

Shiawassee River Qualitative Assessment

Davisburg, Oakland County, Michigan

November 22, 2019



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Document Information



Prepared for

Springfield Charter Township
12000 Davisburg Road, Davisburg,
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Project Name

Shiawassee River Qualitative
Assessment
Davisburg, Oakland County, Michigan

Job Reference

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Date

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1 Introduction

1.1 Project Purpose

Springfield Charter Township contracted Cardno to complete a qualitative assessment of the biological community and stream habitat associated with the reach of the Shiawassee River between Long Lake and Davis Lake. Standard survey protocols were used during the assessment and sampling locations documented to allow for future sampling efforts as desired. The data collected during this study can be used as baseline community data for fish, macroinvertebrates, mussels and available instream and surrounding riparian habitat. Results of the various assessments are used to qualitatively describe the biological integrity and habitat quality in the project area. A general discussion of the results are presented in the report and general recommendations for follow-up assessment efforts provided.

1.2 Project Location

The sampling area is located on Springfield Charter Township property immediately north of the Town of Davisburg, Oakland County Michigan. Specifically, the Shiawassee River was assessed between Long Lake and Davis Lake with the total length of stream reach physically walked and sampled was approximately 2,500 linear ft (Figure 1). The Shiawassee River in this location is considered to be in the headwaters of the drainage as the sampling reach is located approximately 3.3 miles downstream from the start of the drainage which begins at Shiawassee Lake.



Figure1. Project location map.

2 Assessment Methods

A goal of this study was to utilize standardized sampling protocols so future assessments could replicate efforts as needed to track the various biological communities and habitat features over time. Therefore, the Michigan Surface Water Assessment Section (SWAS) Procedure 51 (MDEQ, 2008) was used to sample fish, macroinvertebrates and habitat, while mussels were sampled with guidance from the Michigan Freshwater Mussel Survey Protocols (MDNR, 2019). Fish, macroinvertebrates and habitat were sampled on September 4, 2019 at two separate locations identified as “upstream reach” and “downstream reach” (Figure 2). The upstream reach is located 400 ft downstream from Davis Lake and extends downstream for 150 ft, to just before the existing culvert crossing. This section of stream was selected due increased diversity of pool habitats, diversity of submerged or emergent aquatic vegetation cover, diversity of substrate types (some cobble present) and accessibility for future work. The downstream reach is located 1,100 ft downstream from Davis Lake and extends downstream for 160 ft. The downstream extent of the downstream reach is located approximately 2,200 ft upstream from Long Lake. This section of stream was sampled because it offered the closest example of “riffle type” habitat within the overall project area. While the reach is not classified as a true riffle habitat it does contain some the most significant assemblage of gravel and cobble substrate within the project area, as well as a diversity of submerged vegetation cover. Mussel sampling efforts were completed on September 3, 2019 and occurred within the areas shown in Figure 2, which include those areas sampled for Procedure 51 efforts. The total linear distance sampled for mussels was approximately 950 ft.



Figure 2. Procedure 51 sampling reaches and mussel reconnaissance extents, Oakland County, Michigan.

Prior to sampling activities Cardno staff member Tom Estrem acquired the necessary Michigan collection permits. These include a state Scientific Collectors permit and state Threatened and Endangered Species permit. Copies of the permits can be found in Appendix A.

2.1 Procedure 51 Sampling: Fish, Macroinvertebrates and Habitat

2.1.1 Fish

Fish were sampled utilizing a Smith Root LR-24 backpack electrofishing unit. Electrofishing efforts were completed along the entire distance of the upstream and downstream sampling reaches and working in an upstream manner. Due to a low number of fish collected during the sampling efforts, each reach was fished through twice and a total effort of 45 minutes was spent actively working to collect fish. Fish collected during sampling efforts were identified to species, length group recorded and any abnormalities noted. Fish community data was analyzed using the Procedure 51 fish assessment metrics to develop an overall rating of the sampled communities.

2.1.2 Macroinvertebrates

Macroinvertebrate sampling consisted of 20 minutes of active collection effort within each sampling reach. Collections were made using triangular or d-shaped dip nets and all habitat types were sampled (ex. aquatic vegetation, bottom of rocks, undercut banks, woody-debris, run and pool habitats). Due to a generally low number of organisms present, subsampling of available individuals was not necessary and therefore all organisms were retained for identification and enumeration. All organisms collected were identified to family level and analyzed using the Procedure 51 macroinvertebrate metrics to develop an overall rating of the sampled communities.

2.1.3 Habitat

Procedure 51 habitat assessment for Glide/Pool streams were completed within each of the sampling reaches. To assess habitat features two times the length of the fish/macroinvertebrate reaches were investigated. Habitat assessments included instream habitat, channel morphology, bank structural features and riparian vegetation. Habitat data was analyzed using the Procedure 51 assessment metrics to develop an overall rating of the available habitat.

2.2 Mussel Reconnaissance Survey

Qualitative mussel sampling was completed using both visual and excavation techniques. The goal of the mussel sampling effort was to develop a species list of the site rather than a determination of species densities. Two persons utilizing snorkeling gear searched the entire channel working in an upstream direction. Visual observations of siphoning mussels was the primary method to locate individuals; however, random 0.5 square meter excavations of the streambed were completed to assist in mussel collections. A total of three person hours were spent actively searching for mussels within the specified search reaches (Figure 2). All mussels collected were identified to species, representative species photos taken and returned to the streambed in the location collected. A tally of the number of individuals was not collected and only a species list was documented.

2.3 Water Quality

General water chemistry sampling was completed on September 4, 2019 in conjunction with Procedure 51 sampling efforts. Water chemistry values were sampled at one location within the project area which was located downstream from the existing culvert crossing approximately 70 ft. Parameters sampled included: water temperature, conductivity, pH, dissolved oxygen (% and mg/L) and turbidity.

3 Results

3.1 Fish

Results of fish sampling efforts are displayed in Tables 1 and 2. Seven species were collected in the upstream reach while eight species were collected in the downstream reach. The total number of species between both sites was 11. Species collected at both sampling locations included: rock bass, yellow bullhead, bluegill and largemouth bass. The most abundant species collected in the upstream reach was bluegill, while rainbow darter was the most abundant in the downstream reach. Overall, most species were represented by only one to three individuals with the dominant species at each reach accounting for approximately 50% of the total catch. Total fish collection numbers at each site was low with 31 individuals at the upstream reach and 27 individuals in the downstream reach. All species collected are common to the region and are not listed by State or Federal agencies. It is important to note that a mudpuppy was collected during sampling efforts in the downstream reach. The mudpuppy is listed as a Species of Special Concern in Michigan. Field sampling datasheets which include length data are available in Appendix B.

Table 1. Upstream Reach fish sampling results. September 4, 2019.

Species	Common Name	# Collected	Relative Abundance (%)
<i>Ambloplites rupestris</i>	Rock Bass	4	12.9
<i>Ameiurus natalis</i>	Yellow Bullhead	1	3.2
<i>Lepomis macrochirus</i>	Bluegill	16	51.6
<i>Lepomis peltastes</i>	Northern Longear Sunfish	5	16.1
<i>Luxilus cornutus</i>	Common Shiner	1	3.2
<i>Micropterus salmoides</i>	Largemouth Bass	1	3.2
<i>Umbra limi</i>	Central Mudminnow	3	9.7
Total		31	100

Table 2. Downstream Reach fish sampling results. September 4, 2019.

Species	Common Name	# Collected	Relative Abundance (%)
<i>Ambloplites rupestris</i>	Rock Bass	2	8.0
<i>Ameiurus natalis</i>	Yellow Bullhead	2	8.0
<i>Etheostoma caeruleum</i>	Rainbow Darter	13	52.0
<i>Lepomis cyanellus</i>	Green Sunfish	1	4.0
<i>Lepomis gulosus</i>	Warmouth	1	4.0
<i>Lepomis macrochirus</i>	Bluegill	2	8.0
<i>Micropterus salmoides</i>	Largemouth Bass	3	12.0
<i>Misgurnus anguillicauda</i>	Oriental Weatherfish	1	4.0
Total		25	100.0

*Mudpuppy (*Necturus maculosus*) collected during sampling effort. Michigan species of Special Concern

Procedure 51 fish community assessment scoring is displayed in Table 3. For metric scoring interpretation reference the following designations are defined:

- +1 = community is performing better than the average conditions found at an excellent site;
- 0 = community is performing between the average condition and minus 2 standard deviations from the average condition found at an excellent site;
- -1 = community is performing outside of 2 standard deviations from the average conditions found at the excellent site.

Overall site scores of +5 or higher are classified as excellent and scores of -5 or lower being classified as poor. Acceptable sites, are scored between excellent and poor in the range of +4 to -4. Site with positive score of +4 or less is tending toward excellent. A site with a negative score of -1 to -4 is tending toward poor. Scores of 0 are considered neutral. It is important to note when less than 50 individuals are collected at a site, that site is automatically classified as poor, which happened to be the situation during the current sampling effort.

The total score for each of the sampling sites was 1 which would classify as trending towards excellent; however, as noted previously less than 50 individuals were collected at each site so the sites are automatically classified as poor. Metrics which received +1 scores at both sites included number of sunfish taxa, % tolerant individuals, % omnivore individuals and % piscivore individuals. Metrics which received -1 scores at each site included total taxa, darter taxa, sucker taxa and intolerant taxa. Overall the few number of individuals collected and resulting limited number of species collected most significantly limited the overall fish scoring potential.

Table 3. Procedure 51 fish metric scoring results.

Fish Metric	Upstream Reach	Downstream Reach	Upstream Reach Metric Score	Downstream Reach Metric Score
Total Taxa	7	8	-1	-1
Darter Taxa	0	1	-1	-1
Sunfish Taxa	3	4	1	1
Sucker Taxa	0	0	-1	-1
Intolerant Taxa	1	2.0	-1	-1
% Tolerant	12.9	12.0	1	1
% Omnivore	12.9	8	1	1
% Insectivore	71.0	64.0	1	0
% Piscivore	16.1	20.0	1	1
% Simple Lithophilic Spawners	3.2	52	0	1
Total Score			1	1
Adjective Rating			Poor*	Poor*
*Less than 50 individuals collected so automatically classified as poor: Upstream Reach 31 individuals; Downstream Reach 25 individuals.				

3.2 Macroinvertebrates

Results of the macroinvertebrate sampling are displayed in Tables 4 and 5. The number of families collected at both the upstream and downstream reach was 14. Overall, the total number of families identified between both sites was 20. Total number of EPT taxa (Ephemeroptera-mayflies, Plecoptera-stoneflies, and Trichoptera-caddisflies), which are generally indicative of high water quality, was six (4 Ephemeroptera and 2 Trichoptera). No stonefly families (Plecoptera) were collected. Dominant taxa in the upstream reach was Amphipoda, followed by Coenagrionidae. Dominant taxa in the downstream reach were Amphipoda followed by Tricorythidae and Calopterygidae. All other taxa collected within the sampling reaches were generally present in low abundance. A lack of riffle habitat and dominance of fine substrates (silt and sand) at either of the sites limited the overall macroinvertebrate community diversity and overall abundance of individuals. Macroinvertebrate field and laboratory datasheets are provided in Appendix B.

Table 4. Upstream Reach macroinvertebrate sampling results, September 4, 2019.

Phylum	Class	Order	Family	# Individuals
Arthropoda	Malacostraca	Amphipoda		62
Arthropoda	Malacostraca	Decapoda		1
Arthropoda	Malacostraca	Isopoda		17
Arthropoda	Insecta	Ephemeroptera	Caenidae	1
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	2
Arthropoda	Insecta	Odonata	Corduliidae	2
Arthropoda	Insecta	Odonata	Libellulidae	2
Arthropoda	Insecta	Odonata	Coenagrionidae	35
Arthropoda	Insecta	Hemiptera	Corixidae	1
Arthropoda	Insecta	Coleoptera	Halplidae	1
Arthropoda	Insecta	Diptera	Chironomidae	2
Arthropoda	Insecta	Diptera	Tabanidae	1
Mollusca	Gastropoda	Basommatophora	Lymnaeidae	1
Mollusca	Bivalvia	Veneroidea	Sphaeriidae	4
Total Individuals				132

Table 5. Downstream Reach macroinvertebrate sampling results. September 4, 2019.

Phylum	Class	Order	Family	# Individuals
Arthropoda	Malacostraca	Amphipoda		72
Arthropoda	Malacostraca	Decapoda		1
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	4
Arthropoda	Insecta	Ephemeroptera	Tricorythidae	42
Arthropoda	Insecta	Odonata	Libellulidae	1
Arthropoda	Insecta	Odonata	Calopterygidae	25
Arthropoda	Insecta	Odonata	Coenagrionidae	17
Arthropoda	Insecta	Hemiptera	Nepidae	1
Arthropoda	Insecta	Trichoptera	Hydroptilidae	1
Arthropoda	Insecta	Trichoptera	Polycentropodidae	2
Arthropoda	Insecta	Coleoptera	Elmidae	1
Arthropoda	Insecta	Coleoptera	Haliplidae	11
Arthropoda	Insecta	Diptera	Chironomidae	11
Mollusca	Bivalvia	Veneroidea	Sphaeriidae	5
Total Individuals				194

Procedure 51 macroinvertebrate metric scoring results are displayed in Table 6. Metric scoring interpretations are the same that that discussed for fish in Section 3.1. The upstream reach had a score of -4 while the downstream reach had a score of 1. The adjective rating for the upstream reach is classified as tending towards poor while the downstream reach is considered tending toward excellent. Scoring metrics receiving scores of -1 at both sites include % caddisfly and % dominance. Percent surface dependent was the only metric receiving at +1 at both sites. Metrics with a score or 0 at both sites included total taxa, mayfly taxa and stonefly taxa. Overall the downstream reach received a higher overall score than the upstream reach due to the increase in gravel and cobble substrates which promoted greater abundance of caddisfly and mayfly taxa.

Table 6. Procedure 51 macroinvertebrate metric score results.

Invertebrate Metric	Upstream Reach	Downstream Reach	Upstream Reach Metric Score	Downstream Reach Metric Score
Total Taxa	14	14	0	0
Mayfly Taxa	2	2	0	0
Caddisfly Taxa	0	2	-1	0
Stonefly Taxa	0	0	0	0
% Mayfly	2.3%	23.7%	-1	1
% Caddisfly	0.0%	1.5%	-1	-1
% Dominance	47.0%	37.1%	-1	-1
% Isopod, Snail, Leech	13.6%	0.0%	-1	1
% Surface Dependent	1.5%	6.2%	1	1
Total Score			-4	1
Adjective Rating			Tending toward poor	Tending toward excellent

3.3 Habitat

Table 7 displays the results of the Procedure 51 habitat assessments. The documented habitat at both of the assessment reaches was classified as good with a score of 141 in the upstream reach and 153 in the downstream reach. It is important to note the downstream reach was only two points away from receiving an excellent classification. All habitat assessment metrics were rated as excellent or good at both sites with the exception of pool variability and channel sinuosity which had a rating of marginal. Overall habitat ratings are high due to the relatively unaltered stream channel profile, pattern and dimension and high quality/wide riparian area. Procedure 51 habitat assessment datasheets are available in Appendix B and representative sites photos available in Appendix C.

Table 7. Procedure 51 habitat assessment results.

Habitat Parameter	Max Score	Upstream Reach		Downstream Reach	
		Score	Condition Category	Score	Condition Category
1. Epifaunal Substrate/Available Cover	20	11	Good	13	Good
2. Pool Substrate Characterization	20	11	Good	13	Good
3. Pool Variability	20	8	Marginal	6	Marginal
4. Sediment Deposition	20	9	Marginal	14	Good
5a. Channel Flow Status-Maintained Flow Volume	10	10	Excellent	10	Excellent
5b. Channel Flow Status-Flashiness	10	9	Excellent	9	Excellent
6. Channel Alteration	20	20	Excellent	20	Excellent
7. Channel Sinuosity	20	8	Marginal	8	Marginal
8. Bank Stability	LB	10	10	10	Excellent
	RB	10	10	10	Excellent
9. Vegetative Protection	LB	10	10	10	Excellent
	RB	10	10	10	Excellent
10. Riparian Vegetative Zone Width	LB	10	5	10	Excellent
	RB	10	10	10	Excellent
Total Score and Classification	200	141	Good	153	Good
Scoring Interpretation		Excellent		>154	
		Good		105-154	
		Marginal		56-104	
		Poor		<56	

3.4 Mussels

Results of the mussel reconnaissance survey efforts are displayed in Table 8. A total of six live mussel species were encountered during survey efforts. The most abundant species' present within the project area include plan pocketbook (*Lampsilis cardium*), rainbow (*Villosa iris*) and giant floater (*Pyganodon grandis*). The least encountered species during survey efforts was cylindrical papershell (*Anodontoidea ferussacianus*). All species encountered are common to the region however rainbow is listed as a species of special concern by the State. Overall, the mussel community appeared to be healthy within the project area due to a perceived moderate abundance of individuals and diversity of sizes collected for each

species. Additionally, no shells were encountered of species not found alive within the survey reaches, suggesting a historically stable community. Representative mussel species photos are available in Appendix C.

Table 8. Mussel reconnaissance survey results. September 3, 2019.

Species	Common Name
<i>Actinonaias ligamentina</i>	Mucket
<i>Anodontooides ferussacianus</i>	Cylindrical Papershell
<i>Lampsilis cardium</i>	Plain Pocketbook
<i>Pyganodon grandis</i>	Giant Floater
<i>Strophitus undulatus</i>	Creeper
<i>Villosa iris</i>	Rainbow (SC)
SC=Special Concern Species in Michigan	

3.5 Water Chemistry

Water chemistry parameters collected during the sampling effort are displayed in Table 9. All parameters analyzed are typical for the region and are acceptable for biological function of a diverse group of aquatic biota.

Table 9. Water chemistry parameters collected on September 4, 2019 near the upstream sampling reach.

Water Temperature	71°F
Dissolved Oxygen	99.4%
	8.41 mg/L
pH	7.91
Conductivity	708 µS
Turbidity	1.05 NTU

4 Discussion and Recommendations

Results of the various biological community assessments for fish, macroinvertebrates and mussels indicates the overall diversity of species is not high within the project area. Abundance of fish and macroinvertebrate populations was also not significant within the surveyed reaches; however, mussel population estimates are suggested to be moderately abundant. Reduced diversity of aquatic species and low population estimates (fish and macroinvertebrates) is likely a function of the natural morphology of the stream which lacks defined riffle habitats and is dominated by fine substrates such as sand and silt. The presence of riffle habitats generally promotes the establishment of additional fish, macroinvertebrate and mussel species due to increased water velocities, generally associated larger substrates such as gravel and cobble, which offer increased areas for invertebrate attachment sites, spawning habitat and increased micro-habitats for invertebrates and small fish to habitat. The lakes at either end of the project area impact the gradient and water level within the stream by slowing water currents down near lake inlets and outlets, transforming those areas to more closely resemble lake habitats. Additionally, the presence of lakes upstream and downstream of project provides additional habitat for fish species to migrate to during various times of the year.

Water quality within the stream is suggested to be high due to the surrounding high quality wetland and upland riparian area and stable geomorphology of the stream reach. Water quality measurement taken during the survey do not suggest any limitations or negative effects to aquatic biota. The presence of a stable mussel community within the project area is a good indication of high water quality and habitat stability. A variety of sizes were collected for each of the mussel species encountered indicating recruitment and also no dead shells were collected from species that were not found alive, indicating a stable community structure. Two species of special concern were collected during the sampling efforts which include the rainbow mussel and a mudpuppy, an aquatic salamander.

Habitat assessments completed within the two sampling reaches were classified as good for glide/pool streams. Of note, the downstream reach was only two points away from be classified as having excellent habitat quality. Habitat characteristics such as stable well-vegetated streambanks, wide/high quality riparian areas, a lack of channel alteration, and a stable flow regime and glide-pool sequencing characterize the available habitat at the project site.

Overall, the assessment completed for the current project provide a baseline set of data for future monitoring efforts. Recommendations or considerations for future assessments includes the following:

- Implement fish and macroinvertebrate monitoring schedule to develop historical database of community structures. Suggest sampling every 3-5 years and include the two sites surveyed during this project.
- Continue to monitor mussel species assemblages to determine stability of community.
- Implement water quality monitoring schedule to develop historical database of measured parameters (yearly sampling if possible). Suggested parameters include, total phosphorus, soluble phosphorus, TKN, ammonia, nitrate, *E. coli*, total suspended solids (TSS), water temperature, dissolved oxygen, pH, conductivity.
- Fish community sampling within Davis and Long Lakes to understand community structure. Associated with fish sampling would be dissolved oxygen and temperature profiles within the lakes and epilimnion and hypolimnion water quality sampling for phosphorus and nitrogen.

5 References

- MDNR (Michigan Department of Natural Resources). 2019. Michigan freshwater mussel survey protocols and relocation procedures.
- MDEQ (Michigan Department of Environmental Quality). 2008. Qualitative biological and habitat survey protocols for wadeable streams and rivers. WB-SWAS-051.

Davisburg, Oakland
County, Michigan

APPENDIX

A

SCIENTIFIC COLLECTORS
PERMITS



GRETCHEN WHITMER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
LANSING



DANIEL EICHINGER
DIRECTOR

August 26, 2019

Thomas Estrem
Cardno
708 Roosevelt Rd
Walkerton, IN 46574

Dear Mr. Estrem:

This letter is an official attachment to your Threatened and Endangered Species Permit (**TE 150**). Your permit is issued in the *Consultant* category only. Your permit expires on **March 31, 2022**. Renewal information will be sent in December of 2021.

Authorization:

To conduct the scientific activities listed under special conditions on the threatened/endangered species listed below. All activities are subject to the standard permit conditions within this letter.

In addition to the standard requirements listed below:

- This permit provides legal authorization to work with **Fish and Mollusks**, as well as the unintentional and incidental take of those species if done in accordance with this permit.
- Permitted are surveys for listed animal species using standard methods and appropriate timing to ensure a high probability of detecting the presence of the species. Only survey methods that minimize disturbance and risk to the organism or its habitat are to be used. Specific requirements for certain taxa are listed below
- Permitted is the collection, temporary holding, and relocation of mussels for identification to occur within the footprint of the US 131 Bridge over the St. Joseph River in St. Joseph County and within the Shiawassee River in Oakland County.
- The methods described in the 2019 Michigan Freshwater Mussel Survey Protocols and Relocation Procedures will be used to relocate mussels found in the work area. Mussels handled must be placed out of harm's way into the nearest suitable habitat to collection site.
- Dead specimens or shells may be collected and salvaged for identification.
- Each state-listed mussel translocated will be identified to species and marked with a GPS point where it is placed.
- Additional permits may be required on specific projects that may affect threatened and endangered species. Such project permits are negotiated by the Department of Natural Resources and issued to the client or landowner. Additional federal permits may be required for federally-listed species.

Mollusks

- Permitted is the collection and temporary holding of mussels for identification. Sampling must be done in a manner that minimizes the amount of time taken from the water and risk to the animals. Animals handled must be returned to the same

site where collected and placed in the same orientation in the substrate as when collected.

Fish

- Listed fish species may be humanely captured for identification and released at the same site using standard non-lethal collection techniques. Dead specimens may be salvaged.

Standard Permit Conditions

- A. All specimens authorized for collection under this Permit shall be deposited in the collection of an approved public educational or research institution prior to Permit expiration.
- B. None of the specimens collected shall become part of a private collection or private property.
- C. This permit does not allow or grant the right of trespass. Projects shall not take place on any private or public lands without permission from the owner or administrator of such lands.
- D. This permit does not provide authorization to circumvent any federal, state, or local laws and ordinances.
- E. Additionally, federal permits may be required for activities affecting federally listed threatened or endangered species and/or migratory birds. Contact the U. S. Fish and Wildlife Service at 2651 Coolidge Road, East Lansing, MI 48823.
- F. The activities covered under this Permit are not transferable to another person unless specifically authorized.
- G. Unless otherwise noted, within 10 days of the expiration of this Permit, the holder is required to file a report detailing the locations of any threatened and endangered species encountered and the number and disposition of specimens handled. Annual reports for multi-year permits are due at the end of each calendar year.
- H. A person conducting any activities authorized by this permit shall carry a copy of this permit and shall produce a copy of this permit upon request of a Department of Natural Resources employee or law enforcement officer.

All permits require an annual report unless indicated otherwise. You can use the enclosed report form and submit forms via email to reitzc@michigan.gov. In addition, please report any new occurrences of threatened and endangered species as soon as possible instead of waiting until the end of the year. This will allow new data to be incorporated into the Michigan Natural Features Inventory database sooner, thus ensuring greater protection for these species and their habitats.

Thank you for helping protect our threatened and endangered species. Feel free to contact me with any questions or concerns.

Sincerely,



Casey M. Reitz, Permit Specialist
DNR-Wildlife Division
Phone: 517-284-6210
Fax: 517-335-6604



APPLICATION FOR A THREATENED/ENDANGERED SPECIES APPLICATION AND PERMIT

By the authority of Part 365, Endangered Species Protection, of the Natural Resource and Environmental Protection Act, Act 451 of 1994, and the rules established thereunder, submittal is required to be considered for a permit.

INSTRUCTIONS: Please type or print all information except the signature and mail with attachments to the Wildlife Division. Federal permits may be required for federally listed or migratory species. A proposal letter is required for any new or amended proposals. Instructions for proposals are on the back of this application.

APPLICANT INFORMATION

<input type="checkbox"/> New Permit		<input checked="" type="checkbox"/> Renewal Permit		If Renewal, Permit Number: <u>TE 150</u>	
<input checked="" type="checkbox"/> Consultant (provide credentials)		<input type="checkbox"/> Education or Scientific		<input type="checkbox"/> Development/Management	
<input type="checkbox"/> Live Animal Programs/Salvage		Name of Applicant (First, Last)		Applicant's Title (If applicable)	
Thomas, Estrem		Organization Name		Subpermittee	
Cardno		Address		John Richardson	
708 Roosevelt Road		City, State, ZIP Code		Walkerton, IN 46574	
Telephone		E-Mail Address		574-229-8764	
tom.estrem@cardno.com		Species Information (PROPOSAL LETTER REQUIRED FOR NEW APPLICANTS)			

SPECIES INFORMATION (PROPOSAL LETTER REQUIRED FOR NEW APPLICANTS)

Species (Scientific or common names)	
state listed mussel species	
Location (Be specific. Include Michigan county(ies))	
mussel relocation to occur within the footprint of US 131 Bridge over the St. Joseph River in the Village of Constantine, St. Joseph County. Second site is located in Shiawassee River, near Davisburg, Oakland County.	
Time period requested (usually one to three years)	
three years	
Number of plants and/or animals to be handled, collected, relocated, etc.	
Unknown. Would estimate between 50-200 individuals listed as T/E	
Name and location of public institution where authorized specimens will be placed	
No specimens are anticipated to be kept.	
Regardless of the category, permit activities are authorized anywhere within the State of Michigan, unless specifically indicated otherwise. This permit does not authorize activities on private or public property without the approval of the land owner or administrator. Permittees and subpermittees shall display this permit, and any required Federal permit, upon the request of any authorized Department personnel	
I have read and understand the front and back of this form and agree to abide by the requirements presented, including maintaining any Federal permit that may be required. If I am a new applicant, I have attached a letter of authority prepared in accordance with the instructions on the back of this application. To the best of my knowledge, the information supplied by me is true and correct. I understand this permit does not provide any authorization to circumvent any Federal, State, local zoning, or any other local laws and ordinances. I understand it is my responsibility to know and comply with the requirements of this permit and Federal, State, and local laws	
Signature of Applicant <i>Thomas Estrem</i>	Date 8/13/2019

Mail completed application and all required attachments to:

PERMIT SPECIALIST - WILDLIFE DIVISION
MICHIGAN DEPARTMENT OF NATURAL RESOURCES
PO BOX 30444
LANSING MI 48909-7944
Or reitzc@michigan.gov, FAX: 517-335-6604

For DNR Use Only		
Permit Number	Issue Date	Expiration Date
TE 150	8/26/19	3/31/22
<i>[Signature]</i>		8/26/19



GRETCHEN WHITMER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
LANSING



DANIEL EICHINGER
DIRECTOR

AMENDMENT TO
SCIENTIFIC COLLECTOR'S PERMIT
Fish, Crustacean, and Mollusk

Amendment Issued: 08/08/2019
Date Permit Issued: 3/15/2019

Under the provisions of Part 487, Act 451, P.A. 1994, as amended, being section 324.48735, permission is hereby granted to:

Name: Thomas L. Estrem Driver's License No.: 4810021248 IN
John B. Richardson 3920156789 IN

Address: Cardno JFNew
708 Roosevelt Rd.
Walkerton, IN 46574

to take, catch, or kill and possess the aquatic species from the waters and land within the jurisdiction of this state, as specified below in the special provisions section. This permit limits the take of aquatic species to the **minimum** number needed.

Prior to field activities occurring on any stream, public lake or public lands under this permit, the permittee **must notify** the local fish biologist or Fisheries Division supervisor of the Management Unit where collections will occur. This contact must be made at least 48 hours prior to commencing field work and during normal business hours Monday-Friday between 8 a.m. and 5 p.m. If a set work schedule has been established for the field season, providing a copy to the unit may alleviate the need for additional contacts with a single unit. It is also strongly recommended that the permittee notify the District Law Supervisor for the county where the permit is being used. Failure to notify the law supervisor may result in the disruption of field work. Both of these contacts can be initiated by calling the appropriate operational service center (map and phone numbers provided).

Any survey or sampling gear that is authorized by this permit and left on public lands or waters of the state unattended by the permittee must be clearly marked with either the permittee's name or organized affiliation. Failure to properly attach and display ownership, may result in unattended gear being removed by the DNR.

SPECIAL PROVISIONS: Permittees are authorized for a scientific survey to collect, identify, enumerate, and release all fish and mollusk species. The permittee will follow the protocol specified in the document titled "Michigan Freshwater Mussel Survey Protocols and Relocation Procedures" (2018). Relocation of mussels and fish from construction sites to areas immediately outside the area of impact is authorized. No lethal collection is authorized, and no voucher specimens may be retained. Fish may not be marked, clipped, or tagged in any way prior to their release. Should a species listed in Michigan as special concern, threatened, or endangered be encountered while in the field, the permittees must release it outside the area of impact immediately upon identification with as

little further handling as possible. Lists of the Michigan's fish and mollusk species as well as their respective health statuses can be found online at www.michigan.gov/scientificcollectorspermit

Due to the high percentage of protected mussel species in Michigan (19 of 45 native mussels are list as T or E), the permittees should discuss their survey plans with the Threatened and Endangered Species Unit in Wildlife Division about the potential need to secure a T&E permit. Please contact Casey Reitz at reitzc@michigan.gov or 517-284-6210.

NOTE: The permittees will also engage in macroinvertebrate sampling.

In response to the VHS virus and other aquatic invasive species in Michigan, the following is required:

- 1) All equipment coming in contact with water including: boat hulls, boat trailers, buckets, waders, nets, etc. must be visually inspected and cleaned by hand picking any attached plants, sediments, or other debris. This should be done immediately upon leaving the water body being worked on.
- 2) All equipment coming in contact with water and/or fish and/or specifically working with aquatic invertebrates including: boat hulls, boat trailers, buckets, waders, nets, etc. must be disinfected using a 1 cup of bleach to 10 gallons of water solution at the end of each sampling day or prior to entering each successive water body if more than one is being sampled per day. If long periods of time (week or longer) are anticipated in between sampling events, thorough drying of all equipment in the sun is an acceptable alternative to using the bleach solution.
 - a. A 20 min Virkon Aquatic bath can be substituted as a bleach alternative.
 - b. A 20 min 100% vinegar bath can be substituted as a bleach alternative.
- 3) If using a boat, live wells and bilges must be emptied and disinfected with a solution of 1 cup of bleach to 10 gallons of water at the end of each sampling day or prior to entering each successive water body if more than one is sampled per day.
 - a. A 20 min Virkon Aquatic bath can be substituted as a bleach alternative.
 - b. A 20 min 100% vinegar bath can be substituted as a bleach alternative.

For more information on VHS or invasive species, go to the Fisheries link on the Department of Natural Resources web site at: <http://www.michigan.gov/dnr>

Permitted collection area: St. Joseph River in Berrien and St. Joseph counties within the Lake Michigan Basin.

Shiawassee River in Oakland County within the Lake Huron Basin.

Permitted collection gear: Electrofishing; by hand; kick and dip nets.

A copy of all reports and scientific papers using organisms collected with this permit shall be provided to DNR, Fisheries Division in addition to a Collector's Report form.

GENERAL PROVISIONS: This permit must be in permittee's possession during collection and must be made available upon request of any Department representative. Collection is limited to species not threatened or endangered. This permit is not transferable. This permit does not provide any authorization to circumvent any federal, state, or local laws and ordinances, including, but not limited to restricted entrance to refuges or other areas closed to the public without written permission of the land administrator. For a complete list of provisions, see Guidelines for Holders of Cultural or Scientific Collector's Permits.

In addition to this permit, separate DNR Public Land Use permits are required from:

- 1) Parks and Recreation Division for activities in State Parks and Recreation Areas and at the state boat launches;
- 2) Wildlife Division for activities in State Game Areas; and
- 3) Forest Resources Division for activities in State Forests

Public Land Use Permit applications can be obtained online at:

http://www.michigan.gov/dnr/0,16077,7-153-30301_31154_35728---,00.html

Permittees are also advised to contact the US Forest Service and National Park Service about any permit requirements for activities occurring in Michigan's National Forests and National Parks, respectively.

Any violation of the conditions of this permit may result in revocation of this permit and misdemeanor penalties of imprisonment for not more than 90 days or a fine of not more than \$500 or all of the above. Unless revoked, this permit **expires on 12/31/2019**.

By



James L. Dexter, Chief
Fisheries Division

cc: Fisheries Division
Southern Lake Michigan Management Unit
Threatened and Endangered Species Unit, Wildlife Division
Southern Lake Huron Management Unit

Davisburg, Oakland
County, Michigan

APPENDIX

B

PROCEDURE 51 DATASHEETS

APPENDIX J. STREAM CARD

Shaded fields are entered into database

STREAM NAME <u>Shigwasseo River, Upstream Reach</u>		LOCATION (road crossing) <u>enter off Marquette</u>	
COUNTY/TOWNSHIP <u>Oakland County Springfield Twp</u>		T R S	
LAT(dd) <u>42.756454</u>	LONG(dd) <u>-83.549171</u>	RIVER BASIN	
STORET #		HUC CODE	ECOREGION
INVESTIGATOR(S) <u>TLE FIS</u>	DATE <u>9/4/2019</u>	REASON FOR SURVEY <input checked="" type="checkbox"/> Targeted: comment <u>Qualitative Assessment</u> <input type="checkbox"/> Randomized: VSEC # _____ VSEC description (eg. cold smelt)	
TIME <u>4:00</u> AM PM <input checked="" type="checkbox"/>			

WEATHER CONDITIONS		WATERSHED FEATURES	
Current <input checked="" type="checkbox"/> Sunny <input type="checkbox"/> Partly Cloudy <input type="checkbox"/> Cloudy <input type="checkbox"/> Rainy	Has there been a significant rain in the last 7 days? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Don't Know Air Temperature <u>75</u> °F	Predominant Surrounding Land Use <input checked="" type="checkbox"/> Forest <input type="checkbox"/> Commercial <input type="checkbox"/> Field/Pasture <input type="checkbox"/> Industrial <input type="checkbox"/> Agricultural <input checked="" type="checkbox"/> Residential <input checked="" type="checkbox"/> Other <u>Wetland Prairie</u>	Local Watershed NPS Pollution <input checked="" type="checkbox"/> No evidence <input type="checkbox"/> Some potential sources <input type="checkbox"/> Obvious Sources Local Watershed Erosion <input checked="" type="checkbox"/> None <input type="checkbox"/> Moderate <input type="checkbox"/> Heavy
RIPARIAN VEGETATION Indicate the dominant type and record the dominant species <input checked="" type="checkbox"/> Trees <input type="checkbox"/> Shrubs Species: <input type="checkbox"/> Grasses <input checked="" type="checkbox"/> Herbaceous Estimate buffer width (left) <u>50</u> ft (right) <u>750</u> ft			

STREAM CHARACTERIZATION		INSTREAM FEATURES	
Stream Subsystem <input checked="" type="checkbox"/> Perennial <input type="checkbox"/> Intermittent <input checked="" type="checkbox"/> Lake Outlet Influenced <input type="checkbox"/> Dam Influenced	Stream Modifications <input checked="" type="checkbox"/> None <input type="checkbox"/> Dredged <input type="checkbox"/> Canopy Removal <input type="checkbox"/> Snagging <input type="checkbox"/> Impounded <input type="checkbox"/> Relocated <input type="checkbox"/> Bank Stabilization <input type="checkbox"/> Habitat Improvement	Avg. Stream Width <u>18</u> ft Avg. Stream Depth <u>1.5</u> ft Surface Velocity <u>0.5</u> ft/sec Est. Flow <u>13</u> cfs (at thalweg) Est. Survey Reach Length <u>150</u> ft Survey Reach Area <u>2700</u> ft ² High Water Mark <u>2.0</u> ft Canopy Cover: <u>0</u> % Shaded	
Stream Origin <input checked="" type="checkbox"/> Spring Fed <input checked="" type="checkbox"/> Lake/Pond <input type="checkbox"/> Swamp, Marsh, Bog <input checked="" type="checkbox"/> Mixture of origins <input type="checkbox"/> Other _____	Stream Type <input type="checkbox"/> Coldwater <input checked="" type="checkbox"/> Warmwater		

AQUATIC VEGETATION		Portion of the reach with aquatic vegetation <u>100</u> %
<input checked="" type="checkbox"/> Rooted emergent <input checked="" type="checkbox"/> Rooted submergent <input checked="" type="checkbox"/> Rooted floating	<input type="checkbox"/> Free Floating <input type="checkbox"/> Floating algae <input checked="" type="checkbox"/> Attached algae	Nuisance aquatic plants or slimes present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Dominant species present <u>filamentous algae</u>

WATER QUALITY		Solids, Turbidity	Color	Surface Oils	Water Odors
Temperature <u>71</u> °F	<input checked="" type="checkbox"/> Clear <u>1.05</u> NTU <input type="checkbox"/> Slightly turbid <input type="checkbox"/> Turbid	<input type="checkbox"/> Floating solids <input type="checkbox"/> Suspended solids <input type="checkbox"/> Settleable solids <input type="checkbox"/> Foams	<input checked="" type="checkbox"/> Clear <input type="checkbox"/> Stained <input type="checkbox"/> Opaque <input type="checkbox"/> Colored _____ <input type="checkbox"/> Other _____	<input checked="" type="checkbox"/> None <input type="checkbox"/> Sheen <input type="checkbox"/> Globbs <input type="checkbox"/> Flecks <input type="checkbox"/> Slick <input type="checkbox"/> Other _____	<input checked="" type="checkbox"/> Normal/None <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Fishy <input type="checkbox"/> Other _____
Water Samples Taken <input checked="" type="checkbox"/> None <input type="checkbox"/> Other _____ <input type="checkbox"/> GA <input type="checkbox"/> GN <input type="checkbox"/> MA <input type="checkbox"/> MN <input type="checkbox"/> VOA <input type="checkbox"/> ON					

SEDIMENT		Sediment Odors	Deposits
Sediment Samples Taken <input checked="" type="checkbox"/> None <input type="checkbox"/> Other _____ <input type="checkbox"/> MS <input type="checkbox"/> GS <input type="checkbox"/> VOA <input type="checkbox"/> OS/BNA	Oils <input type="checkbox"/> Absent <input type="checkbox"/> Slight <input type="checkbox"/> Moderate <input type="checkbox"/> Profuse	<input checked="" type="checkbox"/> Normal/None <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Anaerobic <input type="checkbox"/> Other _____	<input checked="" type="checkbox"/> None <input type="checkbox"/> Sludge <input type="checkbox"/> Sawdust <input type="checkbox"/> Paper fiber <input type="checkbox"/> Sand <input type="checkbox"/> Relict shells <input type="checkbox"/> Other _____
Looking at stones that are not deeply embedded, are the undersides black in color? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			

APPENDIX J (Continued)

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	Diameter	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Reach
Bedrock		0	Detritus	Sticks, wood, coarse plant material (CPOM)	20
Boulder	>10"	0			
Cobble	2.5"-10"	5	Muck-Mud	black, very fine organic (FPOM)	40, on stream margin
Gravel	0.1"-2.5"	25			
Sand	Gritty (course)	50	Other		
Silt	Gritty (fine)	20			
Clay	slick	0			

Proportion of Reach Represented by Stream Morphology Types

Riffle 0 %

Run 45 %

Pool 40 %

Depositional 15 %

Additional Structure Available for Macroinvertebrate Colonization

	Extensive	Moderate	Sparse	Absent
Undercut banks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Overhanging vegetation	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Large woody debris	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Aquatic macrophytes	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rootwads	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

SITE LOCATION MAP Draw a map of the site and indicate the areas sampled (or attach a photograph)

Further investigation necessary (explain)

Obvious pollution source/expression

* See representative photo pages of upstream sampling reach.

APPENDIX J. STREAM CARD

Shaded fields are entered into database

STREAM NAME <i>Shawnee River, Downstream Reach</i>		LOCATION (road crossing) <i>enter off Marquait</i>	
COUNTY/TOWNSHIP <i>Oakland Co. Springfield Twp.</i>		T R S	
LAT(dd) <i>42.756228</i>	LONG (dd) <i>-83.551595</i>	RIVER BASIN	
STORET #		HUC CODE	ECOREGION
INVESTIGATOR(S) <i>TLE FIS</i>	DATE <i>9/4/19</i>	REASON FOR SURVEY <input checked="" type="checkbox"/> Targeted: comment <i>Qualitative Assessment</i> <input type="checkbox"/> Randomized: VSEC # _____ VSEC description (eg. cold, small)	
TIME <i>4:00</i> AM <input checked="" type="checkbox"/> PM			

WEATHER CONDITIONS

Current
 Sunny
 Partly Cloudy
 Cloudy
 Rainy

Has there been a significant rain in the last 7 days?
 Yes No
 Don't Know

Air Temperature *75* °F

WATERSHED FEATURES

Predominant Surrounding Land Use
 Forest
 Commercial
 Field/Pasture
 Industrial
 Agricultural
 Residential
 Other *Wetland Prairie*

Local Watershed NPS Pollution
 No evidence
 Some potential sources
 Obvious Sources

Local Watershed Erosion
 None
 Moderate
 Heavy

RIPARIAN VEGETATION

Indicate the dominant type and record the dominant species

Trees Shrubs Species:
 Grasses Herbaceous

Estimate buffer width (left) *>150* ft (right) *>150* ft

STREAM CHARACTERIZATION

Stream Subsystem
 Perennial
 Intermittent
 Lake Outlet Influenced
 Dam Influenced

Stream Origin
 Spring Fed
 Lake/Pond
 Swamp, Marsh, Bog
 Mixture of origins
 Other _____

Stream Modifications
 None
 Dredged
 Canopy Removal
 Snagging
 Impounded
 Relocated
 Bank Stabilization
 Habitat Improvement

Stream Type
 Coldwater
 Warmwater

INSTREAM FEATURES

Avg. Stream Width *12* ft Avg. Stream Depth *1.1* ft

Surface Velocity *0.8* ft/sec Est. Flow *13* cfs (at thalweg)

Est. Survey Reach Length *160* ft

Survey Reach Area *1920* ft² High Water Mark *2* ft

Canopy Cover: *0* % Shaded

AQUATIC VEGETATION

Rooted emergent Free Floating
 Rooted submergent Floating algae
 Rooted floating Attached algae

Portion of the reach with aquatic vegetation *50* %

Nuisance aquatic plants or slimes present? Yes No

Dominant species present *Filamentous algae*

WATER QUALITY

Temperature *71* °F Solids, Turbidity
 Clear *1.05 NTU*
 Slightly turbid
 Turbid
 Floating solids
 Suspended solids
 Settleable solids
 Foams

Water Samples Taken
 None Other _____
 GA GN
 MA MN
 VOA ON

Color *pH 7.9 / Cond. 708*

Clear
 Stained
 Opaque
 Colored _____
 Other _____

Surface Oils
 None
 Sheen
 Globbs
 Flecks
 Slick
 Other _____

Water Odors
 Normal/None
 Sewage
 Petroleum
 Chemical
 Fishy
 Other _____

SEDIMENT

Sediment Samples Taken
 None Other _____
 MS GS
 VOA OS/BNA

Oils
 Absent
 Slight
 Moderate
 Profuse

Looking at stones that are not deeply embedded, are the undersides black in color? Yes No

Sediment Odors
 Normal/None
 Sewage
 Petroleum
 Chemical
 Anaerobic
 Other _____

Deposits
 None
 Sludge
 Sawdust
 Paper fiber
 Sand
 Relict shells
 Other _____

APPENDIX J (Continued)


INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	Diameter	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Reach
Bedrock		0	Detritus	Sticks, wood, coarse plant material (CPOM)	10
Boulder	>10"	0			
Cobble	2.5"-10"	15	Muck-Mud	black, very fine organic (FPOM)	10
Gravel	0.1"-2.5"	30			
Sand	Gritty (course)	45	Other		
Silt	Gritty (fine)	10			
Clay	slick	0			

Proportion of Reach Represented by Stream Morphology Types	Additional Structure Available for Macroinvertebrate Colonization			
	Extensive	Moderate	Sparse	Absent
<input type="checkbox"/> Riffle _____ %	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/> Run <u>75</u> %	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Pool <u>25</u> %	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Depositional _____ %	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

SITE LOCATION MAP Draw a map of the site and indicate the areas sampled (or attach a photograph)

Further investigation necessary (explain) ** See representative photo pages of downstream reach.*

Obvious pollution source/expression



9/4/19

Appendix J (continued)

FISH

Station Number: Upstream Reach

Length Sampled (ft): 150

Area Sampled (sq ft): 2610

Sampling Time: 45 minutes # Probes: 1
Passes: 2

Gear: boat / ss / ops

Number of Anomalies: 0

Comments: few fish collected. Abundant aquatic vegetation made fish collection difficult in certain locations

Petromyzontidae (Lampreys)		Sand shiner	_____	Gasterosteidae (Sticklebacks)	
Sea lamprey (a/l)	_____	Redfin shiner	_____	Brook stickleback	_____
Silver lamprey (a/l)	_____	Mimic shiner	_____	Threespine stickleback	_____
Northern brook lamprey (a/l)	_____	Brassy minnow	_____	Perchichthyidae (Temp. bass)	
Chestnut lamprey (a/l)	_____	Fathead minnow	_____	*White bass	_____
American brook lamprey (a/l)	_____	Bluntnose minnow	_____	*White perch	_____
Lepisosteidae (Gars)		Suckermouth minnow	_____	Centrarchidae (Sunfishes)	
*Spotted gar	_____	Silverjaw minnow	_____	*Rock bass	<u>4</u>
*Longnose gar	_____	Northern redbelly dace	_____	*Green sunfish	_____
Amilidae (Bowfins)		Southern redbelly dace	_____	*Pumpkinseed	_____
*Bowfin	_____	Finescale dace	_____	*Warmouth	_____
Clupeidae (Herrings)		Blacknose dace	_____	*Orangespotted sunfish	_____
*Alewife	_____	Longnose dace	_____	*Bluegill	<u>16</u>
*Gizzard shad	_____	Redside dace	_____	*Longear sunfish	<u>5</u>
Salmonidae (Salmon/Trout)		*Pearl dace	_____	*White crappie	_____
*Rainbow trout	_____	Cottidae (Sculpins)		*Black crappie	_____
*Brown trout	_____	Mottled sculpin	_____	*Largemouth bass	<u>1</u>
*Brook trout	_____	Slimy sculpin	_____	*Smallmouth bass	_____
*Coho	_____	Catostomidae (Suckers)		Percidae (Perch)	
*Chinook	_____	*Longnose sucker	_____	N. sand darter	_____
Umbridae (Mudminnow)		*White sucker	_____	Rainbow darter	_____
Central mudminnow	<u>3</u>	*Creek chubsucker	_____	Iowa darter	_____
Esocidae (Pike)		*Lake chubsucker	_____	Greenside darter	_____
*Grass pike	_____	*Northern hog sucker	_____	Fantail darter	_____
*Northern pike	_____	*Spotted sucker	_____	Orangethroat darter	_____
*Muskellunge	_____	*Silver redhorse	_____	Johnny darter	_____
Cyprinidae (Minnows and Carp)		*River redhorse	_____	Blackside darter	_____
Central stoneroller	_____	*Black redhorse	_____	Logperch	_____
Lake chub	_____	*Golden redhorse	_____	*Yellow perch	_____
*Goldfish	_____	*Shorthead redhorse	_____	*Walleye	_____
*Carp	_____	*Greater redhorse	_____	Percopsidae (Trout-perch)	
Bigeye chub	_____	Ictaluridae (Bullhead/Catfish)		Trout-perch	_____
*Honeyhead chub	_____	*Black bullhead	_____	Anguillidae (Eels)	
*River chub	_____	*Brown bullhead	_____	*American eel	_____
*Creek chub	_____	*Yellow bullhead	<u>1</u>	Gadidae (Cod)	
*Golden shiner	_____	Stonecat	_____	*Burbot	_____
Pugnose shiner	_____	Tadpole madtom	_____	Sciaenidae (Drums)	
Emerald shiner	_____	Brindled madtom	_____	*Freshwater drum	_____
Bigeye shiner	_____	*Channel catfish	_____	Cobitidae (Loaches)	
Ironcolor shiner	_____	*Flathead catfish	_____	Oriental weatherfish	_____
*Common shiner	<u>1</u>	Aphredoderidae (Pirate perch)		Other family/species:	
Central bigmouth shiner	_____	Pirate perch	_____	_____	_____
Blackchin shiner	_____	Atherinidae (Silversides)		_____	_____
Blacknose shiner	_____	Brook silverside	_____	_____	_____
Spottail shiner	_____	Cyprinodontidae (Topminnows)		_____	_____
Silver shiner	_____	Banded killifish	_____		
Rosyface shiner	_____	Blackstripe topminnow	_____		
Spotfin shiner	_____				

* = Measure length

Appendix J (continued)

Location Sampled Upstream Reach

Date 9/4/19

Length sampled 150' Time sampled 45 Gear type (circle): (ops) stream shocker boat shocker other

Species length (in)	Bluegill	Rockbass	Central mudminnow	Common shiner	Largemouth Bass	Yellow perch	longear sunfish	In
1		•						1
2	••		••					2
3	••	•					••	3
4	••			•			••	4
5	••	•			•			5
6	••							6
7						•		7
8								8
9		•						9
10								10
11								11
12								12
13								13
14								14
15								15
16								16
17								17
18								18
19								19
20								20
>20								

For individuals >20" record actual length

Species length (in)								In
1								1
2								2
3								3
4								4
5								5
6								6
7								7
8								8
9								9
10								10
11								11
12								12
13								13
14								14
15								15
16								16
17								17
18								18
19								19
20								20
>20								

Number of Anomalies 0

Number/Species of tagged/fin clipped fish 0

Description: N/A

9/4/19

Appendix J (continued)

FISH

Station Number: Downstream Reach

Length Sampled (ft): 160

Area Sampled (sq ft): 1920

Sampling Time: 45 minutes # Probes: 1
Passes:

Gear: boat / ss (bps)

Number of Anomalies: 0

Comments: few fish collected. Some difficulty collecting small darter individuals in rock substrate

Petromyzontidae (Lampreys)	Sand shiner	_____	Gasterosteidae (Sticklebacks)	_____
Sea lamprey (a/l)	Redfin shiner	_____	Brook stickleback	_____
Silver lamprey (a/l)	Mimic shiner	_____	Threespine stickleback	_____
Northern brook lamprey (a/l)	Brassy minnow	_____	Perchichthyidae (Temp. bass)	_____
Chestnut lamprey (a/l)	Fathead minnow	_____	*White bass	_____
American brook lamprey (a/l)	Bluntnose minnow	_____	*White perch	_____
Lepisosteiidae (Gars)	Suckermouth minnow	_____	Centrarchidae (Sunfishes)	_____
*Spotted gar	Silverjaw minnow	_____	*Rock bass	<u>2</u>
*Longnose gar	Northern redbelly dace	_____	*Green sunfish	<u>1</u>
Amlidae (Bowfins)	Southern redbelly dace	_____	*Pumpkinseed	_____
*Bowfin	Finescale dace	_____	*Warmouth	<u>1</u>
Clupeidae (Herrings)	Blacknose dace	_____	*Orangespotted sunfish	_____
*Alewife	Longnose dace	_____	*Bluegill	<u>2</u>
*Gizzard shad	Redside dace	_____	*Longear sunfish	_____
Salmonidae (Salmon/Trout)	*Pearl dace	_____	*White crappie	_____
*Rainbow trout	Cottidae (Sculpins)	_____	*Black crappie	_____
*Brown trout	Mottled sculpin	_____	*Largemouth bass	<u>3</u>
*Brook trout	Slimy sculpin	_____	*Smallmouth bass	_____
*Coho	Catostomidae (Suckers)	_____	Percidae (Perch)	_____
*Chinook	*Longnose sucker	_____	N. sand darter	_____
Umbridae (Mudminnow)	*White sucker	_____	Rainbow darter	<u>13</u>
Central mudminnow	*Creek chubsucker	_____	Iowa darter	_____
Esocidae (Pike)	*Lake chubsucker	_____	Greenside darter	_____
*Grass pike	*Northern hog sucker	_____	Fantail darter	_____
*Northern pike	*Spotted sucker	_____	Orangethroat darter	_____
*Muskellunge	*Silver redhorse	_____	Johnny darter	_____
Cyprinidae (Minnows and Carp)	*River redhorse	_____	Blackside darter	_____
Central stoneroller	*Black redhorse	_____	Logperch	_____
Lake chub	*Golden redhorse	_____	*Yellow perch	_____
*Goldfish	*Shorthead redhorse	_____	*Walleye	_____
*Carp	*Greater redhorse	_____	Percopsidae (Trout-perch)	_____
Bigeye chub	Ictaluridae (Bullhead/Catfish)	_____	Trout-perch	_____
*Honeyhead chub	*Black bullhead	_____	Anguillidae (Eels)	_____
*River chub	*Brown bullhead	_____	*American eel	_____
*Creek chub	*Yellow bullhead	<u>2</u>	Gadidae (Cod)	_____
*Golden shiner	Stonecat	_____	*Burbot	_____
Pugnose shiner	Tadpole madtom	_____	Sciaenidae (Drums)	_____
Emerald shiner	Brindled madtom	_____	*Freshwater drum	_____
Bigeye shiner	*Channel catfish	_____	Cobitidae (Loaches)	_____
Ironcolor shiner	*Flathead catfish	_____	Oriental weatherfish	<u>1</u>
*Common shiner	Aphredoderidae (Pirate perch)	_____	Other family/species:	_____
Central bigmouth shiner	Central perch	_____	_____	_____
Blackchin shiner	Atherinidae (Siversides)	_____	_____	_____
Blacknose shiner	Brook silverside	_____	_____	_____
Spottail shiner	Cyprinodontidae (Topminnows)	_____	_____	_____
Silver shiner	Banded killifish	_____		
Rosyface shiner	Blackstripe topminnow	_____		
Spotfin shiner		_____		

* = Measure length

Appendix J (continued)

Location Sampled Downstream Reach

Date 9/4/19

Length sampled 100 ft Time sampled 45 min Gear type (circle) stream shocker boat shocker other

Species length (in)	Rainbow Darter	Rockbass	Largemouth Bass	Green sunfish	Bluegill	Yellow perch	Warmouth	oriental weather fish	ln
1	Li								1
2	Li								2
3				.		..			3
4							.		4
5			.		.				5
6		6
7			.						7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									

For individuals >20" record actual length

Species length (in)									ln
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									

Number of Anomalies 0

Number/Species of tagged/fin clipped fish 0

Description: N/A

9/4/19

MACROINVERTEBRATES

Station: Upstream Reach

Area Sampled: 2610 ft²

Time Sampled: 15 minutes

- PORIFERA _____
- PLATYHELMINTHES
 - Turbellaria _____
- NEMATOMORPHA _____
- BRYOZOA _____
- ANNELIDA
 - Hirudinea _____
 - Oligochaeta _____
- ARTHROPODA
 - Crustacea
 - Amphipoda 62
 - Decapoda 1
 - Isopoda 17
 - Arachnoidea
 - Hydracarina _____
 - Insecta
 - Ephemeroptera
 - Ametropodidae _____
 - Baetiscidae _____
 - Baetidae _____
 - Caenidae 1
 - Ephemerellidae _____
 - Ephemeridae _____
 - Heptageniidae 2
 - Isonychiidae _____
 - Leptophlebiidae _____
 - Metretopodidae _____
 - Polymitarcyidae _____
 - Potamanthidae _____
 - Siphonuridae _____
 - Tricorythidae _____
 - Odonata
 - Anisoptera
 - Aeshnidae _____
 - Cordulegastridae _____
 - Corduliidae 2
 - Gomphidae _____
 - Libellulidae 2
 - Macomiidae _____
 - Zygoptera
 - Calopterygidae _____
 - Coenagrionidae 35
 - Lestidae _____
 - Plecoptera
 - Capniidae _____
 - Chloroperlidae _____
 - Leuctridae _____
 - Nemouridae _____
 - Peltoperlidae _____
 - Perlidae _____
 - Perlodidae _____
 - Pteronarcyidae _____
 - Taeniopterygidae _____

- Hemiptera
 - Belostomatidae _____
 - Corixidae 1
 - Gelastocoridae _____
 - Gerridae _____
 - Mesoveliidae _____
 - Naucoridae _____
 - Nepidae _____
 - Notonectidae _____
 - Pleidae _____
 - Saldidae _____
 - Veliidae _____
- Megaloptera
 - Corydalidae _____
 - Sialidae _____
- Neuroptera
 - Sisyridae _____
- Trichoptera
 - Brachycentridae _____
 - Glossosomatidae _____
 - Helicopsychidae _____
 - Hydropsychidae _____
 - Hydroptilidae _____
 - Lepidostomatidae _____
 - Leptoceridae _____
 - Limnephilidae _____
 - Molannidae _____
 - Odontoceridae _____
 - Philopotamidae _____
 - Phryganeidae _____
 - Polycentropodidae _____
 - Psychomyiidae _____
 - Rhyacophilidae _____
 - Sericostomatidae _____
 - Uenoidae (*Neophylax*) _____
- Lepidoptera
 - Noctuidae _____
 - Pyrilidae _____
- Coleoptera*
 - Dryopidae _____
 - Dytiscidae _____
 - Elmidae _____
 - Gyrinidae (a) _____ (l) _____
 - Haliplidae (a) 1 (l) _____
 - Heteroceridae _____
 - Hydraenidae _____
 - Hydrophilidae _____
 - Lampyridae (a) _____ (l) _____
 - Noteridae (a) _____ (l) _____
 - Psephenidae(a) _____ (l) _____
 - Ptilodactylidae (a) _____ (l) _____
 - Scirtidae (a) _____ (l) _____

- Diptera
 - Athericidae _____
 - Ceratopogonidae _____
 - Chaoboridae _____
 - Chironomidae 2
 - Culicidae _____
 - Dixidae _____
 - Dolichopodidae _____
 - Empididae _____
 - Ephydriidae _____
 - Muscidae _____
 - Psychodidae _____
 - Ptychopteridae _____
 - Sciomyzidae _____
 - Simuliidae _____
 - Stratiomyidae _____
 - Syrphidae _____
 - Tabanidae 1
 - Thaumaleidae _____
 - Tipulidae _____
- MOLLUSCA
 - Gastropoda
 - Ancylidae _____
 - Bithyniidae _____
 - Hydrobiidae _____
 - Lymnaeidae 1
 - Physidae _____
 - Planorbidae _____
 - Pleuroceridae _____
 - Pomatiopsidae _____
 - Valvatidae _____
 - Viviparidae _____
 - Pelecypoda
 - Dreissenidae _____
 - Pisidiidae _____
 - Sphaeriidae 4
 - Unionidae _____

Other taxa or comments:

No riffles present in sampling reach.

* record # of adults (a) or larvae (l) as indicated

9/4/19

MACROINVERTEBRATES

Station: Downstream Reach

Area Sampled: 1920 ft²

Time Sampled: 15 minutes

PORIFERA _____	Hemiptera	Diptera
PLATYHELMINTHES	Belostomatidae _____	Athericidae _____
Turbellaria _____	Corixidae _____	Ceratopogonidae _____
NEMATOMORPHA _____	Gelastocoridae _____	Chaoboridae _____
BRYOZOA _____	Gerridae _____	Chironomidae <u>11</u>
ANNELIDA	Mesoveliidae _____	Culicidae _____
Hirudinea _____	Naucoridae _____	Dixidae _____
Oligochaeta _____	Nepidae <u>1</u>	Dolichopodidae _____
ARTHROPODA	Notonectidae _____	Empididae _____
Crustacea	Pleidae _____	Ephydriidae _____
Amphipoda <u>72</u>	Saldidae _____	Muscidae _____
Decapoda <u>1</u>	Veliidae _____	Psychodidae _____
Isopoda _____	Megaloptera	Ptychopteridae _____
Arachnoidea	Corydalidae _____	Sciomyzidae _____
Hydracarina _____	Sialidae _____	Simuliidae _____
Insecta	Neuroptera	Stratiomyidae _____
Ephemeroptera	Sisyridae _____	Syrphidae _____
Ametropodidae _____	Trichoptera	Tabanidae _____
Baetiscidae _____	Brachycentridae _____	Thaumaleidae _____
Baetidae _____	Glossosomatidae _____	Tipulidae _____
Caenidae _____	Helicopsychidae _____	MOLLUSCA
Ephemerellidae <u>4</u>	Hydropsychidae _____	Gastropoda
Ephemeridae _____	Hydroptilidae <u>1</u>	Ancylidae _____
Heptageniidae _____	Lepidostomatidae _____	Bithyniidae _____
Isonychiidae _____	Leptoceridae _____	Hydrobiidae _____
Leptophlebiidae _____	Limnephilidae _____	Lymnaeidae _____
Metretopodidae _____	Molannidae _____	Physidae _____
Polymitarcyidae _____	Odontoceridae _____	Planorbidae _____
Potamanthidae _____	Philopotamidae _____	Pleuroceridae _____
Siphonuridae _____	Phryganeidae _____	Pomatiopsidae _____
Tricorythidae <u>42</u>	Polycentropodidae <u>2</u>	Valvatidae _____
Odonata	Psychomyiidae _____	Viviparidae _____
Anisoptera	Rhyacophilidae _____	Pelecypoda
Aeshnidae _____	Sericostomatidae _____	Dreissenidae _____
Cordulegastridae _____	Uenoidae (<i>Neophylax</i>) _____	Pisidiidae _____
Corduliidae _____	Lepidoptera	Sphaeriidae <u>5</u>
Gomphidae _____	Noctuidae _____	Unionidae _____
Libellulidae <u>1</u>	Pyrilidae _____	
Macomiidae _____	Coleoptera*	
Zygoptera	Dryopidae _____	
Calopterygidae <u>25</u>	Dytiscidae _____	
Coenagrionidae <u>17</u>	Elmidae <u>1</u>	
Lestidae _____	Gyrinidae (a) _____ (l) _____	
Plecoptera	Haliplidae (a) <u>11</u> (l) _____	
Capniidae _____	Heteroceridae _____	
Chloroperlidae _____	Hydraenidae _____	
Leuctridae _____	Hydrophilidae _____	
Nemouridae _____	Lampyridae (a) _____ (l) _____	
Peltoperlidae _____	Noteridae (a) _____ (l) _____	
Perlidae _____	Psephenidae(a) _____ (l) _____	
Perlodidae _____	Ptilodactylidae (a) _____ (l) _____	
Pteronarcyidae _____	Scirtidae (a) _____ (l) _____	
Taeniopterygidae _____		

Other taxa or comments:

No riffles present in
sampling reach.

* record # of adults (a) or larvae (l) as indicated

9/4/2019

HABITAT ASSESSMENT FIELD DATA SHEET - GLIDE/POOL STREAMS

Habitat Parameter	Condition Category			
	Excellent	Good	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of island or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5a. Channel Flow Status - Maintained Flow Volume	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	10 9	8 7 6	5 4 3	2 1 0
5b. Channel Flow Status - Flashiness	Vegetation along the stream bank is complete nearly to the waters edge. Little or no evidence of frequent changes in discharge and/or frequent high water events that scours stream bank vegetation. Large woody debris (if present) stable and extending laterally across the stream channel.	Some evidence of bank scour approximately 4-8 inches above the waters surface. Large woody debris (if present) mostly stable and extending partially into the active stream channel.	Bank scour evidence 9-18 inches above the waters surface. Large woody debris (if present) tend to lay more against the stream bank rather than extending into the active channel.	Bank scour (>20 inches) along the stream channel. Large woody debris are generally absent from the active channel and/or may exist as woody debris jams along the stream bank above the active channel.
SCORE	10 9	8 7 6	5 4 3	2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization is continuous but not recent (>5 years). Embankments without mature trees and dominated by grasses and shrubs.	Stream reach has been recently channelized (<5 years). OR Banks shored with gabion, rock, cement or bare earth. Instream habitat greatly altered or removed entirely. Bank vegetation moderately dense to absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Appendix J (continued)

Habitat Parameter	Condition Category																				
	Excellent					Good					Marginal			Poor							
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas)					The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.					The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. (Note lack of sinuosity may be due to channelization)			Channel straight, waterway has been channelized for a long distance.							
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.			Unstable, many eroded areas, "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.							
SCORE (LB)	Left Bank 10 9					8 7 6					5 4 3			2 1 0							
SCORE (RB)	Right Bank 10 9					8 7 6					5 4 3			2 1 0							
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but 1 class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common, less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation has been removed to 2 inches or less in average stubble height.							
SCORE (LB)	Left Bank 10 9					8 7 6					5 4 3			2 1 0							
SCORE (RB)	Right Bank 10 9					8 7 6					5 4 3			2 1 0							
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >150 feet and dominated by native vegetation including trees, shrubs, or non-woody macrophytes or wetlands; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. Human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.					Width of riparian zone 75-150 feet; human activities have impacted zone only minimally.					Width of riparian zone 10-75 feet; human activities have impacted zone a great deal.			Width of riparian zone <10 feet; little or no riparian vegetation due to human activities.							
SCORE (LB)	Left Bank 10 9					8 7 6					5 4 3			2 1 0							
SCORE (RB)	Right Bank 10 9					8 7 6					5 4 3			2 1 0							

Total Score 141

9/4/2019

HABITAT ASSESSMENT FIELD DATA SHEET - GLIDE/POOL STREAMS

Habitat Parameter	Condition Category			
	Excellent	Good	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom, little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep, very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of island or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5a. Channel Flow Status - Maintained Flow Volume	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel, or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	(10) 9	8 7 6	5 4 3	2 1 0
5b. Channel Flow Status - Flashiness	Vegetation along the stream bank is complete nearly to the waters edge. Little or no evidence of frequent changes in discharge and/or frequent high water events that scours stream bank vegetation. Large woody debris (if present) stable and extending laterally across the stream channel.	Some evidence of bank scour approximately 4-8 inches above the waters surface. Large woody debris (if present) mostly stable and extending partially into the active stream channel.	Bank scour evidence 9-18 inches above the waters surface. Large woody debris (if present) tend to lay more against the stream bank rather than extending into the active channel.	Bank scour (>20 inches) along the stream channel. Large woody debris are generally absent from the active channel and/or may exist as woody debris jams along the stream bank above the active channel.
SCORE	10 (9)	8 7 6	5 4 3	2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization is continuous but not recent (>5 years). Embankments without mature trees and dominated by grasses and shrubs.	Stream reach has been recently channelized (<5 years). OR Banks shored with gabion, rock, cement or bare earth. Instream habitat greatly altered or removed entirely. Bank vegetation moderately dense to absent.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Appendix J (continued)

Habitat Parameter	Condition Category																				
	Excellent					Good					Marginal			Poor							
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas)					The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.					The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. (Note: lack of sinuosity may be due to channelization)			Channel straight, waterway has been channelized for a long distance.							
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion, high erosion potential during floods.			Unstable; many eroded areas, "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.							
SCORE (LB)	Left Bank 10 9					8 7 6					5 4 3			2 1 0							
SCORE (RB)	Right Bank 10 9					8 7 6					5 4 3			2 1 0							
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but 1 class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation has been removed to 2 inches or less in average stubble height.							
SCORE (LB)	Left Bank 10 9					8 7 6					5 4 3			2 1 0							
SCORE (RB)	Right Bank 10 9					8 7 6					5 4 3			2 1 0							
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >150 feet and dominated by native vegetation including trees, shrubs, or non-woody macrophytes or wetlands, vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. Human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.					Width of riparian zone 75-150 feet, human activities have impacted zone only minimally.					Width of riparian zone 10-75 feet; human activities have impacted zone a great deal.			Width of riparian zone <10 feet; little or no riparian vegetation due to human activities							
SCORE (LB)	Left Bank 10 9					8 7 6					5 4 3			2 1 0							
SCORE (RB)	Right Bank 10 9					8 7 6					5 4 3			2 1 0							

Total Score 153

Davisburg, Oakland
County, Michigan

APPENDIX

C

REPRESENTATIVE PHOTOS



Representative habitat photo in upstream sampling reach, 9/4/2019



Representative habitat photo in downstream sampling reach, 9/4/2019



Representative substrate photo in downstream sampling reach, 9/4/2019



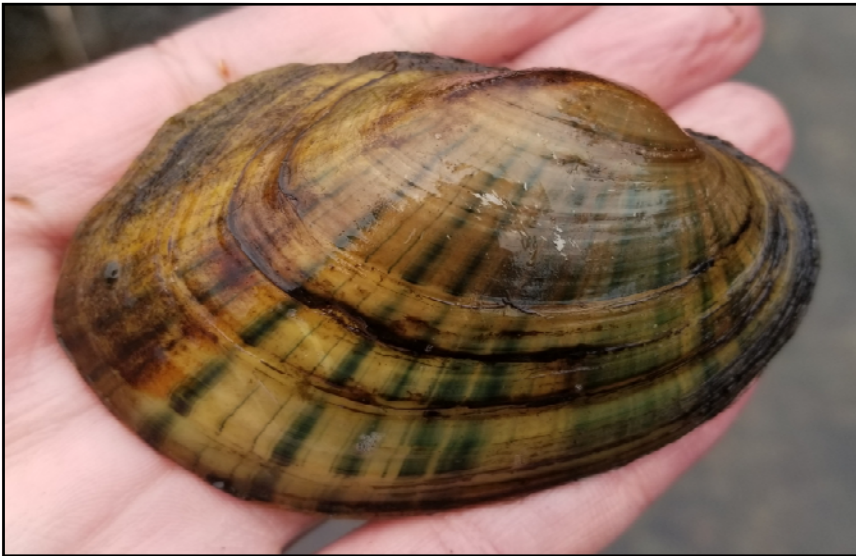
Mudpuppy collected in downstream sampling reach, 9/4/2019



Giant Floater



Rainbow



Plain pocketbook



Creeper

About Cardno

Cardno is an ASX-200 professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage, and deliver sustainable projects and community programs. Cardno is an international company listed on the Australian Securities Exchange [ASX:CDD].

Cardno Zero Harm

Cardno
**ZERO
HARM**
EVERY JOB. EVERY DAY.

At Cardno, our primary concern is to develop and maintain safe and healthy conditions for anyone involved at our project worksites. We require full compliance with our Health and Safety Policy Manual and established work procedures and expect the same protocol from our subcontractors. We are committed to achieving our Zero Harm goal by continually improving our safety systems, education, and vigilance at the workplace and in the field. Safety is a Cardno core value and through strong leadership and active employee participation, we seek to implement and reinforce these leading actions on every job, every day.