Brandenburg Park Shoreline Restoration

Post-Construction Biological Monitoring 2021

Contents

Introduction

This report summarizes pre- and post-construction biological monitoring conducted at the Brandenburg Park Shoreline Restoration site in Chesterfield Township, located along the shore of Anchor Bay. The 17-acre parcel serves as a primary recreational destination for boaters, fisherman, wildlife enthusiasts, and other park visitors. Pre-construction seawall erosion caused unsafe recreational conditions for park users and increased sedimentation into Lake St Clair, resulting in decreased habitat viability for desired fish species. Removal of the seawall, implementation of a gradual transition between the land and water, and the creation of pools and shelves created niche habitats for plants, invertebrates, fish, and herpetofauna. The shoreline was stabilized using Bio-D-Block, a densely packed mattress of coir fiber block attached to a bristle coir woven fabric, creating wave protection for newly planted native emergent and submergent wetland vegetation. These protected areas are critical for the establishment of diverse native vegetative communities and the success of the Brandenburg Park restoration project. Project goals prioritized the improvement of fish habitat and coastal recreation while eliminating shoreline safety hazards. To determine ecological restoration success, growth of *Vallisneria americana* (Eelgrass) was monitored closely due to its importance in creating productive spawning, nursery, and forage habitat for fish species. In addition to the special consideration given to *Vallisneria americana,* comprehensive vegetative, fish, and avian surveys were conducted to assess the short-term effects of structural changes and restoration efforts implemented at Brandenburg Park. The following summarizes pre- and post-construction vegetation sampling activities and discusses their compounding results.

Vegetation Sampling

In order to facilitate before-and-after comparison of plant communities within the restoration site, an assessment of submergent, emergent, and upland flora was performed post-construction in fall of 2021. Brandenburg Park is currently dominated by mowed turfgrass and park-managed trees. The mixture of wet and mesic native plants installed during restoration, as well as naturalized vegetation from the existing seedbank are emerging along the shoreline and in open water. Great Lakes Marsh was the relevant vegetative community referenced for this ecosystem restoration planting design; the vegetative structure, native species composition, and density were determined to be best suited for this site. Project design recommends an ideal aquatic planting density is 4,840 plants per acre or spaced 3'x3', however, actual planting density implemented was on average 680 plants per acre or spaced 8'x8'. The Universal Floristic Quality Assessment Calculator (FQA) in conjunction with University of Michigan's Herbarium and Michigan State's Michigan Natural Features Inventory was used to make qualitative evaluations of the development of the plant communities. Quantitative evaluations were assessed by creating six random quadrat sampling plots, documenting their GPS locations, and collecting relevant data. These data were collected per the guidance of the Conservation Research Institute and the Michigan Department of Natural Resources (MDNR). Further methodologies can be reviewed in the National Oceanic and Atmospheric Administration (NOAA) approved Quality Assurance Project Plan (QAPP) located in the Pre-Construction Monitoring Report, Appendix C.

Results

Several indications of habitat improvement were observed during post-construction vegetation monitoring. Few native species utilized in the seed mixes had either minimal detection or were absent from the site. The area of plant deficiencies is depicted in (Figure 1). *Vallisneria americana* (Eel-Grass) fragments were well documented within the wildlife exclusion fence. *Potamogeton robbinsii* (Robbin's Pondweed) was found free floating and several rooted plants including *Alisma triviale* (Northern Water-Plantain) and *Pontederia cordata* (Pickerelweed) were observed at the edges of the artificial shoals. An abundance of *Vallisneria* fruiting stalks were observed both attached to plants and floating along the rock shore. The *Vallisneria* bed area more than doubled post-construction from pre-construction surveys as shown in the Plant Survey Map in Appendix A. Following the removal of the seawall, disturbance allowed several native plant species to emerge from the seedbank (Table 1), however, sparse populations of *Phragmites australis* and other adventive weeds were identified within the restoration site. Adventive species were observed at sample plot locations P2, P5, and P6 (Figure 2). Two of these locations are along the shoreline in the littoral zone of the restoration area and can be identified in the Plant Survey Map, Appendix A.

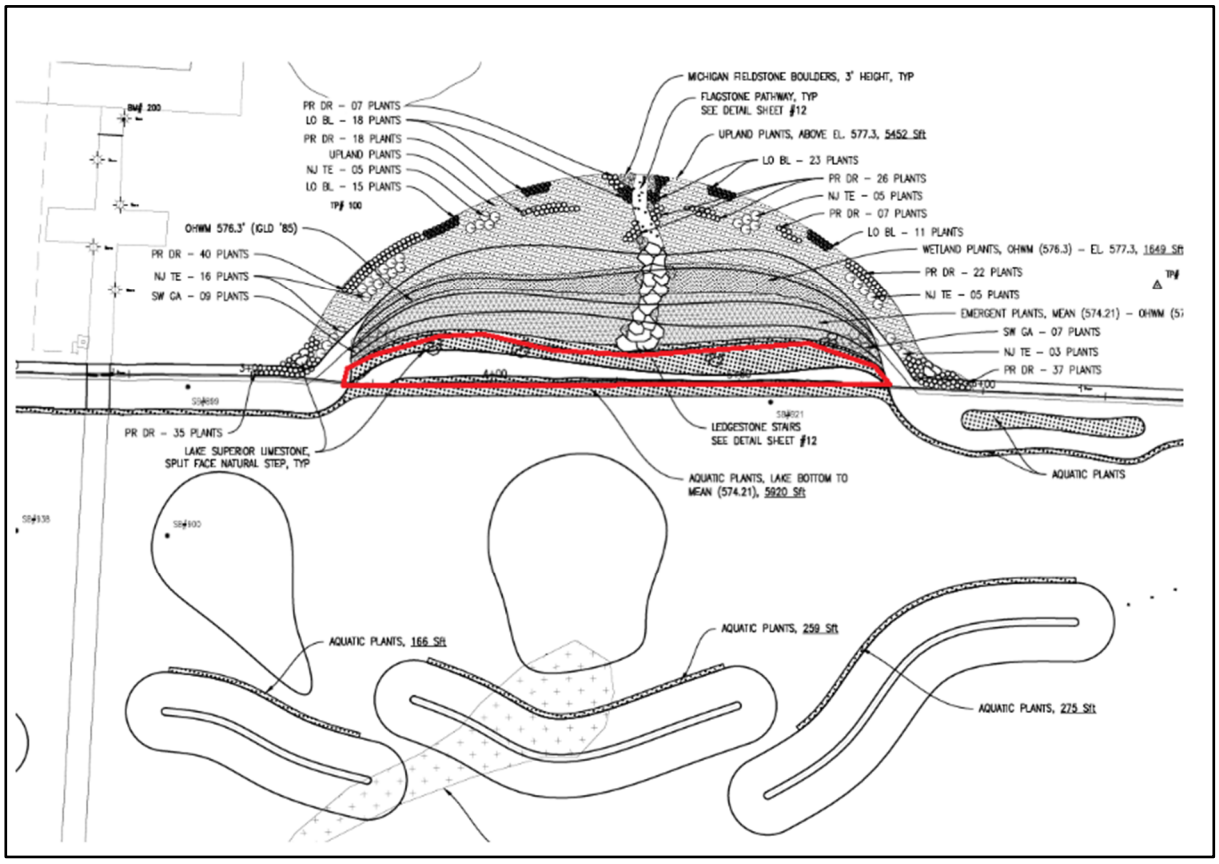

Figure 1. Area of aquatic plant deficiency encircled in red.

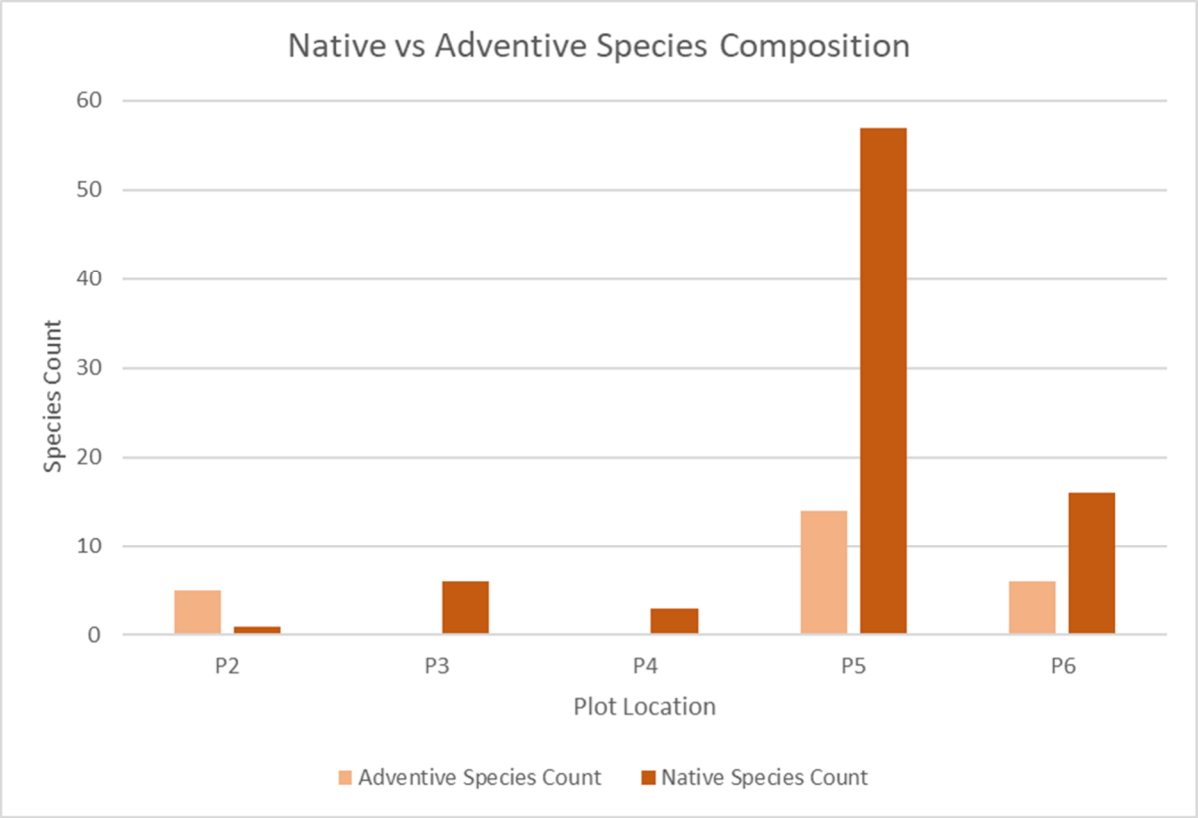

Figure 2. Native vs Adventive Species Composition comparison across sampling locations.

Table 1. Herbaceous species released and established from the native seedbank after soil disturbance.

Scientific Name	Common Name	Native	Life Cycle	Physiognomy	Pop. Density	Community
Leerisa oryzoides	Cut Grass	Yes	Perennial	Graminoid	Sparse	Terrestrial
Impatiens capensis	Jewelweed	Yes	Annual	Forb	Sparse	Terrestrial
Mimuls ringens	Monkey Flower	Yes	Perennial	Forb	Sparse	Terrestrial
Solanum ptychanthum	Black Nightshade	Yes	Annual	Forb	Sparse	Terrestrial
Asclepias syriaca	Common Milkweed	Yes	Perennial	Forb	Patchy	Terrestrial
Bidens frondose	Common Beggar-Tick	Yes	Annual	Forb	Sparse	Terrestrial
Galium tinctorium	Stiff Bedstraw	Yes	Perennial	Forb	Sparse	Terrestrial
Persicaria pensylvanica	Bigseed Smartweed	Yes	Annual	Forb	Sparse	Terrestrial
Verbena hastata	Blue Vervain	Yes	Perennial	Forb	Patchy	Terrestrial

A total of 92 herbaceous species, 75 native species sand 17 adventive species, were identified during monitoring, the complete vegetative survey can be viewed Appendix B. This is a 338% increase from the species total of 21 in the pre-construction survey. Plot location P5 had the greatest number adventive and native species overall (Figure 2). Approximately 48% of species surveyed in pre-construction monitoring were adventive species (10 out of 21). These numbers decreased to just 18.5% after construction. Including adventive species in the total

species count (n) the mean coefficient of conservatism (mean-C) was found to be 3.2, and the Floristic Quality Index (FQI) 30.7. When native species are exclusive in the analysis, native mean-C becomes 4.0, and FQI 34.6. According to the Floristic Quality Assessment of Michigan (Herman et al. 2021), a native mean-C ≥4.0 for wetlands indicates a high-quality aquatic resource. A visual comparison of pre- and post-construction Florist Quality Index and mean coefficient of conservatism is depicted in (Figure 3). It is important to note that 1,500 plugs were planted in the upland and wetland zones of the site and were not included in the FQA. Mean coefficient of wetness for the transect was -0.8, which indicates marginal wetland, but when analyzing only native species, which correlated more to open water/Great Lakes Marsh, wetness increases to -1.6. For further explanation of Floristic Quality Assessment, see the QAPP in the Pre-construction Biological Monitoring Report in Appendix C.

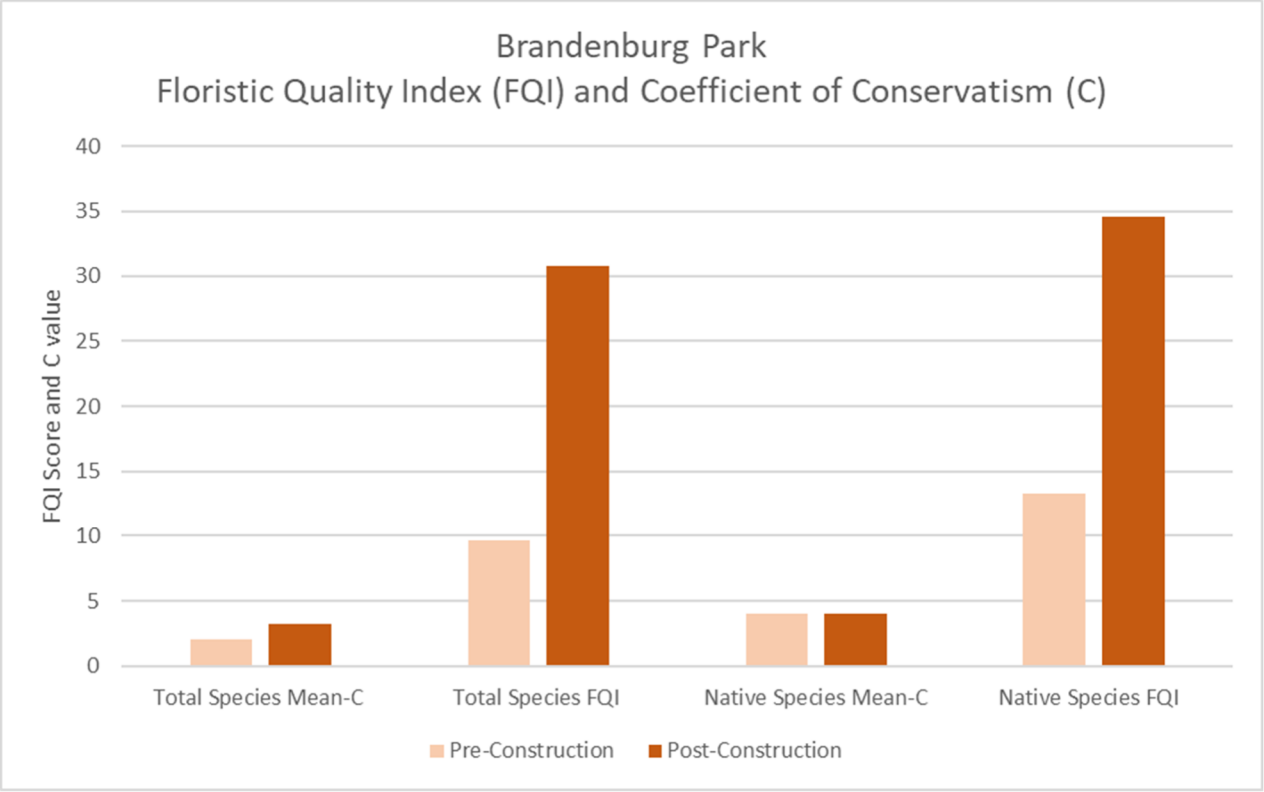

Figure 3. A comparison of pre- and post-construction Floristic Quality Index (FQI) and Coefficient of Conservatism

Discussion

Post-construction monitoring efforts indicate an overall improvement of plant communities from their pre-construction state. Native mean coefficient of conservatism remains at 4.00, and pre-construction native FQI increased from 13.27 to 34.6 post-construction (Figure 3). This change in FQI scores indicates an improvement in vegetative quality signifying floristic importance statewide defined in the QAPP located in Appendix C. At the time of monitoring, the water level was above the ordinary high-water mark (OHWM) making detection of smaller submergent species difficult. Dormancy of pondweeds or washout in storms could possibly have

impacted planting densities observed for aquatic plant species. According to NOAA and the Army Corps of Engineer's future water level predictions for 2022 at Lake St. Clair, lake water level is expected to remain above average for the first 6 months of the year then return to near average levels by December 2022. Anticipated implications of fluctuating water levels are such that elevated water levels will likely expand submergent aquatic plant communities near the shoreline. Low water levels can reasonably be expected to increase herbaceous species density and diversity within the recently restored emergent shoreline communities, however, submergent aquatic plant communities may decline with lower water levels. For best restoration results, it is important to continue monitoring the establishment, abundance, and density of planted vegetation in the aquatic nurse habitat.

The *Vallisneria* beds and a limited number of *Potamogeton robbinsii* indicate a significant submergent community that should continue to be protected and encouraged. Efforts to promote growth of floating and rooted *Vallisneria americana* beds was successful. Pre-construction *Vallisneria* beds occupied an area of 0.65 acres and increased 498% to 3.87 acres at the time of the post-construction vegetation survey. These beds responded well to transplanting after disturbance resulting in the expansion of bed size into deep pools and shoal backwater wetlands; existing beds more than doubled in size since the pre-construction survey shown in the Plant Survey Map, Appendix A. Establishment of other aquatic species appear to be sparse currently, however are anticipated to improve over time.

Although invasive species occurrences were minimal, detection of *Phragmites australis* as well as other minor adventive plant species instigate a recommendation to monitor their progression to prevent further establishment and distribution throughout the restoration area.

Fish Sampling

A post-construction assessment of suitable habitat and overall fish population was conducted along the shoreline and in open water, in the nearshore zone at Brandenburg Park. Field sampling was performed utilizing electroshocking equipment, and gill, hoop, seine, and fyke nets. Electrofishing efforts conducted by the Michigan Department of Natural Resources (MDNR) at Brandenburg Park were performed for three consecutive years in the fall of 2019, 2020, and 2021. Sampling took a total of 30 minutes by three crew members, by boat, using dip nets. The metrics used for measurement include total catch per unit effort (CPUE), defined as the number of fish collected per minute of electrofishing, and fish length, measured in centimeters (cm). It is important to note that electrofishing is sometimes less effective at sampling small fish—they often lack swim bladders, therefore they are less buoyant and stay near the lake floor evading the electroshocking dip net. This electrofishing site will be used as an index for comparison of other nearby sites in the future.

Species count, tolerance to environmental degradation, and age structure identification of sampled fish (fry, juvenile, and adult) were the primary metrics used in the various net surveys to determine population improvements and the efficacy of littoral zone community restoration. Methods for this survey mimic those in the pre-restoration monitoring effort outlined, however, due to open-water conditions creating safety concerns,

newly installed restoration features, and continued shoreline habitat restoration, sample location adjustments were made to complete the survey. Each adjusted sample location was GPS located; the map can be viewed in the Fish Survey Map located in Appendix A. The following summarizes and comparatively discusses pre-construction survey results with those from surveys conducted in September and October 2021.

Results

Twenty-one different species were observed from a total of 495 individual fish sampled, a 10.5% increase in species detection from 2019 (19 species sampled). Minnows, defined as small silvery fishes belonging to several genera of the Cyprinidae family, and *Fundulus diaphanous* (Banded killifish) were identified in the improved shoreline with newly established aquatic vegetation. Common game species identified include *Ambloplites rupestris* (Rock Bass), *Lepomis macrochirus* (Bluegill), *Micropterus salmoides* (Largemouth Bass), *Perca flavescens* (Yellow Perch), *Cyprinus carpio* (Common Carp), *Pomoxis annularis* (White Crappie), *Morone americana* (White Perch) and *Amia calva* (Bowfin). Rock Bass numbers increased from 2019 (20 sampled) to 2021 (39 sampled), accounting for a 95% increase in population size. This increase can be attributed to a greater number of fry and juveniles in the sample. The Bluegill population increased 237% from 2019 (51 sampled) to 2021 (169 sampled) due to an increase in fry and juvenile representation in the species count, as well. The ratio between predator (piscivores) and prey (omnivores, insectivores, and herbivores) species is relatively uniform from pre-monitoring to post-monitoring; observed was a slight increase in predators and a slight decrease in the rest of the fish population (Figure 4). Age structure of the fish population varied from pre-construction monitoring to post-construction results. The fry and juvenile age classes experienced a 368% and 8% population increase respectively, from 2019 to 2021(Figure 5). The adult age class decreased 42% from 2019 to 2021(Figure 5Figure 5).

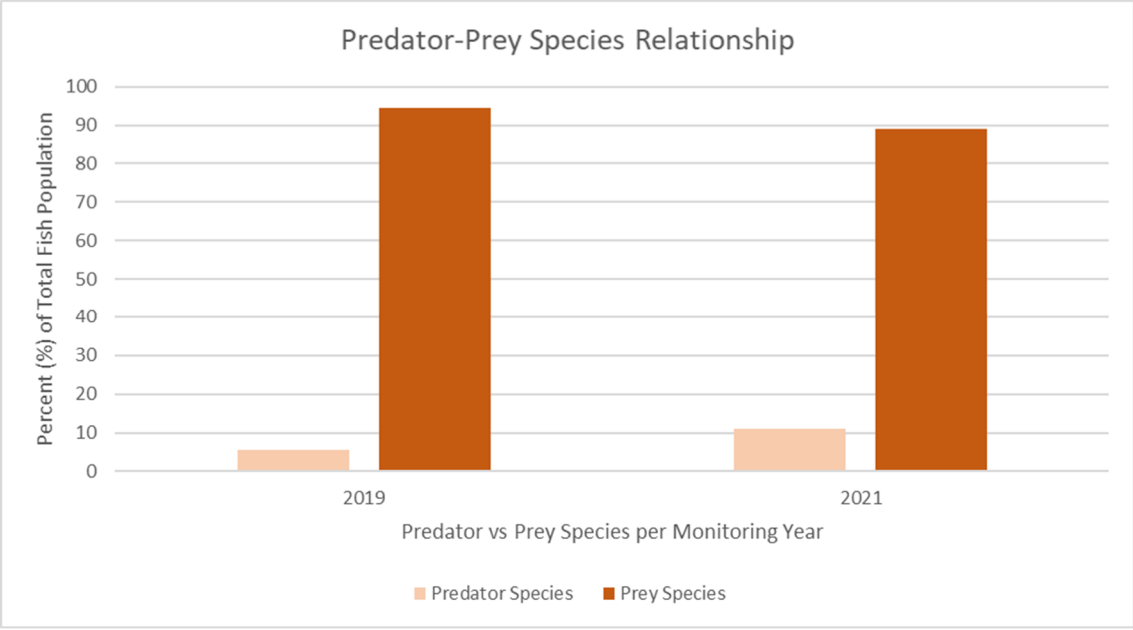

Figure 4. Percent total fish population of predator and prey species by monitoring year.

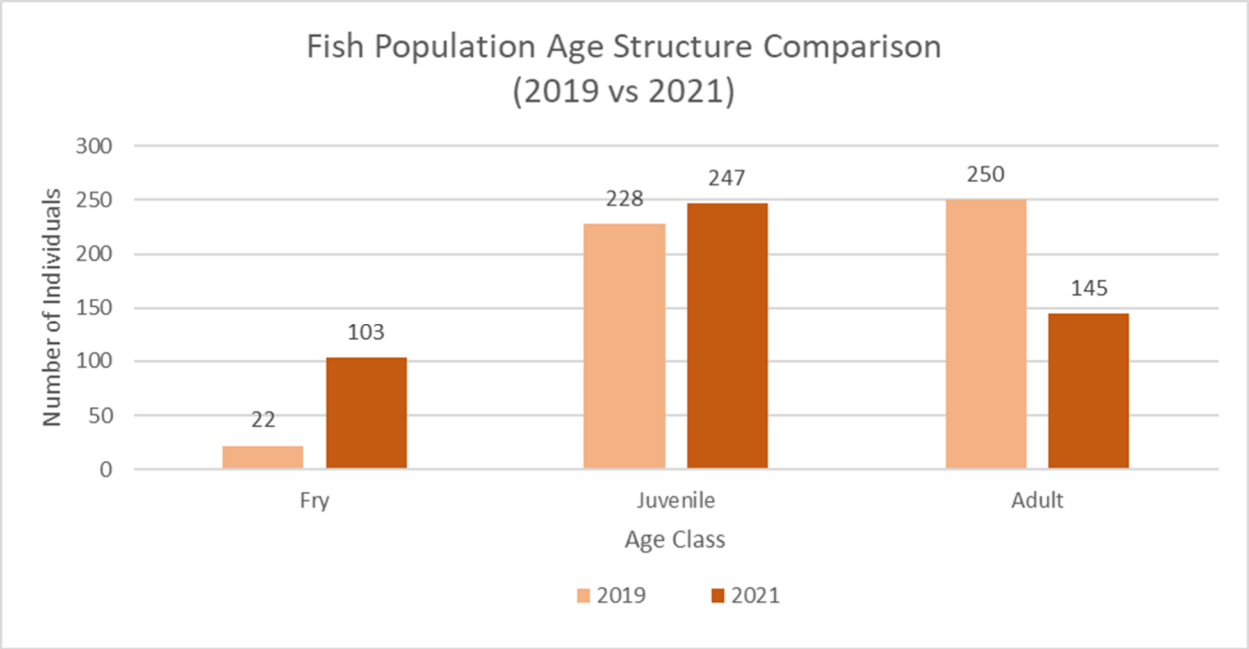

Figure 5. Fish population comparison by age class between pre- and post-construction fish surveys.

Four intolerant species, *Ambloplites rupestris* (Rock Bass), *Fundulus diaphanous* (Banded Killifish), *Lepomis macrochirus* (Bluegill), *Etheostoma exile* (Iowa Darter) were collected throughout the restoration area, see the fish species composition table Appendix B. Intolerant species require high quality water for reproduction and survival. The number of intolerant species sampled in 2019 increased 183%, from 80 individuals to 226 individuals in 2021. Round and Tubenose Gobies are an invasive species detected in the 2021 sample (15 and 8 respectively), however, total numbers decreased by approximately 48% from the pre-construction monitoring effort in 2019, when44 Round Goby were sampled.

Total species counts were relatively similar across the three sampling years of the electrofishing survey increasing approximately 11% from 2019 to 2021. The total number of species caught in 2019, 2020, and 2021 were 9, 7, and 10 respectively (Table 2). The total number of fish caught during sampling increased 83.6% from 134 in 2019 to 246 in 2021 (Figure 6). Total CPUE was the greatest post-construction, increasing over 800% from 2020 during construction (Table 2). Average lengths of sampled fish increased 1.4% from 21.7 cm in 2019 to 22.02 cm in 2021. No *Ambloplites rupestris* (Rock Bass) were caught in 2019 or 2020 from electroshocking efforts, however, 5 were caught in 2021 with an average length of 13.3 cm. *Micropterus salmoides* (Largemouth Bass) were sampled each year from 2019-2021 (5, 3, and 9 respectively). A single *Sander vitreus* (Walleye) was collected across the 3-year span in 2021 after construction at a length of 46 cm. Not all fish species sampled were collected each year, therefore there are no recorded lengths or average lengths in the results for those specific species (Figure 7). A map of the MDNR electrofishing efforts and complete data table can be viewed in Appendix D.

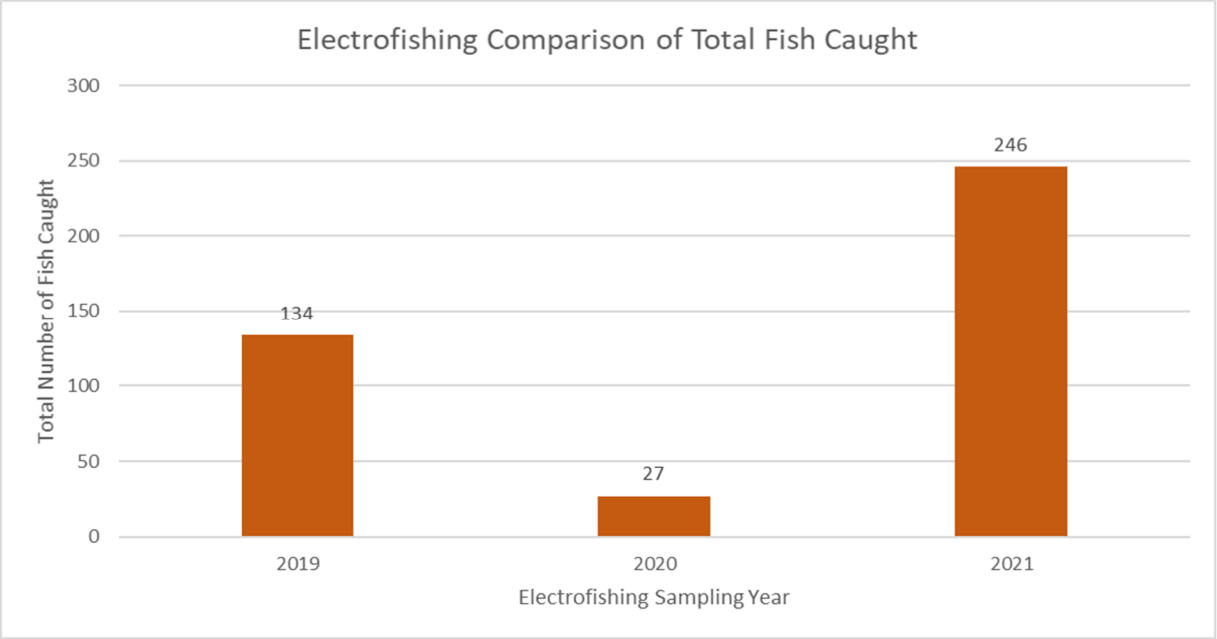

Figure 6. Total number of fish caught during MDNR electroshocking efforts from 2019-2021.

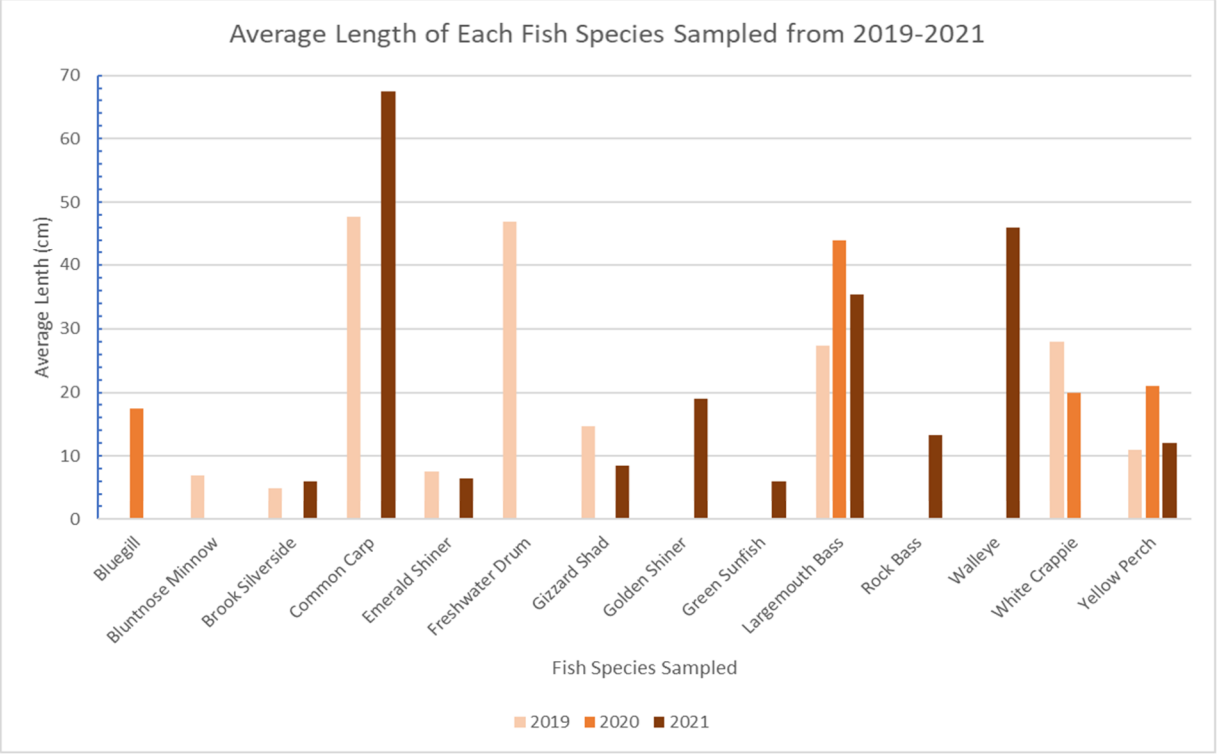

Figure 7. This graph is a summary of the average length (cm) of each fish species sampled from 2019-2021.

Table 2. Summary of electrofishing data conducted by the Michigan Department of Natural Resources (MDNR).

Electrofishing Summary	2019	2020	2021
Total Number of Fish Caught	134	27	246
Species Count	9	7	10
Total CPUE	6.7	1.35	12.3
Average Length (cm)	21.7	25.6	22.0

Discussion

The 10.5% increase in species composition, overall increase in community population, and the distribution of generalist and specialist species observed throughout the restoration site is a positive result from the Brandenburg Shoreline Restoration Project. The rocky shoals and gradual shoreline interface provide critical habitat and breeding area for the *Pimephales notatus* (Bluntnose Minnow) as well as insectivore species which include the many Shiner species and *Labidesthes sicculus* (Brook Silversides). The addition of submerged aquatic vegetation provides cover which can lead to increased spawning and nursery success. A single female Iowa Darter was collected in a fyke net (F1) off the restored planted area. This is an intolerant species that needs aquatic plants to spawn in. The increase in large omnivorous and piscivorous species is likely a result of an increase in prey species availability. A new presence of *Morone americana* (White Perch) and *Amia calva* (Bowfin), both piscivores not observed in 2019, is an example of the predator-prey relationship previously discussed.

Electrofishing efforts show an 83.6% increase in number of fish sampled at the restoration site from 2019 to 2021. The decrease in number of fish sampled and CPUE in 2020 is likely due to the concurrent construction operations. Total CPUE was also the greatest in post-construction monitoring, increasing approximately 83% from 2019. Approximately 11% of fish species identified increased from pre-construction to post-construction monitoring by the MDNR. Consistent sampling at Brandenburg Park over the last three years make this an exemplary site for comparison in future electrofishing at nearby sites. In conclusion, the fish sampling at restoration area is illustrating that the site currently provides adequate habitat for promotion of desired fish species and increased overall species diversity. For best management practice, further monitoring and adaptive management can be continually conducted as aquatic vegetation matures and more of the micro-niche habitats are utilized.

Bird Sampling

In pursuit of increased biodiversity and recreational wildlife viewing at Brandenburg Park, project goals aimed to promote primary habitat requirements for common bird species. Viability weighs heavily on prey availability and habitat structure. The restored, rocky shoreline and newly established wetland vegetation is suitable habitat for hunting and foraging. The dynamic composition of vegetative strata has greatly expanded the availability of nest sites, shelter from predators, food accessibility and other structural habitat requirements of wetland, woodland, and forest birds. This survey was conducted during migration season, fall 2021. The post-

construction bird survey results are analyzed and further discussed relative to the 2019 pre-construction bird survey in the following content.

Results

Twenty-four bird species (20 native/4 non-native) were detected visually and/ or identified by call during the survey. Species richness, the number of different species observed, quantified at 14, remained the same from 2019 to 2021, however, there was a notable 450% increase in total avian abundance, from 94 in 2019 to 423 in 2021(Table 3). Conservation value (CV) abundance, a metric used to prioritize conservation efforts of a particular community when considering the association of species richness and abundance, also increased 369% from 2019 to 2021 (Table 3). Two gull species and six waterfowl species, including the non-native species *Cygnus olor* (Mute Swan), made use of the shoal areas. Point-count sampling locations can be found in the Bird Survey Map in Appendix A, and data tables can be found in Appendix B.

Table 3. Summary of Avian Survey Data

Avian Survey	2019	2021
Species Richness	14	14
Total Abundance	94	423
Native Abundance	79	370
Non-native Abundance	15	53
Conservation Value Abundance	158	741

Discussion

Brandenburg Park lies in the Great Lakes flyway and provides ideal stopover habitat for various migratory bird species. Observation of a diverse collection of species from mature forest, grassland, and wetland habitats is a great advancement from the common backyard and open woodland species observed in the pre-construction bird survey. Heightened counts of waterfowl and other wetland and shoreline species indicate utility of the restoration area. Woodland and riparian breeding songbirds such as warblers, vireos, waxwings, and the Eastern Kingbird, are relatively common neotropical species that were observed resting and foraging at the site during their fall migration. *Ardea herodias* (Great Blue Heron) waded and foraged in the new aquatic planting. An *Actitis macularius* (Spotted Sandpiper) call was heard among the new rock shoals. All these encounters are indicative of optimal habitat with quality resources to maintain and promote avian diversity and abundance. Broadly, greater CV abundance is strongly associated with improved habitat provisions. The site's carrying capacity, or ability to support and sustain abundant bird populations, is also dependent upon the improved ecosystem, therefore it is necessary to continue prioritization of restoration and conservation efforts.

Conclusion

Results of before-and-after comparisons of pre- and post-construction biological assessments are positive overall. Vegetation sampling results concluded a 338% population increase from just 21 in pre-construction monitoring to a total of 92 plant species, 75 native species and 17 adventive species. Native mean-C (mean Coefficient of Conservatism), 4.0 and native Floristic Quality Index, 34.6 increased as a result from restoration efforts. Although avian species richness remained the same, there was a 450% increase in total avian abundance, and

Conservation Value abundance increased 369%. The fish population collected from netting increased by 10.5% from pre-construction monitoring. Fry and juvenile age classes experienced a population increase, as well, suggesting an improvement in spawning and nursery habitat. Electrofishing sampling resulted in an overall population increase of 83.6% while the number of species collected increased approximately 11% from pre-construction to post-construction monitoring.

The goal of the Brandenburg Park Restoration Project in Chesterfield Township was to improve fish species abundance and diversity through the creation of habitat types unique to the Great Lakes and Lake St. Clair and thereby improving the recreational experience of park goers seeking to engage in fishing and other wildlife viewing activities. By utilizing a variety of plant species to create habitat missing from the park, an overall increase in fish, plant, and bird diversity has been achieved. The comparative results from pre-construction and post-construction monitoring surveys are representative of how the biotic factors interact with and depend on one another to succeed. The gradual shoreline interface reduces erosion and sedimentation, creates a more diverse vegetative landscape by increasing emergent and submergent wetland vegetation which results in improved water quality and habitat availability for fish species. As the new vegetative communities mature, a more complex mosaic landscape will encourage birds to enter, rest, and forage in the restoration area. Maintaining these vital connections is the key to sustaining ecosystem composition, structure, and function. Continued and consistent biological monitoring used to drive adaptive management is the recommended proactive strategy to assess and correct any deficiencies in vegetative, fish, or bird communities.

Brandenburg Park Restoration Post-Construction Biological Monitoring Sites

Overall

- Bird Survey
- Plant Survey

Fish Survey

- FN1 - FN4: Fyke Net Locations
- FS1 - FS6: Seine Locations
- GN1: Gill Net Locations
- HN1: Hoop Net Locations

Vallisneria Bed Survey

- Vallisneria (Floating)
- Vallisneria (Rooted)

N

0 100 200

Feet

Source: Data provided by OHM Advisors, State of Michigan, and NearMap. OHM Advisors does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

Coordinate System: Lambert Conformal Conic

Map Published: January 10, 2022

Brandenburg Park Restoration Post-Construction Biological Monitoring Sites

Plant Survey

- Plant Survey

Pre-Construction Vallisneria Bed Survey
- Vallisneria (Floating)
- Vallisneria (Rooted)

Post-Construction Vallisneria Bed Survey
- Vallisneria (Floating)
- Vallisneria (Rooted)

N

0 100 200
Feet

Source: Data provided by OHM Advisors, State of Michigan, and NearMap. OHM Advisors does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

Coordinate System: Lambert Conformal Conic

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Brandenburg Park Restoration Post-Construction Biological Monitoring Sites

Fish Survey

- FN1 - FN4: Fyke Net Locations
- FS1 - FS6: Seine Locations
- GN1: Gill Net Locations
- HN1: Hoop Net Locations

N

0 100 200
Feet

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Brandenburg Park Restoration Post-Construction Biological Monitoring Sites

Bird Survey

Bird Survey

N

0 100 200

Feet

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Map Published: January 10, 2022

CHESTERFIELD TWP. BRANDENBURG PARK VEGETATION SURVEY				7-Sep-21									
Taxonomic source: MICHIGAN FLORA ONLINE. A. A. Reznicek, E. G. Voss, & B. S. Walters. February 2011.													
Point	**Latitude**	**Longitude**	**BOTANICAL NAME**	**COMMON NAME**	**Coefficient of conservatism**	**Coefficient of wetness**	**Wetness index**	**Nativity**	**Life cycle**	**Physiognomy**	**Pop.Density**	**Community**	**Note**
P2	42.66572646	-82.7584382	Convolvulus arvensis	field bindweed	0	5	UPL	Adventive	Perennial	Vine	Patchy	Terrestrial	
P2	42.66572646	-82.7584382	Lolium perenne	Ryegrass	*	3	FACU	Adventive	Perennial	Grass	Sparse	Terrestrial	
P2	42.66572646	-82.7584382	Lythrum salicaria	Purple loosestrife	*	-5	OBL	Adventive	Perennial	Forb	Sparse	Emergent	
P2	42.66572646	-82.7584382	Plantago lanceolata	Narrow-leaved plantain	*	3	FACU	Adventive	Perennial	Forb	Sparse	Terrestrial	
P2	42.66572646	-82.7584382	Poa pratensis	Kentucky bluegrass	*	3	FACU	Adventive	Perennial	Grass	Sparse	Terrestrial	
P2	42.66572646	-82.7584382	Vallisneria americana	WILD-CELERY, EEL-GRASS	7	-5	OBL	Native	Perennial	Forb	Patchy	Submergent	Not rooted
P3	42.66572437	-82.75744758	Acorus americanus	sweet-flag	6	-5	OBL	Native	Perennial	Forb	Patchy	Emergent	
P3	42.66572437	-82.75744758	Lemna minor	Duckweed	5	-5	OBL	Native	Perennial	Forb	Dense	Submergent	
P3	42.66572437	-82.75744758	Potamogeton robbinsii	pondweed	10	-5	OBL	Native	Perennial	Forb	Sparse	Submergent	Rooted
P3	42.66572437	-82.75744758	Potamogeton sp.	pondweed				Native	Perennial	Forb	Sparse	Submergent	Not rooted
P3	42.66572437	-82.75744758	Sagittaria cuneata	arum-leaved arrowhead	6	-5	OBL	Native	Perennial	Forb	Sparse	Submergent	Not rooted
P3	42.66572437	-82.75744758	Schoenoplectus pungens	Threesquare	5	-5	OBL	Native	Perennial	Sedge	Patchy	Emergent	
P4	42.66664787	-82.75640816	Lemna minor	Duckweed	5	-5	OBL	Native	Perennial	Forb	Dense	Submergent	
P4	42.66664787	-82.75640816	Najas flexilis	Slender naiad	5	-5	OBL	Native	Annual	Forb	Patchy	Submergent	
P4	42.66664787	-82.75640816	Schoenoplectus tabernaemontani	softstem bulRush	4	-5	OBL	Native	Perennial	Sedge	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Acer saccharinum	silver maple	2	-3	FACW	Native	Perennial	Tree	Patchy	Terrestrial	Seedlings
P5	42.6656161	-82.75656601	Alisma triviale	northern water-plantain	1	-5	OBL	Native	Perennial	Forb	Patchy	Submergent	Rooted
P5	42.6656161	-82.75656601	Allium cernuum	nodding wild onion	5	3	FACU	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Andropogon gerardii	big bluestem	5	0	FAC	Native	Perennial	Grass	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Asclepias incarnata	swamp milkweed	6	-5	OBL	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Asclepias syriaca	common milkweed	1	5	UPL	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Asclepias tuberosa	butterfly-weed	5	5	UPL	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Bidens cernua	nodding beggar-ticks	3	-5	OBL	Native	Annual	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Bidens frondosa	common beggar-ticks	1	-3	FACW	Native	Annual	Forb	Sparse	Terrestrial	
P5	42.6656161	-82.75656601	Carex aquatilis	sedge	7	-5	OBL	Native	Perennial	Sedge	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Carex bebbii	sedge	4	-5	OBL	Native	Perennial	Sedge	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Carex vulpinoidea	sedge	1	-5	OBL	Native	Perennial	Sedge	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Catalpa speciosa	northern catalpa	0	3	FACU	Adventive	Perennial	Tree	Sparse	Terrestrial	Seedlings
P5	42.6656161	-82.75656601	Ceanothus americanus	new jersey tea	8	5	UPL	Native	Perennial	Shrub	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Chenopodium album	lambs-quarters	0	3	FACU	Adventive	Annual	Forb	Sparse	Terrestrial	
P5	42.6656161	-82.75656601	Cirsium vulgare	bull thistle	0	3	FACU	Adventive	Biennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Conyza canadensis	horseweed	0	3	FACU	Native	Annual	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Cyperus bipartitus	brook nut sedge	3	-3	FACW	Native	Annual	Sedge	Sparse	Terrestrial	
P5	42.6656161	-82.75656601	Cyperus strigosus	long scaled nut sedge	3	-3	FACW	Native	Perennial	Sedge	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Desmodium canadense	showy tick-trefoil	3	0	FAC	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Digitaria ischaemum	smooth crab grass	0	3	FACU	Adventive	Annual	Grass	Sparse	Terrestrial	
P5	42.6656161	-82.75656601	Elymus virginicus	virginia wild-rye	4	-3	FACW	Native	Perennial	Grass	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Euphorbia vermiculata	hairy spurge	0	5	UPL	Adventive	Annual	Forb	Sparse	Terrestrial	
P5	42.6656161	-82.75656601	Eutrochium maculatum	joe-pye-weed	4	-5	OBL	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Galium tinctorium	stiff bedstraw	5	-5	OBL	Native	Perennial	Forb	Sparse	Terrestrial	
P5	42.6656161	-82.75656601	Helenium autumnale	sneezeweed	5	-3	FACW	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Hibiscus moscheutos	swamp or rose mallow	7	-5	OBL	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Juncus sp.	rush				Native	Perennial	Rush	Patchy	Terrestrial	Seedlings
P5	42.6656161	-82.75656601	Juncus torreyi	torreys Rush	4	-3	FACW	Native	Perennial	Rush	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Leersia oryzoides	cut grass	3	-5	OBL	Native	Perennial	Grass	Sparse	Terrestrial	from Seedbank
P5	42.6656161	-82.75656601	Lemna minor	Duckweed	5	-5	OBL	Native	Perennial	Forb	Patchy	Submergent	
P5	42.6656161	-82.75656601	Lobelia siphilitica	great blue lobelia	4	-3	FACW	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Lolium perenne	ryegrass	0	3	FACU	Adventive	Perennial	Grass	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Monarda fistulosa	wild-bergamot	2	3	FACU	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Myrica gale	sweet gale	6	-5	OBL	Native	Perennial	Shrub	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Nuphar advena	yellow pond-lily	8	-5	OBL	Native	Perennial	Forb	Patchy	Emergent	
P5	42.6656161	-82.75656601	Panicum capillare	witch grass	0	0	FAC	Native	Annual	Grass	Sparse	Terrestrial	
P5	42.6656161	-82.75656601	Panicum sp.	panic grass				Adventive	Perennial	Grass	Patchy	Terrestrial	

P5	42.6656161	-82.75656601	Panicum virgatum	switch grass	4	0	FAC	Native	Perennial	Grass	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Penstemon digitalis	foxglove beard-tongue	2	0	FAC	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Persicaria pensylvanica	bigseed smartweed	0	-3	FACW	Native	Annual	Forb	Sparse	Terrestrial	
P5	42.6656161	-82.75656601	Phleum pratense	timothy	0	3	FACU	Adventive	Perennial	Grass	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Phleum pratense	timothy	0	3	FACU	Adventive	Perennial	Grass	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Pontederia cordata	pickerel-weed	8	-5	OBL	Native	Perennial	Forb	Patchy	Emergent	Rooted
P5	42.6656161	-82.75656601	Populus deltoides	cottonwood	1	0	FAC	Native	Perennial	Tree	Patchy	Terrestrial	Seedlings
P5	42.6656161	-82.75656601	Portulaca oleracea	purslane	0	3	FACU	Native	Annual	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Pycnanthemum virginianum	common mountain mint	5	-3	FACW	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Ratibida pinnata	yellow coneflower	4	5	UPL	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Rudbeckia hirta	black-eyed susan	1	3	FACU	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Rudbeckia triloba	three-lobed coneflower	5	3	FACU	Native	Biennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Rumex crispus	curly dock	0	0	FAC	Adventive	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Schoenoplectus pungens	Threesquare	5	-5	OBL	Native	Perennial	Sedge	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Scirpus cyperinus	wool-grass	5	-5	OBL	Native	Perennial	Sedge	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Scrophularia lanceolata	early figwort	5	3	FACU	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Senna hebecarpa	wild senna	5	-3	FACW	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Silphium terebinthinaceum	prairie-dock	6	0	FAC	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Solidago nemoralis	old-field goldenrod	2	5	UPL	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Solidago riddellii	riddells goldenrod	6	-5	OBL	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Sorghastrum nutans	indian grass	6	3	FACU	Native	Perennial	Grass	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Spartina pectinata	cordgrass	5	-3	FACW	Native	Perennial	Grass	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Sporobolus heterolepis	prairie dropseed	10	3	FACU	Native	Perennial	Grass	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Symphyotrichum sp.	aster				Adventive	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Trifolium hybridum	alsike clover	0	3	FACU	Adventive	Perennial	Forb	Sparse	Terrestrial	
P5	42.6656161	-82.75656601	Trifolium repens	white clover	0	3	FACU	Adventive	Perennial	Forb	Sparse	Terrestrial	
P5	42.6656161	-82.75656601	Triticum aestivum	wheat	0	5	UPL	Adventive	Annual	Grass	Sparse	Terrestrial	
P5	42.6656161	-82.75656601	Vaccinium augustifolium	low sweet blueberry	4	3	FACU	Native	Perennial	Shrub	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Vallisneria americana	WILD-CELERY, EEL-GRASS	7	-5	OBL	Native	Perennial	Forb	Patchy	Submergent	Not rooted
P5	42.6656161	-82.75656601	Vallisneria americana	WILD-CELERY, EEL-GRASS	7	-5	OBL	Native	Perennial	Forb	Sparse	Submergent	Rooted
P5	42.6656161	-82.75656601	Verbena hastata	blue vervain	4	-3	FACW	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Verbesina alternifolia	wing-stem	4	-3	FACW	Native	Perennial	Forb	Patchy	Terrestrial	
P5	42.6656161	-82.75656601	Zizia aurea	golden alexanders	6	0	FAC	Native	Perennial	Forb	Patchy	Terrestrial	
P6	42.66756984	-82.75686231	Asclepias syriaca	Milkweed	1	5	UPL	Native	Perennial	Forb	Sparse	Terrestrial	
P6	42.66756984	-82.75686231	Calamagrostis canadensis	Bluejoint grass	3	-5	OBL	Native	Perennial	Grass	Sparse	Emergent	
P6	42.66756984	-82.75686231	Carex comosa	Sedge	5	-5	OBL	Native	Perennial	Sedge	Sparse	Emergent	
P6	42.66756984	-82.75686231	Convolvulus arvensis	field bindweed	0	5	UPL	Adventive	Perennial	Vine	Patchy	Terrestrial	
P6	42.66756984	-82.75686231	Cornus amomum	Silky dogwood	2	-3	FACW	Native	Perennial	Shrub	Sparse	Emergent	
P6	42.66756984	-82.75686231	Equisetum arvense	common horsetail	0	0	FAC	Native	Perennial	Fern	Sparse	Terrestrial	
P6	42.66756984	-82.75686231	Glechoma hederacea	ground-ivy	0	3	FACU	Adventive	Perennial	Forb	Patchy	Terrestrial	
P6	42.66756984	-82.75686231	Impatiens capensis	spotted touch-me-not	2	-3	FACW	Native	Annual	Forb	Sparse	Terrestrial	from Seedbank
P6	42.66756984	-82.75686231	Juglans cinerea	butternut	5	3	FACU	Native	Perennial	Tree	Sparse	Terrestrial	(1) 3" DBH
P6	42.66756984	-82.75686231	Melilotus albus	White sweet-clover	*	3	FACU	Adventive	Biennial	Forb	Sparse	Terrestrial	
P6	42.66756984	-82.75686231	Mimulus ringens	monkey-flower	5	-5	OBL	Native	Perennial	Forb	Sparse	Terrestrial	from Seedbank
P6	42.66756984	-82.75686231	Oenothera biennis	Common evening-primrose	2	3	FACU	Native	Biennial	Forb	Patchy	Terrestrial	
P6	42.66756984	-82.75686231	Phalaris arundinacea	Reed canary	0	-3	FACW	Adventive	Perennial	Grass	Sparse	Emergent	
P6	42.66756984	-82.75686231	Phragmites australis	Phragmites	*	-3	FACW	Adventive	Perennial	Grass	Patchy	Emergent	
P6	42.66756984	-82.75686231	Poa pratensis	Kentucky bluegrass	*	3	FACU	Adventive	Perennial	Grass	Sparse	Terrestrial	
P6	42.66756984	-82.75686231	Sagittaria cuneata	arum-leaved arrowhead	6	-5	OBL	Native	Perennial	Forb	Sparse	Terrestrial	
P6	42.66756984	-82.75686231	Schoenoplectus pungens	Threesquare	5	-5	OBL	Native	Perennial	Sedge	Patchy	Emergent	
P6	42.66756984	-82.75686231	Solanum ptychanthum	black nightshade	1	3	FACU	Native	Annual	Forb	Sparse	Terrestrial	from Seedbank
P6	42.66756984	-82.75686231	Solidago canadensis	canada goldenrod	1	3	FACU	Native	Perennial	Forb	Patchy	Terrestrial	
P6	42.66756984	-82.75686231	Symphyotrichum ericoides	Heath aster	3	3	FACU	Native	Perennial	Forb	Sparse	Terrestrial	
P6	42.66756984	-82.75686231	Vallisneria americana	WILD-CELERY, EEL-GRASS	7	-5	OBL	Native	Perennial	Forb	Sparse	Submergent	Rooted
P6	42.66756984	-82.75686231	Vitis riparia	river-bank grape	3	0	FAC	Native	Perennial	Vine	Patchy	Terrestrial	

Overall Species Composition List, Species Tolerance, and Age Structure. 2021

Scientific Name	Common Name	Species Tolerance	Fry	Juvenile	Adult	Total
Ambloplites rupestris	Rock Bass	Intolerant	12	22	5	39
Ameiurus natalis	Yellow Bullhead	Tolerant	0	0	1	1
Amia calva	Bowfin	Tolerant	0	0	2	2
Cyprinella spiloptera	Spotfin Shiner	Tolerant	0	3	41	44
Cyprinus carpio	Common Carp	Tolerant	0	0	4	4
Dorosoma cepedianum	Gizzard Shad	Tolerant	0	1	3	4
Etheostoma exile	Iowa Darter	Intolerant	0	0	1	1
Fundulus diaphanus	Western Banded Killifish	Intolerant	0	16	1	17
Labidesthes sicculus	Brook Silverside	Tolerant	0	11	42	53
Lepomis macrochirus	Bluegill	Intolerant	82	82	5	169
Micropterus salmoides	Largemouth Bass	Tolerant	0	10	2	12
Morone americana	White Perch	Tolerant	0	0	1	1
Neogobius melanostomus	Round Goby	Tolerant	3	5	7	15
Notemigonus crysoleucas	Golden Shiner	Tolerant	0	2	1	3
Notropis atherinoides	Emerald Shiner	Tolerant	0	21	5	26
Notropis hudsonius	Spottail Shiner	Tolerant	0	3	7	10
Notropis volucellus	Mimic Shiner	Tolerant	0	12	1	13
Perca flavescens	Yellow Perch	Tolerant	0	2	8	10
Pimephales notatus	Bluntnose Minnow	Tolerant	4	51	7	62
Pomoxis annularis	White Crappie	Tolerant	0	0	1	1
Proterorhinus marmoratus	Tubenose Goby	Tolerant	2	6		8
Grand Total			103	247	145	495

	AOU Code	Common name	Conservation Value (cv)	Abundance	(cv) Abundance
1	DCCO	Double-crested Cormorant	2	3	6
2	RBGU	Ring-billed Gull	2	290	580
3	CANG	Canada Goose	2	43	86
4	KILL	Killdeer	3	3	9
5	MALL	Mallard	1	10	10
6	HOSP	House Sparrow	0	13	0
7	EUST	European Starling	0	11	0
8	GBHE	Great Blue Heron	2	1	2
9	NOPI	Northern Pintail	4	2	8
10	BEKI	Belted Kingfisher	3	1	3
11	MUSW	Mute Swan	0	3	0
12	SPSA	Spotted Sandpiper	3	1	3
13	HERG	Herring Gull	3	2	6
14	REVI	Red-eyed Vireo	2	1	2
15	RUDU	Ruddy Duck	2	2	4
16	AMCR	American Crow	2	1	2
17	EAKI	Eastern Kingbird	3	1	3
18	TRWA	Yellow-rumped Warbler	1	1	1
19	MODO	Mourning Dove	2	4	8
20	NOCA	Northern Cardinal	2	1	2
21	CEDW	Cedar Waxwing	2	1	2
22	DOWO	Downy Woodpecker	2	1	2
23	AMGO	American Goldfinch	2	1	2
24	ROPI	Rock Pigeon	0	26	0
		Total		423	741
		Mean	1.875	17.625	30.875
		Median	2	2	2.5

SITE	Brandenburg
DATE	9/7/2021
OBSERVER	John, Don and
TIME START	710
TIME END	800
TEMP START	65
SKY START	Clear
WIND START	Still

CODE RICHNESS	24
SPECIES RICHNESS	14
TOTAL ABUNDANCE	423
NATIVE ABUNDANCE	370
NON-NATIVE ABUNDANCE	53
CV ABUNDANCE	741

Brandenburg Park Shoreline Restoration

Pre-Construction Biological Monitoring 2019

DRAFT

Contents

Introduction

Although Brandenburg Park's shoreline habitat is fully developed and degraded, it is part of the St. Clair-Detroit River System (SCDRS), and as Great Lakes waters, is likely to rebound to some degree from limnetic stresses with the implementation of integrated restoration practices. Because high-quality connected habitats are important for sustained Great Lakes fish production, protecting and improving habitat can directly benefit fish communities. Fish habitat improvement techniques range by scale, and at Brandenburg Park local actions that improve connectivity or restore function of littoral, wetland, and open-water physical and vegetative habitats may have a positive impact on the existing fish population. With the undertaking of shoreline restoration and nearshore habitat creation at Brandenburg Park, The Township of Chesterfield hopes to successfully improve overall habitat complexity and quality. In order to gauge success of the goal to promote growth of Vallisneria americana, which serves as important spawning, nursery, and forage areas for many game fish, biological sampling of vegetation has been conducted. Sampling of fish populations has also been conducted in order to measure effectiveness of this restoration project in promoting the increase of game and juvenile fish populations. The following report is a summary of activities and an update on plant and fish communities sampled at the restoration site prior to implementation of the project.

Vegetation Sampling

An assessment of submergent, emergent, and upland flora within the restoration site was performed on October 12, 2019, during the pre-construction phase of this project. The following summarizes vegetation sampling activities performed in order to establish an understanding of existing conditions and develop a baseline of the current plant community within the project site at Brandenburg Park, in order to perform before-and-after comparisons with post-construction assessments.

Floristic Quality Assessment

Qualitative evaluations were performed using the Universal Floristic Quality Assessment Calculator (FQA) from the Michigan Floristic Quality Assessment Database according to Herbarium, and Michigan Natural Features Inventory, Michigan State University (2014). The FQA assigns a coefficient of conservatism (C) to each plant species; the higher the coefficient of conservatism (1-10), the greater the likelihood the plant occurred in a landscape relatively unaltered from pre-settlement conditions. The Floristic Quality Index (FQI) value is then calculated by multiplying the mean C for the entire plant community by the square root of the total number of species encountered on the site. The FQI score can then be used to assess how significant a plant community is relative to pre-settlement conditions. Most remaining undeveloped lands in Michigan have FQI scores of less than 20 and have minimal significance from a natural quality perspective. Areas having an FQI greater than 35 exhibit sufficient conservatism and species richness to be floristically important and of statewide significance in Michigan. FQI scores greater than or equal to 50 are rare and represent important elements of Michigan's biodiversity. The FQA also provides an average wetness ranking for all plant species present. The wetland scores, ranging from -5 to 5 with -5 representing obligate wetland plants, are based on "coefficients of wetness," which are derived from the five main National Wetland Indicator Categories. During the assessment of submergent vegetation the areal extent of *Vallisneria americana* beds were GPS located in order to ensure they are properly addressed during construction. Six random quadrat locations were established within the restoration site for vegetation sampling, shown in Figure 1. Each of the vegetation sampling plots are to be sampled annually to assess floristic quality of the vegetation of the upland, wetland, and aquatic habitats. Sampling quadrats were randomized along the corridor of extant naturalized vegetation to gauge both quality and variation in plant community quality and hydrologic preferences. Conservation Research Institute and Michigan DNR guidance was utilized for the transect/FQI methods and standard choice of transect determination.

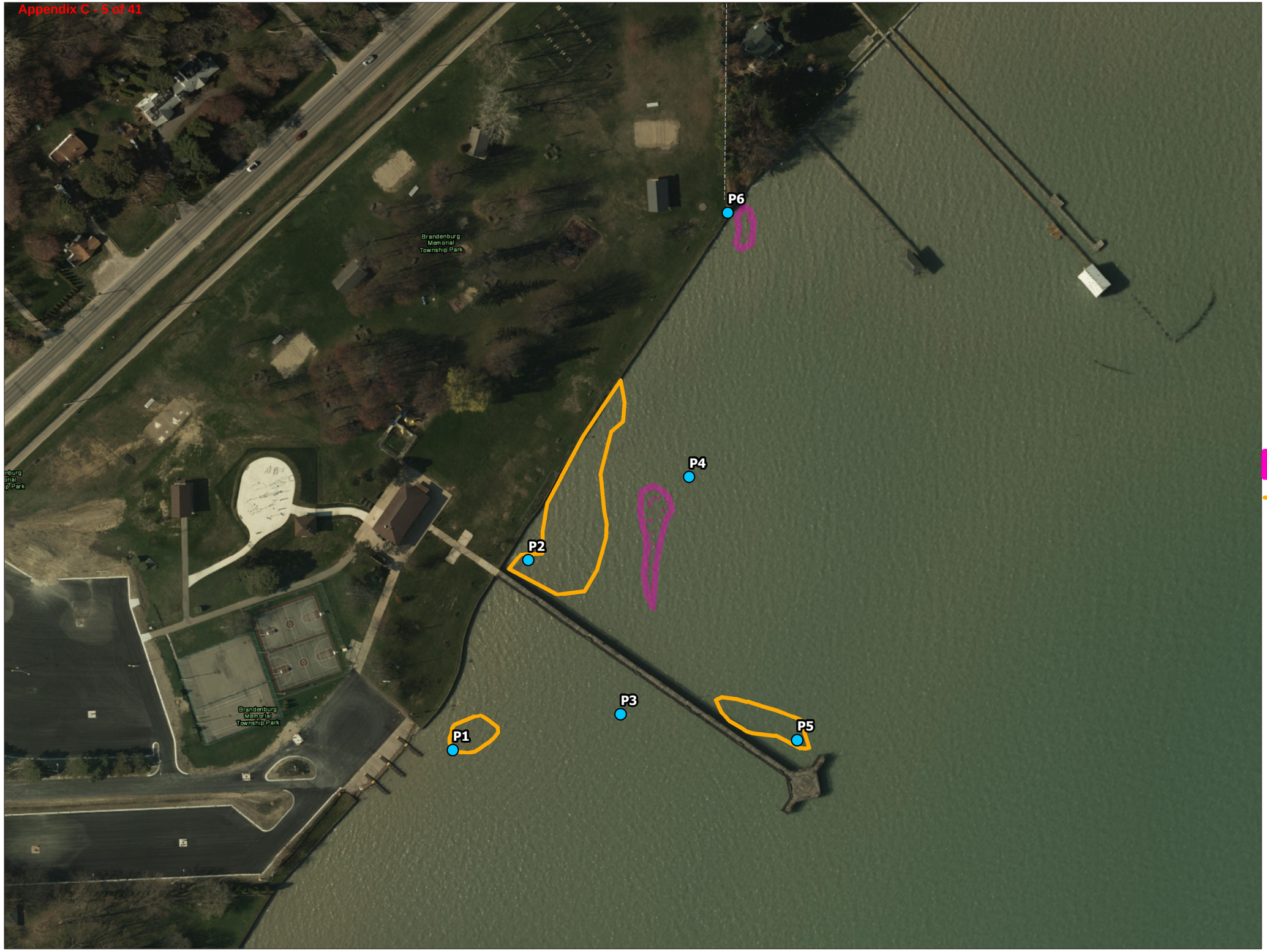
Results

The taxa discovered during this 2019 vegetation assessment can be found below in Table 1. Assessment results found a total of 21 unique species (n) across the six quadrats, eleven of which are native and ten being adventive. Including adventive species in the total species count *n*, the mean coefficient of conservatism (mean-C) was found to be 2.09, and the Floristic Quality Index (FQI) 9.6. When only native species are included in the analysis, native mean-C becomes 4.00, and FQI 13.27. FQI scores of under 20 indicates low vegetative quality, while scores of 35 or more signify floristic importance statewide. These mean-C results characterize a low diversity site, containing comparatively low percent native species and is characterized by mesophytic upland and facultative hydrologic-transitional plants. Mean coefficient of wetness for the transect was slightly greater than -1, which indicates marginal wetland plant dominance, but when calculated using only native species, the coefficient of wetness suggests a greater wetland plant dominance, as the wetness index value drops to -2.5 score.

These taxa formed a patchy vegetative community with turf species upland of the seawall with very limited diversity of species and physiognomies present. Quadrat P6, located in the northeastern corner of the site, is a small sheltered area with some characteristic riparian herbs, trees, and shrubs, as well as a handful of conservative aquatic emergent and submergent plants, of which *Vallisneria americana* (eelgrass) is by far the most dominant across the open water at the site. Eelgrass is the only aquatic submergent species and is a monitoring priority for the project. The emergent sedges and rushes and shoreline shrub populations can be monitored to determine if hydrologic gradient specialists colonize after restoration. *Vallisneria* beds very important consideration as the only high-C value species (7) present on the site, as well as being food for fish and other aquatic herbivores.

Vallisneria americana

Eelgrass beds were GPS located with submeter accuracy with the intent of properly protecting or transplanting during construction and comparison with post construction extents. For the purpose of this assessment, an eelgrass bed is defined as a minimum of 3 rooted shoots per 0.25 m^2 found within 1 meter of any adjacent rooted shoots. To identify the bed boundary, investigators proceeded in a linear direction and found the last shoot within 1 meter of an adjacent shoot along that transect. The bed boundary (edge) is defined as the point 0.5 meters past that last shoot, in recognition of the average length of the roots and rhizomes extending from an individual shoot. Since *Vallisneria americana* actively roots into shallow littoral substrates, assume rooted clumps will not dislodge with light surveyor tugging. When shoot frequency was difficult to see in wave-action, investigators performed a grab/tug-test to determine if surface foliage was in fact rooted at the point it was discovered. While *Vallisneria americana* survey initially followed the chosen transects, final work established complete and intensive population delineation throughout the site, in order to differentiate rooted material from foliage and shoots sloughing off as part of wind-wave action. Extents of free-floating and rooted *Vallisneria americana* beds found at the project site are depicted in Figure 1.



Brandenburg Park Restoration
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Figure 1 Vegetation Sampling

- Plant Sampling Quadrats
- Vallisneria Bed
- Vallisneria (floating)

N

0 100 200

Feet

1" = 125'

Source: Data provided by /INSERT DATA SOURCE\. OHM Advisors does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 IntlFeet

Map Published: January 15, 2020

Table 1: Pre-Construction Floristic Quality index Vegetation Sampling Results, October 12, 2019

Taxonomic source: MICHIGAN FLORA ONLINE. A. A. Reznicek, E. G. Voss, & B. S. Walters. February 2011.

Point	BOTANICAL NAME	COMMON NAME	Coefficient of conservatism	Coefficient of wetness	Wetness index	Nativity	Life cycle	Physiognomy	Pop.Density	Community	Note
P1	Vallisneria americana	WILD-CELERY, EEL-GRASS	7	-5	OBL	Native	Perennial	Forb	Patchy	Submergent	Rooted
P1	Lemna minor	Duckweed	5	-5	OBL	Native	Perennial	Forb	Dense	Submergent	
P2	Elymus repens	Quack grass	*	3	FACU	Adventive	Perennial	Grass	Sparse	Terrestrial	
P2	Lolium arundinaceum	Tall fescue	*	3	FACU	Adventive	Perennial	Grass	Sparse	Terrestrial	
P2	Lolium perenne	Ryegrass	*	3	FACU	Adventive	Perennial	Grass	Sparse	Terrestrial	
P2	Lythrum salicaria	Purple loosestrife	*	-5	OBL	Adventive	Perennial	Forb	Sparse	Emergent	
P2	Plantago lanceolata	Narrow-leaved plantain	*	3	FACU	Adventive	Perennial	Forb	Sparse	Terrestrial	
P2	Poa pratensis	Kentucky bluegrass	*	3	FACU	Adventive	Perennial	Grass	Sparse	Terrestrial	
P2	Vallisneria americana	WILD-CELERY, EEL-GRASS	7	-5	OBL	Native	Perennial	Forb	Patchy	Submergent	Not rooted
P3	Lemna minor	Duckweed	5	-5	OBL	Native	Perennial	Forb	Dense	Submergent	
P3	Schoenoplectus pungens	Threesquare	5	-5	OBL	Native	Perennial	Sedge	Patchy	Emergent	
P4	Lemna minor	Duckweed	5	-5	OBL	Native	Perennial	Forb	Dense	Submergent	
P4	Najas flexilis	Slender naiad	5	-5	OBL	Native	Annual	Forb	Patchy	Submergent	
P5	Lemna minor	Duckweed	5	-5	OBL	Native	Perennial	Forb	Patchy	Submergent	
P5	Vallisneria americana	WILD-CELERY, EEL-GRASS	7	-5	OBL	Native	Perennial	Forb	Patchy	Submergent	Not rooted
P6	Asclepias syriaca	Milkweed	1	5	UPL	Native	Perennial	Forb	Sparse	Terrestrial	
P6	Carex comosa	Sedge	5	-5	OBL	Native	Perennial	Sedge	Sparse	Emergent	
P6	Calamagrostis canadensis	Bluejoint grass	3	-5	OBL	Native	Perennial	Grass	Sparse	Emergent	
P6	Cornus ammomum	Silky dogwood	2	-3	FACW	Native	Woody	Shrub	Sparse	Emergent	
P6	Melilotus albus	White sweet-clover	*	3	FACU	Adventive	Biennial	Forb	Sparse	Terrestrial	
P6	Oenothera biennis	Common evening-primrose	2	3	FACU	Native	Biennial	Forb	Patchy	Terrestrial	
P6	Phalaris arundinacea	Reed canary	0	-3	FACW	Adventive	Perennial	Grass	Sparse	Emergent	
P6	Phragmites australis	Phragmites	*	-3	FACW	Adventive	Perennial	Grass	Patchy	Emergent	
P6	Pinus sylvestris	Scotch pine	*	3	FACU	Adventive	Perennial	Tree	Sparse	Terrestrial	
P6	Poa pratensis	Kentucky bluegrass	*	3	FACU	Adventive	Perennial	Grass	Sparse	Terrestrial	
P6	Salix sericea	Silky willow	6	-5	OBL	Native	Woody	Shrub	Sparse	Emergent	
P6	Schoenoplectus pungens	Threesquare	5	-5	OBL	Native	Perennial	Sedge	Patchy	Emergent	
P6	Symphyotrichum ericoides	Heath aster	3	3	FACU	Native	Perennial	Forb	Sparse	Terrestrial	
P6	Vallisneria americana	WILD-CELERY, EEL-GRASS	7	-5	OBL	Native	Perennial	Forb	Sparse	Submergent	Rooted

Fish Sampling

A pre-construction assessment of fish populations in the nearshore zone at Brandenburg Park was conducted in October and November of 2019 utilizing an array of methods to gather a representative sample and create a baseline which can then be used to conduct before-and-after comparison with further fish assessment conducted in the post-construction phase.

Field sampling of fish was performed utilizing electroshocking equipment by Michigan Department of Natural Resources (MDNR) and also using seine and fyke nets, which was performed by Natural Community Services (NCS). A total of 500 individual fish comprised of nineteen unique species were sampled during efforts, compared to 65 fish species existing within the SCRDRS, according to MDNR. During the field collection several game fish, including Smallmouth and Rock Bass, Freshwater Drum, and White Crappie were found, as well as Sculpins, Gizzard Shad, several species of Shiners, and other minnows which sustain predators. In addition, some forage species such as yellow perch were discovered, which provide recreational and commercial fishing opportunities. Below are results from pre-construction fish sampling at mapped interval sampling locations in shoreline and nearshore open water habitats within the proposed habitat restoration area.

Electroshocking Results

MDNR field staff conducted electrofishing in the nearshore zone of Brandenburg park on October 25, 2019 for 30 continuous minutes. Beginning at the northeast side of the pier and ending north of the park (Figure 2), the first and last 10 minutes of the effort all species were targeted, while for the middle 10 minutes only muskellunge were targeted. The objective of the effort was to cover varying effective depths and habitat as much as possible during the 30 minutes. All fish collected were held in a tub on the boat for processing upon completion of the sample collection activities. All fish were identified and measured to the centimeter group (i.e. 1.0-1.9 cm = 1 cm) and the result can be found in Table 2. As with any fisheries gear, environmental factors can have an impact on the efficiency. The water temperature was 51.4°F and visibility was poor as evidenced by a Secchi reading of 1 ft. Conductivity was measured at 190 micro-Siemens per centimeter. Setting for the electrofishing output was 60 pulses per second, 290 volts, 17.5 amps (max) and a duty of 18%.

Poor visibility likely limited the catch, especially for smaller species that might not have been near the surface. There were multiple times when investigators needed to back up for fish floating to the surface after we went through. The Brandenburg Park site had low species diversity collected through electroshocking, with a total of 9 unique fish species, when compared to13 other electroshocking sites on Lake St. Clair with an overall average of 13 species. For all 14 sites the 25th percentile mark was 10 fish species, slightly higher than what was found at Brandenburg Park.

Table 2: MDNR Catch summary of the electrofishing effort at Brandenburg Park, October 2019.

Species	Common Name	Adult	Fry	Juvenile	Total
Aplodinotus grunniens	Freshwater Drum	1	0	0	**1**
Cyprinus carpio	Common Carp	0	0	1	**1**
Dorosoma cepedianum	Gizzard Shad	2	0	4	**6**
Labidesthes sicculus	Silverside	29	0	33	**62**
Micropterus salmoides	Largemouth Bass	3	0	2	**5**
Notropis atherinoides	Emerald Shiner	4	0	0	**4**

Species	Common Name	Adult	Fry	Juvenile	Total
Perca flavescens	Yellow Perch	31	0	19	**50**
Pimephales notatus	Bluntnose Minnow	1	0	0	**1**
Pomoxis annularis	White Crappie	1	0	0	**1**
TOTAL		**72**	**0**	**59**	**131**

Seine and Fyke Netting Results

Utilizing both fyke and seine nets, NCS sampled sixteen unique species of fish, including several game fish and an array of minnows and prey fish, which were documented at the project site. Seine netting was conducted on October 14th and 28th, 2019 at six separate locations and fyke netting was conducted on November 5th and 6th, 2019 at four separate locations in both shoreline and open water areas of Brandenburg Park (Figure 2). Please see the QAPP document for further details on these methods employed (Appendix A). All fish were identified and measured to the centimeter group (i.e. 1.0-1.9 cm = 1 cm) and the result can be found in Table 3, below. A representative individual from each species sample was also photographed and catalogued (See Appendix B). Individual fish listed by species and size class at each seine and fyke netting can be found in Appendix C.

Table 3: Seine and Fyke Netting Results from October and November 2019.

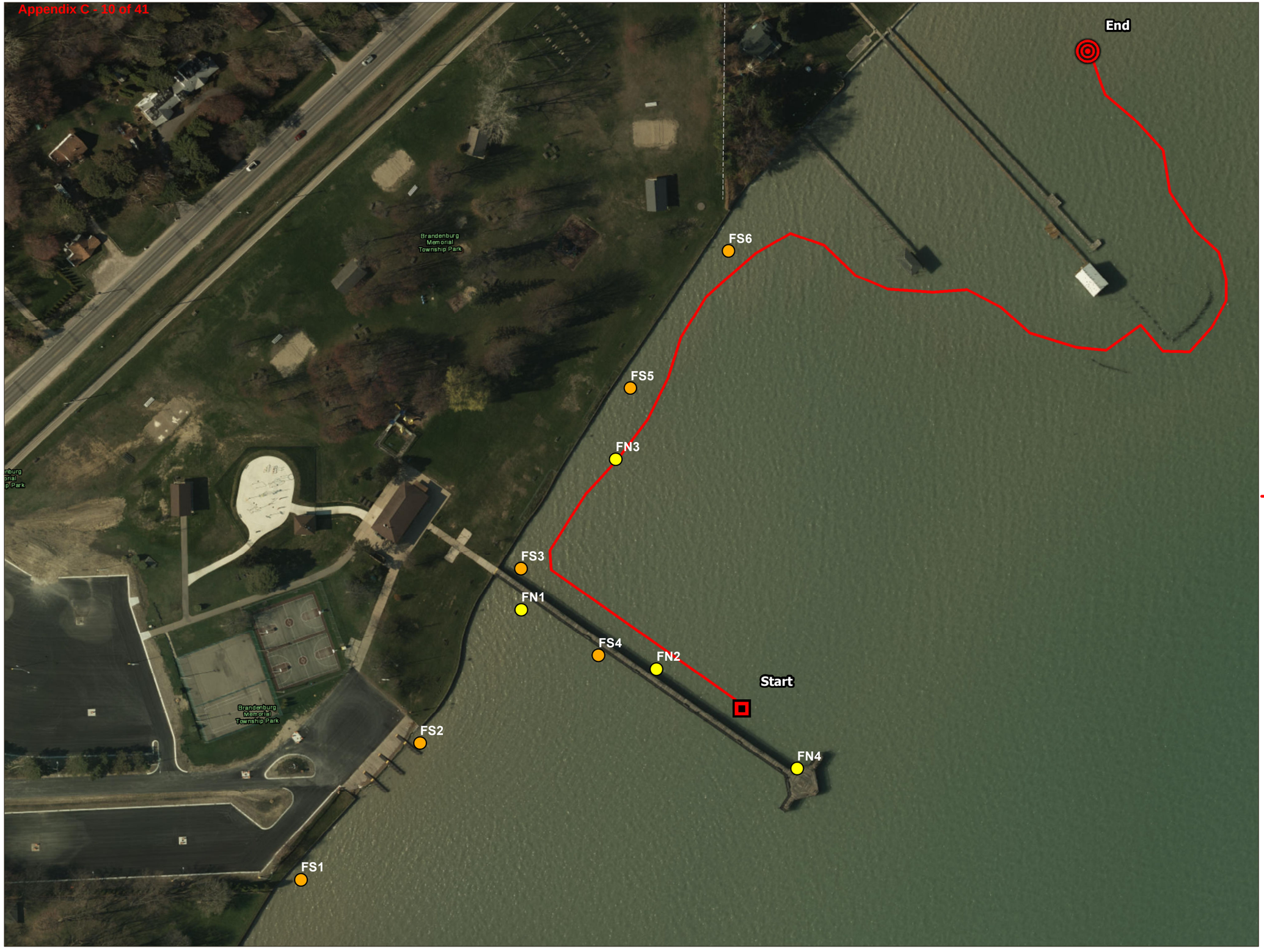
Species	Common Name	Adult	Fry	Juvenile	Total
Ambloplites rupestris	Rock Bass	8	0	12	20
Cyprinella spiloptera	Spotfin Shiner	4	0	2	6
Dorosoma cepedianum	Gizzard Shad	29	0	3	32
Fundulus diaphanus	Banded Killifish	2	0	7	9
Labidesthes sicculus	Brook Silverside	29	0	10	39
Lepomis macrochirus	Bluegill	2	19	30	51
Menidia beryllina	Inland Silverside	4	0	3	7
Micropterus dolomieu	Smallmouth Bass	1	0	1	2
Micropterus salmoides	Largemouth Bass	0	0	1	1
Nacomis biguttatus	Hornyhead Chub	1	0		1
Neogobius melanostomus	Round Goby	25	3	16	44
Notropis atherinoides	Emerald Shiner	1	0	8	9
Notropis volucellus	Mimic Shiner	23	0	14	37
Perca flavescens	Yellow Perch	16	0	47	63
Percina caprodes	Logperch		0	2	2
Pimephales notatus	Bluntnose Minnow	33	0	13	46
GRAND TOTAL		**178**	**22**	**169**	**369**

Overall Pre-Construction Fish Sampling Results

Of the 500 individual fish sampled at the restoration site through all methods, exactly 250 of these were adult, representing 50% of the sampled population, while juvenile fish numbered 228, or 46%, and fry numbered 22, or 4% of the total population. Juvenile Yellow Perch were the most numerous (66), followed by adult Brook Silverside (58), and adult Yellow Perch (47). A total of 44 individual invasive Round Goby were also sampled during activities. Nine of the total 19 unique species discovered are considered minnows or small prey fish and account for 302 of 500 individuals (61%). Below are sampling totals by species and age class, and associated fish sampling map. A quantification of each species collected at each unique sampling point can be found in Table 4, below.

Table 4: Overall Fish Sampling Results from October and November 2019.

Species	Common Name	Adult	Fry	Juvenile	Total
Ambloplites rupestris	Rock Bass	8	0	12	20
Cyprinella spiloptera	Spotfin Shiner	4	0	2	6
Dorosoma cepedianum	Gizzard Shad	31	0	7	38
Fundulus diaphanus	Banded Killifish	2	0	7	9
Labidesthes sicculus	Brook Silverside	58	0	43	101
Lepomis macrochirus	Bluegill	2	19	30	51
Menidia beryllina	Inland Silverside	4	0	3	7
Micropterus dolomieu	Smallmouth Bass	1	0	1	2
Micropterus salmoides	Largemouth Bass	3	0	3	6
Nacomis biguttatus	Hornyhead Chub	1	0	0	1
Neogobius melanostomus	Round Goby	25	3	16	44
Notropis atherinoides	Emerald Shiner	5	0	8	13
Notropis volucellus	Mimic Shiner	23	0	14	37
Perca flavescens	Yellow Perch	47	0	66	113
Percina caprodes	Logperch	o	0	2	2
Pimephales notatus	Bluntnose Minnow	34	0	13	47
Pomoxis annularis	White Crappie	1	0	0	1
Cyprinus carpio	Common Carp	0	0	1	1
Aplodinotus grunniens	Freshwater Drum	1	0	0	1
GRAND TOTAL		**250**	**22**	**228**	**500**



Brandenburg Park Restoration

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Figure 2 Fish Sampling Locations

- Fyke Net Location
- Seine Net Location
- Electrofishing Transect

N

0 100 200

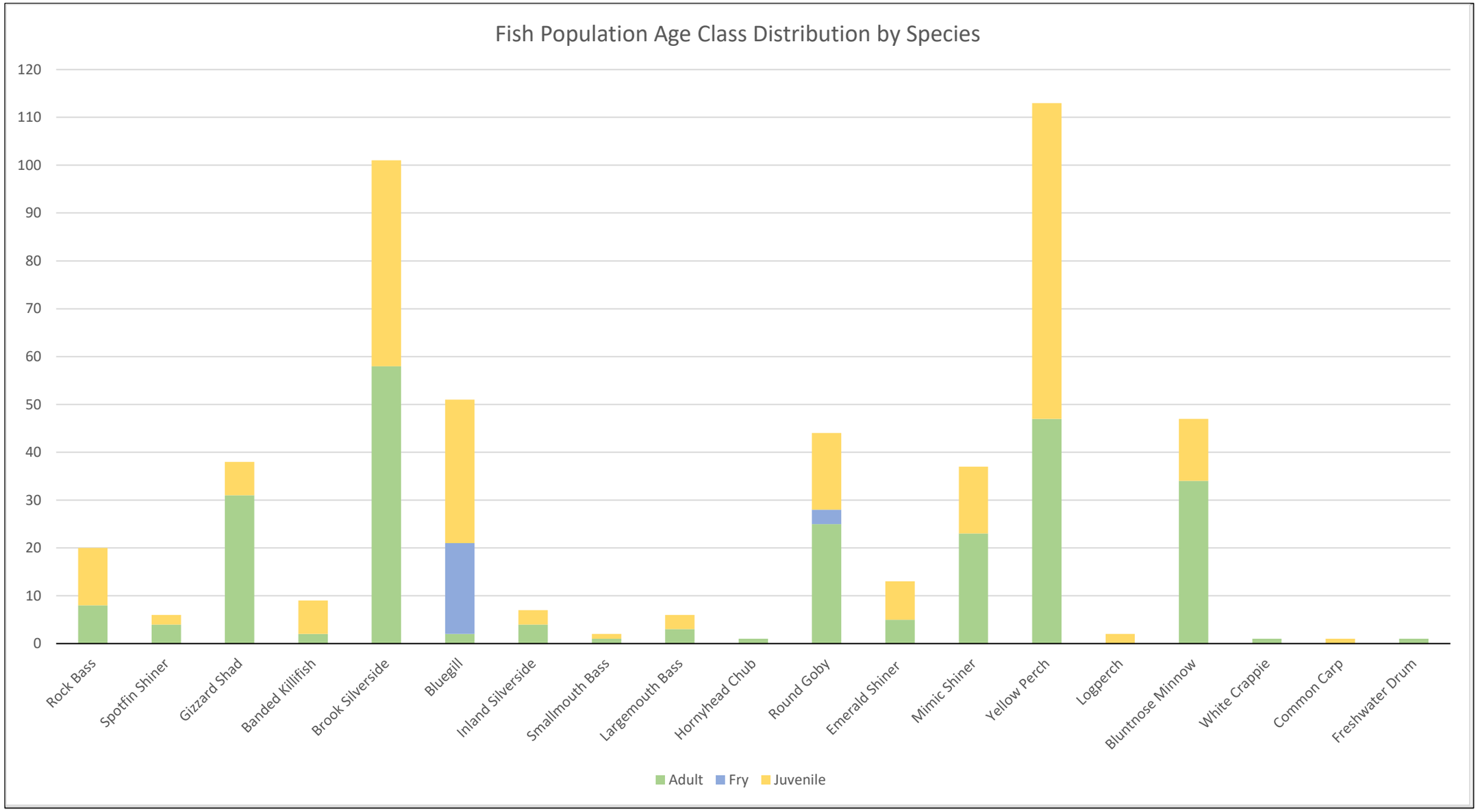
Feet

Source: Data provided by /INSERT DATA SOURCE\. OHM Advisors does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 IntlFeet

Map Published: January 15, 2020

Table 5: Fish Population Age Class by Species



APPENDIX A:

Brandenburg Park Shoreline Restoration
St Clair-Detroit River System Coastal Restoration Initiative
Cooperative Agreement No. GLC-3529

Quality Assurance Project Plan (QAPP)

October 2019

Charter Township of Chesterfield

Great Lakes Commission

Required Signatures for GLRI Quality Assurance Project Plan

The signatories have reviewed and approved of the Quality Assurance Project Plan for the Charter Township of Chesterfield and the Great Lakes Commission for the project titled "Brandenburg Park Shoreline Restoration".

Daniel Acciavatti
Charter Township of Chesterfield, Township Supervisor
Date: 10/10/2019

Josh Sonnenberg
Charter Township of Chesterfield, Operations and Facilities Maintenance Director
Date: 10/10/2019

Mitch O'Connor, P.E.
Charter Township of Chesterfield, Township Engineer
Date: 10/10/19

Terry Heatlie
NOAA Technical Monitor
Date: 10/16/2019

Rina Studds
NOAA Federal Program Officer
Date: 10/16/19

Table of Contents

I. Distribution List

Charter Township of Chesterfield

- Daniel Acciavatti, Township Supervisor
- Josh Sonnenberg, Operations and Facilities Maintenance Director
- Mitch O'Connor, Township Engineer

Great Lakes Commission (GLC)

- Eric Ellis, Habitat Project Manager
- Jillian Estrada, Habitat Program Specialist

National Oceanic and Atmospheric Administration (NOAA)

- Terry Heatlie, Technical Monitor
- Rina Studds, Federal Program Officer

Office of the Great Lakes (OGL)

- Michelle Selzer

OHM Advisors

- Steve Siklich, P.E.
- Valerie Novaes, P.E.
- John Deslippe

II. Project Organization

Table 1. Personnel and Responsibilities

Category	Personnel	General Responsibilities
Federal Program Officer	Rina Studds, NOAA	Provides overall project/program oversight and ensures all contract issues are properly addressed.
Technical Monitor	Terry Heatlie, NOAA	Ensure monitoring efforts are performed according to this QAPP and provide technical input on monitoring objectives and methods.
Project Management	Valerie Novaes, OHM Advisors	Oversee project team to ensure all project work is performed at a high quality, and within the agreed upon timeline
QA/QC	John Deslippe, OHM Advisors	Perform quality control review of sampling protocol, field efforts and data analysis/recommendations
Field Activities	John DeLisle, Natural Community Services (NCS)	Perform fieldwork for biological monitoring and prepare summary of findings
Data Analysis	John Deslippe (OHM) and John DeLisle (NCS)	Review fieldwork data and prepare summary of results and implications for project design/implementation
Clerical	Dana Pulver, OHM Advisors	Provide administrative support for file and report formatting and review

Table 2. Contact information for the main personnel is provided below:

Valerie Novaes, P.E. 34000 Plymouth Road Livonia, MI. 48150 Direct: 734-466-4567 Mobile: 248-935-8557 Valerie.novaes@ohm-advisors.com	John Deslippe 34000 Plymouth Road Livonia, MI. 48150 Direct: 734-466-4565 Mobile: 248-979-3543 John.deslippe@ohm-advisors.com
John DeLisle, PWS West Bloomfield, Mi. 48324 248-672-7611 john@naturalcommunityservices.com	Dana Pulver 34000 Plymouth Road Livonia, MI. 48150 Direct: 734-466-4424 Dana.pulver@ohm-advisors.com

III. Problem Definition and Background

Since 1976, Brandenburg Park has been the recreational crown jewel of Chesterfield Township. Located off Jefferson Avenue a quarter-mile south of 23 Mile Road, this 17-acre parcel is positioned along the shore of Anchor Bay and serves the recreational needs of the township and the greater Lake St. Clair area with a unique assortment of facilities. Owned and maintained by Chesterfield Township, the park sees a steady stream of visitors and features four open-air pavilions, a splash pad, and a multipurpose building. The park's 500 ft pier is one of only a few in Metro Detroit from which individuals can fish and view wildlife. Located five miles from I-94, this park's public boat launch attracts boating and fishing enthusiasts from all over the county and throughout the region.

Erosion has led the original seawall to crumble and breakaway, resulting in portions of the land being unsafe for park users, increased sediment flow into the lake, and reduced access for fishing. The primary goal of this project is to improve fish habitat at the park while eliminating a shoreline safety hazard and improving coastal recreation, especially fishing. Strong local government and community support will help sustain the proposed restoration activities and support healthy populations of native fish species into the future. Fish species found in Anchor Bay and the area near Brandenburg Park include: smallmouth bass, Great Lakes muskellunge, northern pike, perch, lake sturgeon, and walleye. Historically, spawning, migration, feeding, and nursery habitat was plentiful along the coast of Lake St. Clair. However, urban development and armoring along the shore, including Brandenburg Park, has significantly reduced available habitats for these, and other fish species.

In order to assess if the project is implemented as planned, a monitoring plan has been developed that contains pre- and post-construction fish and vegetation assessments to evaluate the short term structural changes at the project site and basic success of the work conducted. Reptiles, amphibians, birds, macroinvertebrates, and water quality may also be assessed at a future time should funding be available to do so. These parameters are included in this quality assurance plan so that appropriate methodology is used for herpetofauna and/or macroinvertebrates monitoring. General NOAA Tier 1 monitoring guidelines will be used as a reference guide and project outcomes and success will be assessed via before and after comparison (BAC) using standardized data collection methods.

IV. Biological Monitoring at Brandenburg Park

The monitoring contractor will conduct an on-the-ground inspection before and after construction to ensure that the project has been constructed according to the restoration plans and has achieved habitat metrics. As mentioned above, this QAPP will cover both planned and potential pre- and post-construction evaluations to document changes in fish, herpetofauna, bird, and macroinvertebrate populations, as well as water quality and aquatic and terrestrial vegetation at the restoration site.

Fish Sampling Design

The fish assemblage across the restoration area will be investigated in a pre- and post –restoration assessment. Using a combination of seine and fyke nets, both shallow and constructed deep water habitat will be sampled to gauge the proposed restoration littoral zone community before and after implementation. All netting material and fixtures will be inspected by field technician prior to each deployment, and appropriate repairs or replacement made before commencement of survey activities.

Four fyke transects will be placed at designated locations, with two being placed on either side of the existing pier, where deeper water habitat construction is proposed. Fyke nets will be left in place for

approximately 24 hours. Seine nets will be deployed at six locations across the project site at shallower water locations. Sample locations will be recorded using handheld GPS units. Netting activities will take place twice within each of the pre- and post –construction monitoring phases. Sampling occurrences will take place in the months of September and October of 2019 to establish a baseline for existing fish community pre-construction. Post-construction monitoring occurrences will take place in September and October of 2020 to measure success of project implementation.

Fish identification will be made in the field by a professional with sufficient training and/or experience required to effectively operate fishing devices and positively identify fish common to Great Lakes waters. An example of each species encountered will be photographed for reference and catalogued for inclusion in reports. Any fish not readily identifiable will be photographed and compared to accepted secondary resources for positive identification and cataloging off site.

Analysis

Geographic information system map layers will be produced from field monitoring data to visualize habitat utilization and species distribution at the sampled points across the restoration site. GIS layers will be attributed with all field-collected biological characteristics. Maps will be prepared as necessary to appropriately display data collected pre- and post- construction. Tabulation of data including species composition, richness, and distribution will be prepared for all fish monitoring results. Preliminary reports will be produced at the end of each field season, summarizing the work completed to date. The preliminary report will include updates and results investigation to-date. A final report detailing the findings of monitoring will be produced at completion of this project.

Herpetofauna Sampling Design

In order to determine herpetological distribution, richness, and relative abundance, sampling will be conducted before and after restoration of the site to determine biologically significant changes to amphibian and reptile populations within the restored areas. A sampling design of integrated techniques will be employed to maximize effectiveness in determining success of the project implementation. Changes in the composition of species and use of habitat and restoration design features will be determined through this monitoring effort, including maps of herpetofauna locations. Collected data will serve to create a baseline for determining further restoration and monitoring at the project site.

A professional with the requisite educational/experiential background will conduct field surveys of herpetofauna at the project pre- and post- restoration. A series of equipment including baited hoop traps and coverboards will be used in conjunction with time-constrained transect surveys utilizing dip nets and funnel traps. Amphibians and reptiles discovered at the site will be examined in order to determine sex age class, and general health, when possible. Photographs will be used to document each individual herpetofauna specimen. All traps, nets, and other devices employed in this survey will be thoroughly inspected before deployment and any defects discovered will be rectified before commencement.

All coverboards will be placed on site before surveys at a time interval sufficient to allow for wildlife utilization to become established. Area underneath coverboards will be surveyed for herpetofauna during field survey after traps have been placed. Funnel nets will then be used during transect surveys. After completing other phases of field survey, traps will be monitored for capture. Coverboards and traps will be placed on site in a manner consistent with public safety, low impact on target species, and device effectiveness.

Analysis

Geographic information system map layers will be produced from field monitoring data to visualize habitat utilization and species distribution at the sampled points across the restoration site. GIS layers will be attributed with all field-collected biological characteristics. Maps will be prepared as necessary to appropriately display data collected pre- and post- construction. Tabulation of data including species composition, richness, and distribution will be prepared for all amphibian monitoring results. Preliminary reports will be produced at the end of each field season, summarizing the work completed to date. The preliminary report will include updates and results of the investigation to-date. A final report detailing the findings of monitoring will be produced at completion of this project.

Aquatic Macroinvertebrate Sampling Design

The proposed restoration site will be surveyed for community composition using static point dip net surveys in nearshore habitat for comparison of pre-restoration and post-restoration aquatic macroinvertebrate presence. All equipment is checked for tear, holes, or damage. When possible, all observed aquatic macroinvertebrates will be collected and documented to level of family and their position recorded based on sample point location. Sample points will be recorded using GPS units and stakes established to reference sample point locations. Dip net surveys will be used to detect and identify aquatic macroinvertebrate families and number of individuals observed within each family. Survey points will be at approximately 150 feet apart and located in areas along the shoreline. Stones, rocks, wood, and leaf litter, and other debris will also be sampled where they occur. Organisms will be identified on site by a qualified professional using microscopy and appropriate field guides. Macroinvertebrates not identified to family will be stored in 95% ethanol for identification off site. Results of survey will be used to determine number of individuals and composition of community. Microscopes will be checked for functionality and lenses cleaned to assure accurate identification. This survey method is effective for detecting shifts in community composition, taxa richness, and provides data to assess biologically significant changes. Data collected will be used to map locations across the restoration site, assess utilization of created habitat, and establish a baseline for future monitoring and restoration.

Analysis

Geographic information system map layers will be produced from field monitoring data to visualize habitat utilization and species distribution at the sampled points across the restoration site. GIS layers will be attributed with all field-collected biological characteristics. Maps will be prepared as necessary to appropriately display data collected pre- and post- construction. Tabulation of data including species composition, richness, and distribution will be prepared for all macroinvertebrate monitoring results. Preliminary reports will be produced at the end of each field season, summarizing the work completed to date. The preliminary report will include updates and results investigation to-date. A final report detailing the findings of monitoring will be produced at completion of this project.

Bird Sampling Design

In order to determine species diversity, relative abundance, age structure, and distribution of species of birds within the restoration areas pre- and post- restoration monitoring will take place at the project site. Monitoring will work to identify use of the site resulting from habitat restoration and creation and determine changes in species composition. This data can be used to assess habitat features created to benefit bird species as well as establish a baseline data for future monitoring and restoration efforts at the project site.

A professional with the requisite educational/experiential background will conduct field surveys of birds at the project pre- and post- restoration.

The proposed restoration site will be surveyed for species presence using time constrained, static point-count surveys for comparison of pre-restoration and post-restoration avian communities. All birds will be documented and their position recorded based on sample point location. Sample points will be recorded

using GPS units and stakes established to reference sample point locations. Point-count surveys ten minutes in duration will be used to detect and identify bird species and number of birds within the project area. Survey points will be located adjacent to the shoreline at strategically determined points in order to provide best survey coverage. Numbers of individuals and species composition will be determined. Counts will be conducted beginning approximately at sunrise on each field survey instance and will be completed before noon. Binoculars will be used to observe birds across the project site on land and water, as well as in the air. This method is effective for detection of waterfowl, shorebirds, songbirds, and migrating birds. This survey will provide data to determine species diversity, relative abundance, age structure, and distribution of bird species within the proposed restoration areas, create maps of locations of birds across the restoration site, assess use of created habitat, and establish a baseline for future monitoring and restoration.

Analysis

Geographic information system (GIS) map layers will be produced from field monitoring data to visualize habitat utilization and species distribution at the sampled points across the restoration site. GIS layers will be attributed with all field-collected biological characteristics. Maps will be prepared as necessary to appropriately display data collected pre- and post- construction. Tabulation of data including species composition, richness, and distribution will be prepared for all bird monitoring results. Preliminary reports will be produced at the end of each field season, summarizing the work completed to date. The preliminary report will include updates and results investigation to-date. A final report detailing the findings of monitoring will be produced at completion of this project.

Vegetation Sampling Design

A qualitative and quantitative assessment of submergent, emergent, and upland flora within the restoration site will be performed pre- and post- construction. Qualitative evaluations will be performed using the Universal Floristic Quality Assessment Calculator (FQA) from the Michigan Floristic Quality Assessment Database according to Herbarium, and Michigan Natural Features Inventory, Michigan State University (2014). Quantitative evaluations involve assessing the character and quality of the restoration site using data from quadrat sampling.

The FQA assigns a coefficient of conservatism (C) to each plant species; the higher the coefficient of conservatism (1-10), the greater the likelihood the plant occurred in a landscape relatively unaltered from pre-settlement conditions. The Floristic Quality Index (FQI) value is then calculated by multiplying the mean C for the entire plant community by the square root of the total number of species encountered on the site. The FQI score can then be used to assess how significant a plant community is relative to pre-settlement conditions. Most remaining undeveloped lands in Michigan have FQI scores of less than 20 and have minimal significance from a natural quality perspective. Areas having an FQI greater than 35 exhibit sufficient conservatism and species richness to be floristically important and of statewide significance in Michigan. FQI scores greater than or equal to 50 are rare and represent important elements of Michigan's biodiversity. The FQA also provides an average wetness ranking for all plant species present. The wetland scores are based on "coefficients of wetness," which are derived from the five main National Wetland Indicator Categories.

Quantitative Sampling

Six random quadrat locations will be established within the restoration site. Each of the vegetation sampling plots are to be sampled annually to assess floristic quality of the vegetation of the restoration site.

Analysis

Geographic information system (GIS) map layers will be produced from field monitoring data to visualize habitat utilization. Maps will be prepared as necessary to appropriately display data collected. Project

before and after comparison results will be documented based on aerial photography acquired through unmanned aerial vehicles (UAVs). Photos will document project outcomes and can be used to map increase in habitat and vegetative cover across the restoration site. Preliminary reports will be produced at the end of each field season, summarizing the work completed to date. The preliminary report will include updates and results of the investigation to-date. A final report detailing the findings of monitoring will be produced at completion of this project.

Water Quality Sampling Design

In order to quantify water quality at the restoration site, sampling design will be adapted from the Coastal Wetland Monitoring Program (CWMP) Sampling Protocols, and as such will follow guidelines provided in CWMP Standard Operating Procedure: Water Quality Sampling and Laboratory Processing (updated 03/19) for all sample collection, QA/QC, and processing. Parameters measured will include temperature, pH, dissolved oxygen, and turbidity. In order to collect water quality data an YSI EXO2 sonde will be employed, and sampling will be coordinated with fish netting locations across the restoration site. Water quality monitoring will occur in conjunction with biological sampling events and monitoring results will be used to evaluate the effects of the habitat restoration on biological communities. Table 3 below outlines field sampling methods and totals.

Table 3. Water Quality Sampling

Task	Method	Parameter	Number of Samples	Field QC Duplicates	Total Samples
Field Sampling	YSI EXO2	Dissolved oxygen, turbidity, pH, temperature, specific conductivity	10	2	12
	Secchi	Turbidity	10	2	12
	Grab Sample	alkalinity, chloride, nitrate and nitrite, total nitrogen, total phosphorus, color	3	1	4

Analysis

Data resulting from water quality sampling and laboratory processing will be compiled for ease of before-and-after comparison across the site. Sampling locations will be referenced on GIS maps in conjunction with habitat restoration features and biological sampling locations.

Table 4. Project Timeline

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	5th Quarter	6th Quarter
	Jul-Sept 2019	Oct-Dec 2019	Jan-Mar 2020	Apr-Jun 2020	Jul-Sept 2020	Oct-Dec 2020
Task 1: Develop QAPP	X					
Task 2: Field Sampling	X	X			X	X

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	5th Quarter	6th Quarter
	Jul-Sept 2019	Oct-Dec 2019	Jan-Mar 2020	Apr-Jun 2020	Jul-Sept 2020	Oct-Dec 2020
Task 3: Project Administration	X	X	X	X	X	X
Year-end Reports		X				X
Final Project Report						X

V. Documentation and Records

Reports

Preliminary reports will be produced for year-end 2019 and 2020 summarizing the work completed to-date. The year-end reports will include updates and preliminary results from all monitoring and assessments. A final report of project assessment will be produced upon completion of all tasks in this project. The report will include details of sampling methods, results of monitoring, analysis of species composition and species richness, and with maps of important habitat use. Electronic copies of the reports will be forwarded to project managers. All reports that contain data collected with funding from NOAA must include the following disclaimer: This report was prepared by The Charter Township of Chesterfield using Federal funds under award [number] from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the [name of operating unit] or the U.S. Department of Commerce.

Data Management

All field work conducted will include the use of a field survey book to document the activities including start and end time, participants, weather conditions, species observed, and site conditions. GPS equipment will be checked on each sampling event to confirm equipment accuracy using reference points. At the end of each sampling event field notebooks will be reviewed for accuracy, errors, or omissions. GPS files will be downloaded and verified for accuracy and completion. Critical data will also be properly documented in hardcopy. All GPS point files will be downloaded into a project folder, as well as a backup folder.

Field data will then be reviewed again in-office for errors and rectified. Any errors that are rectified are noted in the project file, along with a description of action taken. All field survey records will be reviewed at the end of the field day by another project team member, and Quality Assurance/Quality Control (QA/QC) performed. Errors or omissions will be noted and corrected.

All data shall be saved electronically in the project file within 48 hours of collection. Original data collected in hard copy format will be scanned and saved in electronic format. This electronic project file shall be backed up each time data is saved or changes to the data file occur. All field data will be entered into a spreadsheet or GIS geodatabase. All data entered manually will be reviewed by a team member other than the one initial processor entering the data. Processed data will be submitted for QA/QC review to the project manager and other project partners according to QAPP guidelines. Any deviations from the monitoring plan and/or QAPP document will be recorded.

GPS and GIS Mapping

GPS units will be used to collect spatial data during monitoring events at the restoration site. GPS units are inspected for proper functionality before the start and at the end of each field survey day. Collected data is reviewed for accuracy using desktop software. If discrepancies are discovered equipment is recalibrated by a qualified technician. Units are powered by batteries that are sufficient for an 8 hour work day, additional batteries will be available to field technicians and can be swapped without affecting data accuracy. Additional GPS units will be available as a backup in the event of on-site failure.

Quality Control

All survey data, including photographic imagery and drone footage, will be subjected to a quality control reviewed by a qualified professional. Any secondary data used to support the project will come solely from validated studies. Any additional supplemental data will come from trusted professional organizations such as Audubon Society, Michigan Natural Features Inventory (MNFI), USGS, and accepted peer-reviewed studies. For this project, a validated study and accepted peer-reviewed studies are documents prepared by an individual or organization that has produced the study based on quantified information either collected by the author or other cited professional that have the same or greater credentials.

VI. References

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Duffy, W.G., T.R. Batterson, and C.D. Mcnabb. 1987. The St. Marys River, Michigan: An ecological profile. U.S. Fish and Wildlife Service Biological Report 85(7.10).

Breen, M.J., & C.R. Ruetz III. 2006. Gear bias in fyke netting: evaluating soak time, fish density, and predators. North American Journal of Fisheries Management 26:32-41.

Janetski, D.J., & C.R. Ruetz III. 2014. Spatiotemporal patterns of fish community composition in Great Lakes drowned river mouths. Ecology of Freshwater Fish doi: 10.1111/eff.12161.

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https://www.greatlakeswetlands.org/docs/QAPPs_SOPs/GLCWMP_Water_Quality_SOP_2019.pdf

AVIAN
Static point for birds
http://wsobirds.org/images/atlas/WBBA_II_Handbook.pdf
http://www.michigandnr.com/FTP/parks/Stewardship_Volunteers/Bird_Surveys/Bird%20Surveying%20Instructions.pdf
https://ecos.fws.gov/ServCat/DownloadFile/28030?Reference=29127

HERPS
Justification for coverboards, supported by call-survey (non-trapping, simple) of herpetofauna
https://mnfi.anr.msu.edu/reports/MNFI-Report-2012-11.pdf
https://www.epa.gov/sites/production/files/documents/wetlands_12amphibians.pdf

FISH
Fyke
https://www.michigan.gov/documents/deq/deq-ogl-mglpf-burton_249369_7.pdf
Seines
http://www.michigandnr.com/publications/pdfs/ifr/ifrlibra/research/reports/2055rr.pdf

Appendix B:

Images From Seine and Fyke Netting Fish Survey at Brandenburg Park

PRE-CONSTRUCTION MONITORING PERFORMED OCTOBER AND NOVEMBER 2019

Surveyed Fish

Emerald Shiner

Brook Silverside

Hornyhead Chub

Yellow Perch

Smallmouth bass

Bluntnose Minnow

Banded Killifish

Bluegill

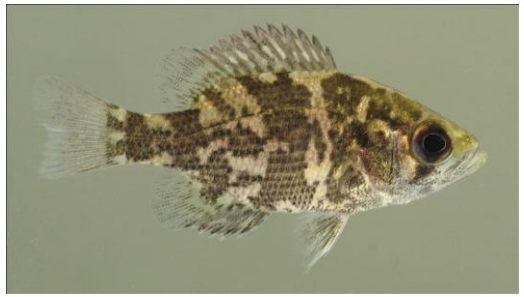
Surveyed Fish cont.

Round Goby

Largemouth Bass

Gizzard Shad

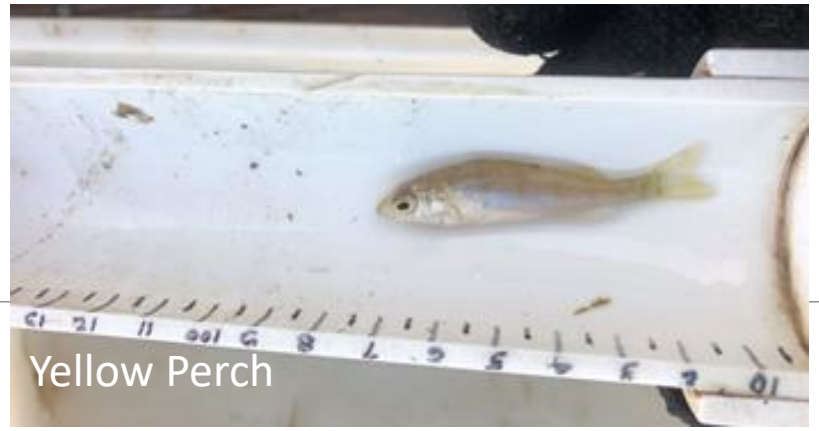
Spotfin Shiner



Rock Bass

Mimic Shiner


Round Goby


Yellow Perch


Mimic Shiner


Brook Silversade


Gizzard Shad


Rock Bass


Spotfin Shiner


Largemouth Bass


Bluegill


Banded Killifish

Largemouth Bass


Rock Bass


Largemouth Bass


Brook Silverside


Yellow Perch

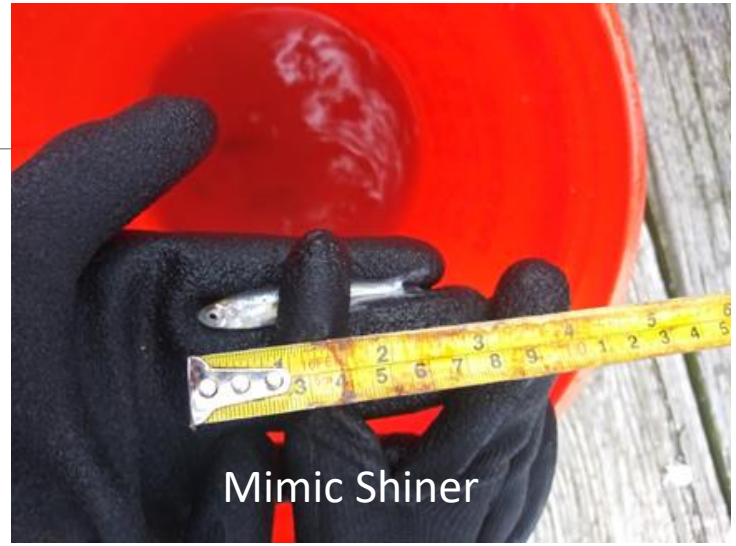

Bluegill


Mimic Shiner


Brook Silverside


Round Goby


Yellow Perch


Mimic Shiner

Largemouth Bass

Bluegill

Appendix C: Fish Sampled by Point, Species, and Size Class - Seine and Fyke Netting

Brandenburg Fish data		SAMPLING PT# FS1											10/14/2019
Temp. 17˚ C.		3 Siene Hauls											
Species	Common	Size Class cm											Total Number of Fish
		< 3	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	
Notropis volucellus	Mimic Shiner					2	3	2	1	7				15
Ambloplites rupestris	Rock Bass							1	1	1	1	4		8
Lepomis macrochirus	Bluegill						1			1				2
Neogobius melanostomus	Round Goby							1						1
Notropis volucellus	Mimic Shiner			7										7
Ambloplites rupestris	Rock Bass			4										4
Lepomis macrochirus	Bluegill		1	1										2
Neogobius melanostomus	Round Goby		1											1
Lepomis macrochirus	Bluegill	1												1
Total Fishes Sampled														41

Adult =	26
Juvenile =	14
Fry =	1
	41

Brandenburg Fish data		SAMPLING PT# FS1														10/28/2019
Temp. ˚ C. 10		3 Siene Hauls														
Species	Common	Size Class cm														Total Number of Fish
		< 3	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10<	
Dorosoma cepedianum	Gizzard Shad									6	7	5	1	1	2		22
Dorosoma cepedianum	Gizzard Shad							1	2								3
Labidesthes sicculus	Silverside							2	3	1	2	1					9
Labidesthes sicculus	Silverside					1											1
Perca flavescens	Yellow Perch									3	1	2	1	1		1	9
Perca flavescens	Yellow Perch				1	3	7	5	4								20
Cyprinella spiloptera	Spotfin Shiner											2					2
Cyprinella spiloptera	Spotfin Shiner									1							1
Lepomis macrochirus	Bluegill					1											1
Lepomis macrochirus	Bluegill	4															4
Notropis atherinoides	Emerald Shiner							1									1
Notropis atherinoides	Emerald Shiner					2											2
Neogobius melanostomus	Round Goby						1	3	2								6
Neogobius melanostomus	Round Goby	1															1
Pimephales notatus	Bluntnose Minnow							4	1	3	2	4	6	1			21
Pimephales notatus	Bluntnose Minnow					4											4
Micropterus salmoides	Largemouth Bass										1						1
Ambloplites rupestris	Rock Bass	2		1													3
																	0
Total Fishes Sampled																	111

RECORD Adult/Juvenile/Fry

Adult =	67
Juvenile =	39
Fry =	5
	111

Brandenburg Fish data		SAMPLING PT# FS2											10/14/2019
Temp. 17˚ C.		3 Siene Hauls											
Species	Common	Size Class cm											Total Number of Fish
		< 3	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0	8.5	9>	
Perca flavescens	Yellow Perch											1	1	2
Neogobius melanostomus	Round Goby							1	1	1	2		3	8
Neogobius melanostomus	Round Goby			1										1
Neogobius melanostomus	Round Goby	1												1
Total Fishes Sampled														12

Adult =	10
Juvenile =	1
Fry =	1
	12

Brandenburg Fish data		SAMPLING PT# FS2														10/28/2019
Temp. ˚ C. 10		3 Siene Hauls														
Species	Common	Size Class cm														Total Number of Fish
		< 3	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10<	
Notropis atherinoides	Emerald Shiner	1														1
Dorosoma cepedianum	Gizzard Shad												1			1
Perca flavescens	Yellow Perch				2	9		2	2							15
Perca flavescens	Yellow Perch									1						1
Lepomis macrochirus	Bluegill		10	10	5											25
Lepomis macrochirus	Bluegill	5														5
Labidesthes sicculus	Silverside							2	2	2						6
Labidesthes sicculus	Silverside				1	2	1									4
Neogobius melanostomus	Round Goby							2						1		3
Neogobius melanostomus	Round Goby					1	2									3
Pimephales notatus	Bluntnose Minnow							2	1	1			1	2		7
Pimephales notatus	Bluntnose Minnow					1	3									4
Ambloplites rupestris	Rock Bass		2	1												3
																0
																0
																0
Total Fishes Sampled																78

Adult =	18
Juvenile =	55
Fry =	5
	78

Brandenburg Fish data		SAMPLING PT# FS3														10/14/2019
Temp. 17˚ C.		3 Siene Hauls														
Species	Common	Size Class cm														Total Number of Fish
		< 3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10>	
Nacomis biguttatus	Hornyhead Chub															1	1
Micropterus dolomieu	Smallmouth Bass											1					1
Perca flavescens	Yellow Perch									1	1			1			3
Neogobius melanostomus	Round Goby								1	1	1	1	4		1		9
Micropterus dolomieu	Smallmouth Bass			1													1
Neogobius melanostomus	Round Goby		1														1
Total Fishes Sampled																	**16**

Adult =	**14**
Juvenile =	**2**
Fry =	**0**
	16

Brandenburg Fish data		SAMPLING PT# FS3														10/28/2019
Temp. ˚ C. 10		3 Siene Hauls														
Species	Common	Size Class cm														Total Number of Fish
		< 3	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10<	
Labidesthes sicculus	Silverside							5	3	4	2						**14**
Labidesthes sicculus	Silverside					3	2										**5**
Dorosoma cepedianum	Gizzard Shad											1	2	2			**5**
Lepomis macrochirus	Bluegill		1														**1**
Lepomis macrochirus	Bluegill	2															**2**
Cyprinella spiloptera	Spotfin Shiner												1	1			**2**
Cyprinella spiloptera	Spotfin Shiner										1						**1**
Fundulus diaphanus	Banded Killifish		1	2	2	2											**7**
Fundulus diaphanus	Banded Killifish							2									**2**
Notropis atherinoides	Emerald Shiner			1													**1**
Perca flavescens	Yellow Perch						1										**1**
Neogobius melanostomus	Round Goby						1										**1**
Neogobius melanostomus	Round Goby							2									**2**
																	0
Total Fishes Sampled																	**44**

Adult =	**26**
Juvenile =	**16**
Fry =	**2**
	44

Brandenburg Fish data		SAMPLING PT# FS4														10/14/2019
Temp. 17˚ C.		3 Siene Hauls														
Species	Common	Size Class cm														Total Number of Fish
		< 3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10>	
No data - water too choppy to pull seine																0
																0
Total Fishes Sampled																0

No data - water too choppy to pull seine

Adult =	0
Juvenile =	0
Fry =	0
	0

Brandenburg Fish data		SAMPLING PT# FS4														10/28/2019
Temp. ˚ C. 10		3 Siene Hauls														
Species	Common	Size Class cm														Total Number of Fish
		< 3	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10<	
Lepomis macrochirus	Bluegill	2														2
Total Fishes Sampled																2

Adult =	0
Juvenile =	0
Fry =	2

Brandenburg Fish data		SAMPLING PT# FS5														10/14/2019
Temp. 17˚ C.		3 Siene Hauls														
Species	Common	Size Class cm														Total Number of Fish
		< 3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10>	
No data - water too choppy to pull seine																0
																0
Total Fishes Sampled																0

No data - water too choppy to pull seine

Adult =	0
Juvenile =	0
Fry =	0
	0

Brandenburg Fish data		SAMPLING PT# FS5														10/28/2019
Temp. ˚ C. 10		3 Siene Hauls														
Species	Common	Size Class cm														Total Number of Fish
		< 3	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10<	
Dorosoma cepedianu	Gizzard Shad												1				1
Perca flavescens	Yellow Perch					9		2									11
Perca flavescens	Yellow Perch									1							1
Lepomis macrochirus	Bluegill	2															2
Menidia beryllina	Silverside					2	1										3
Menidia beryllina	Silverside							2		2							4
Neogobius melanosto	Round Goby							2									2
Neogobius melanosto	Round Goby					1	2										3
Pimephales notatus	Bluntnose Minnow							2	1	1			1				5
Pimephales notatus	Bluntnose Minnow					1	3										4
																	0
																	0
Total Fishes Sampled																	36

Adult =	13
Juvenile =	21
Fry =	2
	36

Brandenburg Fish data		SAMPLING PT# FS6														10/14/2019
Temp. 17˚ C.		3 Siene Hauls														
Species	Common	Size Class cm														Total Number of Fish
		< 3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10>	
Lepomis macrochirus	Bluegill	1														1
																0
Total Fishes Sampled																1

Adult =	1
Juvenile =	0
Fry =	0
	1

Brandenburg Fish data			SAMPLING PT# FS6													10/28/2019
Temp. ˚ C 10		3 Siene Hauls														
Species	Common	Size Class cm														Total Number of Fish
		< 3	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10<	
Mimic Shiner	*Notropis volucellus*					2	3	2								7
Mimic Shiner	*Notropis volucellus*								1	7						8
Lepomis macrochirus	Bluegill	2														2
Neogobius melanostomus	Round Goby	1														1
Total Fishes Sampled																18

Adult =	8
Juvenile =	7
Fry =	3
	18

Brandenburg Fish data													
	11/5/19 and 11/16/19	Fyke #1 (hoop net)											
Species	Common	Size Class cm											Total Number of Fish
		< 3	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	~ 13.0	
	no fish caught												
Total Fishes Sampled													0

Brandenburg Fish data													
	11/5/19 and 11/16/19	Fyke #2											
Species	Common	e Class cm											Total Number of Fish
		< 3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	~ 13	
	no fish caught												
Total Fishes Sampled													0

Brandenburg Fish data													
	11/5/19 and 11/16/19	Fyke #3											
Species	Common	Size Class cm											Total Number of Fish
		< 3	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	~ 13.0	
Lepomis macrochirus	Bluegill		1										1
Pimephales notatus	Bluntnose Minnow			1									1
Ambloplites rupestris	Rock Bass	2											2
Percina caprodes	Logperch			1									1
Notropis atherinoides	Emerald Shiner					1							1
Total Fishes Sampled													6

Adult =	
Juvenile =	6
Fry =	
	6

Brandenburg Fish data													
	11/5/19 and 11/16/19	Fyke #4											
Species	Common	e Class cm											Total Number of Fish
		< 3	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	~ 13.0	
Notropis atherinoides	Emerald Shiner					2		1					3
Percina caprodes	Logperch					1							1
Total Fishes Sampled													4

Adult =	
Juvenile =	4
Fry =	
	4

Below is a catch summary from the MDNR electrofishing efforts at the Brandenburg Park site (Figure 1). The effort went through the whole project site and further, taking a total of 30 minutes. All species were collected during the first and last 10-minute section while just muskellunge were collected during the middle 10-minute section (Table 1). This allowed for consistency in methods among other sites along the Michigan shoreline of Lake St. Clair. The electrofishing effort is conducted by three crew members, one driving the boat and two on the front of the boat with dip nets capturing fish. Electrofishing efforts for this program are conducted in the fall when lake water temperatures reach 50° F. This site will be compared with other sites nearby in the future and will remain as one of the index sites for this fall effort into the future.

Figure 1. Site location for the Brandenburg Park electrofishing site on Lake St. Clair.

Table 1. Overall catch summary for electrofishing efforts at the Brandenburg Park site, collected as part of the MDNR nearshore fall electrofishing on Lake St. Clair. The total catch, catch per unit effort (CPUE) and length are identified for each species for the three years of sampling (2019-2021) for this site. CPUE is reported as number of fish per minute of electrofishing, while only factoring in the all-species portions of the efforts. Length is reported as a range (in centimeters) for each species followed by the average length in parentheses.

	Year								
	2019			2020			2021		
Species	Total caught	CPUE	Length (cm)	Total caught	CPUE	Length (cm)	Total caught	CPUE	Length (cm)
Bluegill	0	0	NA	2	0.1	15 - 20 (17.5)	0	0	NA
Bluntnose Minnow	1	0.05	7	0	0	NA	0	0	NA
Brook Silverside	62	3.1	3 - 7 (5)	2	0.1	NA	46	2.3	4 - 8 (6)
Common Carp	4	0.2	17 - 66 (47.7)	12	0.6	NA	10	0.5	66 - 69 (67.5)
Emerald Shiner	4	0.2	4 - 10 (7.5)	0	0	NA	16	0.8	3 - 10 (6.5)
Freshwater Drum	1	0.05	47	0	0	NA	0	0	NA
Gizzard Shad	6	0.3	11 - 17 (14.6)	6	0.3	NA	152	7.6	7 - 10 (8.5)
Golden Shiner	0	0	NA	0	0	NA	1	0.05	19
Green Sunfish	0	0	NA	0	0	NA	1	0.05	6
Largemouth Bass	5	0.25	5 - 43 (27.4)	3	0.15	42 - 46 (44)	9	0.45	6 - 50 (35.4)
Rock Bass	0	0	NA	0	0	NA	5	0.25	5 - 25 (13.3)
Walleye	0	0	NA	0	0	NA	1	0.05	46
White Crappie	1	0.05	28	1	0.05	20	0	0	NA
Yellow Perch	50	2.5	5 - 17 (11)	1	0.05	21	5	0.25	6 - 17 (12)
Total	134	6.7		27	1.35		246	12.3	
Species Count	9			7			10		