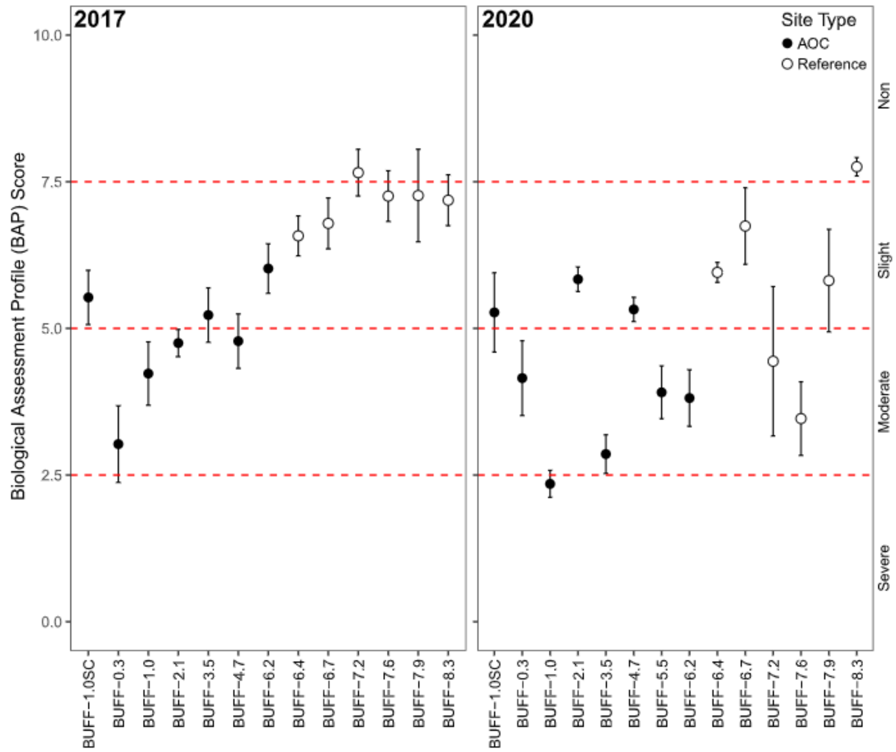


Figure 5: Mean BAP scores of the four multiplate replicates for each site sampled in 2017 and 2020 (George et al. 2022).

Sediment toxicity test data were used to directly quantify sediment toxicity, indirectly determine the potential for impairment of benthic communities in the AOC, and to evaluate whether sediment toxicity at AOC sites differed significantly from that observed at reference sites. Toxicity endpoints from each AOC site were evaluated separately against the pooled mean from the reference sites to determine if they met standard criteria for toxicity (USEPA and USACE, 1998b). Sediments were considered to be toxic if any of the following criteria were met (USEPA and USACE, 1998b):

- mortality (calculated as 100 – percent survival) of *C. dilutus* >20% higher than in reference sediments and difference is statistically significant, OR
- mortality of *H. azteca* >10% higher than in reference sediments and difference is statistically significant, OR
- mean weight (growth) of *C. dilutus* <0.6 mg per organism, and difference between test and reference sediments >10%, and difference is statistically significant.

Survival and growth of *C. dilutus* and *H. azteca* were generally high in the AOC and were similar between the AOC and reference area. None of the eight AOC sites met established criteria for toxicity which suggests bed sediments should not cause toxicity to benthic organisms. Table 1 presents the mean survival and growth of *C. dilutus* and *H. azteca* from the 8 AOC sites and 6 reference sites for both the 2017 and 2020 surveys.

Table 1: Results of Sediment Toxicity Tests (George et al. 2022)

		***C. dilutus* survival (%)**	***C. dilutus* growth (mg)**	***H. azteca* survival (%)**	***H. azteca* growth (mg)**
2017	AOC	91.3	1.52	97.5	0.07
	Reference Sites	82.9	1.58	97.1	0.07
2020	AOC	97.5	1.18	96.3	0.11
	Reference Sites	97.0	1.37	93.3	0.13

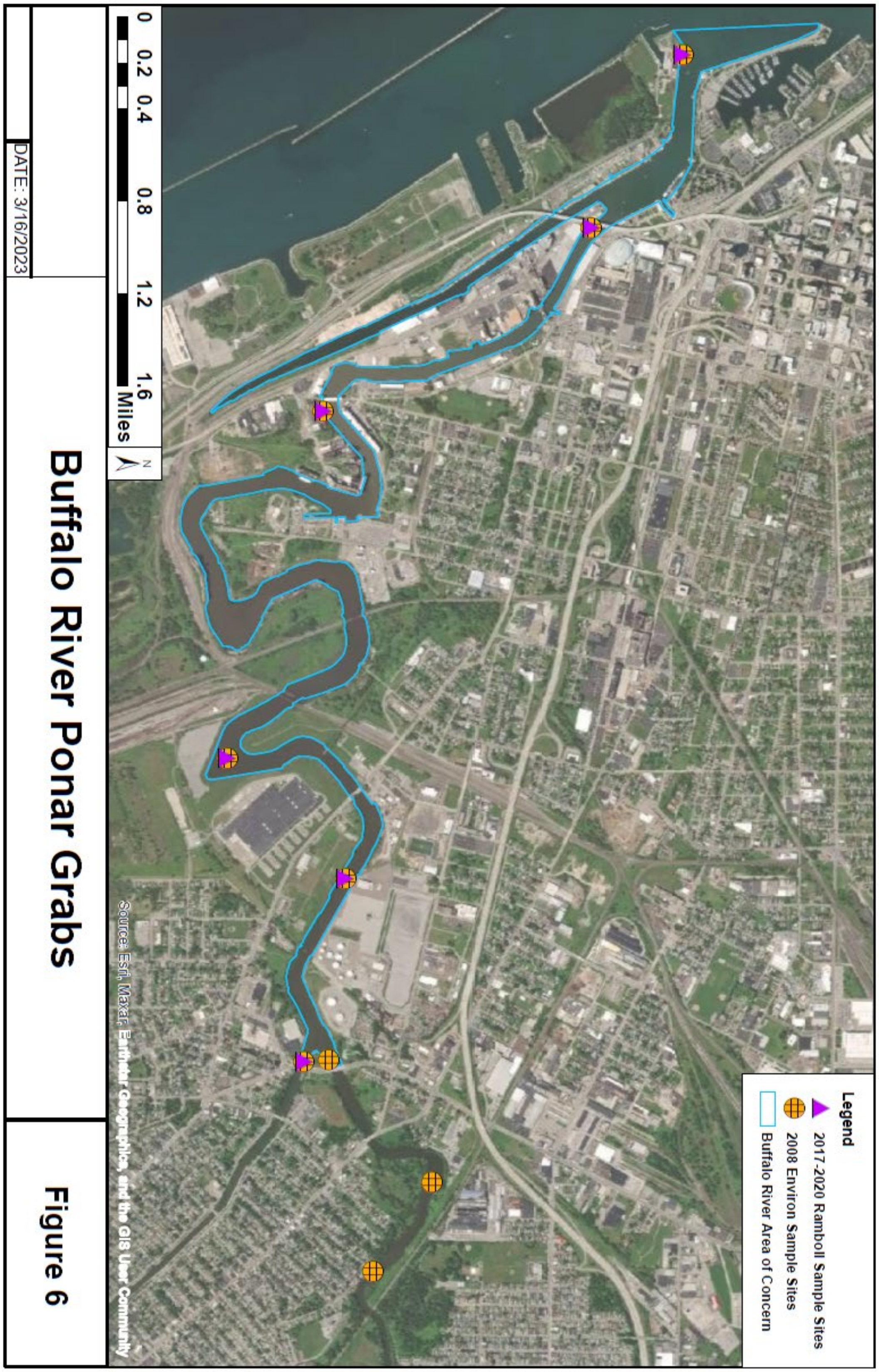


Figure 6: Macroinvertebrate Petite Ponar Grab Sample Sites Along the Buffalo River and Reference Areas.

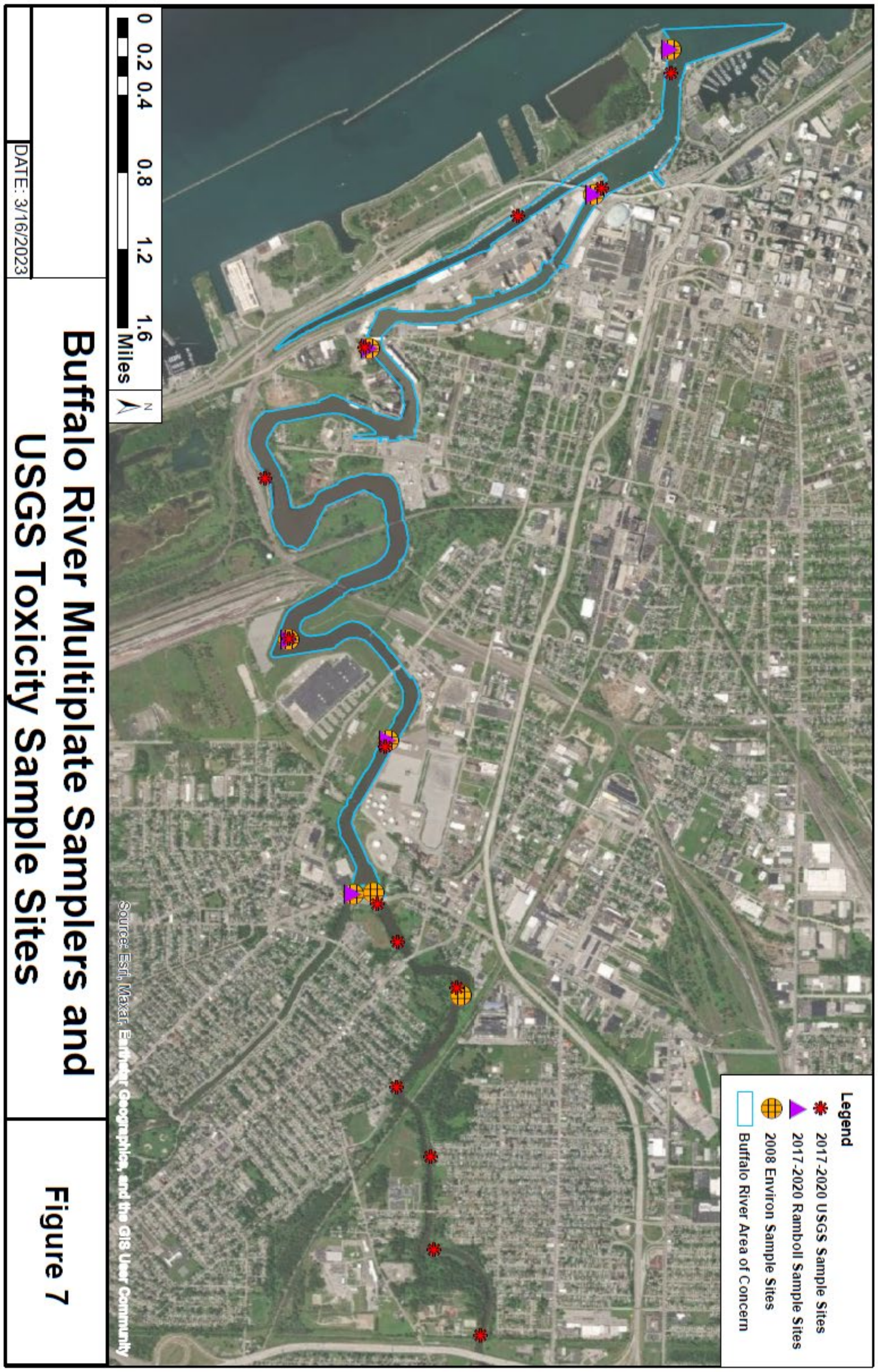


Figure 7: Macroinvertebrate Multiplate and USGS Toxicity Sample Sites along the Buffalo River and Reference Areas.

3.4 NYSDEC Rotating Integrated Basin Studies (RIBS) Monitoring

As part of the RIBS statewide water quality monitoring program, NYSDEC conducts routine monitoring across the state on a five-year rotating schedule of New York State watersheds. The RIBS program assesses water quality across the state waters, which includes documenting good and poor water quality, long-term trends, and establishing baseline conditions for use in measuring the effectiveness of site-specific restoration and protection activities. Statewide RIBS data can be found in the DOW Monitoring Data Portal. One RIBS site located on the Buffalo River has been sampled regularly since 1987 using the suspended multiplate method to examine the state of the macroinvertebrate community. It is important to note that the RIBS program places multiplates 1.0 meter below surface water, and the associated data may reflect water quality more directly than benthic conditions. The sample site is located approximately 115 ft downstream of the Ohio Street bridge.

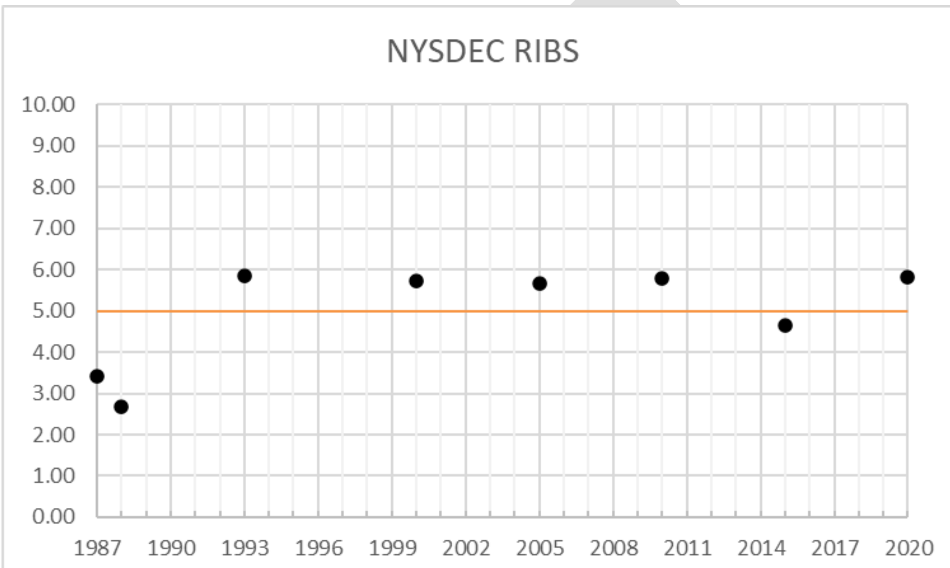


Figure 8: RIBS BAP Scores.

The data in Figure 8 show that macroinvertebrate community condition at this site has improved since being designated as impaired in 1987. In the last 30 years, the BAP score has largely hovered above 5.0, demonstrating the macroinvertebrate community is slightly impacted. In 2015, the BAP score dipped to 4.64, likely due to the disturbance of extensive remedial dredging within the Buffalo River AOC during the preceding years but the benthic community has since recovered as indicated by the BAP score in 2020 of 5.81.

3.5 Buffalo Harbor Toxicity Testing

In 2018, USACE conducted sediment sampling within the Buffalo River federal navigation channel and potential open water placement areas in Lake Erie. The purpose of this work was to determine whether the sediments from the federal navigation channel would meet the Clean Water Act (CWA) Section 404(b)(1) Guidelines for open water placement, including potential beneficial reuse in aquatic environments. Sediments were tested for Buffalo River AOC contaminants of concern and some additional parameters, all of which are listed in the original report, *Buffalo Harbor Dredged Sediment Evaluation* (USACE 2019). Additionally, 10-day sediment toxicity testing with *C. dilutus* and *H. azteca* was performed for all sample sites. These tests used the same species and methods (USEPA 2000) as that of the USGS/DEC study described in Section 3.3. There were six sites, intended to represent USACE dredge material management units, within the AOC, and one reference site located offshore of Cattaraugus Creek Harbor that were sampled for benthic toxicity analysis. Within each of the six management units, a single composite sample (composed of five discrete subsamples) was used for the sediment toxicity assessments.

Table 2: USACE Benthic Survival Rates.

	Management Unit	Test Species		
		H. azteca	***C. dilutus***	
		Mean Survival (%)		**Mean Growth (mg/individual)**
Reference Site	**LE5-COMP**	96 ± 6	94 ± 6	2.1 ± 0.1
City Ship Canal	**SC-DMMU**	96 ± 6	98 ± 5	2.2 ± 0.3
Buffalo River Channel	**BR-DMMU-2**	94 ± 6	92 ± 8	2.1 ± 0.3
	BR-DMMU-3	94 ± 9	100	2.1 ± 0.2
	BR-DMMU-4	98 ± 5	94 ± 13	2.2 ± 0.3
	BR-DMMU-5	94 ± 9	100	2.2 ± 0.2
	BR-DMMU-6	98 ± 5	98 ± 5	2.4 ± 0.3

The mean survival rates for *C. dilutus* and *H. azteca* within the AOC were 96.8% and 95.6%, respectively while samples from the reference area averaged 94.0% and 96.0%, respectively. None of the sites met the USEPA established criteria for toxicity. Survival in Buffalo River samples was not more than 20% reduced compared to lake reference samples (USACE 2019). The report concluded sediments in the Buffalo River AOC should not be toxic to resident benthic organisms.

4 Analysis

The *Degradation of Benthos* BUI was originally listed as Impaired in the 1989 RAP I/II due to low diversity and abundance of the benthic macroinvertebrate community and evidence of sediment toxicity caused by contaminated bottom sediments. Since then, much remedial work has been accomplished to address contamination. Many upland point sources have been remediated and planning is underway to address additional sources of contamination. The Buffalo River channel has also been heavily dredged of contaminated sediments which was a key effort in meeting project remedial goals. Subsequent sediment chemistry data indicates remedial dredging has reduced chemical contamination in the Buffalo River. The sediments in the river have been found to meet criteria for open lake placement, which suggests that there should be little or no ecological impairment due to contaminated sediments (NYSDEC 2022). The navigation channel continues to be regularly dredged by USACE and therefore can affect long term stability and condition of benthic communities. The results of the macroinvertebrate community and sediment toxicity data summarized in the previous section, indicate that multiple influences to the Buffalo

River can hinder complete restoration of the benthic community due to the confounding influence of habitat alterations (George et al. 2022). The modification of the river channel via historical dredging resulted in a lacustrine environment in the lower portion of the Buffalo River. The changes led to slower flow velocities and changes in grain sizes of bed sediments. Fine grain sediments settle in the lower reaches of the Buffalo River, contrasting to the more coarse-grained sediments found in the upstream areas.

There are many factors, apart from contaminated sediments, that could affect the apparent health of benthic macroinvertebrate communities in the Buffalo River AOC. The extensive habitat modification and influence of Lake Erie in the lower Buffalo River have enabled proliferation of zebra mussels and were implicated as a key driver of benthic community condition and BAP scores during two recent surveys (George et al., 2022). First documented in the Great Lakes in the 1980s (Benson, 2013; Karatayev et al., 2015), zebra mussels were abundant at most AOC sites and were negatively associated with macroinvertebrate community integrity in this study. A literature review by Karatayev et al. (1998) indicated that the unidirectional flow of rivers limits the density of zebra mussels by sweeping larvae downstream and that the highest densities generally form in the downstream-most sections of rivers and deltas where flow velocities are minimal. This is important because zebra mussels are regarded as ecosystem engineers and their establishment provides physical habitat for other taxa, potentially further altering community structure (Karatayev et al., 2015; Ricciardi et al., 1997). For example, in a dredged and dammed portion of the Ohio River, the establishment of zebra mussels was linked to a decline in the abundance of *Cyrnellus fraternus*, a historically abundant caddisfly. Thus, the dominance of zebra mussels in the lower Buffalo River is a clear biological response to the lentic conditions caused by historic habitat alterations and appears to be negatively affecting macroinvertebrate communities or at least the metrics used to describe them. The effect of zebra mussels on macroinvertebrate communities, however, is generally not an AOC-specific issue. Grapentine (2009) lists the invasion of dreissenid mussels as an example of an external (non-AOC) issue that may prevent complete recovery of impaired benthic communities but should not prohibit the removal of the Degradation of Benthos BUI from an AOC.

Some weight should also be given to the relationship between river-channel conditions and BAP scores. Ponar and multiplate BAP metrics were originally calibrated to detect a range of impacts on the benthos caused by degraded water quality in large non-wadeable rivers with a mix of fine (silt/clay) to moderate (gravel) sized bed sediments (Duffy et al., 2021; Baldigo et al., 2023). In lacustrine environments, very low velocities, deep accumulations of fine sediments and organic materials, and low dissolved oxygen levels may produce benthic communities that are not representative of typical large rivers. Therefore, Ponar and multiplate BAP scores from such sites may not correctly categorize the degree of impairment in resident benthic communities. This was apparent in the Niagara River where lake-like conditions yielded very low Ponar BAP scores within benthic communities that were more characteristic of lake harbors or bays than of riverine environments (Baldigo et. al 2023). Habitat in the highly modified Buffalo River AOC is also clearly influenced by Lake Erie, and as noted by George et al., (2022) produced highly variable and relatively low BAP scores in two recent studies. Low densities of organisms in bed sediments (and samples) from such sites can also create problems with BAP calculations. The specimen counts for many Ramboll and some USGS/DEC samples from the Buffalo River were far below the numbers required for some component metric calculations. Combining component metrics that were created with substandard counts may generate suspect (unusually low) BAP scores and potentially inaccurate impact classifications. To summarize, historic habitat alteration, predominance of dreissenid mussels, low specimen counts, lake and watershed influences, and seasonal (and annual) variability in physical conditions in the Buffalo River all contributed to inconsistent macroinvertebrate community findings and only inconclusive evidence of alleviated impairment.

Multiple factors, listed above, indicate the macroinvertebrate community data in the Buffalo River is inconclusive. The *Degradation of Benthos* BUI removal criteria state that in the absence of conclusive community data, sediment toxicity results should be used to evaluate status of the BUI. Sediment sampling conducted by USGS and NYSDEC in 2017 and 2020 and by USACE in 2018 tested for sediment toxicity to directly measure potential for impairment to benthic communities. Results of the survival and growth of *C. dilutus* and *H. azteca*, which are presented in Tables 1 and 2, were measured against the USEPA established criteria for toxicity (supplied in Section 3.3). Toxicity assays are much less influenced by confounding variability than are community results due to the controlled nature of the standardized tests (USEPA 2000). Toxicity tests, conducted in a laboratory in which the environment and testing variables can be controlled contrast to field testing where multiple uncontrolled, and sometimes undefined, variables exist that can impact results of the test. Though field testing does present real world conditions in the natural environment, the results of the BAP scores did not provide enough information to establish whether the benthic community was impaired due to sediment toxicity as defined in the Stage I/II RAP. None of the sediment samples in the Buffalo River AOC or reference sites in each of the three sampling events met the criteria for toxicity, in other words, Buffalo River sediments are not toxic to resident benthic organisms. Therefore, benthic communities should not be impaired by contaminated sediments within the Buffalo River AOC.

5 Public Outreach

NYSDEC, in partnership with BNW, Erie County Department of Environment and Planning, USEPA, and the Buffalo River RAC, hosted a virtual public meeting on ______________to present the case for removing the *Degradation of Benthos* BUI to local stakeholders. The meeting was held during the 30-day public review period from _________________ during which public was invited to review and provide input on a draft version of this BUI removal report, which was hosted on the BNW website.

During the virtual public meeting, (to be added later). BNW has prepared a summary of the public meeting comments reflecting the public's general desire to understand a very complicated topic and acceptance of the RAC/NYSDEC conclusions without any opposition noted. This summary is included as **Appendix X.**

6 Conclusions

6.1 BUI Removal Steps

	Completed	*Date*	*Step Taken*
1.	√	11/1989	BUI first designated as "impaired" in Stage I/II RAP.
2.	√	12/2011	Final BUI removal criteria established with RAC consensus.
3.	√	12/2021	RAC agreed to proceed with BUI removal.
4.	√	3/31/23	Initial Draft BUIRR provided to USEPA Technical Review Lead.

5.	√	4/5/23	Receive comments from USEPA Technical Review Lead and revise removal report accordingly.
6.			Hold public outreach meeting to present BUI removal rationale to local stakeholders (including a 30-day public comment period).
7.			NYSDEC completes final modifications to the *Degradation of Benthos* BUI removal document, based on public comments received.
8.			Coordinate the formal transmittal of the BUI removal report with USEPA GLNPO.
9.			Communicate results to RAC for appropriate recognition and follow-up.

6.2 Removal Statement

In the Stage I/II RAP for the Buffalo River AOC, the *Degradation of Benthos* BUI was originally listed as Impaired due to low diversity and abundance of the benthic invertebrate community and evidence of sediment toxicity. The 2005 RAP status report (BNW 2005) identified the likely cause of this impairment was contaminated sediments and navigational dredging. Subsequently, major remedial dredging efforts removed approximately one million cubic yards of contaminated sediments from the federal navigation channel and areas outside the navigation channel from 2011 to 2015. Long-term RIBS data show that the macroinvertebrate community within the Buffalo River has improved overall since the benthos BUI was first designated as impaired.

A comprehensive suite of macroinvertebrate community and sediment toxicity data collected from the Buffalo River AOC two-years and five-years after sediment remediation indicates that macroinvertebrate communities are still moderately to slightly impacted but that this impairment is not driven by contaminated sediments. This finding has several important implications for the Degradation of the Benthos BUI. First, the baseline investigation conducted in 2008 noted that it was unclear whether the degraded condition of macroinvertebrate communities in the AOC was attributable to legacy sediment contamination or more general habitat influences consistent with an urban watershed (ENVIRON, 2009). Since sediment remediation was completed in 2015 and concentrations of most contaminants of concern have reached or are approaching remedial goals (Ramboll and Anchor QEA, 2018; USACE, 2019), the post remediation data suggest that the current degradation observed in macroinvertebrate communities in the Buffalo River AOC is primarily driven by physical alteration and habitat quality – not the toxicity of sediments. Second, the criteria for removing the Degradation of Benthos BUI state that the BUI can be removed in the absence of ‘‘conclusive community data” if sediment toxicity ‘‘is not statistically higher than controls” (Riverkeeper, 2014). Given that nearly half of AOC sites met the threshold BAP score (5.0) in the USGS/NYSDEC study and that the degradation observed at most other sites was attributed to habitat quality, it seems appropriate to treat the macroinvertebrate community data as inconclusive and to consider the second BUI removal criteria. The USGS/NYSDEC (2017 and 2020) and USACE (2018) sediment toxicity data provide no evidence that contaminant levels in sediments of the Buffalo River AOC are toxic to biological communities. The absence of toxicity at all sites in the AOC suggests that slight-to-moderate community impacts were linked, not to legacy contaminants in sediments, but to the lentic conditions which exist in the Buffalo River AOC. This finding is consistent with that observed in other urban

AOCs and suggests that little additional improvement should be expected in the condition of benthic macroinvertebrate communities in the Buffalo River AOC as long as it remains a dredged navigation channel characterized by lacustrine conditions.

The BUI removal criteria states "Benthic macroinvertebrate communities are non-impacted or slightly impacted according to NYSDEC indices; AND in the absence of conclusive community structure data, the toxicity of sediment-associated contaminants is not statistically higher than controls." Multiple factors discussed in this report (insufficient number of organisms in the multiplate and Ponar data and dominance of zebra mussels in the multiplate data) indicate community structure data are inconclusive therefore the toxicity criteria must be met to redesignate the benthos BUI as not impaired. The results of the toxicity testing conducted by USGS and NYSDEC in 2017 and 2020 and by USACE in 2018 reflect high survival and suggest no evidence of toxic impacts to the biological communities due to bottom sediments (George et al. 2022).

As stated in Section 4, the toxicity data indicates the benthic community is not impaired due to contaminated sediments, therefore the BUI criteria has been met. The NYSDEC has determined the *Degradation of Benthos* BUI can be removed from the list of designated impairments for the Buffalo River AOC in accordance with EPA guidance and the GLWQA. The Buffalo River RAC fully supports the removal of this BUI.

6.3 Post-Removal Responsibilities

6.3.1 New York State Department of Environmental Conservation

Through the statewide RIBS ambient water quality monitoring program, NYSDEC will continue to monitor water quality in the AOC. Biological (macroinvertebrate) samples are collected every five years at Ohio Street Bridge. The water sample is analyzed for a wide range of potential contaminants, and it includes toxicity bioassays using *C. dubia* every five years.

Through the State Pollutant Discharge Elimination System (SPDES), NYSDEC will continue to regulate point source discharges of industrial and municipal wastewater and stormwater in accordance with the federal Clean Water Act. There are several point-source discharges in the AOC as well as outside of the AOC upstream the Buffalo River.

Additionally, NYSDEC will continue to provide regulatory oversight for inactive hazardous waste sites within the Buffalo River watershed that have not yet completed remedial activities to control contaminant releases to the river.

6.3.2 United States Environmental Protection Agency

The USEPA will continue to provide funding for RAP/RAC Coordination and technical resources to the extent resources are available to support the removal of remaining BUIs and ultimately the delisting of the AOC.

6.3.3 Buffalo Niagara Waterkeeper

BNW will continue to serve as the RAP coordinator for the Buffalo River AOC until EPA/GLRI grant funding expires. As RAP coordinator, BNW facilitates RAC meetings, provides technical and administrative assistance for AOC documentation, serves as the primary point of contact for the AOC, and coordinates the overall implementation of the RAP for the Buffalo River AOC.

6.3.4 Erie County Department of Environment and Planning

Erie County Department of Environment and Planning will continue to partner with BNW in implementing responsibilities associated with the Buffalo River RAP until EPA/GLRI grant funding expires. Erie County staff participate in RAC meetings, provide feedback on AOC-related documentation and progress reports, and capacity support for the Buffalo River AOC.

6.3.5 Remedial Advisory Committee

The RAC will continue to forward the objectives of the RAP by evaluating, supporting, and documenting the restoration of the Buffalo River AOC, until all the Beneficial Use Impairments are restored and the long-term goal of delisting the AOC can be achieved.

6.4 Future Recommendations

In addition to post-removal responsibilities mentioned above, it is recommended that an adaptive management approach is taken to monitor the areas of restoration and identify potential threats that may occur after BUI removal so that success of restoration activities can be sustained in the future. These threats may include impacts from invasive species, point and non-point source pollution, climate change, and other factors that may negatively impact the benthic community.

The Lake Erie Nine Element Watershed Management Plan (Lake Erie 9e Plan), currently being drafted, details water quality concerns and a strategy to address those concerns. The nine elements are intended to ensure that the contributing causes and sources of nonpoint source pollution are identified, and that restoration and protection strategies are identified that will address the water quality concerns. Implementation of the Lake Erie 9e Plan is expected to result in improved water quality in the tributaries that are within New York's portion of the Lake Erie watershed, including the Buffalo River.

As feasible and as funding allows, NYSDEC will work with local partners to develop a plan for continued monitoring of conditions within the AOC after delisting, and to maintain the improved conditions leading to the removal of the Degradation of Benthos and other BUIs NYSDEC will also continue to work with other federal, state, and local partners to pursue projects under the binational Lake Erie Lakewide Action and Management Plan (LAMP) that will further contribute to restoration of the Buffalo River and its surrounding watershed.

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