

QUALITY ASSURANCE PROJECT PLAN
for
**Hogansburg Dam Removal Pre-Construction Mussel Surveys
And Mussel Relocation Site Investigations**

Prepared for:
U.S. Environmental Protection Agency Region 2 and
Great Lakes National Program Office

Part of:
Freshwater Mussel Restoration in the St. Regis River GL-00E01943



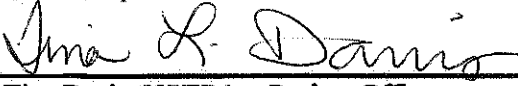
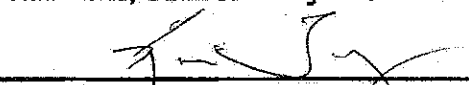
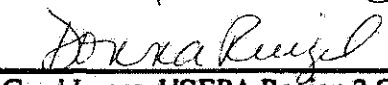

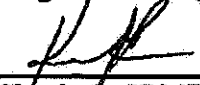
Prepared by:
Jessica L. Jock
St. Regis Mohawk Tribe
Environment Division
Akwesasne, 13655

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QUALITY ASSURANCE PROJECT PLAN
Saint Regis Mohawk Tribe
St. Regis River Mussel Surveys and Relocation Site Investigations
Approval Page

Approvals:

	8/15/2016
_____ Jessica Jock, Project Manager, SRMT Environment Division	Date
	9/19/2016
_____ Lisa Holst, NYSDEC	Date
	9/22/16
_____ Tina Davis, USEPA - Project Officer	Date
	9/22/16
_____ Kai Tang, USEPA Region 2 Quality Assurance-Tribal Liaison	Date
	8/21/16
_____ Carol Lynes, USEPA Region 2 Quality Assurance (QA) Officer	Date
<i>for</i> 	8/16/16
_____ Angela Benedict, SRMT Quality Assurance Officer (QAO)	Date
	8/16/16
_____ Ken Jock, SRMT Environment Division Director's Approval	Date

Project Initiation:	June 13, 2016
Project Termination:	December 1, 2016
Project Manager:	Jessica L. Jock, SRMT Environment

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1.1 PROJECT MANAGEMENT

1.2 *Distribution list*

1. Jessica Jock
St. Lawrence River AOC, Program Manager
Saint Regis Mohawk Tribe (SRMT), Environment Division
518-358-5937 x139
jessica.jock@srmt-nsn.gov
2. Tina Davis
GLRI – Project Officer
USEPA, Region 5
77 West Jackson Blvd., GL-17J
Chicago, IL 60604 - 3507
312-353-8254
Davis.Tina@epa.gov
3. Lisa Holst
Rare Fish Unit Leader and Freshwater Mussels
Bureau of Fisheries
625 Broadway
Albany, NY 12233
518-402-8887
Lisa.holst@dec.ny.gov
4. Carol Lynes
USEPA, Region 2
Quality Assurance Program
Division of Environmental Science and Assessment
2890 Wood Bridge Ave.
Edison, NY. 08837
732-321-6616
lynes.carol@epa.gov
5. Kai Tang
USEPA, Region 2
Quality Assurance Program, Tribal Liaison
2890 Wood Bridge Ave.
Edison, NJ 08837
732-321-4364
tang.kai@epa.gov

6. Angela Benedict
Air Program Manager/Tribal Quality Assurance Officer (TQAO)
Saint Regis Mohawk Tribe (SRMT), Environment Division
518-358-5937 x129
angela.benedict@srmt-nsn.gov
7. Ken Jock
Division Director
Saint Regis Mohawk Tribe (SRMT), Environment Division
518-358-5937 x 116
ken.jock@srmt-nsn.gov
8. Tony David
Water Resource Program Manager
Saint Regis Mohawk Tribe (SRMT), Environment Division
518-358-5937 x 112
Tony.david@srmt-nsn.gov
9. Mark Erickson
Freshwater Mussel Expert Scientist
Chapin Professor Emeritus, St. Lawrence University (SLU)
15 Church Street
Canton, NY 13617
315-229-5193
meri@stlawu.edu
10. Jay Wilkins
Environmental Specialist
Saint Regis Mohawk Tribe (SRMT), Environment Division
518-358-5937 x 123
jay.wilkins@srmt-nsn.gov
11. Craig Arquette
Environmental Specialist
Saint Regis Mohawk Tribe (SRMT), Environment Division
518-358-5937 x 119
craig.arquette@srmt-nsn.gov
12. Angello Johnson
Apprentice, Akwesasne Cultural Restoration Program Saint
Regis Mohawk Tribe (SRMT), Environment Division 518-
333-0221 x 5006
angello.johnson@srmt-nsn.gov

13. Vaughn Adams

Master, Akwesasne Cultural Restoration Program
Saint Regis Mohawk Tribe (SRMT), Environment Division

518-333-0221 x 5006

vaughn.adams@srmt-nsn.gov

1.3 *Project Management*

The project will be implemented by the Saint Regis Mohawk Tribe's Environment Division with mussel species identification made by Dr. J. Mark Erickson, and voucher verification as needed by New York State Museum malacologists in consultation with NSYDEC. This section describes roles and responsibilities of individuals involved.

EPA GLRI- Project Officer

Tina Davis will be responsible for providing funding and QAPP approval, and coordination with the proposed project and reporting needs.

SRMT Environment Director

Ken Jock, SRMT Environment Division Director, is responsible for providing financial and staff resources necessary to meet project objectives and implement the requirements describes in this QAPP. The Director is the official project contact of all funding resources and has primary signing authority for all purchases and project plans.

Quality Assurance (QA) Officers

Angela Benedict, Tribal Quality Assurance Officer (TQAO) is responsible for reviewing and approving all QAPPs according to the Tribe's Quality Assurance Management Plan, 2015 (QAMP). She has signing authority for a project work plan for the SRMT Environment Division and coordinating QAPP approval with Region 2 QA Officer (Carol Lynes) and Tribal QA Liaison (Kai Tang). Should there be a need for any significant corrective actions, Carol and/or Kai will be contacted and consulted with prior to any continued work.

SRMT Project Manager

Jessica L. Jock, St. Lawrence River Area of Concern (AOC) will be responsible for directing field crew, field data collection oversight and sampling QA/QC, data collection via SCUBA, and consulting with Lisa Holst, NYSDEC on relocation strategy and voucher samples, reporting quarterly to EPA, and final report compilation.

Species Identification, Aging, and Sexing

Dr. J. Mark Erickson, Professor Emeritus, St. Lawrence University has over 30 years of Freshwater Mussel species research and identification in the greater St. Lawrence River watershed and has familiarity with St. Regis River species from past surveys. If questions about specific identifications persist, appropriate information will be collected (photograph and vouchers) and forwarded to outside experts for validation.

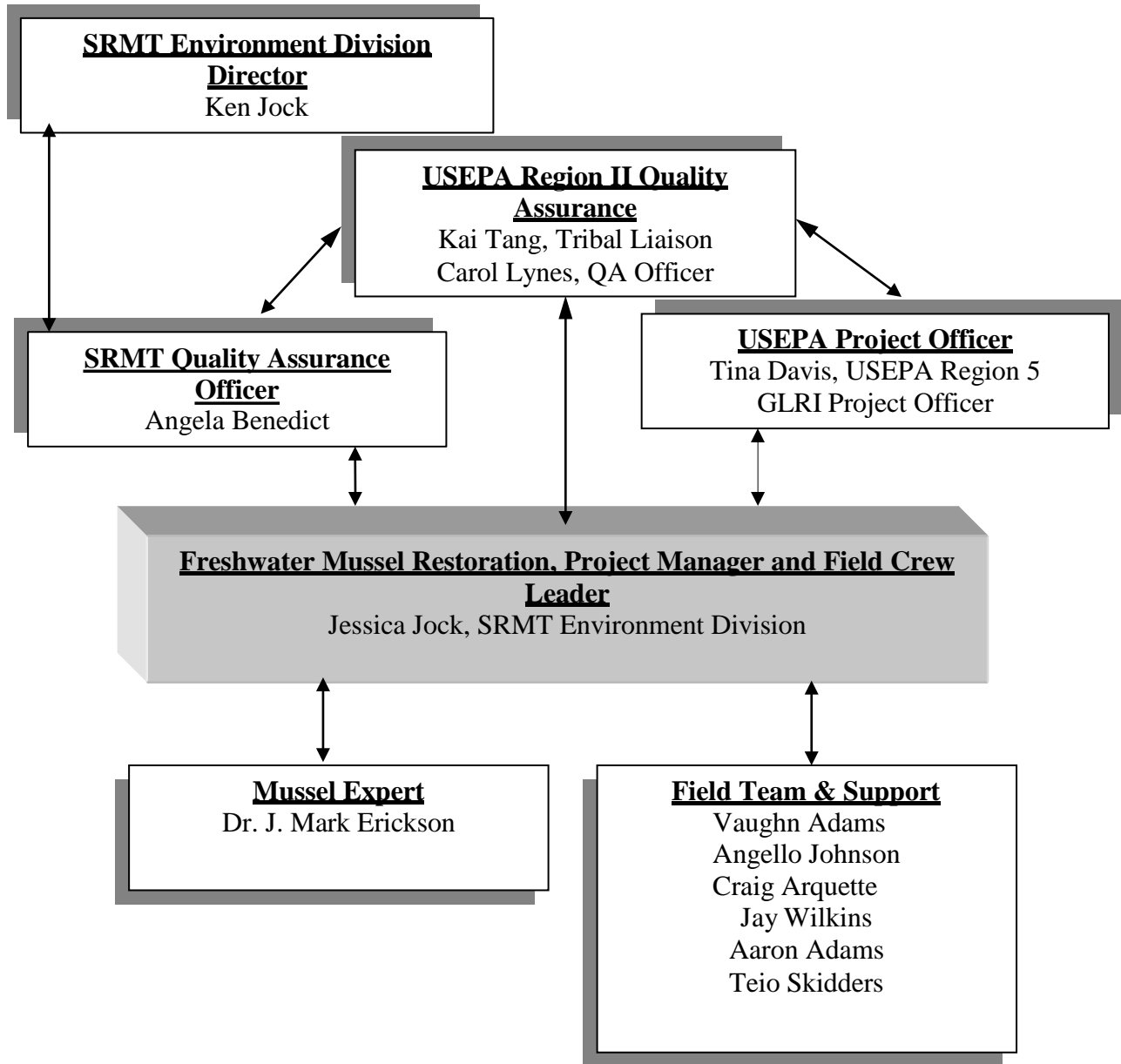
Field Team

Field tasks include performing mussel surveys, habitat evaluations, and mussel relocation. The field crew will also be responsible for documentation and records to be maintained in the field. They will be responsible for all field data labeling, photo documentation, recording, management, and mapping GPS locations of sampling sites. They are expected to follow the methodologies outlined in this QAPP.

Craig Arquette will serve as the Dive Safety Officer (DSO). Craig has 20 years of American Canadian Underwater Council (ACUC) International certification, and familiarity with SCUBA diving in the St. Regis River.

Vaughn Adams will lead a support team for mussel collection via snorkeling and wading, streamside safety assistance and boat support daily during surveys.

Figure 1. Organizational chart of management for Freshwater Mussel Surveys



1.4 Project schedule

QAPP Review by USEPA and NYSDEC	June 2016
Field Reconnaissance and Survey Markings	June 13 th , 2016
Pre-Construction Mussel Surveys	June 14th-24th, 2016
<i>Impoundment Drawdown</i>	<i>June 27th, 2016</i>
Relocation Conservation Effort #1&2	June 30th-July 14th, 2016
<i>Demolition of dam spillway</i>	<i>July 18th, 2016</i>
Relocation Conservation Verification	TBD
1-mo. check for survivability of relocated mussels	August/September
Kawenn:ios Newsletter	September 2016
Draft Final Report	December 2016
Present Findings at RAC	December 2016
Complete Final Report	March 2017

Tasks 1: QAPP

A Quality Assurance Project Plan (QAPP) as per USEPA requirements including all QA/QC measures, field collection work plan, and field data sheets, etc. will outline the details and study objectives of the mussel surveys in the St. Regis River.

Task 2: Collaboration with NYSDEC, Albany

In lieu of a license to collect freshwater mussels in sections of the St. Regis River that are in NYS jurisdiction (whereas other waters are Mohawk waters), SRMT has a letter of understanding regarding off-territory scientific studies with NYSDEC (see letter dated June 6, 2016 from NYSDEC to SRMT). Sampling methodology, relocation strategy, and sample vouchering will be conducted in consultation with Lisa Holst, NYSDEC.

Task 3: Field data collection

Field reconnaissance and survey activities will begin immediately. Surveys are to be conducted June 14th-24th, consistent with reputable mussel expert availability and dam removal construction schedule and timeline. Survey will also target habitat in upstream un-impacted areas (i.e. Relocation Pools) to determine if similar habitat exists to further refine relocation strategy and efforts during drawdown and dam demolition. Relocation efforts will be described in a separate addendum, with every effort made to conduct consistent to relocation protocols outlined in Piette 2005, Clayton et al., 2015, and VDGIF 2013 (Guidelines in the States of Wisconsin, West Virginia, and Virginia, respectively).

Task 4: Draft report

Summary of 2016 mussel surveys and relocation efforts will be reported to NYSDEC and USEPA.

1.5 Project background

In March of 2015, the Saint Regis Mohawk Tribe (SRMT or Tribe) became co-licensee of the Hogsburg Hydroelectric Project—a small, historic dam on the St. Regis River and first impassible barrier to fish—for the purposes of decommissioning the obsolete facility and removing the dam to restore migratory fish access from the St. Lawrence River. Removal will begin in the summer of 2016, to restore this tributary river to free-flowing conditions for up to 267 river and stream miles of potential fisheries spawning habitat. It is currently home to several state listed species of fish that may benefit by increased connectivity with the St. Lawrence River (McKenna et al., 2015; Dittman et al., 2010; Carlson 1997).

Based on 2012 and 2013 surveys conducted by Riveredge Associates, LLC under contract to SRMT, 10 species of freshwater mussels were identified in the St. Regis River. Five of those identified species are listed as New York State Species of Greatest Conservation Need (SGCN), but none of the found species to date are State, Provincial, or Federally listed threatened and endangered species. Potential species that may occur in or near the Hogsburg dam impoundment include: *Alasmodonta marginata*, *Anodontoides ferussacianus*, *Elliptio complanata*, *Lampsilis cariosa*, *Lampsilis ovata*, *Lampsilis radiata*, *Leptodea fragilis*, *Ligumia recta*, *Potamilus alatus*, and *Strophitus undulatus* (Harper et al., 2015). Other species that have been identified in or near the St. Lawrence River Area of Concern and their conservation status are outlined in Table 1.

Freshwater mussels are long-lived, slow growing, and slow moving organisms that have difficulty adapting to any drastic and sudden habitat alteration; such as lowering of a reservoir during dam removal. Lessons learned on other dam removal sites indicate a high mortality of mussels may occur from stranding, desiccation, or exposure to predation (Doyle et al., 2005), especially in shallow nearshores and adjacent ponds upstream of the impoundment proposed for dewatering (Cooper 2011). Proactive measures to mitigate unintended harm to restore existing unionid populations in the area of potential effect (APE) can be achieved through a relocation effort. Relocation success has been reported as high as >97% at some sites (Cope et al., 2003), in comparison to 77%-95% mussel mortality (Cooper 2011; Doyle et al., 2005) by a ‘do nothing’ or ‘no action’ approach during dam removal. Relocation has been used as a conservation strategy by state and federal agencies for freshwater mussels as a way to protect mussel populations from unintended adverse effects during dewatering, sedimentation, construction projects, and chemical pollution impairments (Cope and Waller 1995; Clayton et al., 2015).

Proposed survey methods to be conducted on the St. Regis River will utilize similar approved time-searched surveys already used in or near the St. Lawrence River AOC (Normandeau 2008; Riveredge 2013; Harper et al., 2015; Riveredge 2015). Field survey search and collection methods will use standard accepted practices such as wading, snorkeling, and SCUBA diving. Survey objectives will prioritize nearshore and shallow mussel habitat areas most likely to be affected by dewatering (including islands), habitats that support high densities of SGCN mussel species, and adjacent ponds or tributary confluences that may be affected by drawdown. Further details provided below in Sampling Methods.

Table 1. Freshwater mussel species potentially occurring in and near the St. Lawrence River AOC and their conservation status. Species previously identified in the St. Regis River in bold below (Table modified from Harper et al., 2015).

	Scientific Name	Common Name	New York Status ³	Species of Greatest Conservation Need (SGCN) in New York ⁴	Species of New England Conservation Concern (Therres, 1999)	COSEWIC ⁵	Ontario Status ⁶	Quebec Status ⁷	SARA Status ⁸
1	<i>Actinonaias ligamentina</i> ¹	Mucket		✓					
2	<i>Alasmidonta marginata</i>	Elktoe		✓	✓			*9	
3	<i>Alasmidonta undulata</i>	Triangle Floater							
4	<i>Alasmidonta varicosa</i>	Brook Floater	T	✓ (HP)	✓	SC			SC
5	<i>Anodontoides ferussacianus</i>	Cylindrical papershell							
6	<i>Elliptio complanata</i>	Eastern elliptio							
7	<i>Lampsilis cariosa</i>	Yellow lampmussel		✓	✓	SC			SC
8	<i>Lampsilis ovata</i>	Pocketbook		✓					
9	<i>Lampsilis radiata</i>	Eastern lampmussel							
10	<i>Lasmigona compressa</i>	Creek heelsplitter							
11	<i>Lasmigona costata</i>	Fluted shell							
12	<i>Leptodea fragilis</i>	Fragile papershell						*9	
13	<i>Leptodea ochracea</i>	Tidewater mucket		✓ (HP)	✓				
14	<i>Ligumia recta</i>	Black sandshell		✓ (HP)					
15	<i>Ligumia nasuta</i>	Eastern pondmussel		✓	✓	E	E		E
16	<i>Margaritifera margaritifera</i>	Eastern pearlshell		✓					
17	<i>Obovaria olivaria</i> ²	Hickorynut				E	E	*9	
18	<i>Potamilus alatus</i>	Pink heelsplitter		✓				*9	
19	<i>Pyganodon cataracta</i>	Eastern floater							
20	<i>Pyganodon grandis</i>	Giant floater							
21	<i>Strophitus undulatus</i>	Creeper							
22	<i>Villosa iris</i>	Rainbow		✓ (HP)		E	T		E
Totals			1	11	5	5 (3 E, 2 SC)	3 (2 E, 1 T)	4 *likely	4 (2E, 2 SC)

E=Endangered, T = Threatened, SC = Special Concern, HP= high priority COSEWIC = Committee and the Status of Endangered Wildlife in Canada

Notes:

1. This species previously reported as occurring in the AOC but further research indicates it is not known to occur in the AOC.
2. This species is considered historical (SH) in New York State.
3. New York Status: <http://www.dec.ny.gov/animals/7494.html>
4. SGCN Status: http://www.dec.ny.gov/docs/wildlife_pdf/sgnc2015list.pdf
5. COSEWIC October 2014 Status: http://www.cosewic.gc.ca/eng/sct0/rpt/csar_fall_2014_e.pdf
6. Ontario Status: <https://www.ontario.ca/environment-and-energy/species-risk-ontario-list>
7. Quebec Status: <http://www3.mffp.gouv.qc.ca/faune/especies/menacees/liste.asp>
8. SARA Status: http://www.registrelep-sararegistry.gc.ca/species/schedules_e.cfm?id=1
9. *Listed as “likely” to be designated threatened or vulnerable

1.6 Description of project area

The Mohawk Territory of Akwesasne is located near the townships of Massena, NY and Cornwall, ON. The territory is at the intersection of northern New York State with the provinces of Ontario and Quebec and straddles the St. Lawrence River. The Hogansburg Dam is located on the St. Regis River, a north flowing 852 square mile watershed with headwaters in the Adirondack Mountains of Northern New York State. The dam is located 2.5 river miles from the confluence with the St. Lawrence River. The focus area of this pre-construction mussel survey is from the upstream limit of the work area under the 401/404 permit, upstream 4.85 miles to the next hydraulic break (a riffle section near the town of Helena, NY). This length of the river includes tributaries to the St. Regis River, uninhabited islands, and submerged sand bars. This section of the river includes the shared jurisdictions of the Saint Regis Mohawk Tribe and the New York State Department of Environmental Conservation (DEC) for the most part separated by the thread of the St. Regis River (Figure 2). The public record includes a Settlement Agreement reached between the Tribe and regulatory stakeholders (DOI, BIA, USFWS and DEC) in 2014 that supports the dam removal.

Figure 2. Green represents the focus of DEC and Army Corp permits for Hogansburg Dam. Red represents the project impoundment. Blue line represents co-management of river resources between SRMT and NYSDEC. Orange line represents the break of anticipated APE for freshwater mussels during drawdown.



1.7 *Quality objectives and criteria*

The primary objectives of the 2016 St. Regis River mussel surveys are to:

1. Conduct pre-construction mussel surveys to identify high density mussel beds most likely to be impacted by dewatering, or mussel beds with high densities of NYS Species of Greatest Conservation Need (SGCN);
2. Use mussel survey results and species identification data to inform development of a relocation restoration strategy to be conducted during dewatering and construction activities summer 2016;
3. Coordinate and implement a mussel relocation/restoration action utilizing both qualified SRMT Environment Division Staff and Akwesasne Community Volunteers.

The primary measurement objectives of the 2016 pre-construction mussel surveys include:

1. Conduct 1-hr time search at each segment, both left bank and right bank and identified habitats of interest, including proposed Relocation Pools (see Figure 3 and Tables 2-3).
2. Conduct species identification and count of all collected mussels during 1-hr time search
3. Record substrate percent composition of habitat supporting mussel populations of area surveyed during 1-hr time search
4. Measure and record length, age, and sex of at least 10-mussels representative of sizes of each different species at each segment surveyed.

Spatial Representativeness

Representativeness expresses the degree to which data represents a characteristic of a population, a parameter variation at a sampling point, or an environmental condition. A systematic approach using 300m-segments and targeting surveys at both right bank and left bank to represent the environment of interest during water level drawdown will be surveyed. Targeted survey in sand shoals, tributaries and around uninhibited islands will also be conducted.

Temporal Representativeness

Qualitative mussel and habitat survey will be conducted during mid to late June to be conducted when stream levels are near base flow (or lower) and water temperatures are rising. June survey is consistent with most standard mussel survey protocols and accepted survey window for freshwater mussels. Daily river flow and stage height conditions for the duration of the survey will be recorded from USGS 04269000 St. Regis River at Brasher Center, NY: http://waterdata.usgs.gov/nwis/uv/?site_no=04269000&agency_cd=USGS. This is the nearest USGS station to the mussel survey area and is located approximately 12-river miles upstream of the Hogansburg dam. A correction factor of 1.163 is applied to estimate the flow at the Hogansburg dam and immediate vicinity (Delaware Engineering, P.C. 2013). In addition to temporal representativeness for data collection, daily flow data is used to assist field decisions for divers, boat access, and staff safety.

Completeness

Every reasonable effort will be made to survey both right and left bank of Segments SRU01-SRU16 (n= 32), with target surveys (i.e. either bank to bank or time-search around island banks) at SRU17-SRU24 (n=8) for a total of n=40 possible sampled areas. Completeness will be dependent on weather, field conditions (flows), and team availability. A minimum of 32 intended survey areas would be needed for 80% completeness to achieve study objectives. However, considering this study is specific to identify high mussel densities in advance of the draw-down, every reasonable effort will be made to survey all 40. Should time constraints inhibit ability to conduct a time-search survey at both right and left bank Segments SRU01-SRU16, only one bank will be selected, biased to lowest water depths (i.e. most likely to be impacted by drawdown).

Accuracy

Accuracy of identifying freshwater mussels will be achieved through the use of species verification and voucher specimens. Given the objectives of this survey, timely needs for relocation efforts, and expected known species to be found in the survey area (Table 1) it is not anticipated many specimens will be vouchered. Any mussel that can't be affirmatively identified by Dr. J. Mark Erickson will be vouchered for later submittal to the New York State Museum. Voucher specimens will include a photograph of the posterior and beak with Location ID, date of collection, and questionable species ID. All voucher specimens will be retained at SRMT, frozen until facilitated transport to New York State Museum. All Segments surveyed (n=40) will also include a group photograph to document all mussels collected at each site. Included in the photograph will be:

1. 1-meter stick and a 6"-ruler or digital calipers for size reference;
2. All mussels collected aligned by size and species;
3. A dry erase board (or two) with Location ID, date of collection, species ID and species count, and total # of live mussels.

Figure 3. Proposed 2016 300m-Survey Segments consistent with Harper and Jock, 2014 and targeted sand shoals and tributaries.

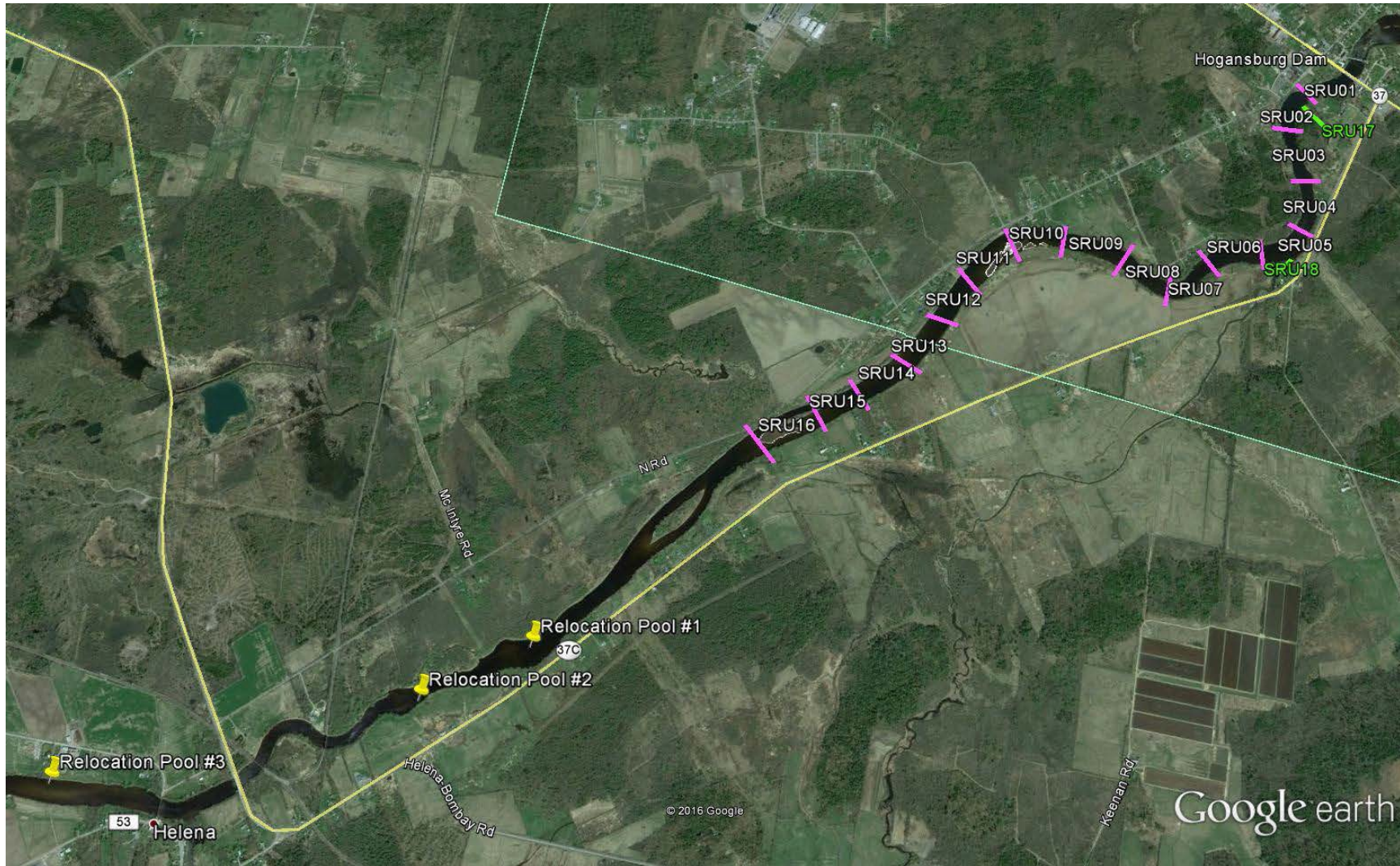


Table 2. Sites proposed for 2016 mussel survey and GPS coordinates.

River Segment	Site Description (if any)	Right Bank ¹		Left Bank ¹	
		Latitude	Longitude	Latitude	Longitude
SRU00	Rte. 37 Bridge	N 44.97325	W 74.66597	N 44.97297	W 74.66504
SRU01	Tsiokwanati:io (left bank)	N 44.97167	W 74.66844	N 44.97131	W 74.66773
SRU02 ²	Mohawk School/boat launch (right bank)	N 44.96916	W 74.66933	N 44.96929	W 74.66843
SRU03	NA	N 44.96655	W 74.66750	N 44.96676	W 74.66654
SRU04	NA	N 44.96402	W 74.66706	N 44.96386	W 74.66614
SRU05	NA	N 44.96254	W 74.66913	N 44.96166	W 74.66870
SRU06	NA	N 44.96115	W 74.67269	N 44.96062	W 74. 67178
SRU07	NA	N 44.95935	W 74.67462	N 44.95852	W 74.67454
SRU08	NA	N 44.96026	W 74.67776	N 44.95941	W 74.67814
SRU09	NA	N 44.96041	W 74.68223	N 44.95961	W 74.68215
SRU10	NA	N 44.95957	W 74.68610	N 44.95861	W 74.68504
SRU11	NA	N 44.95681	W 74.68828	N 44.95621	W 74.68713
SRU12	NA	N 44.95425	W 74.68949	N 44.95419	W 74.68808
SRU13	NA	N 44.95171	W 74.69110	N 44.95143	W 74.68972
SRU14	NA	N 44.94975	W 74.69324	N 44.94912	W 74.69229
SRU15	NA	N 44.94831	W 74.69561	N 44.94745	W 74.69444
SRU16 ²	North Road where close to west bank	N 44.94609	W 74.69881	N 44.94539	W 74. 69752
SRU17 ³	Tributary #1 – adjacent Tsiokwanati:io	N 44.97072	W 74. 66815	N 44.96992	W 74.66641
SRU18 ³	Tributary #2 – adjacent 37C	N 44.96229	W 74.66694	N 44.96138	W 74. 66762

Notes: 1. Bank orientation when facing upstream 2. Sampled in 2013 3. Proposed bank to bank time search survey

Table 3. Sites proposed for 2016 feature specific mussel survey.

River Segment	Site Description	Latitude	Longitude
SRU19	Sand Shoal	N 44. 95792	W 74.68629
SRU20	Island #1	N 44.94741	W 74.69633
SRU21	Island #2	N 44.94140	W 74.70171
SRU22	Relocation Pool #1	N 44.93319	W 74.70863
SRU23	Relocation Pool #2	N 44.92983	W 74.71419
SRU24	Relocation Pool #3	N 44.92127	W 74.73551

1.8 *Special training and certification requirements*

The primary field sampling crew has been trained to locate and identify freshwater mussels, the proper use of sampling gear, and the need for accurate and complete documentation in the field. The field team is the same that has been trained on substrate percent composition and utilized for previous SRMT AOC studies (2011-2013) including recent 2016 spring Lake Sturgeon Egg Trap Study that also included a substrate percent composition metric.

Dr. J. Mark Erickson has 30+ years of training for mussel identification, sexing, and aging. He will be on-site for all survey days June 14-24th, 2016 for this specific task. He is a recognized local expert in key characteristics of mussels used in identifications, and will make the identification of each mussel. He will train field crew and technicians on-site on species identification, sexing, and aging characteristics.

Appropriate reference material (see checklist) and supporting photographs used to identify species will be available in the field for all crew. If questions persist after species identification by Erickson; photographs, measurements and field notes will be collected and forwarded to NY State Museum Mussel specialists (e.g. Dr. David Strayer or Dr. Denise Mayer) for further consultation.

All field team members engaged in wading and snorkeling must adhere to safety plan and safe wading and snorkeling procedures outlined in Appendix C. This safety program is designed to ensure that all wading and snorkeling activities are conducted in a safe manner that protects snorkelers from accidental illness and injury, and was adopted from previous QAPPs for mussel survey under contract to SRMT (Riveredge 2013).

SRMT diving activities will adopt and follow Riveredge’s Diving safety protocols used previously for mussel surveys under contract to SRMT. Their Diver Safety Protocol program identifies the qualifications, safety protocols, and oversight responsibilities for scientific diving operations associated with research into aquatic environmental conditions. This safety program specifically prohibits commercial diving, solo dives, night dives, decompression dives, or low

visibility dives. Riveredge's Diving Safety Plan is on file with SRMTED, and SRMT staff will defer to it as needed, but will follow the daily safety plan and briefing as outlined by the Diver Safety Officer (DSO).

The Dive Safety Officer (DSO) is Craig Arquette. No diving is permitted without Craig Arquette on site. All divers shall possess a valid SCUBA diver certification from a recognized SCUBA organization, such as NAUI, PADI, SSI, and PDIC, and must obtain authorization from the DSO prior to conducting diving activities. For freshwater mussel surveys, DSO authorization permits the diver to conduct surveys to a depth not to exceed 30 feet. Prior to each dive all diving equipment shall be examined and functionally checked by the person using it. The examination and check shall be performed in the presence of the diving buddy, tender, or DSO. In addition, a safety hazard evaluation of the task(s) and site environmental conditions shall be completed and hazard controls identified. A briefing shall be held by the DSO prior to each diving operation that a minimum outlines the dive plan, safety procedures, and emergency procedures associated with the survey.

1.9 *Documentations and records*

A Field Supplies Check list (Appendix A) will be used to ensure all field data logging supplies are present in the field. A Field Data Sheet (Appendix B) will be maintained and completed at each segment location by the field crew. Supplemental field notes will be maintained in a field journal in pen or sharpie marker and note such things as time of departure and time of completion each day of survey to calculate man hours, descriptions of mussels found, habitat type of segment, etc. Photographs will be taken of mussels and other evidence when identifications need to be confirmed during follow-up. Photographs will include the Location ID and Sampling Date. Photographs will be organized electronically using Location ID and Sampling Date.

Location ID will include a distinct code for each 300-m St. Regis River segment:

- SR – St. Regis River
- U – Upstream the Hogansburg Dam
- Independent number assigned each segment (i.e. 01, 02,...24)
- R – Right Bank, L- Left Bank, BB – Bank to Bank
- Location ID Example: **SRU12R** indicates Survey Segment #12, Right Bank

2.1 DATA ACQUISITION

2.2 *Experimental design and sampling tasks*

Field reconnaissance efforts will include identifying and recording with GPS coordinates any and all mussel middens located between SRU01-SRU16 to inform field crew of any special attention needed for surveys, or additional information useful for prioritizing relocation strategy segments. All mussel middens with high densities will be marked with a survey flag/tape and a photograph taken with a dry erase board identifying nearest Location ID, GPS coordinates, and date.

Sampling efforts for 2016 include assessing mussel species and densities present within the 300-m segments, and targeted shoals, tributaries, and uninhabited islands within the Area of Potential Effect (APE) from anticipated dam removal and dewatering of the upstream impoundment. This will entail a minimum of a 1.0 person-hour, timed search, to provide qualitative data on what species exist, or recently existed, with the segment, as well as the habitat quality supporting the mussels.

Surveys will take place in both the right bank and left bank (when looking upstream) of each Segment. The sampling protocols are time-searches adapted from methods previously used in the St. Regis River, and outlined in EPA approved QAPPs (Riveredge 2012 & 2013).

All mussels will be bagged and brought to shore by boat for processing. Mussels will be kept in water (river or holding containers with water) except for a brief period during identification, measuring, and/or photographing.

The length of ten mussels representative of the size range collected at each segment (i.e. smallest to largest; with representative sizes in between) will be measured with digital calipers for each species. If fewer than 10 mussels of a given species collected, all mussels collected of that species will be measured. Based on results reported in Harper et al., 2015 of previous mussel surveys in the St. Regis River and surrounding tributaries, ten (10) would capture field measurements of all the non-*Elliptio complanata* species, and is consistent with measuring objectives in 2015 and 2016 Grasse River Mussel Studies (Riveredge 2015). The same 10 mussels (representative of size range) of each species will be aged (estimated by counting growth rings on the exterior of the shell) and sexed.

If time allows, length measurement, aging, and sexing, of all mussels will be recorded (in addition to the 10 of each species present). This will be a field decision that considers mussels length of time out of water, mussel densities in a given sample, and staff recording efficiency and speed.

2.3 *Sampling procedures and requirements*

The following sampling methods are consistent and amended to previously used sampling protocols as outlined in previously approved Quality Assurance Project Plans (QAPPs) (Riveredge 2012 & 2013).

Prior to the first survey, permission will be obtained from landowners for river segments that require access through private lands. Reference materials and guidebooks will be utilized in the field to reduce freshwater mussel identification errors.

1. Set up at furthest downstream site and work your way upstream. Water depth (m) will be measured after timed-searches and recorded by waders, snorkelers, and divers to obtain a minimum and maximum water depth surveyed. The field crew will be a minimum of two people.
2. Using the handheld GPS, verify the coordinates at the starting point of the 300-m segment or record new coordinates if for any difference they are different from the pre-determined GIS coordinates for the segment. Using aerial photographs, the GPS, and/or the laser rangefinder, the field crew leader will identify the bounds of the segment and communicate these bounds by reference to local landmarks (specific trees, rocks, logs, power lines, or other clearly and readily visible cues) to the field crew. The field crew leader will be responsible for ensuring that all information is recorded neatly and accurately on the field data form and that the searcher(s) remain within the bounds of the segment.
3. One person will keep track of time and alert other field crew when the 1.0 person-hour search time is completed. Start and end times will be recorded on the field data sheet (Appendix B). Search time will only include time searching for mussels and not include mussel identification, travel between sites, assembling gear, set-up and breakdown, data entry, etc.
4. Each 300-m segment on both right and left banks will be searched for 1.0 person-hours, using wading, snorkeling, or scuba diving methods. If water depth is less than one meter throughout the segment, field crew will use masks and snorkels. Depths greater than one meter will require certified open-water divers at a minimum. Field crew will work from a downstream to upstream direction. Searchers will search all available mussel habitats in the segment but must stay in the segment as earlier defined by the field crew leader.
5. Field crew will search the substrate visually looking for mussel siphons and tactilely by running their hands through the substrate to a depth of two to ten centimeters to feel mussels below the substrate surface. The following minimum data will be recorded for every surveyed segment:
 - Segment number
 - Field crew name(s)
 - Search time (person-hours)
 - Date
 - Number of mussels by species
 - Location within segment where mussel was found
 - Mussel condition by species (live, fresh dead, weathered dead, relic)
 - Lengths (mm) of ten individuals of each species
6. Mussels retained for measurement will be returned to the approximate collection location. Whenever identification of a mussel is uncertain, consult all available reference material, the field team leader, and/or Co-Project Manager. Also take a photograph for later examination. See Section 1.6 Accuracy above for consistent photograph protocol. Photographs or specimen vouchers may be forwarded to outside experts for confirmation.

7. After the timed search, field crew will record the physical aquatic habitat data where the mussels were found on the field data sheet. This data will include:
 - Depth of water where mussels located by waders, snorkelers, and divers
 - Substrate percent composition (to nearest 5%)
 - Bedrock
 - Large boulders (>45 cm)
 - Boulders (>25-45 cm)
 - Cobble (>6-25 cm)
 - Gravel (>2-60 mm)
 - Sand (0.06 – 2 mm)
 - Mud/silt (0.004-0.06 mm)
 - Clay (<0.0005mm) Either dark brown or gray in color. Feels gummy and sticky in hands; slippery when underfoot. Retains shape when compacted.
 - Detritus: partially decayed organic matter such as leaves, sticks, dead macrophytes, etc. when very fine may appear similar to silt.
8. Return mussels from segment and bank (right or left) originally collected from. Attempt to return mussels to average water depths collected from (to keep out of shallows). Relocation of mussels will only occur once the drawdown begins and stranded mussels are discovered.
9. Repeat the above steps for all remaining segments.

2.4 *Sample handling, custody procedures, and documentation*

This study involves only the use of in-situ measurements and does not involve collection of discreet environmental samples. Voucher samples will be collected as described above. Vouchers determined to be shipped for verification will include a chain of custody detailing all details of specimen in a printed excel spreadsheet and signed by SRMT Project Manager. Chain of custody will also be sent electronically for facilitated sharing.

2.5 *Analytical procedures*

Field data collection methods

No samples will be collected for chemical analysis or other for this qualitative mussel survey effort.

2.6 *Quality control requirements*

Data Quality is assured through the use of experienced and knowledgeable field crew, care taken in observation and documentation procedures, and following methodologies and the safety plan for wading and snorkeling (Appendix C). The SRMT QAMP will be followed as a

management tool for planning, implementing, documenting, and assessing the effectiveness of activities supporting environmental data operations (submitted electronically to EPA previously).

Experienced field expertise via Dr. J. Mark Erickson assures the accuracy of identification of freshwater mussels. The field crew is responsible for ensuring all sampling gear and equipment is in good working condition and signing off on the Field Supplies Checklist.

Field photographs are taken with a 6-inch ruler, and mussels measured to the nearest mm with digital calipers. The Field Crew is responsible for all proper documentation in the Field Data Sheets and Field Log Book and signs off on them indicating their review and approval. Latitude and longitude coordinates are recorded for each sampling transect using Global-Positioning systems (GPS) at the beginning and end of each transect survey, and when target species are identified. The PM will review all field data sheets and documentation for any discrepancies and will be responsible to resolve those discrepancies.

2.7 Equipment calibration and maintenance requirements

Field Instrumentation

All field sampling gear will be inspected prior to each sampling day to ensure that all equipment is in working order and safe to use and spare parts or backup equipment are readily accessible.

Use of a handheld GPS unit, Radio/Cell Phone, and digital camera will be needed in the field. It is important to check to make sure all units are charged prior to leaving the office, and backup batteries are packed. Prior to departure, the field crew is responsible for making sure that equipment in the Field Supplies Checklist is inspected and in working condition.

Latitude and longitude coordinates are recorded for each sampling site using a handheld Garmin GPS 76 to confirm sampling location, and mussel beds. The handheld GPS has an accuracy of +/- 3 meters and is only used as a verification tool to estimate start/stop locations. The use and maintenance of GPS units will be reviewed each week with each field crew member.

2.8 Data management requirements

It is the responsibility of the Field Crew to maintain field data sheets and field notebooks, and confirm equipment checklist. Field observations will be tabulated in a field log notebook and Field Data Sheets will be brought back from the field to the office daily. Field Data Sheets will be stored in a 3-ring binder only for this project with the project name on the outside cover at the SRMT Environment Division, in the St. Lawrence River Area of Concern (AOC) office. Photographs of field observations will be uploaded daily and saved in dated Electronic Folders with date of photo, Location ID (i.e. SRU01-24) and identification of Right Bank, Left Bank, or other river feature, if relevant. Field notebooks will document a summary of daily field activities.

For data collected under this project, the Project Manager will review all field data for accuracy. After Project Manager verifies Field Data Sheets, all Field Data Sheets will be scanned and saved electronically as backup. Hand recorded data from Field Data Sheets (Appendix B) will be tabulated and reported in the Final Report as Tables with Field Data Sheets attached as an Appendix. Field documents and records will be retained for up to 6 years after the final report is issued.

3.1 ASSESSMENTS

This section describes activities that will be conducted to ensure that data generated is sufficient quality for its intended use, and that appropriate responses are in place to address non-conformances from the QAPP.

3.2 *Technical systems assessments*

Following both the field reconnaissance and field survey activity, our team will conduct a post audit to identify problems encountered during the activity and will pay particular attention to documentation at the end of the event. Field crew discussion will be used to inform next day daily field activity, plan of action, and safety.

3.3 *Performance audits of measurement and analytical systems*

Performance audits have two components: proficiency evaluation and split sample analysis. These audits are generally applied to studies involving sampling protocols, chain of custody, and third party analytical services. This a Freshwater Mussel pre-construction survey in association with dewatering and restoration strategy development for potentially stranded mussels during dam removal. Therefore, the application performance audits are **not** applicable in this study.

3.4 *Surveillance of operations*

All records including field data sheets, field sampling gear preparation, field supplies check lists, and field log notebooks will be available for inspection and subject to routine surveillance and inspection by SRMT Project Manager and TQAO.

3.5 *Audits*

The SRMT Project Manager will perform audits so that any field and/or sampling deficiencies can be found and corrected. Audits are to be conducted during the project at least once at the beginning of field operations to ensure that Field Data Sheets, Field Notebooks are completed and managed properly, and staff safety is ensured in the field.

Should corrective actions need to be taken due to problems that are encountered; appropriate steps will be taken to correct this. For example, if a procedure is not being followed, training or retraining of a technician may be required. Should a problem be encountered that needs corrective action involving the program outlined in this QAPP, appropriate chain of command communication as indicated in Figure 1.0 will commence to effectively and efficiently rectify the problem or receive permission for any such changes. The Project Manager will be responsible for communicating to the EPA Project Officer and TQAO any problems encountered, and responsible for communicating or distributing any corrective actions needed to

the field crew. All corrective actions will be documented and explained in the field notebook and reports as necessary.

3.6 *Corrective Actions*

Corrective actions will be implemented as needed. For this study the SRMT Project Manager and Field Crew Leader is the same. Jessica L. Jock is responsible for initiating corrective action and implementing it in the field. The Field Crew is responsible for communications to the SRMT project manager the status of any corrective actions. It is their combined responsibility of the SRMT team to ensure that measurement procedures are followed as specified and that the data generated meet the prescribed acceptance criteria. Specific corrective actions necessary will be clearly documented in the logbooks.

The need for technical corrective actions may be identified through technical assessment or as equipment malfunctions. Once identified, the problem may be addressed immediately or an audit report may serve as notification to project management staff that corrective action is necessary. Immediate corrective actions will be documents in the project logbook. Examples of corrective actions include:

- Battery replacements
- Educating personnel about proper field procedures and documentation
- Accepting data with an acknowledged level of uncertainty
- Adapting location of sampling based on environmental conditions

After a corrective action has been implemented, its effectiveness will be verified through a post audit. If the action does not resolve the issue, then appropriate investigative and remedial actions will be taken.

4.1 DATA REVIEW, USABILITY, AND REPORTING

Data review and verification will be done by the Field Crew Leader prior to leaving the sampling segment to evaluate the completeness, correctness, and compliance with requested information on the Field Data Sheets and entries into the field notebooks. Data validation will be done by Jessica L. Jock. These processes will occur both during and at the end of the project. Data meeting the quality objectives outlined in this QAPP will be considered acceptable and usable by the project.

4.2 *Data verification and validation*

The entire project team is responsible for ongoing assessment of the work performed by the team; identification of nonconformance with the project objectives; and initiation, implementation, and documentation of corrective action. Data generated during field activities will include general information such as: segment identification numbers; date; time; observations; but will also include specific information on mussel species and lengths; substrate composition; and specific water quality values. Reference books will be used for mussel identification. For verification, a subset of photographs for each species found will be sent to Dr. David Strayer, or other identified well-respected, mussel identification experts. The following reference books will be used in the field:

- Erickson, J.M. and Garvey, K.L. 1997. Key to the unionacean clams (Mollusca) of the Grass River drainage, St. Lawrence County, New York. St. Lawrence Aquarium and Ecological Center Special Paper
- Nedeau, E. and Victoria, J. 2001. A Field Guide to the Freshwater Mussels of Connecticut. Department of Environmental Protection. Hartford, CT.
- Strayer, D. and K. Jirka. 1997. The Pearly Mussels of New York State. The New York State Education Department, Albany, NY.

Field data will be noted in pen or sharpie in a field notebook and field data sheets. Pencil will not be used. No erasures will be made. Corrections will consist of a single strike-out with the date and initials of the individual making the correction or change. Data will be recorded by the Field Crew and validated by the SRMT Project Manager. Verification of data completeness of field data sheets and field notebooks will occur after each segment sampling by the Field Crew Leader prior to initiating next sampling activity.

Field employees will have thoroughly reviewed the QAPP and will be familiar with the basic procedures before field collection efforts. All personnel involved with the study shall follow the QA/QC Sampling Plan to avoid errors that may occur in the field.

10% of all electronic field photos and data entry into excel sheets and/or tables will be reviewed by an independent SRMT reviewer (i.e. TQAO or Water Resources Program Manager) to verify photo labeling and data transferral/input accuracy and usability. If errors found in 10% of reviewed data, data verification will be increased to 50% of all photos and data entry. If a substantial amount of errors found, independent SRMT review 100% of field photos and data entered electronically.

The final report will include all data that has been attained throughout the study in text, tabular and graphical form in Microsoft Programming (i.e., Excel, Word, and/or Access) and mapping tools. The final report will be drafted when all surveys, relocation, and post-monitoring has been completed. The Relocation Plan will be submitted as an addendum to this QAPP upon completion of pre-construction surveys

4.3 *Reconciliation with project requirements*

Any deviations from quality objectives for the project will be documented and provided to the data users for the project. The data that are determined to be incomplete or not usable for the project will be discussed with the project team and discuss resolution of the issue and implement necessary corrective actions (for example re-sampling or utilizing archive samples).

The usability of all data types for making recommendations for relocation and restoration efforts will be ensured through careful attention to the following factors:

- Scientifically sound, acceptable methods will be used for all data collection activities
- Competent experienced biologists will be involved in the identification of mussel species to ensure that correct identifications are made.

- When sampling segments, SRMT project staff will diligently fill out field data sheets consistent with this QAPP are followed.
- Rigorous procedures and checks will be in place to ensure that all project data are accurately recorded and incorporated into the project database.

Any deviations from performance criteria or quality objectives will be documented in the summary report provided to the data users for the project. The SRMT Project Manager will work with the final data user in performing data quality assessments. An example of data quality assessment procedures include:

- Data that are determined to be incomplete or not usable for the project will be discussed with the project team. Data user will notify Project Manager regarding data that may impact the ability to meet project objectives.

4.4 *Data usability*

The usability of the data for freshwater mussel surveys will be ensured through attention to the following factors:

- Accepted field collection methods will be used for data collection activities.
- Competent SRMT staff will be involved in all phases of field data collection, documentation, data processing and analysis to ensure high quality data.
- Field personnel will be diligent in completing all required documentation to ensure consistency with procedures described in the QAPP.
- Rigorous documentation control will be in-place to ensure data is properly recorded and stored.

4.5 *Reports to management*

Upon completion of the field data collection activities, all field and QC data will be included in a comprehensive report that summarizes field activities and data evaluation. A discussion of data validation and adherence to QA/QC will be provided in the report. The need for corrective action will be dependent on the importance of the data issue to the overall project objective.

Final report on the *St. Regis River Freshwater Mussel Restoration* will be prepared by the Project Manager and submitted to USEPA and NYSDEC. This report won't be completed until after all relocation strategy and relocation verification field efforts associated with community volunteer efforts dam removal are completed. Final Report will be in Word with Tables, Figures, Photos, and Field Data Sheets attached as an Appendix.

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APPENDIX A: FIELD SUPPLY CHECKLIST FOR MUSSEL SURVEYS

- First Aid Kit
- GPS, cell phone, chargers, batteries
- Second, backup, GPS in vehicle in case it is needed
- Data sheets and clipboard, pens, pencils; field notebook

- Underwater view tube (s)
- Water shoes or other appropriate footwear
- Snorkeling equipment
- Scuba gear (if needed; see separate checklist)

- Canoe, kayaks or small boat
- All required safety gear (i.e. throw bags, underwater lights, dive flags, wading sticks, etc.)
- Personal Floatation Devices (PFDs)
- Paddles, Anchor

- Digital calipers (mm)
- Measuring staff for water depth
- Floats, ropes, , survey tape, anchors for marking sites
- Jewelers lens
- Meter stick
- 6-inch Small ruler (inch and mm)
- Waterproof digital camera, extra batteries
- Mesh bags, 5-gallon buckets
- Reference material (Erickson and Garvey 1997, Nedeau and Victoria 2001, Strayer and Jirka 1997)

Checklist for Scuba Gear for Mussel Surveys – St. Regis River

Date: _____ Completed By: _____

<input type="checkbox"/>	Tanks
<input type="checkbox"/>	BC
<input type="checkbox"/>	Wetsuit
<input type="checkbox"/>	Regulator, octopus
<input type="checkbox"/>	Gloves
<input type="checkbox"/>	Booties
<input type="checkbox"/>	Mask, fins, snorkel
<input type="checkbox"/>	Weight belt
<input type="checkbox"/>	Weight pockets
<input type="checkbox"/>	Swimsuit
<input type="checkbox"/>	Towel
<input type="checkbox"/>	Dry clothes
<input type="checkbox"/>	Knife
<input type="checkbox"/>	weights
<input type="checkbox"/>	Dive flag - tall for boat
<input type="checkbox"/>	Dive flag – short with float
<input type="checkbox"/>	Polypropylene tag line
<input type="checkbox"/>	Mesh bag
<input type="checkbox"/>	Watch
<input type="checkbox"/>	Computer batteries
<input type="checkbox"/>	U/W Flashlight
<input type="checkbox"/>	Mask cleaner
<input type="checkbox"/>	Dive computer/tables
<input type="checkbox"/>	Hood(s)
<input type="checkbox"/>	First aid kit
<input type="checkbox"/>	2-way radio
<input type="checkbox"/>	Sunscreen
<input type="checkbox"/>	Sunglasses
<input type="checkbox"/>	Zip ties
<input type="checkbox"/>	Cell phone
<input type="checkbox"/>	Dive ladder(s)
<input type="checkbox"/>	C-Cards
<input type="checkbox"/>	Spare mouthpiece
<input type="checkbox"/>	Spare O-rings

APPENDIX B. FIELD DATA SHEET

ST. REGIS RIVER MUSSEL TIME SEARCHED SURVEYS

Sheet ____ of ____

Date (MM/DD/YY): _____ Time: _____ Crew: _____

Location ID: _____

Left Bank _____ Right Bank _____ Bank to Bank _____ Island _____ Shoal _____

Total length of distance searched (m) _____

Substrate Percent Composition (nearest 5%):

Detritus _____ Clay _____ Silt_Sand _____ Gravel _____ Cobble _____ Boulder _____
 _____ Bedrock _____

Substrate Stability _____ Flow (cfs) _____

Collection Method (wading, snorkel, or SCUBA)	Time In/Time Out	Search Time	Water Depths	Notes

Species Found

N	Species and Number of Individuals of Each Species Found	Live	Dead
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Total Number of Live Mussel Species	Total Number of Live Individuals	Total Search Time (Hrs)	Mussels per Search Hour (CPUE)

Form completed by:

Form verified by:

Site description:					
	Species	Sex (M, F, U)	Length (mm)	Age (yrs)	Notes
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
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St. Regis Mohawk Tribe St. Regis River Mussel Measurements Data Sheet

Form completed by: _____

Form verified by: _____

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Site description:					
	Species	Sex (M, F, U)	Length (mm)	Age (yrs)	Notes
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APPENDIX C. Safety Plan and Procedures - Wading and Snorkeling

Wading and Snorkeling Safety Procedures

It is important to take every possible precaution to prevent accidents that cause personnel to enter the water unintentionally. Follow these safety guidelines when working along the shoreline and snorkeling. Carefully plan access to the river along a safe and secure route. The Field Team Leader must brief all field team members on the intended survey route, survey procedures and safety guidelines prior to the start of any field survey.

**A First Aid Kit must be carried in the field at all times.*

**A portable AED will be in the field at all times.*

**In case of emergency, dial 358-9200 for Tribal Police and local dispatch immediately for most time efficient response (911 is an acceptable alternative if staff can't remember Tribal Police #).*

Wading Procedures

The decision to wade will ultimately be a personal one dependent upon the size of the person - their experience, physical stature, strength and prowess; the size of the stream - width, velocity, and depth; and the particular environment in which the work is being conducted – substrate, weather, location, etc. Two important factors to consider are the velocity of the stream and the height of the water line relative to the individual - below the knees, at the knees, mid thigh, or hips. The substrate of the stream should also be considered in the wading decision. A slippery or craggy stream bottom may be too difficult or dangerous for wading. The likelihood of falling or foot entrapment are serious safety concerns that should be taken into account.

The time of year and/or weather conditions may also play a key role in the decision to wade or boat. A good rule of thumb is the rule of 120 (American Canoe Association). If the air and water temperature added together does not exceed 120, there is an increased risk of hypothermia. Depending upon how far below 120 the factor is, the field staff may decide to boat (if possible and practical), reschedule field work for another day, or wade with the proper cold-weather gear such as a drysuit. Extreme weather conditions should be avoided and/or planned for in all cases.

If the decision has been made to wade, there are some important personal safety equipment items that should be employed.

- Waders – the decision to wear waders and the type of waders worn should be a function of the temperature conditions for both air and water and the waterline height on the individual. Additionally, waders may not be necessary for summer field work, for example. Waders and/or clothing should always appropriately protect the field staff from the effects of hypothermia as conditions dictate (neoprene waders, drysuit, etc.). The waterline height of the stream on the individual will dictate the appropriate length of the waders (chest vs. hip)
- Footwear – often a function of the waders chosen. Substrate should also be a consideration in choosing appropriate footwear (*i.e.* does the substrate necessitate the use of cleats or felt bottoms). Sneakers may be an appropriate choice for summer season wading.

- Life vests – The appropriate use of life vests is encouraged whenever working near the water. Life vests employed during wading situations should be rated a Coast Guard Class III or better.
- Cell phone or radio – it is extremely important to have communication devices on you at all times (when on/near the water, carrying these items in a waterproof container is advised) to ensure safety in emergency situations and to allow communication between field staff and plant operators where appropriate. In those instances where this is not possible, field crews should establish a communication protocol to notify a contact person prior to and at the end of each days field work.
- Polarized sunglasses – sunglasses with polarized lenses are always a wise choice for in-stream work. In addition to protection from UV rays, polarized lenses reduce reflective glare from the water enabling the wearer to better see the substrate, equipment, and in-stream conditions.
- Wading staff – a wading staff will offer extra stability in in-stream situations. A top-set wading rod may act as a wading staff.

The buddy system should be used for all in-stream field work. When wading is required, field work should be conducted by at least two people to provide an extra measure of safety. Depending on the conditions, more people may be required to insure safety. In swift water, group safety items should include:

- Throw bags – throw bags are very important safety items that can assist in recovery of a swimmer or foot entrapment. In current situations, throw bags can also be dangerous, leading to entanglement. It is very important to not only have the throw bag, but to know how to properly use it. It is the responsibility of the field crew leader to ensure that field staff are properly trained in the use of all safety equipment, including throw bags.
- Catch line – a catch line may be used in situations where field staff are conducting in-stream work. As with throw bags, it is the responsibility of the field crew leader to ensure that catch lines are employed and used properly if conditions and situations dictate.

Snorkeling procedures

These snorkeling safety procedures guide employees when snorkeling.

With no exceptions at any time will anyone carry out any work alone, there must be at least two (2) employee's present when snorkeling. Employees involved in snorkeling safety procedures must make prior arrangements to notify Field Team Leader or PI of a) the expected duration of the trip, 2) his/her departure time, and 3) the immediate end of the trip and approximate return time.

The Field Team Leader is the person in charge of the snorkeling activity. The Field Team Leader is responsible for the safety of the snorkeling operation.

The Field Team Leader is responsible for ensuring that:

- All Snorkelers skill levels are evaluated and are up to a level suitable for the planned task. This may require a skill level evaluation in a shallow, calm water location.
- Risk Assessment is completed and control measures necessary to minimize the risks are implemented.
- All snorkelers are made aware of medical conditions that may be aggravated by snorkeling activities.
- Each team member is aware of their responsibilities, and rescue and first aid procedures are fully explained.
- A snorkel briefing is given to all snorkelers including advise about local hazards and conditions
- All snorkelers have a buddy assigned. Inexperienced snorkelers are to be paired with an experienced snorkeler.
- The required equipment is available at the snorkel site (*i.e.* communication equipment, first aid kit, sunglasses, hydration, and whistle)
- A recall system has been established, such as an air horn or whistle.
- Head counts are to be conducted: prior to, during the activity (5 minute intervals) and a final head count is completed after the activity is finished.

General snorkeling procedures

- Snorkelers should not snorkel in the following conditions: 1) when wind speeds exceed 21 knots (freeze breeze). 2) when wave height at the site exceeds 0.5m, or 3) in strong currents where the snorkeler runs the risk of being carried away from the shore or boat. (*note: the current at the snorkeling site should be such that all snorkelers are able to easily swim against the current with minimum exertion*)
- All snorkelers' skill levels are evaluated and are up to a level suitable for the planned task. This may require a skill level evaluation in a shallow, calm water location. (assistance from an experienced dive staff may be helpful)
- Risk assessment is completed and control measures necessary to minimize the risks are implemented.
- All snorkelers are made aware of medical conditions that may be aggravated by snorkeling activities and a medical declaration wavier has been signed.
- Snorkel teams should consist of at least 2 people in low risk conditions that are at least a buddy pair or one snorkeler and a lookout. Solo snorkeling shall be avoided.
- Where possible avoid areas of frequent boat traffic. When any vessel is approaching you should immediately leave the area until the vessel has departed. Larger vessels cannot easily maneuver in these confined areas to avoid swimmers.

Boat based snorkeling

In addition to the general snorkeling procedures outlined above, the following procedures should be followed for boat-based snorkeling procedures:

- drift snorkeling should be avoided unless a very experienced skipper is used and the boat & dive staff have approved the snorkel plan.
- a surface lookout must be posted at all times. Using a snorkel lookout should be considered.
- a dive flag should be displayed when snorkelers are in the water.
- no snorkeling activities should take place further than 50 meters from the boat.
- a boat log should be filled out giving every ones full names.
- a final head count shall be done before leaving the site. As well as a head count every 5 minutes.
- adhere to safe boating procedures.