

Cascade Metro Park Cuyahoga River Restoration Valley View Phase 2 (NA16NMF4630341)

Post-Construction Monitoring Report: Year I (2021)

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Describing the methods and results of multiple metrics for post-construction monitoring for the former Valley View golf course restoration project in Cuyahoga Falls, Summit County, Ohio.

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I INTRODUCTION

This report summarizes the post-construction and restoration monitoring efforts and results for the Cascade Metro Park Cuyahoga River Restoration Valley View Phase 2 Project (NA16NMF4630341) (*Project*), the methods for which are outlined in the Monitoring Plan for the Cascade Metro Park Cuyahoga River Restoration Valley View Phase 2 Project (NA16NMF4630341) (*Monitoring Plan*) [1]. Monitoring was conducted by Summit Metro Parks (SMP) biologists as well as EnviroScience, Inc., outside contractors.

Phase 1 Objectives:

The Project’s Phase I Objectives were to restore the 200-acre property from a heavily altered golf course back to an ecologically well-functioning section of the Cuyahoga River by and natural habitat by:

- Restoring approximately 33 acres of wetlands from former water hazard ponds
- Restore approximate 4,500 linear feet of headwater stream
- Remove exotic species throughout the property
- Seed approximately 200 acres with native seed mixes
- Reforest approximately 116 acres of the property

Phase 2 Objectives:

Phase 2 Objectives, about which this report is concerned, were to restore approximately 5,000 feet of the Cuyahoga River to remove Area of Concern (AOC) Beneficial Use Impairments (BUI) by implementing the following Project goals measured by the following performance goals.

Table 1: AOC BUI Project Goals and Performance Goals

Project Goals	Performance Goals	Monitoring Method
Improve the in-stream habitat to primarily focus on removing BUIs for fish population, benthos, and loss of fish habitat	Attainment of WWH Criteria with IBI Narrative Range Scores of ≥ 40 or 36-39	Ohio EPA biological criteria for IBI
	Attainment of WWH Criteria with ICI Narrative Range Scores of ≥ 34 or 30-33	Ohio EPA biological criteria for ICI
	QHEI 74-84	Ohio EPA biological criteria for QHEI
Restore hydrologic connection to an accessible floodplain	Bank Height Ratio 1.0-1.2 in Tier 1 floodplain expansion areas	Morphologic Cross Section Survey
	Increase bankfull recurrence interval flood prone width by at least 2x in floodplain expansion areas	Morphologic Cross Section Survey
	Verify regular inundation / utilization of restored floodplain areas	Visual Observations / USGS Gage readings / On-site water level monitor

Funding was secured from the National Oceanic and Atmospheric Administration (NOAA), The Great Lakes Commission (GLC), and Ohio Public Works, Clean Ohio Conservation Fund (Clean Ohio). Project

success and attainment is measured by several required metrics for reporting. Deviations from the monitoring plan, supplemental monitoring, and recommendations for further monitoring will be discussed in applicable sections in the body of the report.

Table 2: Monitoring Schedule

Monitoring Effort	Agency Reporting Requirements	Monitoring Year				
		Year 1 (2021)	Year 2 (2022)	Year 3 (2023)	Year 4 (2024)	Year 5 (2025)
As-Built Survey	NOAA, AOC/Ohio EPA	X				
Stream Morphology	NOAA, AOC/Ohio EPA	X	X	X	X	X
IBI	AOC/Ohio EPA	X		X		X
QHEI	AOC/Ohio EPA	X		X		X
ICI	AOC/Ohio EPA	X		X		X
USGS Staff Gage	NOAA, AOC/Ohio EPA	X	X			
Wrack Line Photos	NOAA, AOC/Ohio EPA	X	X			
Reporting	NOAA, AOC/Ohio EPA	X	X	X	X	X

Instream habitat enhancements included boulder and cobble clusters, as well as woody debris placements. Boulder types are ODOT A+, A, B, C, and D sizes, arranged as per plan. Specified quantities are included below.

Table 3: Cuyahoga River Habitat Enhancement Structure Descriptions and Quantities

Habitat Item	Quantity
Boulder Structures	359
Woody Habitat Structures	117

2 METHODS

Monitoring methods listed below are derived directly from the Monitoring Plan [1].

2.1 HABITAT METRICS

2.1.1 Qualitative Habitat Evaluation Index (QHEI)

The fish community habitat was evaluated at each fish sampling location using the QHEI [2]. Habitat assessments were conducted in conjunction with the fish community assessments. Data was recorded using the Ohio EPA QHEI form that is included in Attachment B. All habitat assessments will be conducted by personnel who have met the Ohio EPA Level 3 QDC requirements for habitat assessment (QHEI), fish community evaluation, or both. In addition, proposed biological and habitat data collection and evaluation methods will meet the quality criteria for Level 3 Credible Data under Ohio EPA's credible data program and will be conducted or directly overseen by staff who have received Level3 QDC status for the various disciplines.

2.1.2 As-Built Survey / Stream Morphology / Hydrologic Reconnection

Per the Monitoring Report [1]: To satisfy NOAA Tier I monitoring requirements for hydrologic connectivity, as well as address the Ohio EPA BUI for hydrologic connectivity, EnviroScience completed an as-built survey with spatial coverage and resolution that is comparable to the level of detail and contours available from pre-design surveys and in the design drawings. The as-built drawings show the final elevations and cross sections of the channels, and land installed or altered by the project. Summit Metro Parks also evaluated morphologic cross sections following the approved QAPP and methods outlined within that document using sound surveying practices. Permanent cross-section pins were established to facilitate annual re-survey. Cross sections were established during the as-built phase of the project and marked with a start and end pin.

The cross-section locations identified in Attachment A are designed to evaluate the major work areas of the project and to demonstrate hydrologic reconnection of floodprone areas. These cross sections will be surveyed annually to evaluate changes each year for the duration of the monitoring period (five years). Data collection shall be performed by a qualified person that is trained in the identification and survey of morphologic features, as outlined in the approved QAPP.

The cross-sectional evaluation will identify key features annually at each cross section to facilitate comparison and analysis. Bankfull is a key feature that marks the active floodplain and provides a consistent reference point for use in comparing rivers. It is generally associated with the point prior to floodplain inundation. Correct identification is necessary for stream classification and description of morphological variables. Personnel performing the monitoring seek indicators in locations appropriate for stream types and use multiple indicators to reinforce bankfull estimates. Bankfull indicators should be generally consistent through an entire reach and at a consistent elevation above the water surface.

Each cross section begins on the top of the start pin called the "left end pin" (LEP) on the left bank of the river. The left and right banks are defined in a downstream direction. Cross-sectional data were recorded using specific notation to denote key features. Data recorded in-between key features were recorded with a "ground" or "g" note. The toe of the floodplain and top of bank on the grade out to the original terrace shall be identified. Bankfull (BKF) feature(s) were identified, at a minimum, on one bank right or left. The active channel begins below the bankfull

location. Recording of station and elevation will continued into the active channel with changes every 0.1-0.3 ft in elevation. All shots were recorded as stream bed (SB) unless they are the following required locations. The stations and elevation of the current left and right edges of water (LEW and REW), which is where the water level hits the side of the bank, were marked. The thalweg (THL) was identified in each section. The thalweg is deepest point in the channel.

See the diagram below as a visual representation of the key features for each cross section. The number of points will vary for each section to capture the proper detail.

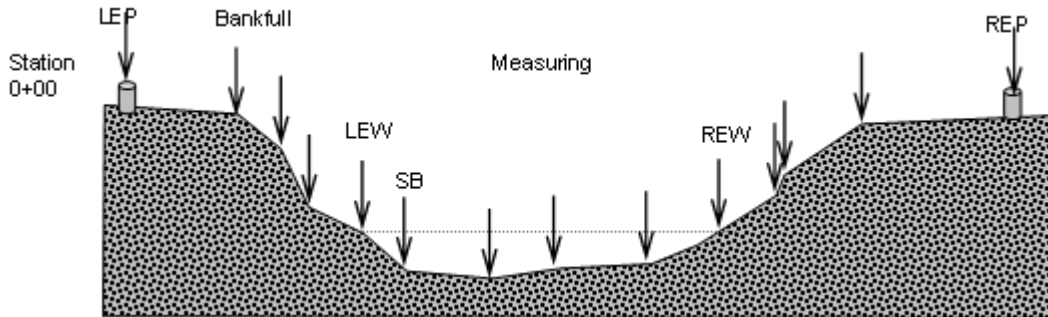


Figure 1: Key Features for Each Cross Section

2.1.3 USGS Staff Gage / Flood Monitoring

The USGS gage (USGS 04206000 Cuyahoga River at Old Portage OH) was used to determine major flooding events. Supplemental river level data was supplied by two Intellisense Systems, Inc. (20600 Gramery Place, Torrance, CA 90501; 310.320.1827) monitors installed at the southeast and northwest areas of the Project. Representative photos of river levels and debris were taken during flooding events where the Cuyahoga River has risen into the adjacent floodplain.

2.2 BIOTA METRICS

2.2.1 Index of Biotic Integrity (IBI)

Per the Monitoring Plan [1]: Fish sampling was conducted using a pulsed DC current electrofishing unit via the boat electrofishing method, which has been selected due to the stream size and drainage area exceeding 300 square miles. The drainage area at the site is approximately 402 square miles. Fish were collected and placed in a live well for identification and enumeration. Sampling consisted of shocking all available habitat types within a 500-meter zone from an upstream to downstream direction. Fish specimens were identified to species level in the field, counted, and examined for the presence of external anomalies, including DELTs (deformities, eroded fins, lesions, and tumors). The three sampling sites have a mix of water depths and current velocities, which create unique and, at times, hazardous electrofishing conditions. Samplers and crew leaders modified techniques to get a representative sample of the community. These techniques included, but were not limited to, multiple passes through high velocity areas, walking the boat using the boom as a modified “sport yak” method, using at least two netters, and being extra cautious to capture darter species that remain on the bottom between rocks.

Fish assessments were conducted on two dates (two passes). All fish assessments were conducted during the sampling season and occurred between the dates of June 15 through September 30.

Sampling passes at the project were separated by a period of 4-6 weeks. Photos were taken of each species collected and representatives from each species were preserved as a voucher for the verification of the field identifications. Endangered species and those too large for preservation were not be collected as voucher specimens, but were instead be photographed and returned to the stream. Photographed vouchers included features that permit definitive identification of the species. Fish were preserved in 10 percent formalin in the field.

Field water chemistry assessments were conducted at all the sampling sites at the time of each biological sampling event. Field measurements were taken using a portable YSI Pro DSS Multi-Parameter Water Quality Meter, or equivalent. Measurements were taken for water temperature, pH, specific conductance, and dissolved oxygen. The field meter was calibrated in accordance with the manufacturer's specifications prior to each sampling event.

One to two fish specimens of each species collected were preserved in the field using a 10 percent formalin solution. Upon receipt in the laboratory, specimens were processed for permanent storage using the following procedure:

- Allowed to set for 5 to 7 days.
- Soaked in tap water for 24 to 48 hours.
- Transferred to solutions of 30 and 50 percent ethanol for 5 to 7 days each.
- Transferred to a final preservative of 70 percent ethanol for long-term storage.

Specimens larger than six inches were slit along the right side and then soaked in formalin for approximately 10 to 14 days before being transferred to water and solutions consisting of 30, 50, and 70 percent ethanol. All identifications were conducted and confirmed by Level 3 QDC fish taxonomists.

For all sampling activities, stream flow conditions were assessed prior to travel to the facility for biological sampling to ensure that flood or drought conditions were not present that would hinder the collection of valid samples. This evaluation included the examination of National Weather Service data and forecasts, and USGS streamflow data from the nearby gauging station, Cuyahoga River at Old Portage (04206000). The site should be at base flow conditions, which are represented by a range of 100-300 cubic feet per second (cfs).

Fish community data was used to compute IBI scores in accordance with Ohio EPA protocols The Modified Index of Well Being (MIwb) was calculated for the boat sites. Attainment status will be summarized by comparing the results to the biological criteria listed in OAC 3745-1-07 and applicable Ohio EPA narrative scoring guidance.”

2.2.2 Invertebrate Community Index (ICI)

Qualitative macroinvertebrate samples were collected by sampling all available habitats using a kick net and hand picking of organisms from in situ substrates, debris, and plant materials. Sampling was conducted for a minimum of thirty minutes or until no new qualitative taxa were observed. Field observations regarding the types of macroinvertebrates observed, their relative abundances, and habitat and water quality observations will be recorded on a Macroinvertebrate Field Data Sheet. Field voucher organisms from all discernable taxa collected were preserved in 85 percent ethanol and taken to the laboratory for examination and identification to the lowest practicable taxonomic level following Ohio EPA protocols. The biological criteria for evaluating qualitative macroinvertebrate data is based upon presence of Ephemeroptera, Plecoptera and Trichoptera

(EPT) and sensitive taxa (ST) [3]. Sensitive taxa are defined as those considered intolerant and moderately intolerant to pollution.

3 RESULTS: RESTORATION METRICS FOR PHASE 2

3.1 HABITAT METRICS

3.1.1 Qualitative Habitat Evaluation Index (QHEI)

QHEI evaluations were conducted concurrently with IBI surveys at the two Project sampling locations. Scores increased significantly post-restoration, most-notably in the Substrate, Instream Cover, and Riffle / Run metrics due to the placement of boulder clusters, woody debris, and the in-stream creation of riffles. Both sites are in attainment of the restoration performance goals. It should be noted that Site 3 (Ohio EPA) was sampled pre-project.

Table 4: QHEI Scores for the Cuyahoga River within the Project Site in 2021

Metric	Cuyahoga River 2021 (Year 1)			
	Max. Pts.	Site 1 (Upstream) RM 42.1	Site 2 (Downstream) RM 41.6	Site 3 (Ohio EPA) RM 41.4
Substrate	20	19	19	13
Instream Cover	20	14	14	10
Channel Morphology	20	16.5	17.5	9.5
Bank Erosion and Riparian Zone	10	6.75	5	8.5
Pool / Glide Quality	12	12	12	9
Riffle / Run Quality	8	7.5	7.5	0
Gradient	10	10	10	10
Total QHEI Score	100	85.75 (Excellent)	85 (Excellent)	60.5 (Good)

Deviations from the Monitoring Plan: None

Recommendations for Continued Monitoring: None. QHEI evaluations will be conducted according to the Monitoring Plan again in Year 3 (2023)

3.1.2 As-Built Cross Sections / River Morphology

Per the monitoring requirements, four cross sections of the restored Cuyahoga River floodplain were completed. As-builts were reviewed and approved by project partners. See Appendix A for data sheets and Appendix C for relevant photos.

Four cross sections (XS1-XS4) were surveyed to document the post-construction condition (Attachment A Sampling Locations). Each cross section should be evaluated with consideration of each respective X and Y axis scale, especially the X axis as some cross sections are considerably wider than others. Table 2 provides a morphologic summary of the cross-sectional data with respect to the bankfull (BKF) indicators. Width depth ratio (W/D) is a parameter to describe channel shape. The Cuyahoga River in this reach is characterized as a Type C channel by the Rosgen classification system. In other words, it is a meandering, low gradient (>2.0%) stream in a wide terraced alluvial valley.

Table 5: Morphologic Cross Section Parameters Summary

XS	BKFW (ft)	BKF Area (ft ²)	BKF mean depth (ft)	BKF max depth (ft)	W/D	Feature
1	115.0	543.5	4.72	7.89	24.4	Riffle
2	94.0	422.1	4.49	5.97	20.9	Riffle
3	87.2	549.8	6.3	10.7	13.9	Pool
4	94.1	573.6	6.1	8.59	15.4	Riffle

Please see Appendix A for completed Cross Sections.

3.1.3 USGS Staff Gage / Flood Monitoring / Hydrologic Reconnection

Per the Monitoring Plan, two flow meters (Intellisense Systems, Inc.) were installed at the Project site to corroborate the USGS staff gauge just downstream (USGS 04206000 Cuyahoga River at Old Portage OH). Unfortunately, the monitors were plagued by technical faults just after installation. One unit was sent back for repair and was out of the field for more than 5 months. In lieu of consistently working on-site monitors, visual inspection and the USGS gage were utilized to determine major flooding events. See following Figure for 2021 gage data and USGS staff gage data. Blanks (null values) represent system / sensor errors for the onsite monitor.

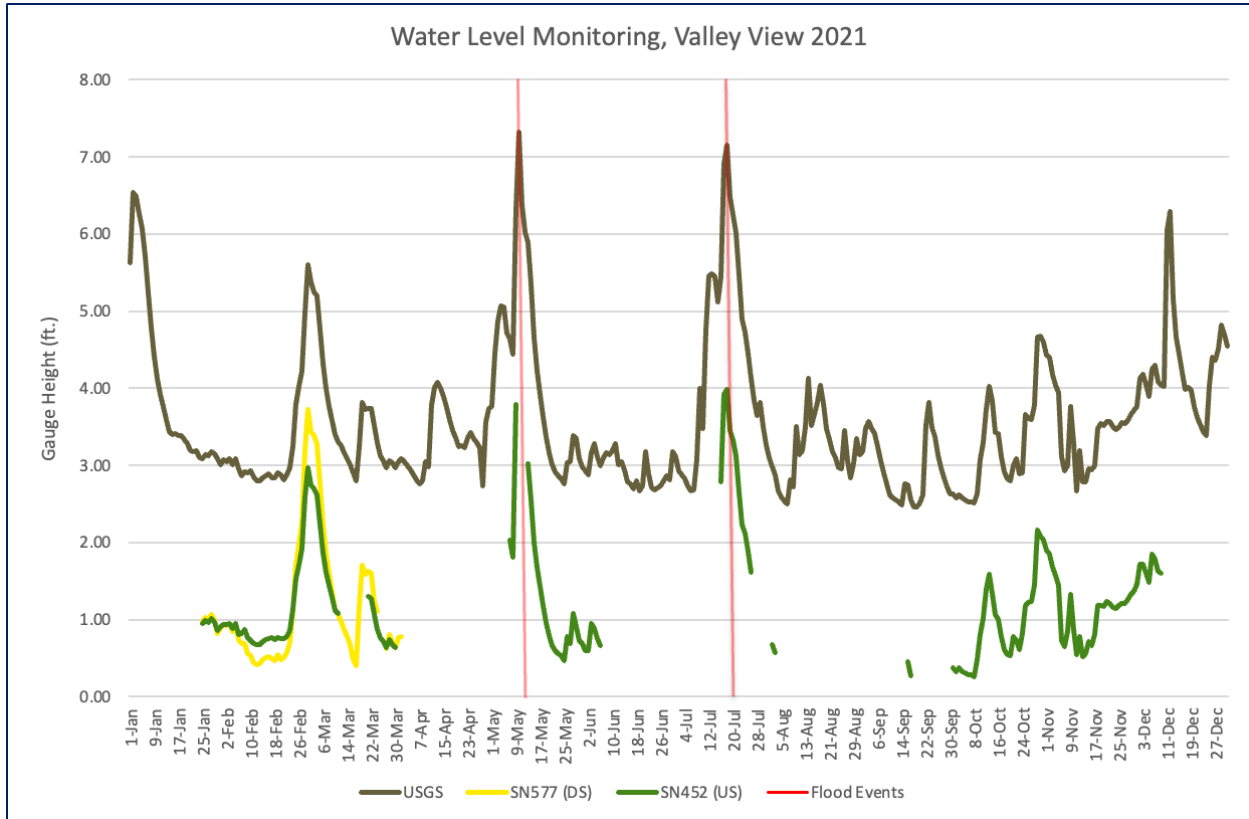


Figure 2: Correlation between USGS Staff Gauge and Onsite Gauges' Water Measurements, Valley View 2021

Gage height values were taken by assessing a daily average of readings for both the USGS and onsite gauges. USGS Gage height is measured in feet from a specific point along the Cuyahoga River, while the onsite gage measures water depth in inches so a division by 12 is necessary to standardize the datasets. While measurements were incomplete for the onsite monitors, the correlation is very close. The difference in gage heights can be explained by the starting depth of the gauges; onsite monitor sensors were placed in the shallows, while baseline for the USGS gauge was placed in a deeper portion of the river.

As part of the NOAA funding, a three-sided box culvert was installed under the existing access road and now permanent park trail to provide hydrologic connectivity with the Cuyahoga River and allow for fish passage upstream to the stream/wetland complex. This culvert does indeed connect approximately 15 acres of restored wetland and some 1,000 linear feet of restored headwater stream to the Cuyahoga River.



Photo 1: Point of Hydrologic Reconnection to the Cuyahoga River Functioning as Required

Two major flooding events were recorded in 2021, May 9 and July 18. Photos were taken May 9 to capture the Cuyahoga River breaking its previously entrenched banks to expand into the restored floodplain areas. Debris lines and original elevations can be seen in the photo. An additional flooding event took place on July 8, but the time-lapse cameras set to record the event were malfunctioning at that time and no photos were taken. This will be remedied for Year 2 (2022) monitoring by a combination of functioning flood monitors, USGS gauge, and on-site photography.



Photo 2: Flooding Event, May 9, 2021 at Valley View Showing River Elevations and Debris Accumulation

Deviations from the Monitoring Plan: Onsite flood/flow monitors were malfunctioning or non-operational for much of the monitoring period and therefore could not be completely correlated with the USGS data. Time lapse cameras set to record flood events also malfunctioned for a period of several weeks and missed one substantial flooding event.

Recommendations for Continued Monitoring: Monitors will be re-deployed in 2022 and will be used to corroborate USGS data for Year 2 (2022). Time lapse cameras will be used in conjunction with flood monitors / USGS data to alert SMP staff to major flooding events and on-site photos will be taken as well.

3.2 BIOTA METRICS

3.2.1 Index of Biotic Integrity (IBI)

Summit Metro Park biologists, under the Level 3 Qualified Data Collector (QDC) credentials of EnviroScience, Inc, conducted two sampling events each at the two prescribed sites in the restored sections of the Cuyahoga River. Table 6 indicates the ecoregional biocriteria for the boat survey method. Table 3 provides a summary of IBI sampling locations, numerical scores, narrative scores, as well as attainment statuses. See Appendix C for photos of fish sampled during the events.

Table 6: EOLP Biological Criteria for Boat Method (Fish)

Narrative	IBI	Miwb	Note
Exceptional	≥48	≥9.6	
Very Good	44 - 47	9.1 - 9.5	

Narrative	IBI	Miwb	Note
Good	40 - 43	8.7 - 9.0	Bold = Biological Criterion
Marginally Good	36 - 39	8.2 - 8.6	Non-Significant Departure Range
Fair	26 - 35	6.4 - 8.1	
Poor	16 - 25	5.0 - 6.3	
Very Poor	<16	<5.0	

Fish community assessments were conducted during the 2021 sampling season between the dates of June 15 and September 30th. Field data forms for the fish collection events are provided in Attachment C. Sampling methodologies differed slightly in 2021 as compared to 2019. First, two rounds of fish collection were conducted in 2021 vs. a single round in 2019. The single round of sampling in 2019 was due to project timing and only one sample could be obtained prior to the season expiring. In addition, in 2021 the sampling of riffles within both sites was aided by using long-line wading electrofishing equipment in the shallows vs. wading in the proximity of the boat during the 2019 effort (use of Ohio EPA Method C in 2021 vs. Method B in 2019).

In 2019, there were 18 species collected cumulatively between Sites 1 and 2. The number of fish species collected in 2021 increased to 26 cumulative species between the two site sites. In 2021, there was a drop in species richness and abundance noted in the late summer (i.e., the second round) samples, but the number of species capture still exceeded the 2019 sample. Overall, the increase in species diversity and particularly abundance was an improvement over the baseline sample.

Notably, one of the species that was collected in 2021 was a Flathead Catfish (*Pylodictis olivaris*). This species is not indigenous within the Lake Erie drainage and had not previously been collected as far upstream from Lake Erie. However, the removal of the Route 82 dam downstream of Valley View Park may have allowed this species to move upstream from Lake Erie, as it is known to have become established there. This is the first record of its capture in a scientific sample from the Cuyahoga River in the vicinity. It should be noted that it is also possible that this species may have migrated downstream from the Tuscarawas River via the Summit Lake - Ohio Canal connection of the Tuscarawas River to the Little Cuyahoga River. This route presents a danger for the Cuyahoga River and Lake Erie for the migration of Asian carp from the Ohio River basin to the Great Lakes that could affect Valley View Park in the future. A large Northern Pike (*Esox lucius*) was also captured during the sampling of Site 1 during both rounds of sampling in 2021 which was a new and desirable species for the site.

Attainment status with respect to fish community integrity is determined based upon comparison to Ohio EPA ecoregional biocriteria index scores for the IBI and the MIwb. Narrative rankings listed are assigned according to current Ohio EPA guidance. The aquatic life attainment status and results for the habitat and biological evaluations for the 2019 and 2021 fish surveys for the Cuyahoga River in the Valley View site are summarized in the table below. Note that scores within the Marginally Good narrative range are considered to be non-significant departures from the applicable ecoregional biocriteria and are deemed to be in attainment for the respective index.

Table 7: IBI Sampling Locations, Scores, and Attainment Status

Year/RM	Date	Drainage (mi ²)	Sampler Type	QHEI	IBI	MIwb	Narrative	Attainment
2019 (Baseline)								
42.1 (Site 1)	10/4/2019	401	A	73.50	34	6.93	F ¹ /F	NON
41.6 (Site 2)	10/4/2019	402	A	68.75	30	5.07	F/P ²	NON
41.4 (OEPA)	10/3/2019	402	A	60.5	38	7.51	MG ³ /F	PARTIAL
2021 (Year 1)								
42.1 (Site 1)	8/6/2021	401	C		36	8.39	MG/MG	FULL
	9/29/2021	401	C		38	7.83	MG ^N /F	PARTIAL
	Average			85.75	37	8.11	MG/MG	FULL
41.6 (Site 2)	8/6/2021	402	C		38	7.83	MG/F	PARTIAL
	9/29/2021	402	C		30	6.27	F/P	NON
	Average			85.00	34	7.05	F/F	NON

Baseline (2019) scores indicate non-attainment for these ecoregional biocriteria within the Project area. The improvement in the 2021 data indicating “Full” and “Partial” attainment is a positive outcome following the restoration activities. Continued monitoring will demonstrate if this is permanent uplift or temporary but the increase in habitat quality as noted in 2021 QHEI scores are a substantial improvement that may be responsible for the increase.

The post-construction 2021 samples showed a positive shift in the number of individuals captured both in terms of total fish captured and the relative numbers minus pollution tolerant and non-native species that positively affect the IBI scores. Overall attainment of the Ohio EPA biocriteria improved at both sites with Site 1 found to be in attainment and Site 2 found to be in Partial Attainment for one of the 2021 sampling passes. Attachment A provides a site-by-site summary of these results, but for example Site 1 in 2019 had only 113 individuals captured which corresponds to a total relative number of 226 individuals per km (198 per km when tolerant and non-indigenous fish are removed). In comparison, the 2021 sampling resulted in an increase to an average relative number of 806 individuals per km for the two passes at Site 1 (696 individuals per km when tolerant and non-indigenous species are removed). This equates to an increase in abundance of 2.5 times the number observed in 2019. The results for Site 2 were similar as the overall

¹ F = Fair (significant departure from ecoregional biocriterion for attainment)

² P = Poor (significant departure from ecoregional biocriterion for attainment)

³ MG = Marginally Good (non-significant departure from ecoregional biocriterion for attainment)

catch increased from 90 individuals per km to 303 per km between 2019 and 2021 (roughly a 3-fold increase in fish abundance).

A notable shift in the fish community was the change in dominance of biomass between White Suckers as compared to Northern Hog Suckers (*Hypentelium nigricans*) observed when comparing data from 2019 to the 2021 surveys. This change was particularly evident during the first round of sampling in August of 2021 but holds true for the 2021 averaged data as well. At both sampling sites, the relative numbers and relative biomass of White Suckers showed little change between years, but four and nine-fold increases in numbers and biomass of Hog Suckers between the 2019 and 2021 assessments. The Northern Hog Sucker is an insectivorous species listed by Ohio EPA as a sensitive species that does not tolerate pollution well. Increases in the abundance of this species is a good indicator of ecological recovery. It is anticipated that as time passes, additional round bodies sucker species such as Redhorse (several possible species) and Spotted Sucker (*Minytrema melanops*) will migrate up the Cuyahoga River to become reestablished within the Valley View Park. The recent removal of the last dam between Valley View Park and Lake Erie bodes well for this to occur in the near future.

It is also notable to see a substantial increase in River Chub (*Nocomis micropogon*), as they became the most abundant fish species numerically in 2021 at both sampling locations. In 2019, River Chub were only represented by 10 individuals between the two sites while in 2021 they were represented by 342 individuals in the first round of sampling. It is also notable that Small Mouth Bass (*Micropterus dolomieu*) abundance and bioamass appear to be unaffected by the restoration work, as both measures remained stable at both sampling locations.

Table 8: Comparison in Relative Numbers of Fish, % Tolerant Fish, and Relative Biomass, Valley View 2019 and 2021

Station ID and Year	Site 1 2019	Site 1 YR 1 2021	Site 2 2019	Site 2 YR 1 2021
Indiv./km (Total)	226	806	90	303
Indiv./km (Excl. Tolerant & Non-Native)	198	696	46	298
Percent Tolerant (by Weight)	12.4	10.4	46.7	16.8
Rel. Weight (kg/km)	8.89	25.86	9.99	6.9

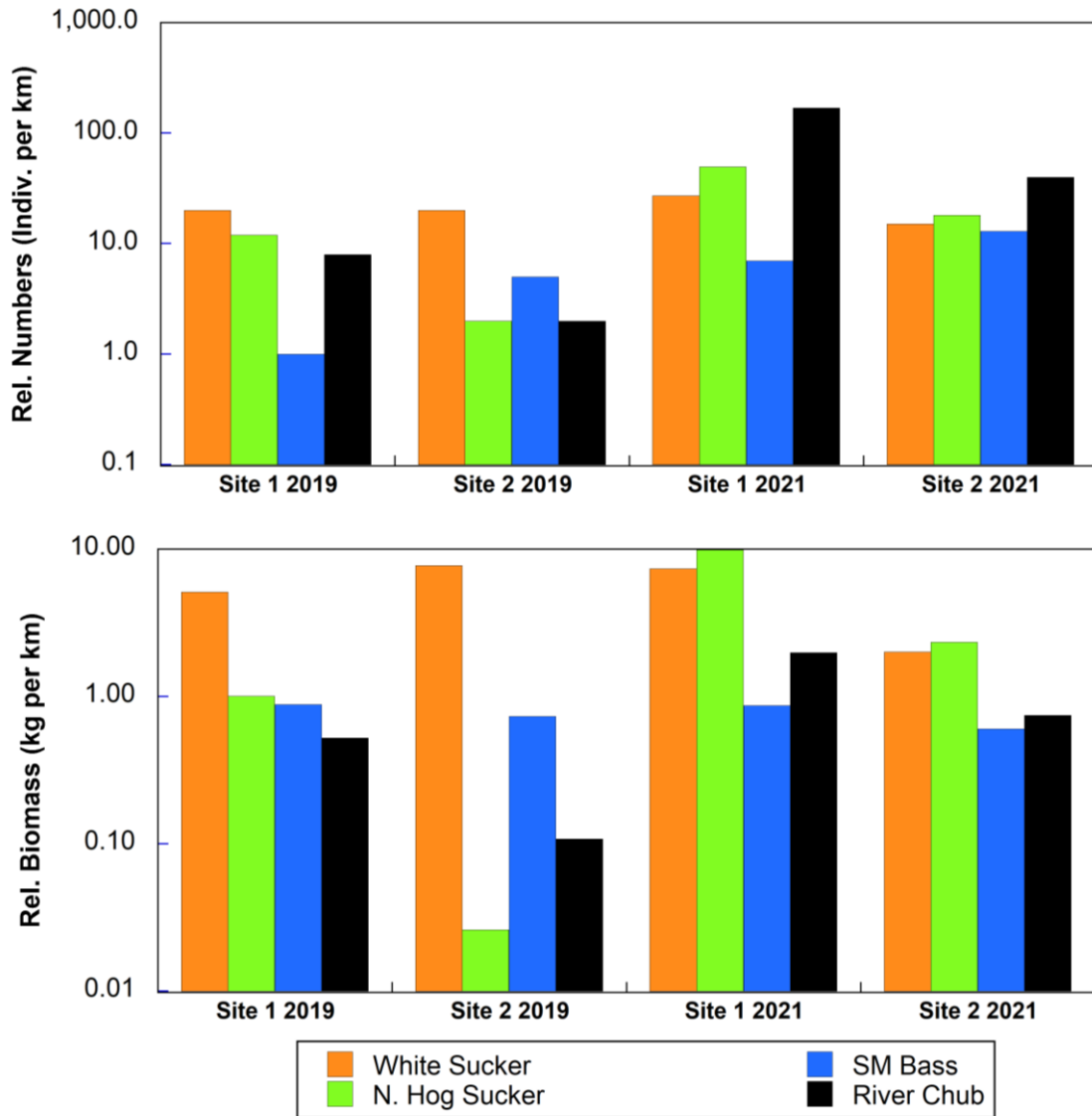


Figure 3: Comparison of relative numbers and relative biomass for White Sucker, Northern Hog Sucker, Smallmouth Bass, and River Chub for Sites 1 and 2 in 2019 and 2021 samples.



Photo 3: Flathead catfish (*Pylodictis olivaris*) from IBI Sampling in 2021

Water chemistry results taken concurrently with sampling events (Table 8). The results show the values and ranges of the parameters are within acceptable ranges for warm water habitat in Ohio.

Table 9: Water Chemistry Results

Site(s)	Date	Conductivity	Temp (C)	Dissolved Oxygen (mg/L)	pH
Sites 1 & 2	8/7/2021	605	22.5	8.40	8.13
Sites 1 & 2	9/30/2021	542	19.8	10.17	8.57

3.2.2 Invertebrate Community Index (ICI)

Qualitative macroinvertebrate sampling was conducted at Sites 1 and 2 during the sampling season. A fine mesh seine net was used to capture organisms dislodged from various substrates for a period of at least 30 minutes per sample. Field observations regarding water and substrate conditions as well as types of macroinvertebrates captures, and relative abundances were recorded using a Summit Metro Parks Stream Assessment form (standard form for all stream assessments conducted by SMP volunteers and staff). Specimens were preserved in ethanol for further taxonomic analysis [4]. Macroinvertebrate samples are evaluated for the presence of *Ephemeroptera* (mayfly), *Plecoptera* (stonefly), and *Trichoptera* (caddisfly) (EPT) taxa as well as pollution sensitive taxa (ST) to determine qualitative stream health. Table 5 lists the ranges for determining WWH / CWH or Exceptional WWH (EWH) for qualitative macroinvertebrate sampling. Table 6 lists the results of macroinvertebrate sampling with narrative results to date.

Table 10: EPT and ST Taxa Qualitative Sampling Expectation Ranges

Ohio EPA Small River Qualitative Criteria	WWH / CWH	EWB
Qualitative EPT	12	18
Qualitative ST	13	20

Table 11: Macroinvertebrate Sampling; Number of EPT, ST, and Narrative Range Results

Sampling Year	River Mile	Stream Site	Qualitative Taxa	EPT Taxa	Sensitive Taxa	Tolerant Taxa	Narrative WWH / CWH Result
2018 (EPA)	41.4	RM 42.6 ⁴	51	14	12	6	Marginally Good ⁵
2019 (Baseline)	42.1	Site 1	28	10	7	3	Marginally Good
	41.6	Site 2	25	9	4	5	Fair ⁶
2021 (Year 1)	42.1	Site 1	16	6	8	4	Fair
	41.6	Site 2	19	7	9	4	Fair

Based upon Ohio EPA [3] scoring ranges, the Project site falls within the “Marginally Good” and “Fair” categories and partially attain the WWH narrative criterion. Scores are anticipated to increase based on river restoration methods, including substrate enhancement, decrease in scouring events by added floodplain capacity, and installed habitat features. Ohio EPA site (RM 42.6) is upstream from Sites 1 and 2 and the confluence with the Little Cuyahoga River, which is heavily modified and flows through the city of Akron before joining the Cuyahoga River. Discrepancies in Qualitative Taxa, Sensitive Taxa, and EPT taxa may be explained by this hydrologic input.

Deviations from the Monitoring Plan: One preserved sample of macroinvertebrates was inadvertently destroyed in a catastrophic feline event.

Recommendations for Continued Monitoring: None. Macroinvertebrate Sampling will continue as prescribed in Monitoring Year 3 (2023 and Year 5 (2025).

3.3 SOCIOECONOMIC METRICS

3.3.1 Annual Operating and Maintenance Costs: Four-Year Estimation

Summit Metro Parks is estimating the costs for maintenance, alteration, and reporting for the first three to five years until the Project site become established and reaches a self-sustaining trajectory toward full ecological restoration. Estimated costs include annual invasive species treatment (~ \$4,500), additional / replacement vegetation (~ \$6,500), and annual monitoring and reporting (~ \$12, 500). These tasks will be accomplished by a cooperative of SMP staff / volunteers and outside contractors.

⁴ Data collected by Ohio EPA, 2018

⁵ Non-significant departure from ecoregional biocriterion (considered to be in attainment)

⁶ Significant departure from ecoregional biocriterion

3.3.2 Public Safety: Hazard Diminished or Eliminated

Prior to purchase and restoration by Summit Metro Parks, the Valley View property posed no public safety issue because it was, in fact, not available for public use. In order to be made available and safe for public use, existing steeply entrenched, and highly erodible banks of the Cuyahoga River was reshaped to allow for river access. This task fit neatly with reshaping the banks to allow for floodplain access, greater ecosystem services, and hydrologic connection.

3.3.3 Community Enhancement: Changes to Infrastructure, Utilities, or Recreational Facilities

As previously mentioned, prior to purchase and restoration, the former Valley View golf course had no community potential in its pay-to-play exclusively private state. Now, as public land, the property will benefit from passive recreational opportunities such as a connection to the Ohio and Erie Towpath Trail, access to / from the proposed Cuyahoga River water trail, improved opportunities to view wildlife, and improved (from non-existent) recreational fishing opportunities.



Photo 4: Recreational paddlers enjoying a restored Cuyahoga River through Valley View.

The recreational fishing opportunities are a direct result of ecological restoration of the Cuyahoga River by placement of boulders, rootwads, and woody debris. Notably, northern pike (*Esox lucius*) were sampled, as well as an observed increase in smallmouth bass (*Micropterus dolomieu*) abundance.

Several species of fish are anticipated to reestablish in this section of river due to habitat improvements: steelhead trout (*Oncorhynchus mykiss*), muskellunge (*Esox masquinongy*), and lake sturgeon (*Acipenser fulvescens*). The timing of the IBI surveys precluded sampling of steelhead, which are known to occasionally use the Cuyahoga River in spawning migration. However, SMP biologists conducted a secondary sampling event in November 2021, in conjunction with interviewing recreational fishing to determine presence and usage within the Project area.

4 RESULTS: PROJECT RESTORATION (PHASE I) MONITORING

4.1 WETLAND DELINEATION

A component of the restoration objectives was to restore 33 acres of wetlands, 5,000 feet of the mainstem of the Cuyahoga River, as well as approximately 4,500 feet of headwater stream. In order to assess restoration success, a wetland delineation was completed of the property. Prior to restoration the main wetland presence was 5 water hazards (golf course ponds) comprising 4.5 acres with little to no emergent fringe permitted to grow.

Approximately 20,000 feet of drain tile was disabled to allow natural rainwater collection and permeation back into the site. Additionally, former water hazard boundaries were reshaped to allow for the development of emergent wetland fringe.

An informal wetland delineation was conducted in April 2021 using a submeter Bluetooth GPS (Geode: Juniper Systems) and wetland vertices were mapped directly into ESRI's Collector application. In the first year following restoration activities, approximately 35 acres of wetlands were mapped. The main wetland complex follows an old oxbow of the Cuyahoga River and is more than 10 acres in extent, primarily comprised of emergent vegetation with a small, forested component within.

4.2 AVIAN SURVEYS

4.2.1 General Avian Survey

In support of restoration monitoring, SMP ecologist Dan Toth conducted avian surveys to determine shifts in species composition.

4.2.1.1 Pre-restoration

The Valley View area of Cascade Valley Metro Park, formally Valley View golf course was a 200 acre site of manicured turf grass with several retaining pond type water features, very limited forested terrain and 2.17 miles adjacent to the Cuyahoga River. Due to the nonexistence of suitable habitat and the steep, channelized banks of the river, species diversity was severely limited to common species for the area. Most avian species found on site were very commonly found birds in urban settings.

4.2.1.2 Post-restoration

Following the restoration, habitat improvements allowed for reestablishing of native species recruitment. Restoration work included the installation of native shrubs and trees, 22 acres of

wetland established, flood plain and riparian habitat creation. Restoration success was almost immediate. Within a year of the site being closed to all foot traffic, a pair of Bald Eagles (*Haliaeetus leucocephalus*) established a nesting site along the northern section of the river. The nesting pair has had two consecutive successful nesting seasons with one and two fledglings respectively. From year-to-year species quantity and quality has improved steadily. Wetland habitat usage has greatly increased with Wood duck (*Aix sponsa*), Green heron (*Butorides virescens*) and Spotted Sandpiper (*Actitis macularius*) found nesting on site. Common Merganser (*Mergus merganser*) have been observed nesting and raising fledglings along the Cuyahoga River prior to restoration, and their numbers have increased significantly.

With the success of the site and the influx of species, the site will start to reflect the habitat downstream in the nearby Cuyahoga Valley National Park. When looking at and comparing the Valley View area with various riparian regions along the Cuyahoga River, the results are very promising. Noted species seen moving into the area include but are not limited to Orchard Oriole (*Icterus spurius*), Willow Flycatcher (*Empidonax traillii*), Yellow-billed Cuckoo (*Coccyzus americanus*), and Yellow -throated Vireo (*Vireo flavifrons*), all of which can be found in similar habitat. With the recent success of the restoration, the site is most comparable to that of the area within the Cuyahoga Valley National Park called the station road trailhead. The area there has species that are of special concern and or state threatened, Cerulean Warbler (*Setophaga cerulea*), Prothonotary Warbler (*Protonotaria citrea*) and Virginia Rail (*Rallus limicola*). It is fair to assume that with the habitat enhancements, within the next decade these species could be found within Valley View.

Valley View area also become a suitable stopover site for migratory birds during both the spring and fall migration. Over the first few years of the restoration, many notable wood warbler species have used the area during migration. Mourning Warbler (*Geothlypis philadelphia*) Connecticut Warbler (*Oporornis agilis*), Blackburnian Warbler (*Setophaga fusca*) and Brewster's Warbler (*Vermivora chrysoptera x cyanoptera*) have all been found on site during migration. Numerous species of waterfowl have been seen using the areas wetlands and other water features during the fall/winter migration.

4.2.2 Bald Eagle Nest

In early 2020, prior to the construction efforts in that portion of Valley View, a large nest was observed by an SMP volunteer in the northwestern portion of the park, adjacent to the Cuyahoga River, in a large sycamore tree. Upon investigation, SMP biologists determined it to be a probable first-year bald eagle nest. Subsequently, SMP applied for an received and Incidental Take Permit to operate construction efforts within the prescribed buffer (200m) and during the nesting season (January 1-August 31). Per permit requirements, the nest was monitored regularly by an SMP volunteer, Jerry Cannon. A summary of the eagle activity follows:

2020: Monitoring of the nest began at the end of January. Eagles were observed in the area, but were not observed in the nest until 2/11/20. From this date on, the eagles were observed many times coming and going from the nest. On March 12th, one Eagle was observed remaining low in the nest while the other eagle would come and go. It is assumed that egg(s) were laid on this date. On March 13th, the observer noted the two eagles switch their turns sitting on the eggs. On 4/18/20, the observer recorded one Eagle stand up in nest and appear to roll eggs or reposition babies. This is the date recorded as the hatching date. On May 5th, an eaglet was observed in the

nest. Both adults continued to come and go from nest feeding the eaglet. On 7/14/21, the eaglet was observed sitting on a branch right outside the nest. On 7/16/21, the juvenile flew off the nest and no activity was noticed at the nest from then on.

The observer named the adult male "SUMMIT" and the adult female "VALLEY GIRL". The juvenile was named "SOLO". Only one hatchling/juvenile was observed, and it was presumed that this event was the first for this pair.



Photo 5: Adult male bald eagle; "Summit"

2021: Both adult eagles were observed in the area during the winter months. On 1/15/21 both eagles were observed at the nest adding to the structure. Due to observed behaviors, it is assumed egg(s) were laid on 2/23/21. On March 26th, Summit was sitting in a tree by the river and an immature eagle came and perched about 10 feet from Summit. It is assumed this was Solo, the fledgling from last year. The juvenile was not observed again. Due to observed activity by the adults, 3/31/21 is believed to be the hatch date for 2021. Two eaglets were observed on 4/7/21. By the end of July all the eagles had gone from the area. The two juveniles for 2021 were named NOAA (National Oceanic Atmospheric Administration) and GLiC (Great Lakes Commission), to recognize the funding agencies for Phase 2.



Photo 6: NOAA and GLiC, 2021

4.3 BAT SURVEY

Summit Metro Parks has on staff three federally-permitted bat ecologists and has been conducting bat inventory surveys for nearly 20 years to ascertain trends in species presence and composition, as well as overall population health and in support of management projects. SMP’s Liberty Park in Twinsburg, OH contains an extensive sandstone ledge system that supports multiple hibernacula for a number of state and federally listed bat species.

During the summer survey season (June 1 – August 15), SMP ecologists conducted 3 mist net surveys as well as a number of nights of acoustic monitoring. During the mist net surveys, 45 big brown bats (*Eptesicus fuscus*) and 1 Eastern red bat (*Lasiurus borealis*) were captured.

Table 12: Bat Capture Summary, Summer 2021

Species	Adult Females ⁷				Adult Males ⁸		Juveniles		Escape ⁹	Total
	P	L	PL	NR	NR	TD	Female	Male		
Big brown bat (<i>Eptesicus fuscus</i>)	--	23	1	1	4	14	--	1	1	45

⁷ pregnant (P), lactating (L), post-lactating (PL), non-reproductive (NR)

⁸ non-reproductive (NR), testes descended (TD)

⁹ captured bat escaped from net or hand before data collection

Eastern red bat (<i>Lasiurus borealis</i>)					1					1
Total Species	--	23	1	1	5	14	--	1	1	46

4.4 CITIZEN SCIENCE PROGRAM

In 2021, SMP biologist and Citizen Science Supervisor Marlo Perdicas initiated an iNaturalist Project to provide volunteers a place to secure photo vouchers of species observed during a year-long BioBlitz event. Over 2,700 observations composed of 680 species were observed by 103 participants.

Table 13: Results of the SMP Volunteer Citizen Science iNaturalist BioBlitz

Taxa Group	Observations	Number of Species
Plants	1,092	349
Birds	813	70
Insects	434	155
Fungi (including lichens)	119	51
Mammals	107	16
Reptiles	83	8
Amphibians	58	4
Fish	16	11
Arachnids	14	8
Mollusks	4	3
Protozoans	2	1

Additionally, SMP volunteers regularly monitored several bird nesting boxes and snake tins throughout the property.

5 SUMMARY AND DISCUSSION

During the summer field season of 2021, Year 1 of restoration monitoring, Summit Metro Parks staff and volunteers, along with qualified biologists and restoration specialists from EnviroScience, monitored the success and attainment of the Cascade Metro Park Cuyahoga River Restoration Valley View Phase 2 Project (NA16NMF4630341). Please see Table 14 for Project attainment status in 2021 using the average scores from the two rounds of sampling. The Project area is in partial attainment due to the “fair” qualitative macroinvertebrate scores and “fair” fish community scores at Site 2. Seasonal differences in the fish community lowered the average score for Site 2 during the fall sample. The foundation habitat has been restored to the site as demonstrated by the substantial improvement in QHEI values. As the restoration project continues to age and near bank woody species and in-stream boulders and woody structures continues to mature and provide stable habitat it is estimated the site will continue to improve.

Table 14 indicates the pre-and post-restoration attainment status for the sampling sites. Site 1 reached attainment in the first year following restoration, Site 2 is anticipated to reach attainment by Year 3 (2023) of monitoring as the restoration matures.

Table 14: Attainment Contrast Pre-and Post-Restoration Efforts for Year 1 (2021)

Year/RM		QHEI	IBI	MIwb	ICI Narrative WWH / CWH Result	Narrative	Attainment
2019 (Baseline)							
42.1 (Site 1)		73.50	34	6.93	Marginally Good	F ¹⁰ /F	NON
41.6 (Site 2)		68.75	30	5.07	Fair	F/P ¹¹	NON
41.4 (OEPA)		60.5	38	7.51	Marginally Good	MG ¹² /F	PARTIAL
2021 (Year 1)							
42.1 (Site 1)			36	8.39		MG/MG	FULL
			38	7.83		MG ^N /F	PARTIAL
	Average	85.75	37	8.11	Fair	MG/MG	FULL
41.6 (Site 2)			38	7.83		MG/F	PARTIAL
			30	6.27		F/P	NON
	Average	85.00	34	7.05	Fair	F/F	NON

¹⁰ F = Fair (significant departure from ecoregional biocriterion for attainment)

¹¹ P = Poor (significant departure from ecoregional biocriterion for attainment))

¹² MG = Marginally Good (non-significant departure from ecoregional biocriterion for attainment)

Phase 1 – Funded by Clean Ohio (1.14 million dollars)

Complete - A total of 120 acres of former golf course restored to natural area including:

- Wetlands (wooded wetlands, open marsh, emergent wetlands (28-acres)
- Headwater stream habitat (2,500 linear feet)
- Upland meadow (that will transition to forest (90-acres)

Phase 2 – Funded by NOAA and GLC (2.5 million dollars)

Riparian/Floodplain Habitat Restored:

Complete - A total of 55.03 acres of riparian/floodplain habitats have been restored as detailed below:

- Floodplain Reforestation (non excavated) = 15 AC
 - These areas were existing floodplains that had been seeded with a native mix during the Phase 1 project and reforested as part of the Phase 2 project.
- Tier 1 Floodplain Forest (excavated) = 3.10 AC
 - Tier 1 floodplain was designed to be flooded by the 1.1-1.5 year storm, sand deposition and deep floodwaters are anticipated within these areas.
- Tier 2 Floodplain Forest (excavated) = 4.10 AC
 - Tier 2 floodplain was designed to be flooded by the (approx.) 1.5 – 2-year storm, and is on average 1.5-2 feet higher than the Tier 1 floodplain. To promote woody tree recruitment and limit competition from herbaceous species, topsoil was not replaced within this tier.
- Forested Wetland/Marsh = 4.2 AC
 - Two existing golf course ponds were filled to create wetland areas; minimal grading was completed in adjacent areas to create wetlands and allow additional flows to cross behind the floodplain tiers and outlet at the downstream end of the project area.
- Upland Area (Meadow/Savannah) Restored: 7 AC
 - This rare upland habitat was established in a small area around the proposed river access point and in association with the future access road
- Riverine Habitat = 13.63 AC
 - The surface area of the Cuyahoga River (bank to bank) was included as part of the proposed restoration area. The full extent of the riverine habitat was restored and is detailed in the section “Stream Habitat Made Available or Restored” (below).
- Post-COVID Public Reforestation Area – 8 AC
 - A small portion of the northwest project area is currently a mix of native meadow that was established during the Phase 1 project. It was not planted with trees during the Phase 2 project and is set aside for a future post-COVID volunteer/public tree planting.

Stream Habitat Made Available or Restored

Complete – A total of_ 4750 LF of mainstem of Cuyahoga River has been restored.

- *Begin Construction @ Sta. 11+00 (N:533472.16, E: 2234087.36) – End Construction @ Sta. 58+50 (N:530872.45, E: 2235940.98)*
 - *Coordinates are in NAD83 OH-N, FT*
- *Within this stream habitat restoration area, approximately 4300 LF of floodplain was restored and 1946 LF of bank was stabilized. See planting, seeding, and habitat installation metrics below which also occurred within this 4750 LF reach.*

Socioeconomic factors include decreased public hazard by reshaping steeply eroded and potentially hazardous banks to restore floodplain connectivity and protect existing infrastructure with the added benefit of making river access safer and easier, total conversion from private, exclusive land access to public greenspace, and connectivity to the Cuyahoga River water trail.

Monitoring efforts will continue for Year 2 (2022) with notable modifications to the methodologies used in 2021, including more thorough flood event records, operational on-site flood monitors, and sample security.

6 WORKS CITED

- [1] EnviroScience, "Monitoring Plan for Cascade Metro Park Cuyahoga River Restoration Valley View Phase 2 Project (NAI6NMF4630341)," 2020.
- [2] Ohio EPA, "Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)," Ohio Environmental Protection Agency, Columbus, OH, 2006.
- [3] Ohio EPA, "Volume III Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities," Ohio Environmental Protection Agency, Columbus, OH, 2015.
- [4] J. R. Voshell, Jr., Ph.D, A Guide to Common Freshwater Invertebrates of North America, Granville, OH: The McDonald & Woodward Publishing Company, 2011.
- [5] Ohio EPA, "2015 Updates to Biological Criteria for the Protection of Aquatic Life: Volume II and Volume II Addendum. User's Manual for the Biological Field Assessment of Ohio Surface Waters," Columbus, OH, 2015.
- [6] Ohio EPA, "The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application.," Columbus, OH, 1989.
- [7] Ohio EPA, "Biological Criteria for the Protection of Aquatic Life: Volume I," Columbus, OH, 1987.

Appendix A

Data Sheets

Appendix B

Project Mapping

Appendix C

Photographic Record