EXECUTIVE SUMMARY

- The remedial action process for the Buffalo River Area of Concern (AOC) is at the stage that aquatic habitat restoration projects (including removal of contaminated sediment) are being considered. The objective of this study was to document the biological, water quality, and use characteristics of 10 promising habitat restoration sites located between Michigan Avenue and the river's confluence with Cazenovia Creek. All habitat restoration sites are located in shallow water areas near the shoreline and outside of the designated navigable channel. As part of the evaluation, the study developed a characterization matrix for each of the 10 candidate sites. The matrix was designed to serve as guidance for stakeholders and decision makers, allowing them to quickly review comprehensive assessments of the potential for effective habitat remediation.

- Larval fishes were sampled at the 10 study sites in June and August of 2003 and 2004 (four surveys total). Larval fish were collected at each site using two 0.5 m plankton nets with 560 μm mesh. The nets were towed at a speed of approximately 50 cm per second for 15 min in a circular pattern (shore to shore, but within the dredged channel of the river). One net was towed near the surface (depth of 1.0 – 2.5 m) and one closer to the river bottom (depth of 2.5 – 6.5 m).

- Sampling for juvenile and adult fish was carried out in June and August of 2003 and 2004 (four surveys total). Buffalo State College's 18' electrofishing boat, equipped with a Smith-Root type VI-A electrofishing unit, was used for each survey. At each site a single pass was made along both shorelines for a total of 300 seconds per site. Pulsed direct current was used at a pulse rate of 30-60 pps; output was maintained at approximately 3,000 watts for each survey.

- Benthos was sampled using a Ponar dredge at the 10 habitat restoration sites and at six sites within the dredged navigation channel. Samples were collected three times between mid-June and the end of October, 2003 and twice between the end of June and end of September, 2004.

- Presence/absence vegetation surveys were conducted at the 10 habitat sites in August, 2004 and 2005, while percentage of overhanging shoreline cover was estimated both from field observation and detailed digital satellite imagery.

- Water quality was evaluated principally through the use of Hydrolab Datasonde 4a's to measure dissolved oxygen, pH, turbidity, temperature, and conductivity. Hydrolabs were installed at three sites (two sites near the top of the AOC and Ohio St. Bridge) to continuously monitor these parameters from June through September of 2003 and 2004. Suspended sediment samples were collected once per week at the three Hydrolab sites. In addition, a Hydrolab Datasonde 4a was used to measure the same analytes at all 10 habitat sites, at three depths, 0.5 m below the surface; 1.0 m below the surface; and near the bed. This profiling was

done once per week for 16 weeks in 2003 and 17 weeks in 2004. Finally, sampling was done for *Escherichia coli* analysis during a major runoff event and three dry days in September, 2004.

- A recreational use survey of the habitat sites and 15 other sites along the AOC was conducted by boat for a total of 73 days in 2003-04. The surveys were done during randomly selected time slots (7-9 am; 9am-12 pm; 12 pm-3 pm; 3-6 pm) on randomly selected days of the week.

- The larval fish sampling showed similar species diversity and abundance in 2003-2004 as compared to 1993 (8-10 species found). No site-specific trends were observed.The adult/juvenile fish sampling showed similar species diversity and abundance in 2003-2004 compared to 1993 (15-20 species across all sites). Lowest species diversity occurred at sites 1, 2, 5, and 10.

- DELT anomalies: varied greatly among species, with a low of 14% in pumpkinseed to a high of 87% in brown bullhead. For the river as a whole, DELT scores averaged 37%, which is much higher than what would be expected for a moderately impacted (2-5%) or unimpacted (<2%) river.

- Index of Biotic Integrity (IBI): Low site-specific species diversity and high DELT scores contributed to low IBI scores. Seven sites (#3, 4, 5, 7, 8, 9, and 10) would be rated "poor" and three (#1, 2, and 6) "very poor" using standard IBI criteria.

- Overall: Based on species diversity, IBI, and DELT scores, sites 3, 4, 7, and 8 tended to score higher in terms of fish community health while sites 1, 2, 5, 6, 9, and 10 tended to score lower.

- The Buffalo River AOC continues to be dominated by a low diversity benthic invertebrate community that is broadly tolerant of pollution and environmental degradation. High densities of tubificid oligochaeates (though lower than historical maxima), and their numerical dominance of the benthos, suggest poor environmental health. Oligochaete densities were higher in the channel than at shoreline habitat restoration sites. Fewer invertebrate families were collected in this study than in the early 1990's, possibly even indicating some reversal of biotic recovery. Substantially more families occurred at shoreline sites than in the channel, although the habitat restoration sites were still dominated by pollution-tolerant oligochaetes and chironomids. Likewise, chironomid taxonomic richness was markedly higher at habitat restoration sites than in the channel, but samples largely constituted pollution-tolerant species and genera. Chironomid mouthpart deformities remain very high at channel sites (as they were in 1990-93), but, interestingly, all of the rather limited number of larvae from shoreline sites had developed normally.

- More than 50 plant species were collected from the Buffalo River shoreline and herbaceous vegetation was well-developed at all sites. The 10 potential restoration

sites differed considerably in their development of overhanging cover, ranging from 0 to 80%. Submerged macrophyte beds are not extensive, but are present at most sites. The presence of invasive plant species, including tree-of-heaven, Japanese knotweed, purple loosestrife, and submerged Eurasian watermilfoil degrades many of the sites and should be subject to eradication campaigns as part of habitat restoration efforts.

- Dissolved oxygen levels frequently were below state guidelines within the dredged portion of the AOC (representing all habitat sites except Site 1), while levels upstream of the dredged channel more frequently were above state guidelines. The low dissolved oxygen levels appear related to a combination of thermal stratification, system hydraulics, high sediment oxygen demand, and background biochemical oxygen demand. At the habitat sites, dissolved oxygen tended to be lower near the riverbed and higher near the surface. During dry periods, turbidity was relatively low (<20 NTU) in the upper 1m at all habitat sites, increasing to about 20-100 NTU near the bed. Turbidity increased during storm events, occasionally reaching values of 1,000 NTU. The levels of *E. coli* were high during the sampled storm event (up to 38,700 m.o./100 mL) and lower (50-2,200 m.o./100 mL) during dry periods. These results were consistent with past studies and re-emphasize the importance of the upper watershed as a source of bacteria.

- A total of 887 person-days of activity were observed through the recreational use survey. Fishing, boating, and "hanging out" in riparian areas were the most frequently observed activities (27%, 28%, and 22% of all activity, respectively). Swimming represented 3% of the observed activities. The observed level of 887 person-days underestimates actual activity because it only represents a three hour segment of each sample date. Adjusting the sampled person-day activity to reflect all daylight hours for the entire week, it is estimated that actual activity may have been on the order of 12,784 person-days in 2003-04. There was spatial variability in the frequency of activity, with habitat sites 3, 4, 5, 6, 8, and 10 having the lowest level of activity of all survey sites (≤8 person-days (unadjusted value) over the two year period).

- The site evaluation matrix was developed using an index approach for various biotic and abiotic categories. The benthic indices included the number of benthic families, oligochaete density, and the product of chironomid biotic score and number of chironomid taxa. The fish indices included species diversity, Index of Biotic Integrity, and DELT (Deformities, Eroded fins, Lesions, and Tumors). The vegetation indices were shading (% overhang) and macrophyte species diversity. The water quality indices were the National Sanitation Foundation Water Quality Index (dissolved oxygen, pH, turbidity) and the Canadian Council of Ministers of the Environment Water Quality Index (dissolved oxygen only). No single site scored consistently high in all indices. Based strictly on the aggregate matrix scores, habitat sites 4, 7, and 8 had the best biological/water quality health while sites 2, 5, 6, and 10 scored lower. Interestingly, based on a recent Corps of

Engineers study, habitat sites 7 and 8 had PAH values in sediment that exceeded probable effect level for benthic organisms.

- Ecological integrity, as reflected by biota and water quality, certainly has improved in the Buffalo River AOC, as compared to 1970's conditions. However, there does not appear to be any improvement since the early 1990's. Habitat restoration measures such as improved overhang cover, macrophyte plantings, eradication of exotic plant species, removal of old dock pilings, naturalization of shorelines, or removal of contaminated bed sediment could improve ecological integrity at selected sites. Constraints on ecological integrity that may prove more challenging to overcome include warmer water temperatures and low dissolved oxygen levels.

- Chapter 8 has been prepared by Buffalo Niagara Riverkeeper based on our own interpretation of the data reported by Buffalo State College and Youngstown State University, and is therefore outside of the Buffalo River Remedial Advisory Committee recommendations of required actions. Riverkeeper strongly supports the findings of the water quality, benthic, fishery, and vegetation analysis. Riverkeeper suggests a continuation of river usage surveys into the future in combination with a market analysis of the river corridor. Riverkeeper strongly supports the ranking and evaluation system that was created for the "Site Characterization Matrix," though Riverkeeper wants to emphasize that the ranking system is just one of many tools available to decision-makers when prioritizing sites for restoration.

- The next steps for the data generated from this study include: the application of the results in the USACE's Environmental Dredging Feasibility Study, and the use of the data during the development of the updated Buffalo River Remedial Strategy and Delisting Criteria/Restoration Targets. Riverkeeper will coordinate an effort to fully investigate sites 5 and 6 regarding its unexplained poor ratings and high deformities. In addition, Riverkeeper will coordinate with the local efforts dedicated to Inner Harbor revitalization in terms of obtaining additional user surveys and a market analysis of the AOC in the near future.

- Buffalo River stakeholders will use this site matrix to prioritize restoration efforts and to identify possible funding sources, generate local community support, and coordinate partnerships for the implementation of recommended remedial actions-as identified by the Buffalo River Remedial Advisory Committee.

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