DETROIT RIVER AREA OF CONCERN HABITAT RESTORATION
BLUE HERON LAGOON

U.S. EPA GREAT LAKES NATIONAL PROGRAM OFFICE

QUALITY ASSURANCE PROJECT PLAN
Version 1.1

PREPARED FOR:

U.S. ENVIRONMENTAL PROTECTION AGENCY, GREAT LAKES NATIONAL PROGRAM OFFICE
77 W. JACKSON BOULEVARD, CHICAGO, ILLINOIS 60604-3511

GRANT NUMBER: E-00474

PREPARED BY:

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ON BEHALF OF:
FRIENDS OF THE DETROIT RIVER
2674 WEST JEFFERSON AVENUE, TRENTON, MICHIGAN 48183

ECT PROJECT NUMBER: 10-0895

JULY 2011

THIS QUALITY ASSURANCE PROJECT PLAN (QAPP) WAS PREPARED ACCORDING TO GUIDANCE PROVIDED IN *GUIDANCE FOR QUALITY ASSURANCE PROJECT PLANS* (EPA QA/G-5), EPA/240/R-02/009, DECEMBER 2002 (HTTP://WWW.EPA.GOV/QUALITY/QS-DOCS/G5-FINAL.PDF) AND *EPA REQUIREMENTS FOR QUALITY ASSURANCE PROJECT PLANS* (EPA QA/R-5, EPA/240/B-01/003, U.S. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF ENVIRONMENTAL INFORMATION, WASHINGTON, D.C., MARCH 2001 HTTP://WWW.EPA.GOV/QUALITY/QS-DOCS/R5-FINAL.PDF) TO ENSURE THAT ENVIRONMENTAL AND RELATED DATA COLLECTED, COMPILED, AND/OR GENERATED FOR THIS PROJECT ARE COMPLETE, ACCURATE, AND OF THE TYPE, QUANTITY, AND QUALITY REQUIRED FOR THEIR INTENDED USE. ECT, INC. WILL CONDUCT WORK IN CONFORMANCE WITH THE QUALITY ASSURANCE PROGRAM DESCRIBED IN THE PROCEDURES DETAILED IN THIS QAPP.

Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating current
ACO	Artificial cover objects
AMRL	AASHTO Materials Reference Laboratory
AOC	Area of Concern
ASTM	American Society for Testing and Materials International
AVAS	Aquatic Vegetation Assessment Sites
BCEE	Board Certified Environmental Engineer
BUI	Beneficial Use Impairment
COC	Chain of Custody
CORS	Continuously Operating Reference System
DC	Direct current
DRD	City of Detroit Parks & Recreation Department
DQI	Data Quality Indicator
DQO	Data Quality Objective
DTM	Digital Terrain Modeling
ECT	Environmental Consulting & Technology, Inc.
EPA	United States Environmental Protection Agency (also USEPA)
FDR	Friends of the Detroit River
GIS	Global Information System
GLNPO	Great Lakes National Program Office
GLRI	Great Lakes Restoration Initiative
GPS	Global Positioning System
HRM	Herpetological Resource Management
ID	Identification
JJR	JJR, LLC
kVA	kilo volt amperes
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MISS-DIG	Miss Dig System, Inc.
MNFI	Michigan Natural Features Inventory database
PARCCS	Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity
P.E.	Professional Engineer
Ph.D.	Doctorate of Philosophy
PO	Project Officer
P.S.	Professional Surveyor
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative percent difference
SM	Standard Method
SMC	Ship Motion Control
SOMAT	SOMAT Engineering
SOP	Standard Operating Procedure
SPT	Standard Penetration Test
t/e	threatened and/or endangered
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey

SECTION A – PROJECT MANAGEMENT

A.1 Title and Approval Page

Quality Assurance Project Plan for

Detroit River Area of Concern Habitat Restoration
Blue Heron Lagoon

Prepared on Behalf of:
Friends of the Detroit River

Rosanne Ellison, US EPA GLNPO, Project Officer — Date: 7/14/11

Louis Blume, US EPA GLNPO, Quality Assurance Manager or his designee — Date: 7/15/11

Charlie Bristol, Friends of the Detroit River, Grant Manager — Date: 07/08/11

John Bona, ECT Inc., Project Manager — Date: 07/08/11

Mark Mikesell, ECT Inc., Project Quality Assurance Manager — Date: 07/08/11

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A.3 Distribution List

This document will be distributed electronically to the following team members involved in this project from the US Environmental Protection Agency's (EPA) Great Lakes National Program Office (GLNPO), Friends of the Detroit River (FDR), City of Detroit Recreation Department, JJR, LLC (JJR), Environmental Consulting & Technology, Inc (ECT), Herpetological Resource and Management, LLC (HRM), Bird Studies Canada, SOMAT Engineering (SOMAT), and Paragon Laboratories, Inc. (Paragon). Additionally, anyone involved in the aspects of this project discussed in this document will receive a copy of the document.

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A.4 Project/Task Organization

The primary objective of this project is to design and restore fish access to high quality wetlands, shallow and deep water habitat, and project personnel will investigate the possibility to connect to about two miles of canals. This will be accomplished by reconnecting and naturalizing the mouth of the Blue Heron Lagoon to the Detroit River. Additionally, data will be collected to monitor the ecological changes that occur after the restoration is complete as a measure of the success of the habitat restoration project. This document is the quality assurance project plan (QAPP) for data collection that is to occur before, during, and after construction.

Project Objectives

This QAPP provides a description of the procedures to be followed for collecting data. This will ensure that the data collection methods are of a sufficient quality to allow for successful design and also that the methods used prior to construction are consistent with the data collection methods used after construction is completed. The data is expected to be scientifically valid and defensible and that uncertainty has been reduced to a practical minimum. Data and information will be collected to help quantify and qualify both the existing and post-restoration conditions and provide a conclusion as to the effectiveness of site restoration in achieving the project goals. This QAPP will set forth the objectives, responsibilities, protocols, procedures, and methods for collecting data on the status of the project area.

Included with this document are seven appendices which include Bird Studies Canada's Standard Operating Procedures (SOPs) for their Marsh Monitoring Program (MMP) (Appendix A); JJR SOPs for topographic and bathymetric survey (Appendix B); SOMAT SOPs for geotechnical survey, sampling, and laboratory analysis (Appendix C); ECT SOPs for Global Information System (GIS) and Global Positioning System (GPS) data collection and management, boat electrofishing, euthanizing invasive fish species, visual aquatic habitat assessment, Measuring Water Transparency Using Secchi Disk, Measuring Water Velocity using Current Meter, water quality measurement using multi-parameter probe, and Fyke Net Fishing (Appendix D); a section from the Michigan Department of Natural Resources (MDNR) Fisheries Division *Manual of Fisheries Survey Methods II*, which includes field forms (Appendix E); and the Michigan Department of Environmental Quality (MDEQ) *Procedures for Aquatic Vegetation Surveys* and Field Forms (Appendix F); and Paragon Laboratories SOPs for sediment chemistry analysis (Appendix G).

Project Organization

The U.S. Environmental Protection Agency (EPA) Great Lakes National Program Office (GLNPO) is providing funding for this project under the Great Lakes Restoration Initiative (GLRI). As a partner for the project, EPA is also providing project oversight and technical input.

Friends of the Detroit River (FDR) is the Manager of the award funding and the project as a whole. As such, FDR is responsible for keeping the project on schedule and within budget. FDR is also responsible for tracking project progress and providing appropriate documentation to EPA, this includes quarterly project status reports and a final project report.

City of Detroit Parks & Recreation Department (DRD) personnel will assist with public involvement activities and design review. The DRD provides outreach and educational programming about the natural world to participants of all ages. Each summer, the Recreation Department conducts 6-9 week-day camps for 400 children from 3-12 years old throughout the city. Day campers are exposed to the natural world through field trips to Belle Isle. The Blue Heron Lagoon is frequently chosen as the site to teach children about wildlife, both aquatic and terrestrial.

Environmental Consulting & Technology, Inc. (ECT) has been hired by FDR and designated as the technical contractor for this project. As such, ECT will be responsible for writing the QAPP, ecological monitoring efforts conducted for this project as discussed in this QAPP, and oversight of sub-contractors hired to achieve project success for these tasks.

JJR has been hired by ECT and designated as the lead design team for this project. As such, JJR will be responsible for the collection of the topographic and bathymetric surveys, habitat restoration design, obtaining necessary permits, site assessment, and project oversight.

HRM has been hired by ECT to perform an assessment of the herpetofauna both pre-restoration and post-restoration.

Allen Chartier has been hired by ECT to conduct an assessment of the water birds in the project area both pre-restoration and post-restoration.

Birds Canada will conduct and coordinate volunteer workshops as part of the Education and Outreach task for the project. This will establish a local base of volunteer monitors who will be able to competently monitor amphibians and wetland bird species at the project site.

Somat Engineering (SOMAT) has been hired by JJR to conduct the geotechnical survey(s) for this project. As such, SOMAT will be responsible for soil borings, test pits, laboratory analysis, and all activities associated with those tasks.

Paragon Laboratories, Inc. (Paragon) has been hired by ECT to analyze the sediment samples to fulfill permit application requirements.

Roles and Responsibilities

Rosanne Ellison will serve as the focal point for programmatic and technical issues as the EPA GLNPO Project Officer (PO). Ms. Ellison will ensure that all contractual issues are addressed as work is performed on this task order according to EPA's programmatic terms and conditions. Ms. Ellison will be responsible for coordinating with the FDR Grant Manager and others to ensure technical quality throughout the project. Ms. Ellison will ensure that contract objectives are adhered to by reviewing all progress reports. Ms. Ellison will also review and approve the QAPP and final report.

Louis Blume is the EPA GLNPO Quality Assurance (QA) Manager. As such, Mr. Blume will supervise the review and approval of the QAPP on behalf of EPA GLNPO.

Charlie Bristol, P.E., BCEE, the FDR Grant and Project Manager, will work with the EPA GLNPO PO and all project partners to ensure that all project objectives are attained. As Grant Manager, Mr. Bristol will supervise activities conducted under the contract. Mr. Bristol will also review, approve, and submit the QAPP on behalf of FDR; provide biannual project summary reports to EPA; and will prepare the final project report.

John Bona, P.E., the ECT Project Manager, will coordinate all consultant activities with FDR. Mr. Bona will assure consistency and avoid duplicative efforts among project personnel. Mr. Bona will prepare all progress summary memorandums and budget materials and act as the primary consultant point of contact for FDR and the EPA. Mr. Bona will be responsible for the day to day operations and management of the project. As such, Mr. O'Meara will be responsible for coordination and oversight of the field investigations, design, permitting and construction.

Mark Mikesell, Ph.D., (ECT) the Project QA Manager will be responsible for QAPP review and approval on behalf of ECT. Dr. Mikesell will be available throughout the project to assist with any quality assurance reviews and/or audits.

Meghan Price, the ECT QA Manager is responsible for QAPP development as well as final QAPP dispersal.

Paul Evanoff, a Landscape Architect, is the Project Manager and Lead Designer for JJR. Mr. Evanoff will provide technical oversight and ensure all activities conducted by JJR will assist in attaining project goals. As lead designer, Mr. Evanoff will be responsible for developing grading plans, concept re-vegetation plans, recreation enhancements/modifications, bidding the project, and will be actively involved with construction administration.

Doug Denison, of JJR is a resources specialist and will work with the team during all phases of the work. Mr. Denison will attend progress meetings, assist in design input for habitat issues, coordinate agency and stakeholder input and assist in permitting and monitoring activities.

John Piatt, P.S., of JJR is responsible for performing the topographical survey as well as the bathymetric survey of the site. Mr. Piatt, a licensed surveyor, will perform the initial review of the data that is collected as part of those surveys and will provide a report of the findings.

Bernie Fekete, P.E., of JJR will serve as lead Civil Engineer and will provide technical assistance to the team throughout the design and construction phases of the work. Mr. Fekete will focus on site hydrology, soils evaluation, structural detailing, and quality assurance reviews. During construction, Mr. Fekete will provide engineering review associated with all structural improvements.

Carol Schulte, an environmental specialist/Horticulturist of JJR will provide permitting and technical assistance throughout the design and construction phases of the work. Carol will provide AutoCAD assistance to Mr. Fekete and Mr. Evanoff and will be responsible for the development of restoration and re-vegetation plans and specifications. Ms. Schulte will also take the lead role in preparing the Joint Permit application. During construction, she will provide construction administration support to Mr. Evanoff and Mr. Fekete, and will overview all aspects of planting and seeding.

Gary Crawford (ECT) will be the lead investigator in the ecological monitoring; will be responsible for guiding the data analysis and the preparation of summary reports to the ECT project manager and Grant Manager. Mr. Crawford will also aid in design review.

John Freeland, Ph.D. (ECT) will assist with the focused areas for wetland delineation, if necessary. Mr. Freeland will be responsible for wetland reconnaissance and mapping of the potentially affected area.

Marty Boote (ECT) will assist with the ecological monitoring portions of this project.

Tonya Hunter (ECT) will assist with the ecological monitoring portions of this project.

Martha Holzheuer (ECT) will assist with the ecological monitoring portions of this project.

Jason Bartholomew (ECT) will assist with the ecological monitoring portions of this project.

John O'Meara, P.E., of ECT will be available for design review, if needed.

Alice Bailey, P.E., of ECT will be available for design review, if needed.

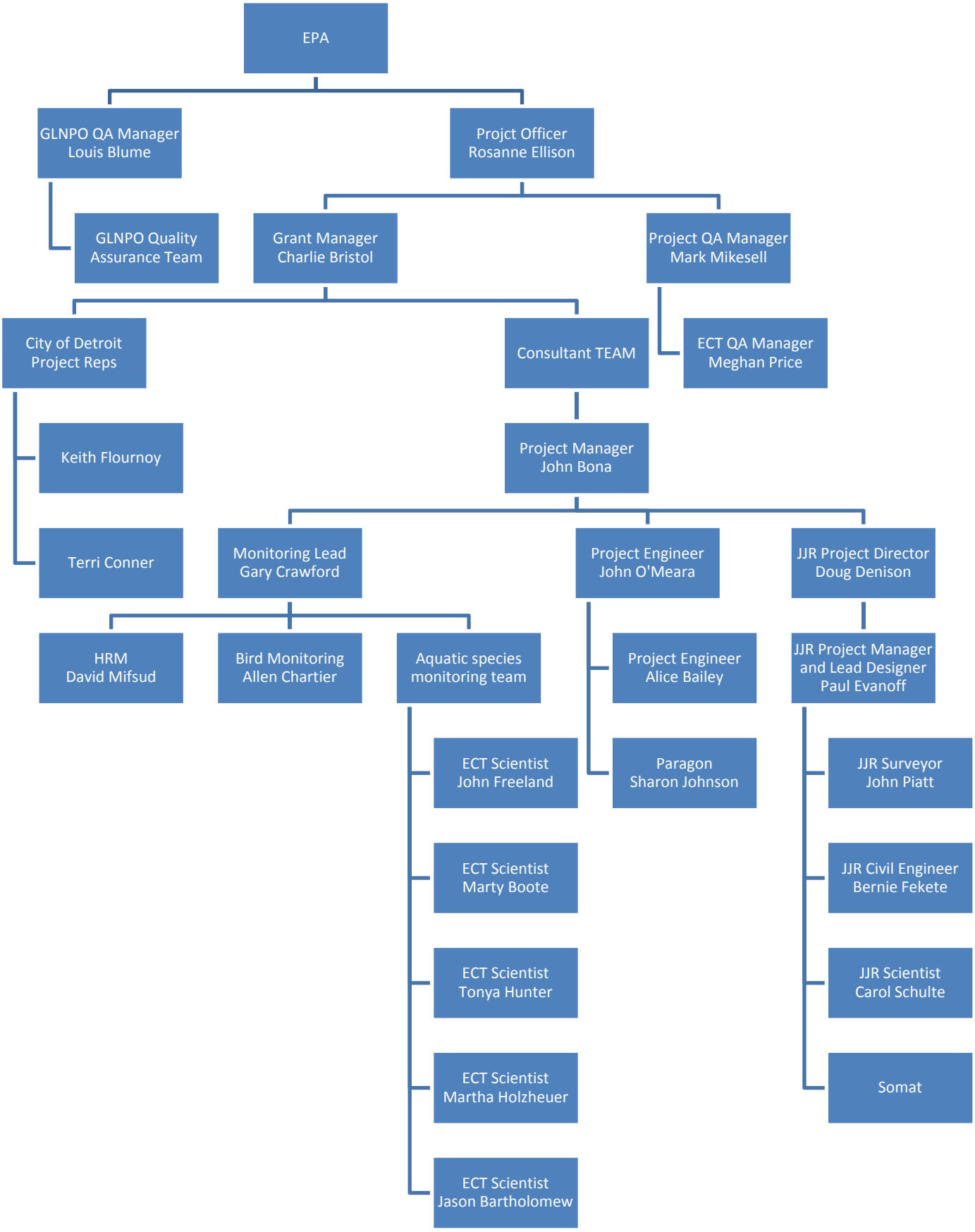
Keith Flournoy, will act as liaison for the DRD. Mr. Flournoy will review the designs and will assist with public involvement activities.

Terri Conner, of the City of Detroit will act as liaison for the DRD and will assist with public involvement activities that relate to the locations within the City of Detroit.

Sharon Johnson, the Senior Account Coordinator for Paragon will be the single point of contact for project personnel and the laboratory. She will also be responsible for communicating with the laboratory personnel responsible for sample handling and analysis and will perform the final QA check on the data before the report is delivered to ECT.

A project organization chart is displayed as Figure 1 – Project Organization Chart.

Figure 1 – Project Organization Chart



A.5 Problem Definition/Background

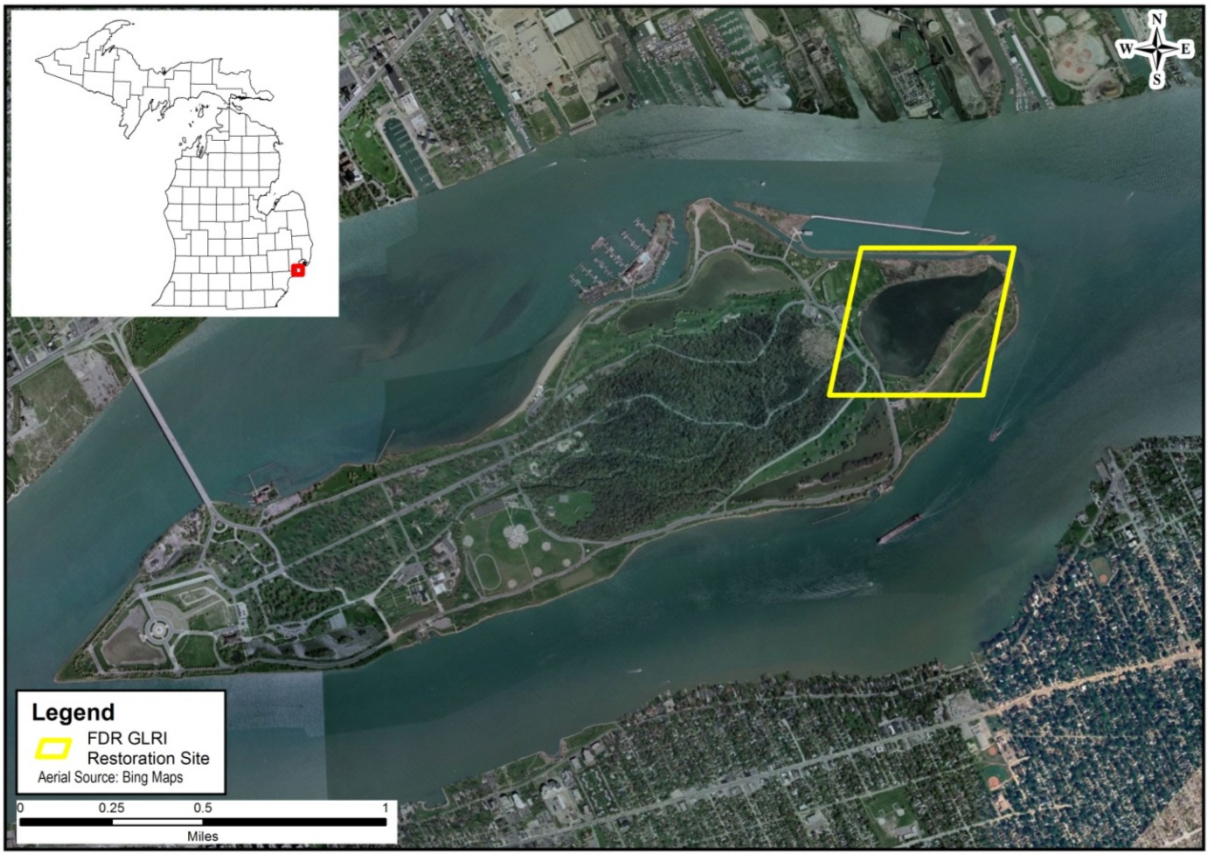
The Detroit River is a 32-mile international connecting channel linking Lake St. Clair and the upper Great Lakes to Lake Erie. The Detroit River Area of Concern (AOC) is a bi-national AOC that directly drains approximately 700 square miles of land in Michigan and Ontario, as well as the 107 square mile City of Detroit "sewershed." Most critically, the Detroit River carries flow from the entire watersheds of lakes Superior, Michigan, Huron and Lake St. Clair. The flow within the Detroit River averages about 180,000 cubic feet per second.

Eleven Beneficial Use Impairments (BUIs) have been identified in the Detroit River. Notable among these are loss of fish and wildlife habitat, degradation of fish and wildlife populations and degradation of benthos.

To address the BUIs affecting the Detroit River AOC, a delisting plan has been developed that includes a list of projects recommended as part of the criteria for delisting. This project was originally proposed under a study prepared in 2002 by the USGS titled: *Habitat Protection and Remediation – Detroit River.*

As shown in Figure 2 – Project Area, the Blue Heron Lagoon is a 41-acre artificial lake/wetland on Belle Isle that is connected to the Detroit River. Direct access for fish from the River to the Lagoon is prohibited by sheet pile walls, grates and drop structures. FDR will lead an interdisciplinary team to implement a key element in the habitat restoration plan for the Detroit River AOC. The project will reconnect and naturalize the mouth of the Lagoon to the Detroit River restoring fish access to Belle Isle wetlands, shallow and deep water habitat, and canals.

Figure 2 – Project Area



This project will restore habitats in the Detroit River AOC and lead to the delisting of the Loss of Fish and Wildlife Habitat related BUI.

Two BUIs relating to fish and wildlife have been identified in the Detroit River Area of Concern: Loss of Fish and Wildlife Habitat and Degradation of Fish and Wildlife Populations. In order to restore these beneficial uses, the project proposes to reconnect and naturalize the discharge of the Belle Isle's Blue Heron Lagoon to the Detroit River. In addition, the project will enhance five acres of coastal wetland specifically designed for fish rearing and nursery habitat. Remedial actions to clean up the Detroit River over the past 30 years have restored adequate conditions for reproduction and early life history survival by a large number of native fish species.

Adequate, suitable water and substrate quality now exist near Belle Isle for successful reproduction by 16 native fish species, including sturgeon, walleye, and lake whitefish. However, there is no suitable coastal wetland nursery habitat in the immediate area of the Belle Isle Sturgeon Spawning Reef or a recently identified spawning shoal just upstream. The success of the fish larvae once hatched is critical for their survival.

In 2003 the Blue Heron Lagoon Natural Area project included an inventory, analysis, design and implementation of enhancement to a nine-acre site located on the north side of the Blue Heron Lagoon. The project restored fragments of an existing lakeplain prairie complex with high species diversity and a well-developed structure. The project included a self-guided interpretive trail with signage, highlighting plants and fish and wildlife using the Blue Heron Lagoon, which will be enhanced to discuss the importance of the reconnection of Blue Heron Lagoon to the Detroit River ecosystem.

Belle Isle's location within several migratory flyways provides additional opportunity for wildlife benefit. According to *Belle Isle Bird Surveys – 2005*, (Chartier), 205 bird species were observed on Belle Isle. As of 2009, 241 species have been noted on the island (personal communication – Allen Chartier). However, evidence of breeding activity has been noted for only 63 of these species. Additional coastal marsh would provide opportunities for breeding by additional species such as blue-winged teal, sora, Virginia rail, and black-crowned night heron.

The island already has small populations of reptiles and amphibians that would also benefit from the restoration of coastal marsh; 17 species have been found there in recent years.

With the implementation of the various elements of the Master Plan, the City of Detroit Recreation Department is a strong partner and will be providing in-kind match in support of the project and are dedicated to having an active role in preserving and enhancing rare and valuable fish and wildlife habitat.

PROJECT MILESTONES

Significant conceptual design is complete for the restoration. Upon QAPP approval, data will be collected in order to modify and finalize the engineering design. The design, permitting and construction of the restoration site can be completed in an estimated 15 – 18 month time period. Final close out will complete the project at 34 months.

These tasks will be accomplished according to Table 1 – Milestone Schedule. These dates are to be considered approximate and are subject to change.

Table 1 – Milestone Schedule

Task	Start Date	Projected Completion Date
Draft QAPP	03/15/2011	04/22/2011
Final QAPP	05/13/2011	07/15/2011
Habitat Restoration		
Design	06/03/2011	11/30/2011
Permitting	07/29/2011	11/30/2011
Bidding	10/14/2011	03/20/2012
Construction	05/14/2012	05/17/2013
Monitoring (Pre Design)	05/24/2011	12/05/2011
Monitoring (Post Construction)	2/26/2013	8/12/2013
Final Project Report	08/12/2013	08/12/2013

A.6 Project/Task Description

The primary focus of the work at this site is to enhance fisheries habitat for spawning and fish rearing for targeted fish species in the Detroit River. There are 4 critical components to this project:

- *Costal Wetland Restoration:* Provide for up to 5 acres of new shallow and deep-water habitat within the existing 41 acre Blue Lagoon (lake) that will function as a nursery for targeted fish species. The lake is currently shallow, sterile and inaccessible to Detroit River fish species.
- *Channel Restoration/Naturalization*: Restore fish passage at the existing outlet to the river and create a second inlet/outlet through the existing peninsula at a location to be determined based on optimizing fish passage.
- *Spawning Reef Enhancements*: Expand upon the existing spawning shoal that exists immediately to the east (upstream) of project area with the intent on providing greater spawning habitat and increasing connectivity to the costal wetland and channel restoration identified above.
- *Existing Upland Recreation Amenity Restoration:* Replace impacted recreation resources that will be disturbed/altered due to the implementation of the above mentioned enhancements. A new pedestrian bridge will span the second channel, native landscape restoration will be completed and damaged asphalt trails will be replaced.

The proposed construction will require permits from both the US Army Corps of Engineers (USACE) and the MDEQ. A single "joint application" process can be followed for these permits. FDR has made preliminary contact with the USACE and received initial support for the effort. JJR will continue interaction with these agencies, complete required permit applications, and obtain permits required prior to construction.

Phases of the Work:

- Design Phase – The design phase will include a number of project deliverables including; meetings and stakeholder coordination, design alternatives, estimation and the preparation and assembly of construction

plans and technical specifications that when combined will provide the basis for bidding and constructing the project.

- Construction Bidding - It is anticipated that all 4 Tasks identified below will be publicly advertised for contractor quotations as one contract for construction. The documents prepared under the Design Phase will become the basis for construction bidding and will be augmented with Federal, State and City bidding requirements. The project team will hold a pre-construction meeting with potential contractors to explain the details and provide clarification to work needed to be performed. Questions and clarification in the form of addenda will be provided as needed. Contractor bids will be opened publicly at a specified time and a review of the proposed bids will follow. At which time the lowest responsible contractor would be chosen to complete the work.
- Construction Oversight – This work effort will consist of field engineering, progress meetings, oversight inspections, field ecology, contractor coordination, contract documents clarification, change order/work directives, record drawings and progress meetings.
- Contract Administration – work activities to manage payment reviews, review submittals, and other relevant contract documentation, and the project close out.

Table 2 – Project Schedule

Task Name	Duration (week days)	Start Date	End Date
Blue Heron Lagoon Habitat Restoration Project	770	10/12/2010	9/23/2013
Task 1 – Project Initiation	170	10/12/2010	6/6/2011
Prepare Project Startup	30	10/12/2010	11/22/2010
Conduct Design Workshop	10	5/24/2011	6/6/2011
Task 2 – Biological Assessment	300	5/24/2011	9/23/2013
Define Sampling Locations	10	5/24/2011	6/6/2011
Collect Available Information	10	6/7/2011	6/20/2011
Monitor Biological Community (PRE)	90	6/7/2011	10/10/2011
Prepare DRAFT Pre-Restoration Report	30	10/11/2011	11/21/2011
Prepare FINAL Pre-Restoration Report	10	11/22/2011	12/5/2011
Re-Evaluate Monitoring Locations	30	2/26/2013	4/8/2013
Monitor Biological Community (POST)	90	4/9/2013	8/12/2013
Prepare DRAFT Post-Restoration Report	30	8/13/2013	9/23/2013
Prepare FINAL Post-Restoration Report	10	9/23/2013	10/15/2013
Task 3 – Habitat Design	213	2/7/2011	11/30/2011
Develop 50% Design	27	6/3/2011	7/11/2011
Design Review	24	7/11/2011	8/11/2011
Joint Permit	89	7/29/2011	11/30/2011
100% Design	45	8/15/2011	10/14/2011
Develop Bid Documents	23	10/31/2011	11/30/2011
Task 4 – Project Construction	265	5/14/2012	5/17/2013
Task 5 – Outreach and Education	60	11/23/2010	2/14/2011
Define Outreach Program	30	11/23/2010	1/3/2011
Prepare Outreach Materials	30	1/4/2011	2/14/2011
Task 6 – Project Management	701	12/6/2010	8/12/2013
Reporting	701	12/6/2010	8/12/2013
GLAS Updates (Quarterly)	455	12/6/2010	8/31/2013
Progress Report #1 (Bi-Annual)	20	4/4/2011	4/29/2011

Task Name	Duration (week days)	Start Date	End Date
Progress Report #2	20	10/3/2011	10/28/2011
Progress Report #3	20	4/3/2012	4/30/2012
Progress Report #4	20	10/3/2012	10/30/2012
FINAL REPORT	0	8/12/2013	8/12/2013
MBE/WBE Report #1 (Bi-Annual)	20	4/4/2011	4/29/2011
Quality Management (QAPP)	90	03/15/2011	7/15/2011
Conduct Bid Process	113	10/14/2011	3/20/2012
Pre-Advertise Contractor	23	10/14/2011	11/15/2011
Advertise BHL Project	33	1/2/2012	2/15/2012
Select Contractor	25	2/15/2012	3/20/2012

Task 1. Project Initiation and Stakeholder Coordination

The purpose of this task is establish open lines of communication between various interests, define the project activities, obtain input into the design, complete the schedule for design and construction and to establish a format for reporting work progress. FDR will initiate a series of meetings with the EPA, State, City of Detroit, technical representatives and stakeholders to solicit input for the development of the final Project Management Plan. This task is also intended to establish open lines of communication with interested technical experts during the design and bidding phase of the project. As the project moves through the design process, up to three technical milestone meetings will be conducted. Key technical experts may include; MDEQ, MDNR, United States Geological Survey (USGS), EPA, City of Detroit Recreation staff, organizations that have expertise in biological inventory and habitat restoration, and public outreach experts.

The following meetings are anticipated:

- Pre-application joint meeting between the USACE, MDEQ and the project team.
- Design workshop to be attended by technical advisory group and critical stakeholders.
- Public meeting to present the plans to and obtain input from interested citizens and park users.

In addition, monthly progress meetings coordinated by FDR and other team members will be included.

Task 2. Ecological Monitoring

Monitoring will be conducted of the fishes, waterbirds, amphibians, reptiles, and aquatic habitat within the project area both before and after construction is complete. The goal of ecological monitoring is to determine if reconnection of the Blue Heron Lagoon will provide spawning, nursery and refuge habitat for fish and wildlife species within the Detroit River, and lead to delisting of the Loss of Fish and Wildlife Habitat BUI. This project directly relates to Goal 1 of and 5 Focus Area 4 of the GLRI by 1) restoring aquatic and terrestrial habitats to improve conditions for native fish and 2) conversion of industrial shoreline into an area suitable for fish spawning, nursery and refuge habitat. Routine monitoring should provide the information necessary to fulfill the following two objectives:

1. To verify that the project was implemented as designed and approved.
2. To determine if the project is biologically effective.

The target species for this work include: Fish: Northern Pike, Smallmouth Bass, Rock Bass, Yellow Perch, Walleye, Spotfin Shiner, Emerald Shiner, Channel Catfish, White Sucker, Quillback, Gizzard Shad, Log Perch, and Trout

Perch. Amphibians: Mud Puppy, Map Turtle, Northern Water Snake and Spiney Softshell Turtle. Birds: American Coot, Belted Kingfisher, Greater and Lesser Yellowlegs, Semi-palmated Plover, Spotted Sandpiper, and Dunlin.

Monitoring is covered in additional detail section B of this document. The ECT SOPs that pertain to this task are included in Appendix D. The field forms for the monitoring work, created by the U.S. Fish & Wildlife Service (USFWS), are included in Appendix E.

As shown in Table 2 – Project Schedule, it is anticipated that the activities associated with this task will begin upon QAPP approval and will be completed by August 12, 2013 (not including the creation of the final monitoring report).

Task 3. Habitat Design

The Blue Heron Lagoon habitat restoration proposes to reconnect and naturalize the mouth of the Lagoon to the Detroit River restoring fish access to over 41 acres of wetlands (shallow and deep water habitats). This task will design a diverse wetland habitat consisting of shallow water submerged island, upland islands for terrestrial species, and deep water habitat for fish access during spawning.

Coastal Restoration, Channel Restoration and Naturalization, Spawning Reef Enhancements, and the Restoration of the Existing Upland Recreation Amenities will be included in the designs.

Sub-task 3.1: Coastal Restoration Design – Based on the results of the geotechnical and topographic surveys, the most cost effective methods for excavating, transporting and placing the site soils will be determined. It is also anticipated that excavation and fill will balance and there will be no off-site disposal. Where necessary and feasible, off-site topsoil will be spread on islands constructed above the water elevation of the lagoon. The plant species composition will be based on the pre-settlement vegetation found in the Detroit River eco-region and what critical plant communities need of preservation in the area.

Sub-task 3.2: Channel Restoration/Naturalization Design – Fish passage between the Costal Wetland Restoration (sub-task 3.1) and Spawning Reef Restoration (sub-task 3.2) are necessary to ensure access to the new wetlands. The existing channel will be surveyed to verify actual water depths and channel width against desired criteria. Designs will be created to demonstrate the desired criteria, and construction specifications will be created to show what needs to be done to achieve the new criteria. Designs will also be created showing modifications to the existing (abandoned) pump station to remove any fish passage obstructions. A second channel will be designed (at a location to be determined after the surveys are conducted) to provide greater fish passage opportunities to the new wetlands. Location criteria will consider currents in the Detroit River and lake, depth of river water and lake, substrate and proximity to spawning shoals. Once determined the new channel designs will demonstrate the required length, width and depth to be excavated.

Sub-task 3.3: Spawning Reef Enhancement Design – Under this task, the existing spawning shoal situated just upriver from the Costal Wetland Restoration site in the Detroit River, will be enhanced to increase spawning capacity and ensure greater opportunities for newly hatched fish species to locate and seek shelter in the wetland restored under sub-task 3.1 above. This substrate enhancement will provide spawning sites for walleye, suckers and whitefish, etc. over a 1-2 acre area. Working closely with the USGS team, the final location of the shoal enhancement, its aerial extent and size and depth of the stone will be identified. Rock will be sized to withstand currents and will be installed at appropriate depths in response to navigation concerns and ice movement.

Sub-task 3.4: Existing Upland Recreation Amenity Restoration – Under this sub-task designs will be created for the existing park features impacted during construction sub-tasks 4.1, 4.2 and 4.3. It is anticipated that features that will be impacted include:

- Asphalt and gravel foot paths: The existing trail system surrounds the lagoon and provides pedestrian and maintenance vehicle access to this eastern-most tip of the park. Construction equipment used to excavate soils, place riprap, complete demolition, install footings for the new footbridge and new channel will damage these surfaces. If needed, designs will be created to match existing path cross sections.
- New footbridge and existing footbridge modifications: A second footbridge will be necessary once the new channel for fish passage to the wetland is constructed. It is anticipated that the same design as the existing footbridge (including span and footing requirements) will be utilized to maintain design continuity and minimize long-term maintenance costs.
- Modifications to the abandoned pump station: As a cost saving measure, the existing concrete and steel pump station materials will be left in place and only those features that impact the new channel cross section will be removed. Where possible, the design will call for the removal of existing features flush with the ground in lieu of full removal. The banks of the existing channel my require reshaping for slope stabilization and habitat enhancements but will be limited to a narrow band of upland on both sides of the channel as to not disturb the existing footbridge foundations.
- Site restoration – seeding and plantings: It is anticipated that contractor staging, access, haul roads and material lay down areas will result in vegetation removals, turf and native vegetation impacts, soil compaction, and removal of riparian vegetation. In the design process, these impact zones will be kept to a minimum. In addition, upland habitat restoration associated with the establishment of expanded riparian vegetation along the banks of the new channels and wetland habitat will be identified and prioritized.

The work activities that will be considered part of task 3 (including all sub-tasks) include:

- General Site Assessment visits;
- Literature search including all previously completed studies that are applicable to the scope of work, and Michigan Natural Features Inventory (MNFI) and USFWS database search for the presence of threatened or endangered (t/e) species in the site area;
- Topographical survey;
- Bathymetric survey;
- Geotechnical survey;
- Ongoing site investigations by interested stakeholders (if necessary) for t/e species as listed on MNFI database results;
- Preparation of site plan documents and specifications describing:
    - Site removals,
    - Soil erosion and sedimentation controls,
    - Footbridge details and cross sections,
    - Shoreline/bank stabilization measures,
    - Trail details,
    - Contractor staging areas,
    - Grading plans and critical details and cross sections,
    - Re-vegetation (including soil compaction issues, planting, and seeding),
    - Estimating, and
    - Schedule, construction phasing.

As shown in Table 2 – Project Schedule, it is anticipated that the activities associated with this task will begin upon QAPP approval and will be completed in November of 2011.

Task 4. Project Construction

All construction activities will be performed according to the site plans created during Task 3: Habitat Design. There will be four separate focus areas for both the design and construction activities. The construction activities for each area are described below.

Sub-task 4.1: Coastal Restoration – The primary work activities will include excavation and placement of soils extracted from the lagoon bottom. The excavated soils will be placed and shaped to the configurations identified on the plans and stabilized with native aquatic plant species (tubers and root stock) and native seed species on exposed islands, as well as other miscellaneous improvements associated with the earthwork and re-vegetation. Where necessary and feasible, off-site topsoil will be spread on islands constructed above the water elevation of the lagoon. These same islands will also receive riprap along the perimeter of each island at the water level to prevent erosion due to wave action and burrowing mammals. Goose deterrents will be designed and installed around the perimeter of the aquatic planting to aid in plant establishment.

Sub-task 4.2: Channel Restoration/Naturalizing – Fish passage between the Costal wetland Restoration and Spawning Reef Restoration are necessary to ensure access to the new wetlands. Under this task, the existing channel will be improved and a second channel will be constructed. Based on the designs from Task 3, the existing channel will be modified to meet these new criteria. In addition, modifications to the existing (abandoned) pump station will occur to remove any fish passage obstructions. The channel substrate will also be modified to enhance fish passage opportunities. A second channel will be constructed at a location to be determined to provide greater fish passage opportunities to the new wetlands. The new channel will be excavated to the required length, width and depth, the substrate and banks will be enhanced to maximize habitat. Soils excavated for the channel will be disposed on site and used to create naturalistic land forms.

Sub-task 4.3: Spawning Shoal Enhancements – Under this task, the existing spawning shoal situated just upriver from the Costal Wetland Restoration site in the Detroit River, will be enhanced to increase spawning capacity and ensure greater opportunities for newly hatched fish species to locate and seek shelter in the wetland restored as described above. This substrate enhancement will provide spawning sites for walleye, suckers and whitefish, etc. over a 1-2 acre area.

It is anticipated that this work will include placement of stone under the same contract for construction as the other Belle Isle construction tasks. No soils will be excavated and the stone will be placed directly onto the river bottom via barge.

Sub-task 4.4: Existing Upland Recreation Amenity Restoration – Under this task the existing park features impacted during construction of sub-tasks 4.1, 4.2 and 4.3 will be restored. It is anticipated that features that will be impacted include:

- Asphalt and gravel foot paths: The existing trail system surrounds the lagoon and provides pedestrian and maintenance vehicle access to this eastern-most tip of the park. Construction equipment used to excavate soils, place riprap, complete demolition, install footings for the new footbridge and new channel will damage these surfaces. Materials will be replaced to match existing path cross sections.
- New footbridge and existing footbridge modifications: A second footbridge will be necessary once the new channel for fish passage to the wetland is constructed. It is anticipated that the same design as the existing footbridge – including span and footing requirements will be utilized to maintain design continuity and minimize long-term maintenance costs. The existing footbridge may require temporary removal and reinstallation to facilitate site improvements associated with the improvements to the

existing channel and modifications to the abandoned pump station. It is anticipated that path impacts will be minimal and bridge foundations will remain in place.

- Modifications to the abandoned pump station: As a cost saving measure, the existing concrete and steel pump station materials will be left in place and only those features that impact the new channel cross section will be removed. Where possible, existing features will be removed flush with the ground in lieu of full removal. The banks of the existing channel my require reshaping for slope stabilization and habitat enhancements but will be limited to a narrow band of upland on both sides of the channel as to not disturb the existing footbridge foundations. All demolition debris – excluding soil, will be removed from the site and disposed at a regional landfill.
- Shaping of excavated site soils: Surplus soils excavated for the site under tasks 4.2 and 4.3 will be transported to a location in the immediate vicinity of the site as directed by Park personnel. This soil will be aesthetically graded to create naturalistic landforms and will be graded to drain. The features will be covered with off-site topsoil and seeded as described below.
- Site restoration – seeding and plantings: It is anticipated that contractor staging, access, haul roads and material lay down areas will result in vegetation removals, turf and native vegetation impacts, soil compaction, and removal of riparian vegetation. These impact zones will be kept to a minimum. In addition, upland habitat restoration associated with the establishment of expanded riparian vegetation along the banks of the new channels and wetland habitat will be identified and prioritized.

The work activities that will be performed in the construction task include:

- General Site Assessment visits;
- Site removals,
- Soil erosion and sedimentation controls,
- Establishment of contractor staging areas,
- Substrate modifications,
- Re-vegetation (including soil compaction issues, planting, and seeding),
- Schedule construction phasing,
- Place stone vial barge mounted construction equipment,
- Procure supplies and materials,
- Complete the earthwork process,
- Complete the substrate modifications,
- Finish upland restoration,
- Provide as-built elevation of the expanded habitat shoal for navigation purposes, and
- Provide complete documentation that will include post-construction reviews.

Data collected under this task may include pre-restoration, during restoration, and post-restoration photographs.

As shown earlier in Table 2 – Project Schedule, it is anticipated that the activities associated with this task will begin in May of 2012 and will be completed in May of 2013.

Task 5. Project Outreach and Education

Under this task, FDR will work closely with our project partner, Detroit Recreation Department (DRD), to design and implement a community outreach and education program. The DRD will take the lead on this task and will integrate existing programs from the following organizations that are currently involved in Belle Isle.

- The Belle Isle Nature Zoo, an outpost of the Detroit Zoological Institute, has an annual attendance of over 60,000 people.
- The Stewardship Network is a grassroots cooperative organization working to protect, restore, and manage Michigan's natural lands and waters.
- The Friends of Belle Isle is a voluntary organization which promotes the preservation of natural beauty, restoration and preservation of Belle Isle's historical sites, and the adaptive use of existing structures on the island for the enjoyment and use by all people.
- Bird Studies Canada's Marsh Monitoring Program (MMP) is a long-term, Great Lakes basin-wide marsh amphibian and bird monitoring program, employing the skills and dedication of hundreds of Citizen Scientist volunteer participants.
- Michigan Sea Grant provides up to date educational programs and information to help keep these waterfront environments sustainable into the future.
- MSU Extension's 4-H Natural Resources and Environmental Education program provides outdoor and environmental outreach programs that are designed to enhance the quality of life for children, youth, and families.
- The Student Conservation Association provides college and high school-aged members with hands-on conservation service opportunities: building trails, restoring river and lakefront environments, and conserving habitats.

As part of the public education and outreach component of the Blue Heron Lagoon Restoration Project, Bird Studies Canada will conduct two Marsh Monitoring Program (MMP) volunteer workshops to establish a local base of volunteer monitors who will be able to competently monitor amphibians and wetland bird species. Two workshops will be held as follows:

Session I
The first session will be held late winter or early spring to correspond with the beginning of the amphibian monitoring season. The session will consist of a Powerpoint presentation and outdoor instruction to prepare monitors for collecting amphibian data according to standard protocols. These protocols can be found in Appendix A.

Session II
The spring session is scheduled to correspond with the beginning of the bird monitoring season. The session demonstrates standard bird survey and data collection procedures.

The two sessions will prepare the volunteer monitors with the framework, techniques, and data recording materials necessary to identify, choose, and utilize one or more monitoring stations to record presence of bird and amphibian species, abundance, and diversity.

The following three MMP publications are included in Appendix A:

1. *Marsh Monitoring Program Participant's Handbook*, 2009.
2. *Marsh Monitoring Program Participant's Handbook for Surveying Amphibians*, Revised 2008.
3. *Marsh Monitoring Program Participant's Handbook for Surveying Marsh Birds*, Revised 2008.

This task will include the development of a public outreach/education plan, and the implementation of that plan, which may include flyers, signage, articles, workshop materials, and presentations.

Task 6. Project Management

This task provides project management services to the project. The FDR has assigned Charlie Bristol, P.E., an experienced project manager, to oversee and manage this project. Project Management activities under this project include:

- Contract administration – work activities to manage payment reviews, contract documentation, and the project close out.
- Monthly project team meetings to discuss project activities, schedule and budget. These meetings will help to identify schedule and budget impacts with sufficient time to address the issues with the EPA PO.
- Using Microsoft Project, update project schedule as necessary to include progress and changes.
- Prepare and submit biannual progress reports to the EPA.

This task also includes the development of the Quality System Documentation required by EPA, which includes this QAPP. The QAPP describes the monitoring and observations that will be undertaken during the project duration. The QAPP identifies project management objectives, measurement and data acquisition methods and procedures, assessment and oversight responsibilities, and data validation and usability.

The activities associated with this task are ongoing, and will be conducted throughout the project.

A.7 Quality Objectives & Criteria

The primary objective of this project is to make a hydrologic connection of the Blue Heron Lagoon with the Detroit River in such a way that allows fish passage. To achieve this objective, several types of data will need to be collected of an acceptable quality to properly design a site plan for restoration sturdy enough to withstand the various forces of the Detroit River thus supplying habitat for aquatic species and to determine the change in ecological conditions within the restoration site after the construction of the additional habitat is complete. Surveys (topographical, bathymetric, and geotechnical) of the area will be conducted prior to the design phase. Additionally, ecological monitoring of select species will be conducted within the project area. The site selection and methods of monitoring are discussed further in Section B.

The table below describes each data set that will be collected as part of this project, the task for which the data is collected and the intended use of the data.

Table 3 – Intended Use of Each Data Set

Intended use	Task(s)	Data Set	Agency
Management decisions	2, 3, 5	General Site Assessment	JJR
	2, 3	Topographic Survey	JJR
	2, 3	Bathymetric Survey	JJR
	2, 3	Geotechnical Survey	Somat
	2, 3	Sediment Chemistry	ECT and Paragon
	2, 3, 4, 5	Design	JJR
	8	Ecological Monitoring	
	8	*Fish monitoring*	ECT
	8	*Aquatic Habitat Assessment*	ECT
	8	*Water Chemistry Sampling*	ECT
	8	*Aquatic Macrophyte Sampling*	ECT
Project efficacy	8	Ecological Monitoring	

Intended use	Task(s)	Data Set	Agency
	8	*Fish monitoring*	ECT
	8	*Aquatic Habitat Assessment*	ECT
	8	*Water Chemistry Sampling*	ECT
	8	*Aquatic Macrophyte Sampling*	ECT
	8	*Herpetofauna Monitoring*	HRM
	8	*Waterfowl Monitoring*	Allen Chartier
	8	*Velocity Measurements*	ECT

As shown in Table 3 – Intended Use of Each Data Set, some data will be collected for informational purposes only. The project personnel recognize that there may be a future use of this data. Therefore, procedures for that data is covered in detail in SECTION B – DATA GENERATION & AQCUISITION. However, as this section requires additional information on the QA for data collected to make management decisions, only data that will be used to make management decisions for this project are covered here.

A mixture of laboratory and field variables may affect data quality. The variables include sample matrix variability, sample collection/handling procedures and equipment, sample analysis techniques and record keeping. To control these variables, the Data Quality Objective (DQO) process is used. The DQOs for the data sets collected for this project are outlined in Table 4 – Data Quality Objectives.

Table 4 – Data Quality Objectives

Intended Use	Task	Data Set	DQO
Design & Management Decisions	2, 3, 4	Geotechnical Survey	Determine with greater than 90% confidence that the substrate used in design will not slough off into adjacent lagoon areas.
	2, 4	Topographic Survey	Determine with greater than 95% confidence the existing land contours of the site.
	3, 4	Bathymetric Survey	Determine with greater than 95% confidence the existing under water contours of the site.
	3	Sediment Chemistry	Obtain data acceptable to the State of Michigan and the USACE in order to obtain the permits needed for the project.
	3, 4, 7	Ecological Monitoring	Determine with greater than 90% confidence the species that will likely utilize the new habitat, and thus allow the designs to be catered to those species.

Data Quality Indicators (DQIs) developed for this project specifies discrete parameters in six areas: Precision, Accuracy, Representativeness, Comparability, Completeness and Sensitivity (PARCCS). The DQOs and resulting PARCCS parameters will require that the sampling/data collection will be performed using standard methods with properly operated and calibrated equipment, and conducted by trained personnel.

A brief description of each of these parameters is presented below, along with the formulas for calculation of precision, accuracy and completeness for the scheduled analyses. Precision and completeness are expressed and evaluated quantitatively. Representativeness, accuracy, comparability and sensitivity are more subjective in nature and are addressed in both quantitative and qualitative terms. The primary QA objective is to measure the quantity of target parameters in each sample without unacceptable bias. Table 5 – Data Quality Indicators and Assessment Methods summarizes the DQIs for each measurement for the project.

Precision

Precision is determined as a measurement of the closeness of individual test results under prescribed conditions, and reflects a combination of random and systematic error, as well as natural variation within a specific matrix. Only data generated within the required precision criteria will be deemed usable. However, the ECT and JJR Project Managers, prior to rejecting data as unusable, will closely evaluate the data collection process for potential interference and its effects on the results.

The precision of measured data is affected by natural variability in the sampling matrix as well as sampling factors. Field precision or the ability of the sampling team to collect two samples with a high degree of similarity, may also be assessed by the collection of field duplicate QC samples. Field duplicate samples are collected from the same location, at the same time, using the same sampling method, and independently analyzed in the same manner. For the purposes of this project, the "same location" will be relative based on stream conditions.

Field duplicate samples will be collected for the geotechnical survey of the soils and GPS data point collection. The duplication of soil samples is difficult due to the non-homogeneous nature of soils. Therefore, the relative percent difference (RPD) of +/- 50% will be used. Duplicate GPS data points will be collected by nesting a second point, using the same sample ID, followed by a "D". The point will be collected consecutively, without changing location. The location of that point (for points collected on land) should be within 1 meter of the original location, and within 3 meters (for points collected on boat) of the original location as measured in ArcView2010. These duplicate measurements will occur once every 20 samples/data points.

Duplicate measurements for the visual aquatic habitat assessment will occur at least once per monitoring day.

Typically a matrix spike/matrix spike duplicate would be used to measure laboratory precision. This would not be appropriate for the analyses being performed for this project. Therefore, laboratory precision will follow the methodologies included in SOMAT's Laboratory Quality Manual, *AASHTO R18 Quality Manual,* which is available upon request.

Topographic survey data collected in the field passes a quality control review and redundancy check. This includes multiple collection of distinguishable features from adjacent project setups of thirty percent (30%) of project data, review of benchmark information and analysis of all raw data line by line. This allows one hundred percent (100%) review of raw data based on field book entries and other notes prior to import into AutoCAD. The overall data precision of unadjusted measurement must be within the overall project tolerance of plus or minus 0.10 feet.

Bathymetric survey data collected in the field passes a quality control review and redundancy check. This includes redundant water level measure during the course of field collection, review of bottom sounding profile as related to floating debris and other false returns, and the review of later data collection lines versus the primary data collection lines, offering a thirty percent (30%) redundancy check of unadjusted observations. The combined methodology and data checks allow a one hundred percent (100%) confidence of all data being processed into AutoCAD and used for calculation and preparation of final deliverables. The overall data precision of unadjusted measurement must be within the overall project tolerance of plus or minus 0.10 feet.

Accuracy

Accuracy measures the bias in a measurement system. Accuracy applies to the fish sampling. The fish sampling plan has been designed to reduce bias by using randomized sampling. More details on the ecological monitoring can be found in the monitoring plan and procedures in Appendices D, E, and F.

Typically, a blank sample would suffice in measuring the accuracy of a given parameter (both for field measurements and laboratory measurements). A blank sample would not be appropriate for the analyses being performed for this project. Therefore, laboratory accuracy will be confirmed by SOMAT staff by equipment calibration. The records and certificates of calibration are in SOMAT's *Equipment Calibration Manual,* which is available upon request.

Representativeness

Representativeness is an expression of the extent to which measured data accurately represents actual conditions. The objective of this sampling effort is to collect samples that accurately represent conditions in the field. The careful design of the sampling plan is of paramount importance in ensuring that the data are representative of prevailing conditions. The sampling plan specifies the number and location of samples to be collected and the method and equipment used to collect samples.

The key factors considered in the design of the sampling plan included: (1), providing a sufficient number of samples, and (2) sufficient spatial distribution of samples to ensure that the target area is covered.

Finally, representativeness is dependent on using appropriate sample collection, handling, and evaluation procedures. These procedures are described in Section B and in more detail in the attached SOPs in the appendices. The QA goal is to have all samples and measurements representative of the media sampled.

Representativeness of laboratory data cannot be quantified. However, adherence to the prescribed analytical methods and procedures will ensure that the laboratory data is representative.

Completeness

Every effort will be made to obtain valid data for each sampling point at each monitoring visit. Completeness will be measured by dividing the number of planned usable sample results to the total number of sample results. The completeness objective for this project is for 90% of the planned data to be usable (samples collected and analyses generated within the established control limits for precision and accuracy). Completeness is calculated as:

$$\%C = (V/T) * 100\%$$

Where:
V = Number of measurements judged valid
T = Total number of samples analyzed

Comparability

There are no existing data of the type that will be collected to which the data can be compared. Fish community data is available for other portions of the Detroit River. That knowledge will be used to evaluate fish survey data and make judgments about whether or not the fish survey represents the expected fish community sufficiently.

In order to maximize the degree of comparability of data generated for this project with previous sampling and analysis program results, sample collection methods will be conducted in accord with specified standard methods and protocol. The object is to facilitate observations and conclusions that can be directly compared with historical and/or available background data.

Sensitivity

Sensitivity is a term broadly applied to the minimum detection capabilities of the specified methods of analysis and instruments used to conduct the scheduled analyses. All fish sampling equipment has inherent bias toward species and/or size of fish. Fish community monitoring will be conducted using electrical current applied to the water body

using a boom-shocker attached to a boat. This device is most versatile and effective in the type of review environment being sampled. It is critical to use an appropriate electrical current output and effort (time) in order to maximize effectiveness while not causing tissue damage, undue stress, or prolonged recovery. Too low of current will allow too many fish to escape capture, while too high of current will cause unnecessary stress, tissue damage, mortality, and prolonged recovery times. The electro-fishing gear will be setup and operated under field conditions within a neutral reach of the river not planned for sampling to evaluate effectiveness. Current output will be adjusted until desired results are achieved. The current output achieved will be held constant throughout all fish sampling thereafter. Therefore, this will be conducted according to the methods outlined in Section B to ensure proper sensitivity to obtain accurate and repeatable results.

Table 5 – Data Quality Indicators and Assessment Methods

Measurement	Unit	Precision/Accuracy	Frequency of re-measurement	Assessment method
Topographic Survey	ft	± 0.10 ft	30% of data	Evaluation of field data as it is collected.
Bathymetric Survey	ft	± 0.10 ft	30% of data	Evaluation of field data as it is collected.
Geotechnical Survey – soils	various	< 50% RPD	At least 5% of samples	Duplicate laboratory analysis
Geotechnical Survey – GPS	m	± 1 m for points on land ± 3 m for points on water	At least 1% of sample points	Comparison in software program.
Sediment Chemistry	Various	< 50% RPD	1 during the project period	Duplicate laboratory analysis
Fish Id	Individual Organism	All captured fish correctly identified to species	Not applicable.	Not applicable. Consistent team members and multiple events.
Fish Count	Number of Individuals	100%	All counts will be duplicated	Duplicate count in situ on all counted fish.
Fish length	mm	± 2mm	5%	Duplicate measurement in situ.
Aquatic Habitat	Qualitative Description of sediment type, structure, %cover	90% accuracy	1 per monitoring day.	Duplicate measurement in situ between two different field personnel.
Macrophyte % Cover	Percent Coverage, % area for distribution	All specimens identified to genus with positive taxanomic confirmation for 100% of samples	Not applicable.	Not applicable. Consistent team members and multiple events.
Macrophyte Id	Individual Organism	All specimens identified to genus with positive taxanomic confirmation for 100% of samples	Not applicable.	Not applicable. Consistent team members and multiple events.
Herpetofauna	Individual Organism	90% of specimens identified to species. All of the specimens identified will be done so correctly.	Not applicable.	Not applicable. Consistent team members and multiple events.
Waterfowl	Individual Organism	90% of specimens identified to species. All of the specimens identified will be done so correctly.	Not applicable.	Not applicable. Consistent team members and multiple events.

Measurement	Unit	Precision/Accuracy	Frequency of re-measurement	Assessment method
Water velocity	m/sec	± 0.5 m/sec, <20% RPD	1 per monitoring event.	Duplicate measurement in situ between field and duplicate readings.
Dissolved oxygen	mg/L	± 0.5 mg/L, <20% RPD	1 per monitoring event.	Duplicate measurement in situ between field and duplicate readings.
Temperature	˚C	±1.0˚C, <10% RPD	1 per monitoring event.	Duplicate measurement in situ between field and duplicate readings.
Water transparency: Secchi disk	m	± 0.1 m, < 20% RPD	1 per monitoring event.	Duplicate measurement in situ between two different readers.

Additional information on data analysis can be found in SECTION D – DATA VALIDATION AND USABILITY.

A.8 Special Training/Certification

All survey work shall be performed by licensed surveyors. Boater's safety certification is required for the operator of the boats used throughout the project. All individuals responsible for the completion of this work have received appropriate training in surveying and/or ecological sampling. Only individuals trained and experienced in the use of applicable sampling equipment shall use or supervise the use of such equipment. SOMAT laboratory has certifications associated with the methods being used for this project. Additionally, individuals selected to be team members have received appropriate health and safety training that is typical for environmental professionals.

A.9 Documents and Records

Survey information will be recorded in field logs or on sample collection data sheets, as appropriate. Fish survey and stream habitat mapping data will be recorded on the field forms in Appendices E and F, respectively. Any field notes (logs, data sheets, forms, etc.) are completed on-site at the time measurement occurs. Project staff shall retain field notes and all records of field activity for five years following completion of the project. Additionally, all field records will be submitted to EPA with the final report. Deliverables for all surveys will be submitted to the project manager both electronically and in hard copy.

Paragon will submit an electronic laboratory report via e-mail to the ECT contact provided on the sample chain of custody (COC). This report will be in PDF format.

ECT will prepare data collection summary memorandums that will address task and subtask milestones, deliverables, adherence to schedule, a summary of the QA/QC review of the data, and financial progression at the end of each monitoring event while the task order for this project is open. The only exception to this will be for data collected during the final planned monitoring event. This information will be submitted separately as a summary report, and will not be included in the final report, as the monitoring will be conducted after the final report has been submitted.

FDR will maintain a project file, which will act as a repository for all field notes, sampling data, and any additional information used in the completion of this project. This file will be maintained for at least five years (unless otherwise directed by the EPA PO). Electronic project files will be maintained on network computers and backed up

periodically. The FDR Grant Manager will supervise the use of materials in the project file. If requested by EPA, FDR will provide this information in an administrative record at a later date.

The following information will be included in the hard copy and / or electronic project files in the central file:

- All EPA-approved versions of the QAPP;
- Any reports and documents prepared;
- All field notes (field logs, sample collection data sheets, etc.);
- Contract and task order information;
- Results of data quality assessments and audits;
- Communications (memoranda; internal notes; telephone conversation records; letters; meeting minutes; and all written correspondence among the project team personnel, subcontractors, suppliers, or others);
- Maps, photographs, and drawings;
- Studies, reports, documents, and newspaper articles pertaining to the project; and
- Spreadsheet data files: physical measurements, analytical chemistry data (hard copy and on CDROM).

Copies of formal reports generated from the data and submitted to EPA will be maintained in the central file (hard copy and / or CDROM/DVD) at FDR's office. The data reports will include a summary of the types of data collected, sampling dates, and any problems or anomalies observed during sample collection.

SECTION B – DATA GENERATION & AQCUISITION

There will be several data collection efforts associated with this project including: a topographical survey of the land, a bathymetric survey of the project area in the river and lagoon, a geotechnical survey of the project area, sediment chemistry analysis, a general site assessment of the entire project site, and ecological monitoring. The ecological monitoring will be conducted both pre-construction and post-construction; all other surveys will be conducted once prior to the design phase. Each data acquisition task and data use task is outlined below.

B.1 Data Collection Process Design (Experimental Design)

GENERAL SITE ASSESSMENT – JJR

In conjunction with the topographic and bathymetric surveys, JJR personnel will conduct a pre-design site visit to gain a better understanding of prevailing site conditions. Included in this site visit will be visual and physical inspection of the project area to record observed flora and fauna, identify potential discrepancies with the topographic survey, observe park users and traffic patterns, and investigate features to be removed or modified.

The previously prepared pre-design concepts will be investigated and site conditions that will benefit/deter from the successful execution of these concepts will be understood. Specifically, the location of the new inlet/outlet channel, modifications to the abandoned pump house, configuration of the habitat structures, shoreline stability and the presence of invasive plant species will be quantified.

Notes will be taken in field log books, which will include all observations of the field team. Extensive photo documentation will also occur and will be used to demonstrate pre and post construction conditions.

TOPOGRAPHICAL SURVEY – JJR

Topographic mapping is the process of measuring three-dimensional locations of natural and artificial features within a project site, graphically representing this spatial relationship in plan document form.

For this project, the field collected data has many uses. Existing natural and artificial features will be mapped and will be evaluated against design objectives. It will serve as the base for measuring impacts to existing site features (preservation and demolition), aid in the identification of the limits of construction, serve as the base conditions for generation of the construction plans, and will enable bidders to accurately calculate construction costs.

The topographic survey is created to better understand the physical features of the site as they exist. For this project, the contours and spot elevations are integral to the understanding of water and how storm water runoff migrates across the site, computing cut and fill calculations, verifying the difference between existing and proposed finish grades and measuring sediment migration and deposition.

Additional details are included in Appendix B.

BATHYMETRIC SURVEY – JJR

Bathymetric echo-soundings and the resultant surface created to represent the submerged surface and features are integral to the understanding of existing structures, habitat, and their representative proximity to the shoreline and upland topography, natural and artificial features as described above.

For this project, the field collected data has many uses. Existing natural and artificial features will be mapped and will be evaluated against design objectives. It will serve as the base for measuring impacts to existing site features (preservation and demolition), aid in the identification of the limits of construction, serve as the base conditions for

generation of the construction plans, and will enable bidders to accurately calculate construction costs associated with cut and fill of site soils. This data will also serve as the basis for any future monitoring of sediment transport and habitat performance.

The operation of both survey and echo-sounding software is utilized to monitor the submerged bottom profile and bottom sounding depths and to calculate target points for any abnormal information that requires further evaluation. If abnormal information is encountered, a target point is used to mark the position, allowing the operator to calculate additional grid navigation lines and collect additional data necessary to analyze the area of interest. Additional details are included in Appendix B.

GEOTECHNICAL SURVEY – SOMAT

The purpose of the geotechnical investigation is to aid in the design of the habitat structures within the lake and to better understand site soils in the upland peninsula where excavation to create a new inlet/outlet is proposed. Six soil borings will be made within the lake where the cut and fill is proposed and will extend to a depth of 10 feet from the existing lake bottom. These borings are intended to determine the soil composition and depth of sediment accumulations above firm soils.

In addition, two (2) test pits will occur on the upland peninsula between the River and the lake to verify the amount of rock rubble or other inert, non-soil materials that will be encountered during excavation of the new inlet/outlet and determine structural requirements for new footbridge (foundations) or boardwalks that will span the new inlet/outlet. The boring pits will extend a maximum depth of 10 feet below grade. Test pits are recommended at this site because it allows observation of a larger cross section area in comparison to soil borings. It also helps evaluate the uniformity of this soil stratum at the site.

SEDIMENT CHEMISTRY – ECT and Paragon

As stated on the Michigan Department of Environmental Quality website, "Permits are required for dredging submerged areas pursuant to Part 325, Great Lakes Submerged Lands and/or Part 301, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended…Dredge material characterization is required by the MDEQ. Sediment testing results (as well as a QA/QC report from the laboratory) need to be submitted with a permit application to be evaluated as part of the proposed project." A minimum of six discrete samples collected to project depth and analyzed separately for the first 10,000 cubic yards, and one additional sample for each 10,000 cubic yards thereafter must be analyzed for the following parameters: 12 Metals (arsenic, barium, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver, and zinc), Polychlorinated biphenyls (PCBs), and Polynuclear aromatic hydrocarbons (PNAs). To fulfill these requirements, ECT will collect 7 sediment samples and one duplicate sample from the sediment pulled by SOMAT for analysis. Samples will be collected from each of the boring locations and analyzed for the required parameters by Paragon. Figure 3 – Planned Geotechnical Boring and Sediment Chemistry Locations displays the approximate planned locations for the sediment chemistry locations (7 locations marked in red and yellow within the lagoon).

DESIGN – JJR

After completion of the surveys and site assessment, the restoration areas will be designed using scaled topographical and bathymetric maps, as created by project personnel. The survey data will be imported into an AutoCAD® 2010 drawing. AutoCAD 2010® and Adobe Photoshop® software will be used to set up the drawings and assure an accurate scale consisting of inches and feet.

Plans, details, and specifications will be compiled and submitted for review and comments as follows:

- Design Development documents – this submittal consists of approximately 50% complete construction drawings. The drawing will contain sufficient detail and clarity to understand the major design, include resolution of all concepts and all details, cross sections and plan drawings as described in Section A.6.
- 100% Construction documents – this submittal consists of the final plans and technical specifications and all relevant plans, elevations, sections and technical specification will be 100% complete.
- Bid Documents – This submittal will consist of the 100% construction documents and all relevant bidding forms.

Section A.6 describes the design features that will be carried forward in the design process.

ECOLOGICAL MONITORING – ECT

Ecological monitoring will be overseen by ECT. However, experts in each area have been brought onto the project team in order to collect the most accurate information for each of the data types. Routine monitoring should provide the information necessary to answer the following questions:

1. Will the restored habitat be utilized by native fish and wildlife species within the Detroit River?
2. What change in habitat composition will occur as a result of the habitat restoration?
3. What change in habitat utilization by fish and wildlife species will result from the habitat restoration?

Pre-restoration and Post-restoration objectives for the ecological monitoring include:

- Characterize the existing fish and wildlife communities at the project site and target fish communities at reference sites using multiple community indices, test for statistical significance.
- Measure abundance of target fish and wildlife communities at the project site and target fish communities at reference sites and test for statistical significance.
- Map habitat variables and distribution within the project site and at reference sites.
- Characterize the existing fish and wildlife communities using multiple community indices and test for statistical significance.

Fish Monitoring – ECT

All monitoring stations will be surveyed upon QAPP approval in 2011 to document the pre-construction fish community at the three monitoring sites. The pre-construction sampling event is planned for assessing fish species prior to construction. Post-construction surveys will be conducted at the same sampling stations in the same time frame (+/- 2 weeks, weather permitting) of 2012 (or 2013 depending on the completion date of construction). Fish will be collected as described in detail in subsequent sections and in the attached SOPs included in Appendix D and according to the methods described in the MDNR Fisheries Division *Manual of Fisheries Survey Methods II,* which is included as Appendix E.

Fish will be identified to species level and counted, generating community-level data that can be used to assess changes in the fish community between sampling stations and at station before and after habitat restoration.

Both pre-restoration and post-restoration monitoring will meet the following objectives:

- Characterize the existing fish communities at the project site and at a reference site downstream of the project site using multiple community indices and test for statistical significance;

- Measure abundance of target species (Northern Pike, Smallmouth Bass, Rock Bass, Yellow Perch, Walleye, Spotfin Shiner, Emerald Shiner, Channel Catfish, White Sucker, Quillback, Gizzard Shad, Log Perch, and Trout Perch) at the project site and at the reference site and test for statistical significance;
- Map habitat variables and distribution within the project site and reference site; and
- Characterize the existing fish communities within all monitoring sites using multiple community indices and test for statistical significance.

Fish collections will be standardized by using the MDNR Fisheries Division *Manual of Fisheries Survey Methods II*. During collections, fish will be identified to species and counted. Fish community diversity, relative abundance, catch-per-unit-effort, and species composition will be determined. Similarity indices will also be calculated for the upstream sampling station. Fish collections will be performed at three stations: within the project site and at reference sites Lake Okonoka and Lake Muskoday. Each station will be a minimum of 1,000 feet in length. The stations have been selected in consultation with the USGS and MDNR Fisheries Division. The surveys will be repeated after Blue Heron Lagoon Reconnection is completed in the same time frame (+/- 2 weeks, weather permitting) of 2012 (or 2013) so that pre and post restoration fish communities can be compared. Fish community surveying will allow ECT to measure whether or not the fish community at the project site exhibits a positive change in species composition, abundance and use in comparison with the reference sites and potentially similar sites within the Detroit River. If the fish community exhibits increases in abundance, species composition and use of the project site post construction, it will be a direct measure of successful restoration. The surveys will also determine to what extent the fish community differs from reference sites. The fish communities of the reference sites and project site should become less similar after site restoration.

Boom electro-fishing gear will be used to sample the shoreline and near-shore fish community at each of the three locations, Project Site A (Blue Heron Lagoon), Reference Site A (Lake Okanoka), and Reference Site B (Lake Muskoday). Figure 4 – Aquatic Ecological Monitoring Locations displays these three monitoring locations. Electro-fishing effort will range from approximately ten to fifteen minutes per site per sampling location within the site. Mini fyke nets with a mouth opening 0.75 m high by 1.25 m wide constructed with 4 mm delta mesh, with a 1 m by 7.5 m single head will be employed to sample fishes in the shallow near shore areas. Mini fyke nets will be set so the lead is perpendicular to shore and the mouth sits in approximately 1 m of water. Fyke nets 1.8 m long x 1.2 m in diameter with 19 mm stretch mesh and 23 m leads will be set so the lead is perpendicular to the shore. Mini-fyke nets will be deployed to sample fish at all monitoring stations where shallow depth limits use of the boom shocker and may capture additional fish species in areas free of obstructions. There will be 2 nets set at differing locations defined by substrate type (muck or sand) for one diel cycle.

All fish collected will be sorted by species. Total lengths (mm) will be measured on a representative sample of each species. All fish will be released except exotic species, which will be euthanized. Maximum and minimum water depth (m), velocity (m/s) and surface water temperature (˚C) will be measured during each sampling event. Presence of tumors, irregularities, and positive spawning condition (extrusion of eggs, milt, or sexual dimorphic coloration) will be recorded. Biotic data tables will be compiled for all fish species. See Appendix E for example field forms for this effort.

Visual Aquatic Habitat Assessment – ECT

Pre and post construction assessments of aquatic habitat will occur upon QAPP approval in 2011 and in the same time frame (+/- 2 weeks, weather permitting) of 2012 (or 2013) at the project site. Visual assessment of aquatic habitat will be conducted and will include assessment of bottom substrate type, presence of large woody

debris and aquatic vegetation. Visual assessment of habitat will be enhanced when visibility from the surface is poor. The habitat assessment will be performed at the same three locations as used for the fish assessment, Project Site A (Blue Heron Lagoon), Reference Site A (Lake Okanoka), and Reference Site B (Lake Muskoday). Figure 4 – Aquatic Ecological Monitoring Locations displays these three monitoring locations.

Water Chemistry Sampling – ECT

Concurrently with the visual aquatic habitat assessment, project and reference sites will be sampled for the following water chemistry parameters: dissolved oxygen at depth (one meter intervals), temperature at depth (one meter intervals), and secchi depth. Assessment of temperature and oxygen profiles will be performed using a YSI model 556 MPS multi parameter meter. Secchi transparency will be estimated using a black and white disk 20-cm in diameter. The water chemistry sampling will be performed at the same three locations as used for the fish assessment, Project Site A (Blue Heron Lagoon), Reference Site A (Lake Okanoka), and Reference Site B (Lake Muskoday). Figure 4 – Aquatic Ecological Monitoring Locations displays these three monitoring locations.

Aquatic Macrophyte Sampling – ECT

Pre and post construction assessments of aquatic macrophytes will occur upon QAPP approval in 2011 and in the same time frame (+/- 2 weeks, weather permitting) of 2012 (or 2013) at the project site. The necessary data will be collected using the standard methods of the MDEQ for assessing macrophytes, as described in Appendix F. The aquatic macrophyte sampling will be performed at the same three locations as used for the fish assessment, Project Site A (Blue Heron Lagoon), Reference Site A (Lake Okanoka), and Reference Site B (Lake Muskoday). Figure 4 – Aquatic Ecological Monitoring Locations displays these three monitoring locations.

Herpetofauna Sampling – HRM

Presence surveys will be conducted to assess the effects of the restoration activities on amphibians and reptiles within the project area. The primary objective of the survey is to determine species diversity, distribution, and relative abundance. In addition, select rare herpetofauna will be marked within the study area for future capture. Sampling will be conducted during the active season at each site both prior to and after restoration to determine if any biologically significant changes occur for herpetofauna within the restored areas. Sites will be visited no less than once during peak activity. Maps will be produced and used to confirm findings in the field.

Outcomes of the survey will:

- Determine species diversity, relative abundance, age structure, and distribution of common and rare species within the restoration areas with emphasis on sensitive and rare species.
- Identify changes in habitat due to restoration activities.
- Map the locations of herpetofauna within the restoration areas within the restoration areas and adjacent habitat.
- Identify critical habitats for amphibians and reptiles within the restoration areas.
- Assess species use of restored habitat within assessment areas.
- Assess population structure and viability of rare herpetofauna.
- Monitor the relative population size to assess changes due to restoration activities.
- Establish baseline data for future restoration and monitoring work within the assessment areas.

Water Bird Monitoring – Allen Chartier

The primary focus of the survey will be to assess water bird populations before and after the reconnection of the Blue Heron Lagoon to the Detroit River. The primary species using Blue Heron Lagoon are migrating waterfowl; therefore, survey days will be concentrated during their migration season. The proposed construction will potentially create habitat for new species to use the area. Arctic-nesting shorebirds and wading waterfowl will be surveyed using the point count method. Point Counts are widely accepted as a good standardized way of conducting comparable bird surveys. Figure 5 – Point Count Locations and Observational Ranges displays the monitoring locations.

Velocity Measurements – ECT

Pre-construction velocity will be measured at the project site in the channel downstream of the existing water control structure. Post-construction velocity will be measured once per month April through October at the location of new connection(s). Post construction velocity measurements will be made at one foot intervals across the new connecting channel(s). The velocity measurements will be averaged for comparison of pre and post velocity measurements within the site. The water velocity measurements will be performed at the same three locations as used for the fish assessment, Project Site A (Blue Heron Lagoon), Reference Site A (Lake Okanoka), and Reference Site B (Lake Muskoday). Figure 4 – Aquatic Ecological Monitoring Locations displays these three monitoring locations.

Figure 3 – Planned Geotechnical Boring and Sediment Chemistry Locations

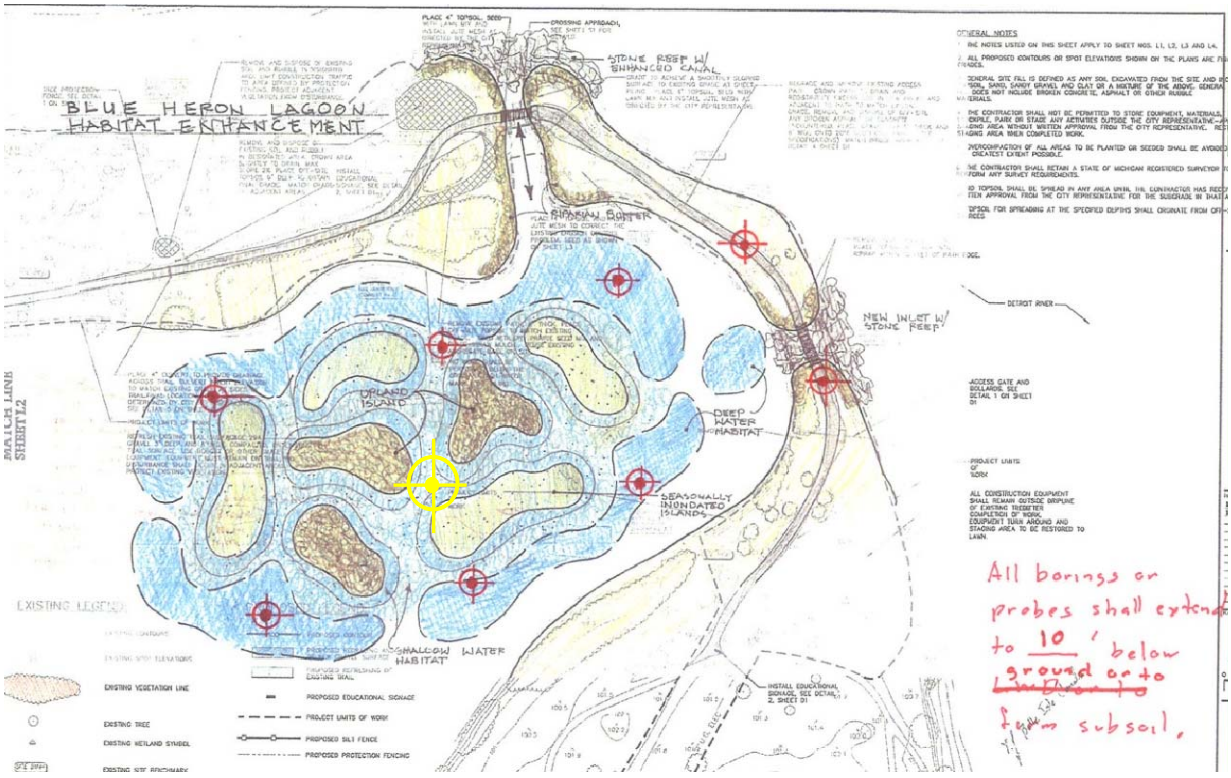


Figure 4 – Aquatic Ecological Monitoring Locations

Figure 5 – Point Count Locations and Observational Ranges

B.2 Data Collection Methods

GENERAL SITE ASSESSMENT – JJR

Digital photographs and general observations will be collected during the site visits. Pictures will be taken with a Nikon CoolPix 4300® or similar. Pre, during and post-construction photographs will be taken of the same vantage point from the same general locations in order to better demonstrate the changes that have occurred at the restoration site. Project personnel will incorporate detailed directional information about the photograph in their field notes. When the photographs are saved to the electronic project file, they will be named in such a way that it is easy for project personnel to compare the photographs meant to depict the changes at the site from a given vantage point.

TOPOGRAPHICAL SURVEY – JJR

Mass points and break lines are collected at a minimum of ten (10) foot interval and more frequently if grade changes occur. Ultimately these data are used to create a 3-dimensional surface illustrated with a 1-foot contour interval using AutoCAD Civil 3D Digital Terrain Modeling (DTM) software. The linear manner employed during data collection allows horizontal and vertical accuracy in artificial and natural features pertinent to the site, allowing evaluation of surface conditions. Spot elevations are represented at a minimum of twenty (20) foot interval and more frequently if grade change clarification is required based on the project site topography, supplementing contour lines. Spot elevations are not intended to represent all project points collected in the field due to drawing scale limitations, but offer supplemental surface data will remain visible during plan evaluation and site inventory. The DTM surface model will utilize all project points even though not all points will be visible in the final deliverable. Data precision of plus or minus 0.10 feet on hard surfaces and 0.20 feet on soft surfaces or natural features, will allow for precise evaluations of site elements.

The following plan features are typically collected as part of a standard mapping effort; structures, roads, paths, foot bridges, relevant features associated with the abandoned pump station, overflow structures, culverts, fences, poles, manholes, catch basins, fire hydrants, wells (both water and monitoring), soil borings, significant trees and vegetation outlines, along with other site specific items of interest. Site features will be evaluated and mapped based on JJR staff experience and knowledge associated with the professional services being performed. Emphasis is placed on features of interest, along with the entire site coverage, allowing all artificial and natural features included in the topographic survey. This knowledge of the site is then passed on to other professionals working on interrelated project components, based on review of the topographic survey document.

Site utilities will be field located at the surface, with subsurface connectivity estimated through review of plan information and flow line measurements. JJR will obtain copies of gas, storm, sanitary, telecommunications and water plans, from local municipalities and public utility agencies, for estimating connectivity. Additional private utilities located on a specific site will be researched and documented based on all available resources.

The topographic survey will be an essential component in referencing existing conditions, and the documentation of site evaluations from other professions on the design team.

Additional information on JJR's methods for conducting topographic survey can be found in Appendix B.

BATHYMETRIC SURVEY – JJR

JJR utilizes a 16 foot v-hull vessel equipped with a starboard mount transducer. The transducer transmits and receives echo-soundings of the submerged bottom through operation of a dual frequency echo-sounder. Both frequencies are utilized to register return signals from different materials, with high frequency used to register return

signals from light sediment and low frequency used to register return signals from hard clay or rock bottom surfaces. Both frequencies can be adjusted in the field based on signal strength, water depth and bottom material, allowing the ability to collect a great deal of information and minimize the false returns or data that requires editing. The echo-sounding software is utilized and operational during the course of the survey to monitor the incoming raw echo-sounding information.

JJR will use both high and low frequency echo-soundings to isolate sediment limits adjacent the shoreline, with this information being an essential component in understanding volumes of sediment, along with a knowledge of how features are located with regard to the visible shoreline. This knowledge will be used by other project team members to better understand the submerged features when proposing changes to shore protection, underwater habitat and navigation on the Detroit River.

Survey software is then utilized to simultaneously record vessel position through data collected from a GPS receiver and echo-soundings of the submerged surface. This information is visible on a heads-up computer display that allows the operator to navigate the vessel according to the planned navigation grid, which is essential to providing adequate coverage and proximity of soundings.

The raw data is collected based on water surface elevation, so operation of a ship motion compensator is used to collect time-stamped heave pitch and roll data, which then allows operation in waves and swells of up to 3 feet in height.

Additional information on JJR's methods for conducting bathymetric survey can be found in Appendix B.

GEOTECHNICAL SURVEY – SOMAT

SOMAT will conduct a geotechnical investigation and provide a geotechnical data report and preliminary design assistance for the proposed lake earthwork and inlet excavation. The proposed geotechnical investigation consists of performing six (6) soil borings in the lake within the limits of the proposed earthwork to construct the submerged habitat structures and two (2) test pits along the peninsula between the lake and the river. The six soil borings and two test pits will extend to a depth of 10 feet below the lake bottom and peninsula. Prior to digging and/or drilling the soil borings, all locations will be cleared for surrounding utilities by use of the MISSDIG system and input from the City of Detroit park personnel. Ground surface elevations at the boring locations will be determined by the project surveyor. Drilling operations will be performed from a small flat bottom boat.

Soil samples collected during the drilling portion of the subsoil exploration will be labeled with the soil boring designation and a unique sample number. Soil boring samples are to be obtained by Standard Penetration Tests (SPT) in general accordance with ASTM D-1586 procedures, whereby a conventional 2-inch O.D. split-spoon sampler is driven into the soil with a 140 pound hammer repeatedly dropped through a free-fall distance of 30 inches. The sampler is generally driven three successive 6-inch increments, with the blows for each 6-inch increment being recorded. The number of blows required to advance the sampler through 12 inches after an initial penetration of 6 inches, is termed the SPT resistance (N-value) and will be presented graphically on the individual Logs of Test Borings. As added information, the number of blows for each 6-inch increment will also be presented on the boring logs.

Soil boring samples will be obtained using split-spoon sampling procedures in general accordance with ASTM Standard D-1586 ("Standard Method for Penetration Tests and Split Barrel Sampling of Soils"). In general, the samples will be obtained at a regular interval of 2-½ feet. The soil samples are to be sealed in glass jars in the field to

protect the samples and maintain their natural moisture contents. All soil samples will be transported to SOMAT's laboratory for further analysis and testing.

In place of some of the split-spoon samples, undisturbed soil samples will be obtained, as necessary, using 3-inch diameter Shelby tubes, in general accordance with ASTM D-1587 procedures. Shelby tubes will be hydraulically pushed into the soil at the base of the borehole and allowed to sit in the ground for about 10 minutes, after which a 1/4 turn by hand is applied to the drill rods to break the soil column at the bottom of the tube.

Shelby tube samples will be sealed immediately at both ends with about one inch of hot liquid wax. The tubes will then be sealed at both ends with plastic end-caps and duct tape. All tubes will be identified with information on boring number, sample number, sample depth and recovery. The tubes are to be stored in a vertical position to minimize sample disturbance and then transported to the SOMAT laboratory for testing.

Upon completion, all test pits and/or boreholes will be backfilled with auger cuttings and the surface restored as best as possible to the original condition. Whenever possible, groundwater level observations will be made during the drilling operations and immediately after completion of drilling, and shown on the individual Logs of Test Borings.

Field forms associated with the geotechnical survey are included in Appendix C: SOMAT Engineering Forms and Procedures as well as the SOMAT scope of work. Additionally, SOMAT will follow the procedure outlined below for this site:

Field Engineer Procedures:

1. Coordinate all fieldwork with JJR and/or ECT.
2. Before going into the field, read the "Procedure Manual for Laboratory and Field Classification of Soil Samples", issued by SOMAT.
3. Read the information provided by the Field Team Leader and/or Project Manager as related to this project.
4. Make arrangements to arrive at the job site on time. If you are delayed, call the subcontractors and site contact to notify them of your arrival schedule.
5. When doing a soil boring you should have the following with you:
    a. Hard hat
    b. Permit (if applicable)
    c. Pocket Penetrometer
    d. Tape measure
    e. Soil boring location diagram
    f. Drilling instructions
    g. Necessary phone numbers
    h. Camera

    Always perform a visual inspection of the equipment for damage before arriving at the site.

6. Prior to performing fieldwork, conduct a Site Safety Procedure Meeting with all subcontractors. Provide contact information and procedures to be followed in the event of a safety emergency. Also inform all subcontractors of site specific hazards, which may be encountered.
7. Perform visual inspection of the subcontractor's equipment (in coordination with the subcontractor) to ensure no visible damage is present prior to performing the fieldwork.
8. Perform soil borings, in accordance with the SOMAT proposal and standard procedures provided in Section B.2 of the QAPP:
    a. Soil Investigation and Sampling by Auger Borings (ASTM D1452)
    b. Penetration Test and Split-Barrel Sampling of Soils (ASTM D1586)

c. Thin-Walled Tube Sampling of Soils for Geotechnical Purposes (ASTM D1587)
d. Classification of Soils (ASTM D2487)

9. Perform test pits along shoreline, in accordance with SOMAT proposal and standard procedures provided in Section B.2 of the QAPP:
    a. Classification of Soils (ASTM D2487)
10. Fill out information on the field logs completely. Include a location diagram for all soil borings and test pits. Do not leave samples out in the sun or cold. Place all lids securely on the sample jars.
11. Upon completion of the fieldwork and before leaving the site for the day, contact the Field Team Leader and provide progress update.
12. Deliver soil samples to the SOMAT laboratory for analysis.

SEDIMENT CHEMISTRY – ECT

Upon QAPP approval, SOMAT will be brought on-site to conduct their geotechnical survey. As part of that survey, SOMAT will collect and homogenize a sediment sample. ECT will take 8 ounces of that well-mixed sediment and place it in a separate cooler with ice to be transported to Paragon. ECT will utilize the same labeling procedure as SOMAT to maintain consistency in the data sets. Samples will be analyzed for the suite of parameters listed in B.4 Analytical Methods by Paragon Laboratories in Livonia, MI.

DESIGN – JJR

Not applicable.

ECOLOGICAL MONITORING – ECT

Fish Monitoring – ECT

Fish community surveys will be conducted in April –June of 2011, and April –June of 2012 (or 2013 depending on the schedule of completion for restoration activities). Fish collections will be standardized by using the MDNR – Fisheries Division *Manual of Fisheries Survey Methods II*. Monitoring locations are shown in Figure 4 – Aquatic Ecological Monitoring Locations.

Fish will be collected using a boom-shocker mounted on a 17-foot aluminum flat bottom boat powered by a 20 horsepower, 4-cycle outboard motor. The boom-shocker will be powered by a 2,000-watt, 120-volt AC gas generator. A Smith-Root 1.5KVA Electrofisher will supply pulsed AC and DC to two boom mounted electrode arrays or two electrode poles if the boat is being used as a tote barge in shallow water. The electrofisher is equipped with a timer for recording fishing effort. Based on conductivity of freshwaters in the Detroit River, the electrofisher will be operated to output approximately 200 to 220 volts with 2 to 6 amperes. Output will be set at 3 amperes and then adjusted to optimize fish collection while minimizing injury and recovery time based on actual conditions at the time of sampling and capture efficiency. Fish sampling will be conducted in 10 to 15 minute intervals.

Fish will be stunned and netted from the river by handlers and temporarily held in aerated tanks with fresh water obtained from the sample location until processing. Sampling will proceed in an upstream direction. During sampling in sites A, B, and C, the three randomly selected sub-reaches will be sampled from the furthest downstream to the furthest upstream. Fish will be processed at the end of each sub-reach. After processing, fish will be immediately live released, with the exception of invasive fish species which will be euthanized. Fish will be released at the downstream end of each sub-reach to reduce potential migration into the next upstream sub-reach selected for sampling. Captured fish will be identified to species, measured, and counted.

Areas too shallow for the boom shocker and relatively free of obstructions will be sampled with the seine. Seines will be deployed to sample fish at all monitoring stations where shallow depth limits use of the boom shocker and may capture additional fish species in areas free of obstructions. Areas along the shore will be scouted for obstructions. A three meter long nylon mesh (6.3 mm mesh) seine will be deployed along the shoreline. The seine haul will proceed in an upstream direction for approximately eight meters with one person near shore and one person off shore making sure to keep the lead line on the bottom. A third person will trail the seine haul to assist in unhooking the lead line from obstructions on the river bottom. A sampling effort of 10 seine hauls per monitoring site will be conducted if conditions permit. Captured fish will be identified and counted as described above. After processing, fish will be released or euthanized as described above.

Visual Aquatic Habitat Assessment – ECT

A visual assessment of aquatic habitat will be conducted and will include assessment of bottom substrate type, presence of large woody debris and aquatic vegetation. Visual assessment of habitat will be enhanced when visibility from the surface is poor. A Marcum Technologies VS625SD UVIR Underwater Camera equipped with Sony's HAD II CCD optics will be used to provide additional visual capabilities for the documentation of aquatic habitat and fish species use of the habitat. Digital video recording will be conducted by connection of the RCA out of the video screen to a portable digital video recorder with a 4GB removable SD media card. Photographs will be taken at each sample quadrant.

Habitat will be mapped in 10 randomly selected 1 meter by 1 meter quadrants along transects within the sampling stations. Water depth, temperature, submergent and emergent vegetation, shoreline characteristics, large woody debris complexes, and rock substrate habitats will be mapped based on the observable predominant bed forms, water surface profiles, and substrate type. Map-grade GPS equipment will be used to mark sample quadrant locations, the predominant habitat types and large woody debris locations (based on centroid). The area of each habitat will be determined by the average percent coverage of each habitat type per plot and multiplying it by the length of the transect to derive average percent coverage per transect. Observations of spawning activity include nest guarding, vacant nests, and the presence of spawning aggregations will be recorded descriptively and numerically in the field notebook and the location will be recorded using a Trimble GPS unit according to the ECT SOP for GPS data collection included in Appendix D. Observations of habitat utilization by young-of-the-year and juvenile fish species will be recorded descriptively and numerically in the field notebook.

Water Chemistry Sampling – ECT

Field personnel will collect in-situ water quality measurements at select sample sites. A YSI 556 multiparameter probe will be used to measure dissolved oxygen (DO) and temperature. Measurements will be taken at three locations across the width of the stream at mid-depth and at mid-depth locations within the lake. The data will be recorded either on field data sheets or in a field book. See the Multi-parameter Probe SOP for additional details (Appendix D).

Aquatic Macrophyte Sampling – ECT

Prior to the visit, the lake will be divided into different Aquatic Vegetation Assessment Sites (AVAS). Each AVAS is approximately 100 meters in length. The AVAS boundaries will be loaded into a GPS unit for location on the survey date. The survey will begin at the access site and will continue around the perimeter in a clockwise fashion. Actual starting points for each AVAS are recorded in the GPS unit and later checked against the planned start points. One person will steer the boat in a zigzag pattern, alternately driving as close to shore as

possible and then as far from shore as plant cover is estimated to occur. Another person will select a position in the front of the boat that provides maximum view of plant communities. Collection of samples of plants from the lake bottom will be conducted by throwing and retrieving a grapple, frodus, or modified thatching rake attached to a rope long enough to not limit toss distance. The rake thrower will call out the names of the plants found while boating through the AVAS. At the end of each AVAS, an estimate of percent cover for each type of plant will be recorded on a map of the lake to provide a record of macrophyte spatial distributions.

Estimates of aquatic macrophyte coverage will be recorded as "found," "sparse," "common," or "dense," using the following classifications and codes:

Table 6 – Breakdown of terminology for Aquatic Macrophyte Sampling

Code	Descriptive term	# of plants/AVAS	Equivalent % of total AVAS surface area
A	Found	1 or 2	< 2%
B	Sparse	Scattered distribution	2 – 20%
C	Common	Common distribution	21 – 60%
D	Dense	Dense distribution – present in considerable quantities	> 60%

Source MDEQ 2005

Herpetofauna Sampling – HRM

Collecting and identifying – Suitable habitat will be surveyed for species presence using time constrained and random line transects. Voucher photos of species will be collected. Depending on site conditions, static line transects will be established for comparison of pre and post restoration herpetofauna species presence. All amphibians and reptiles will be documented and their position recorded using GPS units. Rare herpetofauna will be collected throughout the study. Specimens will be measured, sexed, reproductive condition noted, photographed, marked for future identification, and released.

Surveying and Monitoring – Artificial cover objects will be placed in areas occupied or believed to be occupied by the snakes as well as adjacent to areas of restoration. Baited hoop traps will be used to collect turtles and aquatic salamanders. For all previously collected and identified specimens, location and biological data will be collected during the active season. Snakes or turtles found without markings will be collected and identified using the previously described protocol.

Mapping – Using GPS data and GIS software, data layers will be generated of observations of home range, habitat use, and minimum convex polygons (when possible) for selected species using the preferred coordinate system.

Schedule – April-November 2011: Establish transects, conduct survey and document occupied habitats. Mark all captured rare snakes and turtles. Analyze data and prepare the 2011 interim report and maps.
April-November 2012 or 2013: conduct survey and document changes in previously occupied habitats (if any). Analyze data and prepare final report and maps.

Survey Outcomes

- Determine species diversity, relative abundance, age structure, and distribution of common and rare species within the restoration areas with emphasis on sensitive and rare species.
- Identify changes in habitat due to restoration activities.

- Map the locations of herpetofauna within the restoration areas and adjacent habitat.
- Identify critical habitats for amphibians and reptiles within the restoration areas.
- Assess species use of restored habitat within assessment areas.
- Assess population structure and viability of rare herpetofauna.
- Monitor the relative population size to assess changes due to restoration activities.
- Establish baseline data for future restoration and monitoring work within the assessment areas.

Water Bird Monitoring – Allen Chartier

Typically, the observer stands in a single spot and counts every bird seen and/or heard in any direction, at any distance, from this point, over a pre-determined time period. The USFWS employ a series of 50 three-minute point counts along a 25-mile route along roadsides for their national Breeding Bird Survey. This method is widely used to analyze population trends of North American breeding birds. Other studies have used 5-minute and 10-minute point counts. Most of these counts are focused primarily on detecting songbirds. The point count method used in this project will be modified to fit the area to be surveyed.

Numbers of individuals and species composition will be determined. Counts will be conducted beginning at sunrise on each Survey Day and will be completed before noon using a telescope. A minimum of three 15-minute Primary Point Counts will be taken from the observation deck at the west end of Blue Heron Lagoon, and one from the easternmost point of the island where Blue Heron Lagoon flows out into the Detroit River. These locations are shown on Figure 5 – Point Count Locations and Observational Ranges. Additionally, a transect count is performed by walking from point E to point F along the eastern shore of Blue Heron Lagoon. Supplemental point counts, away from the target areas, may be used for tracking movements of waterfowl by season, and to detect any changes in movements pre- and post-construction.

The following schedule (for calendar year 2011 and either 2012 or 2013) will be used to survey all species both efficiently and thoroughly. Each month will have a minimum of 1 survey day, with additional days as follows:

- January, February, May, August and December – 2 survey days each
- March, April, September, October, and November – 4 survey days each

Velocity Measurements – ECT

Field personnel will use either a Type AA current meter or a Pigmy meter to capture the velocity of selected cross-sections. The measurements will be made at partial sections such that no more than 5-10% of the flow passes through any one partial section. Velocity measurements will be made at 0.6-depth if the majority of partial section depths are less than 2.5 feet or at 0.2-depth and 0.8-depth if most depths are greater than 2.5 feet. For both meters, see the Current Meter SOP for additional details (Appendix D).

B.3 Sample Handling & Custody

The geotechnical survey and the sediment chemistry sampling are the only data collection efforts for this project that will require chain-of-custody (COC) procedures. These samples will follow COC to provide documentation of the handling of each sample from time of collection through receipt by the laboratory. Both SOMAT laboratory and Paragon Laboratory shall provide chain-of-custody forms to be filled out by the sampler/sample team leader to accompany each sample through transit from the field to the laboratory. This form is used by both the field sampler and the laboratory to verify the contents of each shipment of samples. When transferring possession of the samples, both the individual relinquishing the container(s) and the receiver are required to sign and date the chain-of-custody

form. Upon receipt of the shipment at the laboratory, the contents of the cooler are checked against the completed chain-of-custody form. Any anomalies are to be immediately reported by the laboratory to the sampling team leader for clarification/resolution. All samples will be delivered to the laboratory within the requisite hours of sample collection in order to give the laboratory enough time to begin to process the samples while maintaining the analysis specific holding time. Samples are kept in coolers with enough ice to maintain ideal sample temperature.

Fish will be stunned (or seined) and netted from the river by handlers and temporarily held in aerated tanks with fresh water obtained from the sample location until processing. After processing, fish will be immediately live released, with the exception of invasive fish species which will be euthanized, according to the SOP for Euthanizing Invasive Fish Species, which is included in Appendix D.

B.4 Analytical Methods

GENERAL SITE ASSESSMENT – JJR

Not applicable.

TOPOGRAPHICAL SURVEY – JJR

Not applicable.

BATHYMETRIC SURVEY – JJR

Not applicable.

GEOTECHNICAL SURVEY – SOMAT

Soil classification and analysis will be conducted by SOMAT's laboratory to cover the required scope and analysis, as follows:

- Classification of Soils ASTM 2487
- Hydrometer Analysis ASTM D422
- Unconfined Compressive Strength ASTM D2166
- Moisture Content ASTM D2216
- Atterberg Limits ASTM D4318

The SOMAT Project Manager is responsible for initiating and scheduling the laboratory analysis. SOMAT will perform all soil classification and laboratory testing at their location in Taylor, Michigan. The laboratory has an AASHTO Certificate of Accreditation for the testing of construction materials and is approved for the procedures listed above by the USACE material test methods. These certifications are included in Appendix C. The laboratory follows the standard operating procedures set by ASTM, which are also included in the appendix.

SEDIMENT CHEMISTRY – PARAGON LABORATORY

Sediment chemistry analysis will be conducted by Paragon Laboratory. All analyses can be conducted from the same 8 oz. glass sample jar. The following table provides a list of the parameters to be analyzed, the method used to analyze the sample, the reporting limit, the sample holding times, and the sample preservation required.

Table 7 – Sediment Chemistry Laboratory Analysis Information

Parameter	Method	Reporting Limit (µg/kg)	Sample Holding Time	Preservative Required
Metals				
arsenic	SM6020	100	6 months	None
barium	SM6020	1,000	6 months	None
cadmium	SM6020	50	6 months	None
chromium	SM6020	2,500	6 months	None
copper	SM6020	1,000	6 months	None
lead	SM6020	1,000	6 months	None
manganese	SM6020	2,000	6 months	None
mercury	SM7471	100	28 days	≤6˚C
nickel	SM6020	1,000	6 months	None
selenium	SM6020	500	6 months	None
silver	SM6020	500	6 months	None
zinc	SM6020	1,000	6 months	None
Polychlorinated Biphenyls (PCBs)	SM8082	330	40 days	≤6˚C
Polynuclear aromatic hydrocarbons (PNAs)	SM8270	330	40 days	≤6˚C

All samples will be analyzed for the metals, PCBs, and PNAs. If a given sample has a concentration 20 times the Type B groundwater value or the Type A Default Background Criteria for metals, the leachate test will be run on that sample, for that parameter. The Paragon Laboratory Manager is responsible for initiating and scheduling the laboratory analysis to ensure that all samples are processed within their holding times. The Paragon Laboratory SOPs are included in Appendix G.

DESIGN – ECT

Not applicable.

ECOLOGICAL MONITORING – ECT

Not applicable.

B.5 Quality Control

Secondary data used throughout the project comes from validated studies. Any additional supplemental data will come from trusted professional organizations such as MNFI, USGS, etc. For the purposes of this project, a validated study is a document prepared by an individual or organization that has produced the study based on quantified information either collected by the author or cites other professional that have the same or greater credentials. Further data evaluation will not be conducted.

The surveying contractors are reputable “land surveyor” or “professional surveyor” properly licensed to perform professional surveys by the Michigan Department of Labor & Economic Growth, Bureau of Commercial Services. JJR adheres to the Accuracy Standards adopted by the American Land Title Association and National Society of Professional Surveyors.

Sampling QC excursions are evaluated by the Project Managers, in consultation with the EPA. Field duplicate sample results are used to assess the entire sampling process, including environmental variability; therefore the arbitrary rejection of results based on predetermined limits is not practical. The professional judgment of the Project Manager and the project Quality Assurance Manager will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility. Evaluation criteria noted previously in this section and in Section A.7 will be used for data review.

Corrective action will involve identification of the cause of the failure where possible. Response actions will typically include re-analysis of questionable samples. In some cases, a site may have to be re-sampled to achieve project goals.

GENERAL SITE ASSESSMENT – JJR

Data collection will be conducted in conformance with the applicable plans and procedures to ensure that consistent, quality data are collected. This data will strictly be used in planning purposes as general information regarding the conditions of the site. Data will be collected by personnel experienced in field assessment. Additionally, the individuals that will be using the data for design are those that will be performing the site assessments. Therefore, the QA/QC for this data is limited only by the experience of the individuals obtaining the information. In doing this, JJR prevents any miscommunication and avoids the need for additional visits due to a lack of information.

TOPOGRAPHICAL and BATHYMETRIC SURVEY – JJR

The surveys will be conducted according to standard practices by a professional licensed surveyor. JJR adheres to the Accuracy Standards adopted by the American Land Title Association and National Society of Professional Surveyors.

Topographic survey Data collected in the field passes a quality control review and redundancy check. This includes multiple collections of distinguishable features from adjacent project setups of thirty percent (30%) of project data, review of benchmark information and analysis of all raw data line by line. This allows one hundred percent (100%) review of raw data based on field book entries and other notes prior to import into AutoCAD. The overall data precision of unadjusted measurement must be within the overall project tolerance of plus or minus 0.10 feet.

Bathymetric survey Data collected in the field passes a quality control review and redundancy check. This includes redundant water level measure during the course of field collection, review of bottom sounding profile as related to floating debris and other false returns, and the review of later data collection lines versus the primary data collection lines, offering a thirty percent (30%) redundancy check of unadjusted observations. The combined methodology and data checks allow a one hundred percent (100%) confidence of all data being processed into AutoCAD and used for calculation and preparation of final deliverables. The overall data precision of unadjusted measurement must be within the overall project tolerance of plus or minus 0.10 feet.

GEOTECHNICAL SURVEY – SOMAT

The geotechnical survey will be conducted according to standard practices by a professional and experienced crew. Laboratory procedures will follow the laboratory document *AASHTO R18 Quality Manual*.

Detailed laboratory QC requirements are contained within each individual method and Laboratory Quality Assurance Manuals. Additional details on the laboratory QC methods are included in Appendix C.

SEDIMENT CHEMISTRY – ECT

A total of 8 samples will be collected and analyzed for sediment chemistry for this project. Seven of these samples are collected to characterize the sediment at the project site. The additional sample will be a duplicate sample to characterize the quality of the data.

Detailed laboratory QC requirements are contained within each individual method and the Paragon QA Manual.

DESIGN – JJR

JJR utilizes a multidisciplinary approach to problem solving and as such, will work collaboratively with a variety of disciplines to ensure that the most highly qualified individuals are assigned to the project. We will utilize a start to finish design approach and the same professionals will be involved through the design and construction phases of the work.

For this project, we will utilize the following professional disciplines throughout all phases of the work:

- *Civil Engineering:* Hydrology, geotechnical, soils evaluations, structural modifications to the existing pump station, foundations and pavement cross sections for recreation items and estimating.
- *Landscape Architecture:* Site grading, habitat restoration, recreation enhancements and estimating.
- *Biologists:* Primarily aquatic and fisheries biologist for habitat criteria, pre-construction assessments, permitting, and post construction monitoring.
- *Professional Surveyo*r: Topographic and Bathymetric surveys

During the design phases identified under part B above, JJR will conduct technical reviews for all project deliverables in advance of its issuance. Each plan specification and calculations will be reviewed by the JJR QA/QC coordinators for both civil engineering and landscape architecture. The Reviews will be conducted for the following submittals:

- Design Development
- Permitting
- 100% construction Documents
- Bid Documents

Each plan and calculations made will be reviewed by the lead engineer, the project manager, and the project QA manager to make sure that all plans are clear and all critical elements (scale, legend, etc.) are included.

ECOLOGICAL MONITORING – ECT

Fish Monitoring, Visual Aquatic Habitat Assessment, Water Chemistry Sampling, Aquatic Macrophyte Sampling, and Velocity Measurements – ECT

A review of monitoring procedures will be conducted at the beginning of each monitoring day in order to maintain objectivity and minimize individual bias. All field forms are reviewed for completeness and accuracy prior to moving from one monitoring location to the next.

All calculations are checked twice, hard copies of all data entered electronically is reviewed for errors by comparing to field data sheets, and a qualified professional will review the data analysis methods and results after each monitoring event. All activities will follow the ECT SOPs included in Appendix D, the MDNR Fisheries Division manual included in Appendix E, and the MDEQ procedures in Appendix F.

Herpetofauna Sampling – HRM

Errors are minimized by using GPS equipment with software integrated into it that provides dataform and database capabilities. The software is customized with dropdown menus and the user cannot proceed until each required field is complete. Critical data is also documented in hardcopy by the team lead. At the end of the data collection for the day, the team downloads a copy of the data into a project folder, as well as a backup folder. At this point, the data is reviewed for discrepancies or errors. If observed, errors are rectified. Additionally, any errors and the actions taken to correct them are noted in the project file.

Water Bird Monitoring – Allen Chartier

There are two components to the accuracy of the data collected on these bird surveys; identification and counts. Accuracy of identification essentially boils down to the experience of the observer. The observer has extensive field experience with all possible species occurring in the area, which is an acceptable level of QC for these types of measurements. All individuals seen or heard are counted within the time specified. For many species, less than 10 individuals will be detected. Sometimes, such as during waterfowl migration, there will be large flocks out on the water. These are scanned with binoculars or most often with a telescope, and counted individually, or if there are thousands of individuals, a system of "block counting" might be used. What is equally important is that the methodology is consistent so that counts over time can be compared. 100% accuracy is less important than this consistency as the object of this monitoring is to detect changes, and not to evaluate populations.

Additional information is also supplied in Section D.

B.6 Instrument/Equipment Testing, Inspection, and Maintenance

GENERAL SITE ASSESSMENT – JJR

The JJR Field Task Manager is responsible for ensuring all equipment is operational and is available for site assessment. This equipment includes a Nikon Digital camera. The batteries for this equipment undergo an overnight charge prior to use in the field. Additionally, spare batteries (when available) are brought with field supplies to ensure enough power is available the day of field work. Additionally, a spare memory card is kept in the camera case to prevent a lack of sufficient memory for site photographs.

TOPOGRAPHICAL SURVEY – JJR

JJR's equipment is cleaned and calibrated annually to ensure accuracy. The specified accuracy of survey equipment is field tested prior to starting a survey by comparing measured positions to known positions. The JJR Field Task Manager is responsible for ensuring all equipment is operational and is available for survey.

BATHYMETRIC SURVEY – JJR

JJR's equipment is cleaned and calibrated annually to ensure accuracy. The specified accuracy of survey equipment is field tested prior to starting a survey by comparing measured positions to known positions. The JJR Field Task Manager is responsible for ensuring all equipment is operational and is available for survey.

GEOTECHNICAL SURVEY – SOMAT

The SOMAT Field Task Manager is responsible for ensuring all equipment is operational and is available for survey (and sampling). SOMAT's equipment is cleaned and maintained annually to ensure working order. The equipment is

field tested prior to starting a survey to ensure accurate results. A visual inspection of the equipment for damage is performed prior to arriving on-site.

SEDIMENT CHEMISTRY – ECT

Any equipment that will come in contact with the sample is decontaminated prior to use. This is performed with a biodegradable soap (alconox), water (distilled or deionized, if available; otherwise, tap water), alcohol (methanol or ethanol). Additionally, if the equipment is not dedicated to this project site, it undergoes a bleach water wash prior to and after use at the project site to minimize the potential for invasive species transport.

DESIGN – JJR

Computers used for AutoCAD© work have sufficient memory available to perform the tasks for those programs. The software program is updated regularly to keep up with the manufacturer's software updates.

ECOLOGICAL MONITORING – ECT

Fish Monitoring, Visual Aquatic Habitat Assessment, Water Chemistry Sampling, Aquatic Macrophyte Sampling, and Velocity Measurements – ECT

All equipment is checked to make sure it is not damaged and is in working order and all equipment is cleaned before and after taking it into the field. Fyke nets and seines are inspected for holes and/or debris, the boom-shocker is checked for any anomalies that could alter proper operation of the unit (exposed wires, chips, dents, etc.) The underwater camera is tested to ensure that it is in operational order prior to departing for field activities. Sensors are checked to be within specifications as outlined in the ECT SOP for the YSI multi-parameter probe, which is included in Appendix D. The Current Meter is cleaned at the beginning of the monitoring day, and again at the end of the monitoring day. Parts are oiled (if necessary) to allow the unit to pass the spin test prior to the collection of any data. The equipment is maintained according to the ECT SOP for the Current Meter, which is included in Appendix D.

The ECT Field Task Manager is responsible for ensuring all equipment is operational and is available for sampling.

Herpetofauna Sampling – HRM

Trapping/detection equipment will include the use of dip nets, funnel traps, hoop traps, and artificial cover objects (ACO). Although no standard acceptance testing is required, all equipment is checked for holes, flaws, or anything that may affect the sampling efficiency. All equipment is thoroughly cleaned after each area analysis and after each site visit with a 10% bleach solution to reduce the risk of transmission of invasive species or diseases. Cleaning and inspection are done on an as needed basis.

Submeter accuracy GPS units will be used to collect spatial data for observed herpetofauna. Prior to the start of each field day, units are inspected for damage. This inspection is repeated at the end of each field survey. At the start up of the GPS unit, the system goes through an auto calibration and correction to maximize accuracy. Collected data is reviewed using desktop analysis to determine accuracy of the observations. If errors are observed, or accuracy is off, equipment is sent in for servicing. Units come with lithium batteries that are sufficient for an 8 hour work day, negating the need for additional batteries.

A digital camera is used to document observations of reptiles and amphibians. No calibration is required. The digital camera requires lithium rechargeable batteries. No additional batteries are required to accomplish the required tasks.

Water Bird Monitoring – Allen Chartier

Not applicable.

B.7 Instrument/Equipment Calibration and Frequency

All calibration records are maintained in the equipment case for each piece of equipment, and upon each site calibration, the date, calibration parameter, and name or initials of the personnel performing the calibration are specified on this document.

GENERAL SITE ASSESSMENT – JJR

Not applicable.

TOPOGRAPHICAL SURVEY – JJR

Nails or spikes are set flush with the ground at various points offering visibility between multiple locations throughout the project site. These points will be used for project control, transferring horizontal and vertical control to the project site. Elevations are referenced to the top of spike.

Either a GPS receiver or electronic total station will be established centered over the reference point using an optical plummet. A vertical measurement is recorded in feet between the top of the reference point and the center of the instrument axis. The vertical reference measurement is recorded in the field book and digitally entered into the instrument. Additionally, the vertical measurement is recorded in the field book in meters, allowing for verification of the English measurement, in the event of vertical discrepancies are encountered between benchmarks.

Foresight and Backsight mirrors are set up on reference points in the same manner discussed above, with electronic measurement collected to establish angles and distances between reference points, allowing for transfer of coordinates through trigonometry to the next location and subsequent new setup of the survey instrument. This process is continued until benchmarks are referenced and the loop is closed back to the point of beginning.

Upon review of project control, the vertical relationship of the traverse is examined, with the unadjusted traverse closure being within 1.0 centimeter of error, plus 1.0 part per million (ppm), based on linear distance traversed. If the data is within tolerance, review of the benchmark elevation is evaluated. All data will be adjusted to multiple benchmarks, provided the unadjusted benchmark elevations are within the survey tolerance, meaning the datum is sound according to our measurement and no benchmarks appear to be disturbed and out of tolerance.

BATHYMETRIC SURVEY – JJR

Nails or spikes are set flush with the ground at various points offering visibility between multiple locations throughout the project site. These points will be used for project control, transferring horizontal and vertical control to the project site. Elevations are referenced to the top of spike. Either a GPS receiver or electronic total station will be established vertically over the reference point using an optical plummet. A vertical measurement is recorded in feet between the top of the reference point and the center of the instrument axis. The vertical reference measurement is recorded in the field book and digitally entered into the instrument. Additionally, the vertical measurement is recorded in the field

book in meters, allowing for verification of the English measurement, in the event that vertical discrepancies are encountered between benchmarks.

Foresight and Backsight mirrors are set up on reference points in the same manner discussed above, with electronic measurement collected to establish angles and distances between reference points, allowing for transfer of coordinates through trigonometry to next location, and subsequent new setup of the survey instrument. This process is continued until benchmarks are referenced and the loop is closed back to the point of beginning.

Upon review of project control, the vertical relationship of the traverse is examined, with the unadjusted traverse closure being within 1.0 centimeter of error, plus 1.0 part per million (ppm), based on linear distance traversed. If the data is within tolerance, review of the benchmark elevation is evaluated. All data will be adjusted to multiple benchmarks, provided the unadjusted benchmark elevations are within the survey tolerance, meaning the datum is sound according to our measurement and no benchmarks appear to be disturbed and out of tolerance.

From the project control, upon adjustment, elevations are transferred to locations on top of sheet piling or other stable fixed objects that can be used for measurement of water elevation from the survey vessel. These reference points will serve to establish the water elevation during the course of the survey.

GEOTECHNICAL SURVEY – SOMAT

No standard calibration is required for the equipment used in the soil boring or test pit investigation. The soil borings will be performed with a drill rig, utilizing an automatic hammer. The drilling and sampling procedures are performed according to the ASTM sections listed below. The drill rig hammer meets the criteria of the penetration test since the automatic hammer utilizes the required weight and drop height. The split spoon sampler meets the standard dimensions and the drill rods are extended using common lengths of 5 foot and 10 foot sections, as needed.

There are no standard requirements for the equipment utilized to perform test pits, however SOMAT will utilize a track mounted excavator for this project.

SOMAT's Taylor laboratory is accredited by AASHTO Materials Reference Laboratory (AMRL). The accreditation program recognizes the competency of testing laboratories to comply with ASTM specifications. SOMAT is also qualified to conduct material tests by the USACE for the specifications included in Appendix C. The laboratory will perform calibration of the instruments, as needed, by following any manufacturer's instructions. Details on instrument and equipment calibration can be found in SOMAT's Laboratory Quality Manual, *AASHTO R18 Quality Manual* and the records and certificates of calibration are in SOMAT's *Equipment Calibration Manual* which are both available upon request. The SOMAT laboratory equipment calibration manual is reviewed in the accreditation process.

SEDIMENT CHEMISTRY – ECT

Field equipment – Not applicable.

Laboratory equipment – The laboratory will perform calibration of the instruments, as needed, by following manufacturer's instructions. Details on instrument and equipment calibration can be found in the method specific laboratory SOPs found in Appendix G. Additional information can be found in the Paragon Laboratory Quality Manual document #M0001 and is available upon request.

DESIGN – JJR

Not applicable.

ECOLOGICAL MONITORING – ECT

Fish Monitoring, Visual Aquatic Habitat Assessment, Water Chemistry Sampling, Aquatic Macrophyte Sampling, and Velocity Measurements – ECT

Not applicable for Fish Monitoring, Visual Aquatic Habitat Assessment, or Aquatic Macrophyte Sampling.

The multiparameter probe is to be calibrated at the beginning of each monitoring day. Calibration should follow the procedures outlined in the SOP for multiparameter probe, included in Appendix D. The ECT Field Task Manager is responsible for ensuring this is performed.

At a minimum, the velocity measurement device will be calibrated according to manufacturer's instruction once prior to the onset of monitoring activities for this project.

Herpetofauna Sampling – HRM

Not applicable.

Water Bird Monitoring – Allen Chartier

Not applicable.

B.8 Inspection/Acceptance of Supplies & Consumables

Details for all equipment inspection can be found in the appropriate SOP documents, which are included in Appendix B, Appendix C, and Appendix D.

GENERAL SITE ASSESSMENT – JJR

Not applicable.

TOPOGRAPHICAL SURVEY – JJR

The JJR Field Task Manager is responsible for ensuring all supplies are available for surveying. This includes the following equipment:

- Leica Geosystems, System 1200 electronic Total Station, equipped with Leica onboard operating software capable of coordinate geometry, data collection and stakeout;
- Leica Geosystems, System 1200 Geodetic Global Positioning System (GPS) Receiver, capable of post processed data passing the Chi-Square test at 2 Sigma confidence level, and also real time operation with geodetic correction through the Michigan Continuously Operating Reference System (CORS) network;
- Survey Field Book, used for written field notes and specific instrument settings used during data collection, and any other necessary site documentation;
- Safety equipment, including; personal flotation devices (USCG Class II), wet suit, waders, fire extinguisher, signs, cones; and
- Nails, spikes and other metallic materials used as project reference points.
- Office network computer, plotter and copier.

BATHYMETRIC SURVEY – JJR

The JJR Field Task Manager is responsible for ensuring all supplies are available for surveying. This includes the following equipment:

- Bathymetric Survey Vessel - 16 foot aluminum deep-v, equipped with a 60 horsepower mercury outboard engine. The vessel is transportable by trailer and can be launched at standard shall water draft facilities.
- Panasonic Tough book field computer, equipped with a Windows 7 Operating platform and antivirus software to protect system and data. Hypack software is the operational bathymetric data collection platform that manages navigation, data collection and post-processing of raw data.
- Leica Geosystems, System 1200 electronic Total Station, equipped with Leica onboard operating software capable of coordinate geometry, data collection and stakeout.
- Leica Geosystems, System 1200 Geodetic Global Positioning System (GPS) Receiver, capable of post processed data passing the Chi-Square test at 2 Sigma confidence level, and also real time operation with geodetic correction through the Michigan Continuously Operating Reference System (CORS) network.
- Knudsen Engineering Single beam dual frequency echo sounder (200 KHz/ 28 KHz), capable of operation in 1 foot of water depth to over 1000 feet of water depth.
- Knudsen Engineering dual frequency transducer and hardware for permanent mount to the survey vessel. The location of the transducer is starboard, midway, 1 foot draft.
- Ship Motion Control (SMC) Motion Compensator model SMC ICU 101, capable of compensation of ship heave pitch and roll, for vessel sizes between 12 feet to 200 feet in length. There is really no limit of the ship size according to manufacturer.
- Survey Field Book, used for written field notes and specific instrument settings used during data collection, and any other necessary site documentation.
- Safety equipment, including; personal flotation devices (USCG Class II), navigation lights, fire extinguisher, nautical ship to shore radio, paddle, anchor, ropes.
- Nails, spikes and other metallic materials used as project reference points.
- Office network computer, plotter and copier.

GEOTECHNICAL SURVEY – SOMAT

The SOMAT Field Task Manager is responsible for ensuring all supplies are available for surveying. The SOMAT Laboratory Manager is responsible for ensuring all supplies are available for analysis.

SEDIMENT CHEMISTRY – ECT

The ECT Field Task Manager is responsible for ensuring all supplies are available for sampling (including a cooler with ice, the sample bottles, blank COCs, and sample bottles). The ECT Field Task Manager will also ensure that decontamination supplies are brought onsite. The Paragon Laboratory Manager is responsible for ensuring all supplies are available for analysis.

DESIGN – JJR

Not applicable.

ECOLOGICAL MONITORING – ECT

Fish Monitoring, Visual Aquatic Habitat Assessment, Water Chemistry Sampling, Aquatic Macrophyte Sampling, and Velocity Measurements – ECT

The boat operator is responsible for ensuring sufficient gas is available for the day's monitoring activities. The ECT Field Task Manager is responsible for ensuring all supplies are available for monitoring.

Herpetofauna Sampling – HRM

Not applicable.

Water Bird Monitoring – Allen Chartier

Not applicable.

B.9 Data Acquisition Requirements for Non-Direct Measurements

Multiple sources of secondary data are available for Belle Isle and the Detroit River adjacent to the project. These data will be available in either hard copy or electronic format. The data will be saved in the JJR project file and copies of information used for management decisions will be provided in the available format to FDR.

- MNFI database of t/e species. A database search will be performed in order to establish whether or not any t/e species have been identified near the project area. Based on the results of that database search a site search may be conducted. The database search will be conducted as part of the permitting process within the required timeframe for the permitting process.
- DTE Energy is conducting mussel surveys in the Detroit River. Some of their locations are adjacent to the lagoon. This data may be used in conjunction with the MNFI site search, if necessary.
- "Belle Isle Canal Rehabilitation", prepared by JJR with support from Tucker Young Jackson Tull, Inc, January, 1993. Its focus is on the lakes and canal system of the Isle and contains information of hydrology, soils and other relevant data and recommendations.
- Field investigation by Park staff identifying reptiles, amphibians, and other flora and fauna in the project area.
- "Belle Isle Bird Survey", prepared by Allen Chartier with funding assistance from DTE Energy, 2005. Its focus is on documented occurrences of bird species observed during the spring and fall survey periods.
- "Belle Isle/Detroit River Spawning and Sturgeon Habitat Restoration Project" construction documents, prepared by JJR, April 2004. The information shows the locations of two spawning shoals constructed in the Detroit River in the vicinity of the project area.
- "Common Tern Habitat Restoration Efforts Expanded on Belle Isle" news release, January 14, 2011. It documents the initiatives being implemented by a number of stakeholders for the protection and development of additional nesting sites in the vicinity of the project area.
- "Detroit River Wildlife Update", Operations Clean Water newsletter, December 16, 2010. It describes the Common tern habitat restoration efforts on Belle Isle adjacent to the project area.
- "Management Plan for Blue Heron Lagoon Natural Area", prepared by JJR, January, 2004. It describes management and restoration recommendations in the natural areas of Belle Isle immediately adjacent to the project area.
- Belle Isle Lakes and Canals Aquatic Weed Control Program 2000 Summary Report", prepared by JJR, October 26, 2000. It provides data and recommendations for controlling invasive aquatic plant species throughout the Isle.
- Spawning by walleye (Sander vitreus) and white sucker (Catostomus commersoni) in the Detroit River: Implications for spawning habitat enhancement, Bruce A. Manny et. al., published April 9, 2010. It documents research associated with the inventory of a spawning shelf for walleye and white sucker in the Detroit River immediately adjacent to the project site.

USGS flow data may be used in the design phase and for selection of materials for construction. This data, considered "preliminary" by USGS, will be retrieved from the USGS website. For the purposes of this project, the

preliminary data is sufficient. If at any point, the data raises questions, more historical data may be used (up to 5 years old) in order to establish what will be considered normal conditions.

Additionally, a conceptual design for the site has been prepared and will be used as the framework for the design and preparation of construction documents.

B.10 Data Management

All data shall be saved electronically in the project file within one week of collection. If originally collected in hard copy format, the data will be scanned and saved electronically. This electronic project file shall be backed up weekly.

GENERAL SITE ASSESSMENT – JJR

All field notes will be recorded in field logs and with photographs. These notes and photographs will be maintained in the JJR project file. Additionally, the notes will be transferred to an electronic portable document format (pdf) to allow for data sharing.

TOPOGRAPHICAL SURVEY – JJR

Field measurements are collected using conventional total station instruments combined with GPS receivers, to gather three-dimensional coordinates and associated metadata necessary to accurately map and delineate site features. AutoCAD Civil 3D computer software is employed to process the raw field data, attaching symbols, linear features and associated feature labels, merging this data into the Photogrammetric Mapping product created by the Photogrammetrist (when Photogrammetric Survey is conducted), ultimately creating a final Topographic Survey product.

BATHYMETRIC SURVEY – JJR

Field data is downloaded and processed to weed out soundings received from abnormal floating debris, weeds and other false returns. The data is then processed using the water elevation established from land benchmarks. Adjacent Great Lakes tide gauge water level information is downloaded for the same time period of the bathymetric survey and correlated to the site based on proximity, thus providing a sound comparison of the water elevation measured and used in the bathymetric survey.

The edited survey and echo-sounding data is processed with the ship motion compensation data to arrive at the final sounding depths, adjusted for heave, pitch and roll of the vessel. This information is then imported into AutoCAD Civil 3D software for surface creation.

GEOTECHNICAL SURVEY – SOMAT

During the field exploration all relevant information will be recorded on the field log of soil borings. The field boring logs will include approximate soil stratification with detailed soil descriptions and selected physical properties for each stratum encountered in the borings. In addition to the observed subsoil stratigraphy, the logs include information relating to sample data, horizontal and vertical boring location, SPT results, groundwater conditions observed in the boring, personnel involved and other observations during the field investigation. The field logs of test borings will be finalized to include the results of the laboratory classifications and testing. Sample forms are included in Appendix C.

SEDIMENT CHEMISTRY – ECT

ECT field crew will note all relevant sampling information in the field notes. Notes will include a description of the sampling location, a note on the number of attempts it took to achieve enough sample for analysis per sampling location, a description of the sediment, the depth of water, the personnel involved, the time of sample, and other

observations made during sample collection. The field notes will be maintained in the project file (both electronic and hard copy).

Paragon Laboratories will provide their analysis report on the samples submitted for analysis via e-mail. This report will be in PDF format.

DESIGN – JJR

JJR will be responsible for data management for all of the design activities. However, FDR will maintain in the project file draft and master plans for the site along will all formal comments on the plans. Design work will be performed in AutoCAD©2010.

ECOLOGICAL MONITORING – ECT

All field data will be entered into a Microsoft Excel® spreadsheet. Any data entered manually will be checked by a person other than the one originally entering the data. The spreadsheet and a summary monitoring report will be submitted to the Project Manager and the project QA Manager for QA/QC review after each survey. The report will summarize monitoring activities for the period covered and discuss any deviations from the monitoring plan and/or this QAPP document. Following this review, the data and summary monitoring reports will be submitted to the Grant Manager for approval. Once approved by the Grant Manager, the data summary reports may be included in the progress report after each monitoring event and in the final project report.

The final monitoring report will be ready for QA/QC review by June 30, 2013. Approval and distribution of the data and final monitoring report will follow the same steps and procedures as outlined above for the interim data and summary reports. However, the results of the final monitoring event will not be included in the final project report.

Fish Monitoring and Visual Aquatic Habitat Assessment – ECT

Fish sampling and habitat mapping data will be collected on the sample field forms in Appendix E. These log sheets will be maintained in the project file.

Water Chemistry Sampling – ECT

Data will be collected on field forms. These forms will be maintained in the project file in both hard copy and scanned in electronically as pdf documents.

Aquatic Macrophyte Sampling – ECT

After the survey, the data will be entered into the MDEQ's Standard Aquatic Vegetation Assessment Site Species Density Sheet and then into the Standard Aquatic Vegetation Summary Sheet which is included in Appendix F.

All of the data from the AVASs will be compiled into one Excel spreadsheet. In the Summary Sheet the total numbers of a, b, c, and d of a species are multiplied by different factors (1, 10, 40, and 80 respectively) and then divided by the number of AVASs to obtain the average percent cover for that species in the lake. A different average percent cover is computed for each species; these are then added together to obtain a general average percent cover of each AVAS. An estimate of percent cover for the project site will be calculated by summing the individual percent covers of each species.

Herpetofauna Sampling – HRM

Most data handling equipment in included in the Trimble GeoXT submeter accuracy GPS units. As mentioned before, these units have software that allow dataforms to be customized and used to reference data geographically. At the end of each field day, GPS units are downloaded for the day's activities. The corrected or validated data is then uploaded into GIS software where it is used for analysis purposes.

An interim report will be produced at the end of each season, summarizing the work completed to date. The interim report will include updates and preliminary results of this investigation. A final report detailing the findings of our investigation will be produced upon completion of this project. The report will detail sampling methods, monitoring results, home range analysis (when possible), maps of habitat use for selected species, photos, and other data identified through this effort as significant. Electronic copies of the reports will be forwarded to all applicable parties.

Water Bird Monitoring – Allen Chartier

Data from every point count on every day will be entered onto an Excel Spreadsheet.

Velocity Measurements – ECT

Velocity measurements will be recorded on the velocity measurement field form. An example of this form is included in the SOP for velocity measurement.

SECONDARY DATA – ECT

The secondary data identified in Section B.9 will be retained in the project file. If the data report is received as a hard copy, it will be scanned as a (pdf) document and retained in both hard and electronic form in the project file.

The data obtained from the USGS flow database will be copied to CDROM and retained in the project file.

The conceptual plans will be retained in both hard and electronic form in the project file.

SECTION C – ASSESSMENT AND OVERSIGHT

The purpose of data assessment is to assure that the generated data meets specified quality acceptance criteria prior to its use in characterizing site conditions. The measured data will be checked using the data quality indicators of PARCCS as discussed in Section A.7 Quality Objectives & Criteria.

The following types of data will be excluded from use or properly flagged prior to use in site characterization.

- Data that does not meet the prescribed limits for precision, accuracy and completeness, described in Section A.7 Quality Objectives & Criteria;
- Data for which no result is reported for every sample submitted for analysis;
- Data for which holding times were exceeded; and
- Data for which minimum detection levels were not achieved.

C.1 Assessments and Response Actions

There are no scheduled audits for this project, however, the PO can schedule one as seen fit.

Informal audits will be performed throughout this project to ensure project success and the quality of data collected for the needs of the project. All data utilized for the project will undergo various assessments to make sure that the information is valid and clear. This includes all measurements, designs, and all construction activities. The following table presents the types of assessments and response action for the activities applicable to the QAPP.

The following table presents the types of assessments and response action for data collection activities applicable to the QAPP.

Table 8 – Assessments and Response Actions

Activity	Responsible Party	Scope	Response Requirements
Project Status, updates, and oversight	FDR	Monitoring the project status and records to ensure requirements are being fulfilled. Monitoring and review of contractor performance and quality of work.	Report to the EPA PO on a monthly basis via electronic reports. Ensure project requirements are being fulfilled.
QAPP submission to GLNPO	ECT	Develop plan for data collection, data handling, and reporting for the habitat enhancement site.	Provide draft and final documents on schedule. Coordinate with EPA on technical questions and document edits.
Surveys	JJR and SOMAT	Conduct surveys to chart site conditions and elevations.	Provide final documents on schedule.
Sediment Chemistry	SOMAT, ECT and Paragon	Collect and analyze sediment chemistry in the dredging locations for permit application.	Provide laboratory documents that fulfill the permit application requirements.
Design review	JJR, ECT, and City of Detroit	Both engineers and scientists will review the proposed designs to ensure the designs are feasible, they will meet the requirements of the property owners, and they will benefit the Detroit River AOC.	Provide final design plans and specifications to be used for contractor bidding and implementation.
Shop drawing/submittal review	JJR and ECT	Review contractor submittals for conformity with contract plans and specifications	Approve contract documents, if needed. If changes are required, notify contractor of needs. Have contractor resubmit for review and approval.

Activity	Responsible Party	Scope	Response Requirements
On-site oversight and prepare Field Report	Project lead engineer and ecologist	Observe the contractor's ability to verify that the progress and quality of the project is being constructed in conformance with the project plans and specifications	Any discrepancies with work amount and/or quality will be immediately identified and the Project Manager and Grant Manager will be notified. The contractor will make any necessary corrections to meet project plans and specifications.
Site "punch-list"	JJR and contractor	Site walks with the selected contractor to develop the project "punch-list" and additional visits to update those items.	Contractor to address list of items remaining to be fixed. Once done, engineer to review and approve final work.
Final documents "as-built" plans	ECT and JJR	Review contractor's final submission of "as-built" plans for compliance with the specifications and actual site conditions.	Coordinate with contractor until final plans meet specifications of the project and are true to the site conditions.
Ecological monitoring	ECT, HRM, and Allen Chartier	Obtain ecological information from the project site and control sites, relative to the restoration location for this project.	
Final Project Report	FDR, ECT, and JJR	Prepare and submit a final Project Report that includes all site plans and final "as-built" drawings. The final report will also address the results of the ecological monitoring and updated photographs and/or field measurements describing the changes and their benefit to the Detroit River AOC.	Provide draft report on schedule. Coordinate with EPA PO on technical questions and document edits.

If problems arise in the process of completing the aforementioned activities, the FDR project manager will determine the appropriate long-term or short-term action to be taken. Steps to address the problem could include: investigation and determining the cause of the problem, implementing a corrective action, following-up with team members to ensure that the appropriate corrective action has been taken and that the problem has been resolved. If these steps do not adequately address the problem, the Project QA Manager will be responsible for corrective action and will inform the FDR Project Manager as appropriate.

C.2 Reports to Management

As stated in section A.9 and B.10 the ECT and JJR Project Managers will issue monthly project status memorandums to the FDR Grant Manager. Included in these reports will be updates on the current findings and project developments, any problems encountered, and solutions to those problems. These reports will be submitted electronically via e-mail.

On a biannual basis, the FDR Grant Manager will submit reports to the EPA PO documenting project progress and noting any problems encountered and/or deviations from this QAPP.

The draft final report will be submitted for review according to Table 2 – Project Schedule. At which point, the EPA PO will review and provide comments. The FDR Grant Manager will address these comments within 2 weeks of receipt and will send the final report document in both hard copy and on CDROM to the EPA PO.

SECTION D – DATA VALIDATION AND USABILITY

D.1 Data Review, Verification, and Validation

All data will be reviewed for completeness and correctness. Raw data that is received in electronic format will be screened using visual inspection of the data (scanning for values outside of the typical ranges) and electronically (data statistics in Microsoft Excel®). Any data received in hard copy will be assessed by comparing the original data to the entered electronic data.

All sampling results will be crosschecked against the field notebook, sample tags, and chain of custody documents to ensure that the data summary is correct and complete. The Project QA Manager will also review the data to determine if it meets the QAPP objectives as outlined in A.7 Quality Objectives & Criteria. Preliminary decisions to accept or qualify data are made by the Project Manager.

Each activity should be completed within 10 feet of the planned location. Any deviations from this are to be clearly noted on the field form, with an explanation as to why the original location was not attainable.

Fish community diversity (Shannon-Weiner index), species richness (number of species), catch-per-effort, and species composition will be determined to compare the fish communities between stations and over time as discussed below. Similarity between monitoring stations will be evaluated using Sørensen's similarity index. The equations that will be used to calculate each of these community indices or metrics are provided below.

- Shannon-Wiener Index of Diversity $H' = -\Sigma p_i \log p_i$

  Where:
  H' Shannon-Wiener Index
  p_i proportion of species *i*

- Catch per Effort $CPE = \frac{n}{T}$

  Where:
  CPE catch per effort (#/minute)
  n total number of individuals or sample size (catch)
  T sampling time in minutes (effort)

- Species Composition $SC_i = \frac{n_i}{n}$

  Where:
  SC_i species composition of species *i*
  n_i number of species *i*
  n total number of individuals or sample size

- Sørensen's Similarity Index $\beta = \frac{2c}{n_1 + n_2}$

Where:

β	Sørensen's Similarity Index (0-1, dimensionless)
c	number of species common between sample stations
n_1	number of species in station 1 sample
n_2	number of species in station 2 sample

The Shannon-Wiener diversity index has been used extensively in the scientific literature to evaluate the difference in biological diversity over time or between sampling stations. Hutcheson (1970)[1] is credited with developing a t-test for the Shannon-Wiener Index as noted and cited by Poole (1974)[2] and Magurran (2004)[3]. The variance of the Shannon-Wiener index (var*H'*), degrees of freedom (*df*), and t-statistic is calculated using the equations below from Hutcheson (1970).

$$\text{var } H' = \frac{\Sigma p_i \ln^2 p_i - \left(\Sigma p_i \ln p_i\right)^2}{n} + \frac{s-1}{2n^2}$$

Where:

var*H'*	variance of the Shannon-Wiener Index (*H'*)
p_i	proportion of species *i*
ln	natural log
s	number of species
n	number of individuals of all species

$$df = \frac{\left[\text{var}\left(H'_1\right) + \text{var}\left(H'_2\right)\right]^2}{\left[\text{var}\left(H'_1\right)^2 / n_1\right] + \left[\text{var}\left(H'_2\right)^2 / n_2\right]}$$

Where:

varH'_1	variance of the Shannon-Wiener Index (*H'*) for community 1
varH'_2	variance of the Shannon-Wiener Index (*H'*) for community 2
n_1	number of individuals for community 1
n_2	number of individuals for community 2

$$t = \frac{H'_1 - H'_2}{\left[\text{var}\,H'_1 + \text{var}\,H'_2\right]^{1/2}}$$

Where:

H'_1	Shannon-Wiener Index for community 1
H'_2	Shannon-Wiener Index for community 2

[1] Hutcheson, K. 1970. A test for comparing diversities based on the Shannon formula. J. Theoretical Biol. 29:151-154.
[2] Poole, R.W. 1974. An introduction to quantitative ecology. Mc-Graw Hill.
[3] Magurran, A.E. 2004. Measuring Biological Diversity. Blackwell Publishing. 256pp.

$varH'_1$ variance of the Shannon-Wiener Index (*H'*) for community 1
$varH'_2$ variance of the Shannon-Wiener Index (*H'*) for community 2

The Hutcheson t-test will be used with α=0.10 to test for statistically significant differences between the fish communities under the following comparisons.

- Project site diversity pre- and post- site restoration
- Upstream Site pre- and post- site restoration
- Project site versus upstream station fish community diversity pre- and post- site restoration

The Shannon-Wiener Index and statistical testing described above can show a significant difference between communities at station or over time (i.e. pre- to post site restoration). However, the index cannot adequately describe the difference or the magnitude of the difference. To further evaluate differences and change within the fish communities, the other community indices proposed and a conversion of the Shannon-Wiener Index will be used as described below.

When the number of species in a community doubles, the community diversity intuitively doubles. This is not the case with the Shannon-Wiener Index, which is highly non-linear. A very large change in true diversity within a community can be represented by a very small change in the Shannon-Wiener Index, thereby masking the true magnitude of the change. Banos (2006)[4] suggests a means of converting the Shannon-Wiener Index from a measure of entropy to a true measure of diversity expressed as the "effective number of species." The effective number of species is the number of species with equal frequency that would result in a Shannon-Wiener index of a certain value. Banos (2006) equates it to true diversity. Mathematically, Banos (2006) defines the effective number of species as the exponential of the Shannon Index [exp(*H'*) or $e^{H'}$; the base of the natural logarithm raised to the power of *H'*]. The effective number of species is proportional to the number of equally common species in a community. If the number of equally common species in a community doubles, the measure of diversity used should also intuitively double.

As the Shannon-Wiener index measures it, diversity is high when there is a high number of species in the community with high equitability (i.e. evenness). Therefore, a high effective number of species equates to high diversity and vice-versa. It is useful to convert the Shannon-Wiener index to the effective number of species because it allows an assessment of the magnitude of difference/change in addition to the statistical significance of that difference/change when used to compare two communities or compare diversity over time in response to a change/disturbance within a system.

Species composition will be used as a side-by-side comparison of fish assemblages. That is, the percent composition or abundance for all species between two communities will be compared side-by-side to illustrate compositional differences in the communities. Consideration of habitat preferences and species rarity/absence will be considered in the analysis to highlight differences in the communities that could be attributed to the effects of the restoration activities within the project site. For example, the project site may not contain some species of fish present at the and upstream station due to some difference in habitat. To graphically illustrate compositional differences between communities, k-dominance curves will be created by plotting cumulative percent dominance (i.e. % composition) on the y-axis and the natural log of the each species' rank based on abundance on the x-axis. The shape of the k-dominance curves can be compared visually to highlight the differences in the communities.

[4] Banos, L.J. 2006. Entropy and diversity. Oikos 113:2 (363-375).

Sorenson's Similarity Index will be used to assess similarity between communities. Sorenson's provides an estimate of the percent similarity between species assemblages based on presence-absence data. More overlap in species between two communities will result in a higher index value, meaning the two communities are similar. Two communities with the same species assemblage will be 100% similar.

The habitat mapping described above will be used to inform the data analysis and decision making process. Differences in habitat from pre- to post-site restoration or between the upstream and project site stations may explain some of the differences in fish assemblages. Project site restoration activities are expected to change the types and abundance of habitats due to restoration of shoreline and reconstruction of shoal habitat.

Pre and post construction velocity will be measured at low flow using a flow meter. Velocity measurements will be made at five locations within the project site and five locations within the upstream and downstream sites. The five velocity measurements will be equally spaced across the cross-section. The five velocity measurements will be averaged for comparison of pre and post velocity measurements within the site.

D.2 Verification and Validation Methods

For all data, the Field Manager responsible for data collection will perform an initial review of all data. That team's Project Manager will then conduct a secondary review to ensure that the data matches known site conditions, based on visual observations from site visits. Upon receipt of the data, the JJR personnel responsible for site design will use professional judgment in review of the data and will discuss any anomalies with the JJR Project Manager and the appropriate members of the project team. Anyone performing a review of the data will report the results of that review to all intended users of the data via e-mail.

D.3 Reconciliation with User Requirements

As mentioned previously, this data is being collected to successfully design and construct a habitat suitable for fish and other wildlife on the shore of the Detroit River and within the Blue Heron Lagoon. Data will be collected throughout the project to create site-suitable designs and to establish whether or not the site remediation project attained the following goals:

1. Benefit native fish and their habitat;
2. Restore habitats limiting productivity;
3. Restore natural systems; and
4. Expands upon the recreational experiences of the Belle Isle park users with emphasis on a future environmental education program.

Surveys of the site will allow JJR to create high quality site plans. In doing so, the contractors hired to construct the habitat will have the most accurate information available and will have fewer problems during construction, thus allowing the project to proceed without issue.

Biological community surveying will allow ECT to measure whether or not the habitat has been restored. Additionally, the availability of the post-construction data will ease in the process of delisting the BUI for lack of fish and wildlife habitat in the Detroit River AOC.

If during the data evaluation process, a data set does not meet all of the data requirements set forth in this document, that data set (or a portion of it) will be rejected. Steps will be taken to ensure that any necessary re-measurement activities undergone will provide the quantity and quality of data required to fulfill the project objectives.

Park users will be provided an opportunity to learn about the Detroit River and the Blue Heron Lagoon habitat through the development of a future environmental education program that can be realized through the implementation of the habitat enhancements.