

Protocol for 2016 sampling of wetland macroinvertebrates

Prepared for:

Slocan River Streamkeepers, Slocan Solutions Society,
Slocan Lake Stewardship Society and BC Wildlife Federation under the Slocan Valley
Wetlands Assessment and Mapping Project (SWAMP)

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1. Introduction

The objective of this document is to provide an overview of potential methodologies for the Slocan Wetlands Assessment and Mapping Project (SWAMP) based upon methods under the Canadian Aquatic Biomonitoring Network, CABIN, (Tall et al. 2008, Bailey and Reynoldson 2009) and other programs in Canada (Adama et al. 2013, Miller and Hawkes 2013, Archer et al. 2010, Eaton 2005) and the United States (Kovalenko et al. 2014, Uzarski et al. 2011, Mazzancano 2011, Apfelbeck 2000). These methodologies have the potential to provide further inference about the status of wetlands in the Slocan Valley.

We have sampled 24 sites to date with funding for 20 sites last year from the National Wetland Conservation Fund and the Columbia Basin Fish and Wildlife Compensation Program. The 2014 sampling year was a pilot program that was carried out with very limited funding. Upcoming analysis of the data collected will assist in optimizing the methodology and provide valuable information regarding aquatic invertebrate populations in relation to types of wetlands in the Slocan Valley

The current SWAMP program has conducted sampling of wetlands using a three Phase process. Phase I involved the identification and mapping of wetlands (Durand 2014). In Phase II & III, a subset of the identified in mapping was assessed in site visits (Durand 2014 & 2015). Each wetland surveyed in Phase II & III was classified (Canadian System of Wetland Classification 1997) and assessed for ecological integrity as described in Faber-Langendown (2012a). The SWAMP Steering Committee suggested that macroinvertebrate samples could be integrated with Phase I-III wetland assessments with the objective of developing a protocol for wetland assessment in the Slocan Valley and the West Kootenays.

Macroinvertebrates are important wetland indicators of anthropogenic-induced stresses such as habitat degradation, development and contaminants (Kovalenko 2014, Mazzacano 2011, Uzarski et al. 2011, Archer et al. 2010, and Apfelbeck 2000). Few studies of wetlands in British Columbia have included bioassessments of macroinvertebrates with the exception of Adama et al. (2013) and Miller and Hawkes (2013). However, they provide a unique approach to assessing bio-integrity and fit well with methods currently being used by SWAMP (Faber-Langendown et al. 2012b, Durand 2014).

In addition, Rebecca Rooney of the University of Waterloo has agreed to provide direction in regards to her work on wetland indicators that may aid in (1) the assessment phases of planning (Rooney and Azeria 2015, Rooney and Bayley 2012 & 2010) and (2) the evaluation of performance indicators for restoration projects (Bayley et al. 2014).

The goals of the SWAMP invertebrate sampling project are:

- Develop a protocol for wetlands ecosystem assessment based on modified CABIN methods to prioritize opportunities for wetland restoration, conservation and compensation.

- Quantify wetland water resources based on mapping, water/sediment quality & a biological index to assess the health of wetlands in the Slocan Valley.
- Report findings to the larger Slocan Community, the Kootenay Region and the Columbia Basin.

The Objectives of the project are to:

- Carry out water/sediment quality and macroinvertebrate sampling at selected wetlands within the Slocan Valley.
- Investigate methods to help assess impacts and prioritize wetland restoration opportunities.
- Develop methods under CABIN for invertebrates and water/sediment quality to rate wetland health.
- Assess wetlands in reference condition as well as those affected by invasive species, mining, agriculture and development.
- Develop a multi-metric Index of Biotic Integrity for wetland macroinvertebrates specific to the Kootenay Region.
- Facilitate dialogue between agencies, non-profits & private landowners with regards to sensitive wetland habitats and water resources.

2. Methods

2.1 SWAMP: mapping, vegetation surveys & ecological integrity

Invertebrate sampling is carried out in coordination with field assessments of SWAMP led by Ryan Durand (Durand 2015). Phase II-III field work under SWAMP first classified each wetland according to the Canadian System of Wetland Classification (1997), and secondly made an evaluation of ecological integrity (Faber-Langendown et al. 2012a). Methods included adaptations from the Field Manual for Describing Terrestrial Ecosystems (RISC 2010) and the Field Manual for the Wetlands of British Columbia (Mackenzie and Moran 2004).

Evaluations of ecological integrity (Faber-Langendown et al. 2012a) included assessments of condition in field surveys of 20 x 20 m plots (Faber-Langendown et al. 2012a). Plot location were be selected by Ryan Durand for wetland sites that were representative of the characteristics of the wetland and non-transitional within the plot. Each site was evaluated for a series of metrics that rate factors such as landscape context, patch size and wetland condition that are used to calculate an overall ranking system of Excellent, Good, Fair, and Poor. The metrics used in the calculation of ecological integrity include: indexes of connectivity, land-use, buffer size, patch size, vegetation structure, regeneration, native plant cover, invasive plant cover, composition, water sources, hydroperiod, hydrologic connectivity, physical patch types of soil and soil disturbance (Durand 2014). Metrics and rankings from Phase II & II of SWAMP that assess ecological integrity will be

used to interpret data from the macroinvertebrate component of SWAMP (Faber-Langendown et al. 2012b, Archer et al. 2010, Adama et al. 2013).

2.2 Macroinvertebrate protocols

The protocols are used for the SWAMP macroinvertebrate monitoring program follow methods developed by Environment Canada described in Tall et al. (2008) and Baily and Reynoldson (2009). These methods were recommended by Emily McIvor and Alain Armellin of Environment Canada so that data from SWAMP could contribute to the development of a general wetland protocol within CABIN at a National level.

Preliminary macroinvertebrate sampling focused on characterizing the community that inhabits the emergent zone of the wetlands. Macroinvertebrates collected from emergent vegetation have been used to differentiate reference sites from impacted sites in bioassessments of wetland habitats on the wetlands of the St. Lawrence River (Tall et al. 2008), Great Lakes coastal wetlands (Uzarski et al. 2011), marshes in the Niagara area (Archer et al. 2010) and wetlands in Montana (Apfelbeck 2000) and Oregon (Mazzacano 2011). In addition, kick samples of the emergent zone (similar to Tall et al. 2008) are currently being used as part of methods in Environment Canada's Prairie, Quebec and Oil sands protocols. The kick sampling procedure in wetlands involves a gentle disturbance of bottom sediments and three minute sweeps of the water column in a zig-zag pattern over a 5 m by 5 m quadrat. Thus, macroinvertebrates are collected from the water column, bottom sediments and aquatic plants at each site within the emergent zone.

2.3 2015 Field sampling

Twenty wetland sites were sampled in 2015 supported by funding from the Columbia Basin Fish and Wildlife Compensation Fund (W-F16-10) and the National Wetland Conservation Fund (NWC1516PYR25) for a total of 24 sites in 2014 & 2015 (Appendix 1).

The mapping and terrestrial vegetation assessment project of SWAMP funded by the Columbia Basin Trust and led by Ryan Durand in collaboration with Tyson Ehlers & Marcy Mahr, provided mapping products and reconnaissance work that suggest potential sites for the invertebrate component. Local community group members including: Rhia MacKenzie, Gregoire Lamoureux, Richard Johnson and Jennifer Yeow aided site selection by providing input on local knowledge of the area.

Environment Canada's latest recommendations (June 2015) from their official field protocol and new CABIN wetland field sheet were used as a basis for field measurements. We sampled upper and lower elevation sites associated with riverine, lacustrine and palustrine wetland types ranging from reference condition to wetlands impacted by mining, agriculture, invasive species or development (Appendix 1). Water & sediment quality samples were analysed by CARO labs in Kelowna/Vancouver including a quality control/quality assurance program. Invertebrate samples have been sent to the taxonomist (Rhithron) for analysis which should be completed by December/early January (2015/16). Rhithron staff includes professional taxonomists, ecologists,

SWAMP: Wetland Invertebrate Assessment Tool

research scientists, technicians, and support and management personnel. Their invertebrate taxonomists collectively hold 34 Level-II certifications from the Society for Freshwater Science, more than any other provider of similar services in the world.

We have identified a potential restoration candidate on private land, created a dialogue with private landowner and have buy-in and enthusiasm with regards to restoring their non-functioning wetland. Our next steps include: data analysis, reporting, presenting results, submitting data to Environment Canada CABIN and consulting with Environment Canada on recommendations and observations of field protocols and sampling procedures.

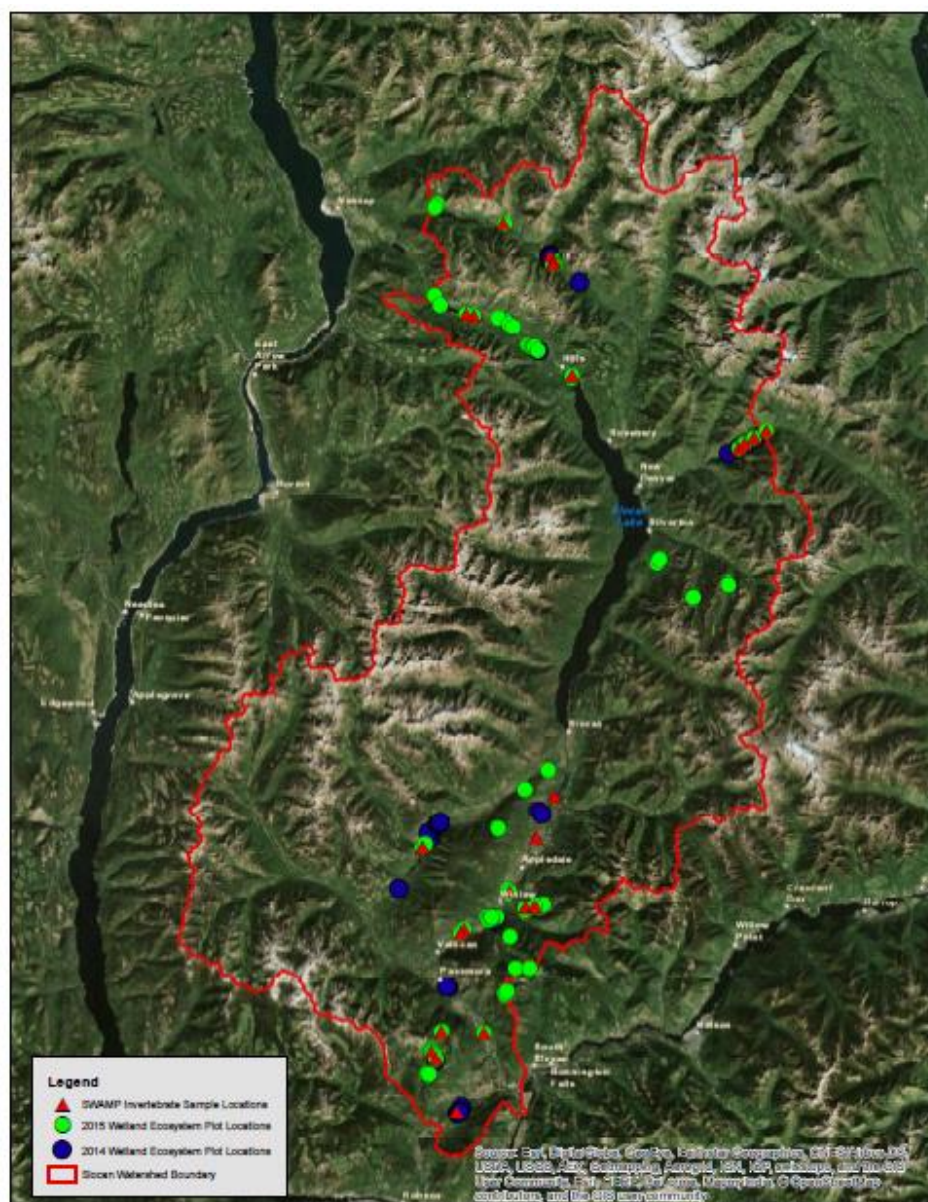


Figure 1. Overview of wetlands described in Phase 3 of SWAMP (map from Ryan Durand)

2.4 2016 Field season planning

As described above, this project has received technical guidance from Environment Canada, CABIN, funding from the National Wetland Conservation Fund and the Columbia Basin Fish and Wildlife Compensation Fund and dovetails with other SWAMP projects (Phases 1-3 & Summit to Bonanza Marsh Corridor). Rebecca Rooney of the University of Waterloo has also agreed to provide technical advice to the project which in turn may lead to further collaboration with the university. We have raised funds under the National Wetland Conservation Fund to have an initial consult and peer-review of work completed in 2015/16.

The long-term goal of SWAMP is to sample at least six or more classes of wetlands and 8-10 sites/class in order to make use of multivariate statistics. Thus, the invertebrate protocols will be developed in a multi-year context funded in an additive approach within the three years. The exact number of sites will be driven by the number of community types and the ability to determine within and between site variability. A recent top-up of funding up to 33% of original funding (Oct, 2015) from the National Wetland Conservation Fund and likely renewal for the 2016 field season demonstrates their support for the project at a Federal level and the potential of our project to raise and leverage funds. The Winlaw Watershed Committee has also recently expressed interest in providing funding to the project.

For the 2016 field season, wetlands identified by Durand (2015) in the Phase III mapping and field assessments will be evaluated as to potential candidate sites for the invertebrate project in 2016. This will be done largely in close collaboration with Ryan Durand and other SWAMP team members. In addition, at least one potential restoration site (Slocan Streamkeepers Society, Spankie Farm Project) will be sampled in the 2016 with monitoring pre and post restoration if possible with reference conditions established by other lower valley sites for comparison. In addition, our sampling may address community concerns around mosquito issues.

The Royal BC Museum has agreed to house the voucher/reference collection from the project. Taxonomic identifications by Rhithron meet the museum's specifications for quality control and the reference collection ensures verification, taxonomic consistency, and repeatability. Specimens curated by the Royal British Columbia Museum will be available in perpetuity for further research and to public inquiry that will be facilitated by an expert in collection management. The Royal BC Museum estimates that they will provide \$15,000 per year in in-kind maintenance of the collection including curation supplies and staff time.

The development of an Index of biotic integrity for the Slocan Valley will provide a rating system and a list of priorities for wetland enhancement and conservation. We also hope to work towards establishing performance indicators for restoration work based on a large body of research by Suzanne Bayley (University of Alberta, emeritus) and Rebecca Rooney of the University of Waterloo (Bayley et al. 2014). These methods could ultimately be used by community members, non-profits,

agencies, landowners to implement and assess restoration, preservation and land acquisition projects.

We have identified a potential wetland restoration candidate on private land, and grass-roots work by the community has created a dialogue with private landowner. Successful restoration work funded by the Columbia Power Corporation under the Slocan River Riparian Restoration Program at the site has resulted in buy-in by land-owners with regards to restoring their non-functioning wetland. Applications for funding for this restoration site will be made in fall/winter of 2015/16. The Central Kootenay Invasive Species Society is willing to contribute to invasive species removal at the restoration site if needed. The Columbia Power Corporation may provide funds for educational signage at the site.

2.5 Macroinvertebrate sampling field crew

All field sampling will be carried out by a trained field crew to ensure that data quality standards are met. Future efforts will involve further training of qualified individuals once methods are refined. The project personnel are:

- **Darcie Quamme**, *M.Sc., R.P.Bio., Integrated Ecological Research, CABIN certified*, Project lead in collaboration with SWAMP.
- **Rhia MacKenzie**, *B.Sc. of Anthropology, Selkirk Recreation, Fish & Wildlife Diploma, CABIN certified*, Field technician and administrative assistant.
- **Tyson Ehlers**, *B.Sc., R.P.Bio., Tysig Ecological Research*, Field biologist and botanist.
- **Ryan Durand**, *B.Sc., R.P.Bio., Durand Ecological Consulting*, GIS specialist and botanist.
- **Jennifer Yeow**, *B.Sc., Passmore Laboratories Ltd., CABIN certified*, provides sample analysis for quality control and assurance and laboratory support.
- **Gregoire Lamoureux**, *Slocan River Streamkeepers Society Restoration specialist*
- **Rebecca Rooney**, *Ph.D., Assistant Professor, Dept. of Biology, University of Waterloo*
Consult and peer review

Field crew for the present survey would undergo an overview and training of field methods conducted by Darcie Quamme prior to sampling. In addition, Darcie Quamme, Jennifer Yeow and Rhia MacKenzie have been certified under CABIN stream assessment protocol. However, no formal training exists for CABIN methods for wetlands at this time. In addition, training and/or education days will be held for interested community members. Passmore Laboratories will primarily carry some water quality analyses, and provide community and laboratory support. Rebecca Rooney will collaborate on the refinement of the protocol particularly with regards to performance indicators for wetland restoration.

2.6 Community events and education

In 2015, SWAMP led a community educational and informational campaign in regards to the wetlands in Slocan Valley. Demonstration materials were developed with assistance from the BC Wildlife Federation including: logo, pamphlet and stickers to handout. SWAMP activities included:

- Identified invasive species, species of concern and rare species at a variety of sites
- Outreach work to a number of local schools
- Hosted two wetland field days – www.slocanswamp.org/wetland-tours-aug-8-12/
- Hosted a wetland media day
- Submitted a press release to the Valley Voice
- Created and updated the SWAMP website – www.slocanswamp.org
- Community Hall presentations scheduled for the fall to be coordinated by Rhia MacKenzie and Marcy Mahr

2.7 Emergent zone kick samples

Macroinvertebrates will be sampled from the near shore of the emergent zone ($\geq 10\%$ emergent vegetation cover) at a depth of approximately 0.5-1 m using a CABIN kick-net of length 45.7 cm, width 25.4 cm, and depth 25.4 cm with a 500 μm mesh net (Environment Canada 2007, Tall et al 2008). The samples will be collected over a 5 m by 5 m plot in a timed 3 minute kick sample similar to protocol used for Quebec wetlands (Tall et al. 2008) and Prairie Wetland Protocol (conference call, Emily McIvor and Allen Armellin, 2014). This technique involves a gentle disturbance of bottom sediments and sweep in a zig-zag pattern within the water column quadrat at each site.

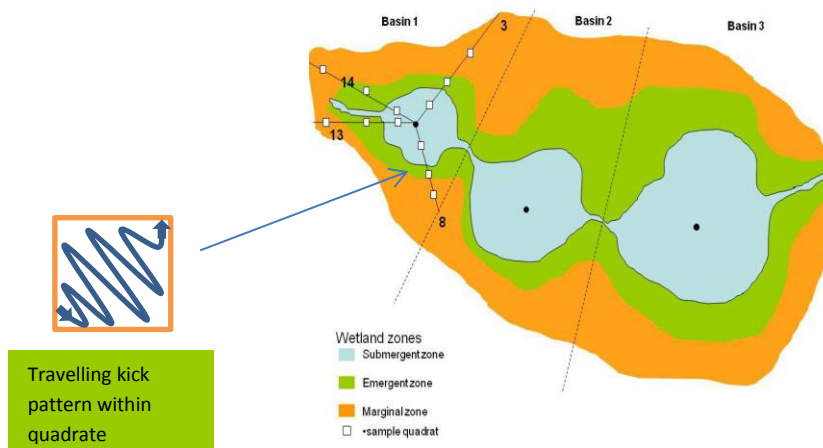


Figure 3. Vegetation plots and a 3 min. kick-net sample will be collected from the 5 x 5 m quadrat within the emergent zone. Samples will not be collected from other zones due to funding constraints. Figure modified from Bailey and Reynoldson (2009) & kick-net pattern from Emily McIvor (conference call, 2014).

2.8 Handling and preservation of macroinvertebrate samples

Following field sampling, the volume of sediment/vegetative matter in each sample will be reduced by gently washing the nets in water well away from sampling area or sample can be taken back to the laboratory and further reduced. All amphibians will be removed from nets following (Ministry of Environment, 2008) protocol for safe handling of amphibians. Material will be gently poured through a 500 µm sieve and further rinsed.

Sample material will be transferred to one liter jars with 80% ethanol used as a preservative. Sample material should comprise no more than 50% of the jar. At the end of the day ethanol should be replaced with fresh 80% ethanol (Mazzacano 2011, Jepsen et al. 2007) and this procedure repeated 48 hours later as an extra precaution. Sample preparation and shipping guidelines are outlined below (Cordillera Consulting 2014).

Summary of sample preparation guidelines for benthic invertebrates:

- Half the jar by volume should be preserved with 80% ethanol if ethanol is used as the preservative
- Two or three jars may be required depending on sample size and jar size so that the muck is saturated with 80% ethanol
- All invertebrates/plant matter within the organic matter need to be exposed to 80% ethanol
- The sample should swirl in the jar so that it is mixed with 80% ethanol
- Labels should be placed inside the jar on rite-in-the-rain paper using pencil with the lids and side of the jars labelled as well
- Plastic jars with well-fitting lids should be used to prevent breakage and leakage, duofilm can be used to ensure a good seal
- Labelling system such as *Sample Site PC01, 08/26/14, Jar 1/3, Jar 2/3, Jar 3/3* should be used
- Sample jars can be sealed with duct tape and bagged before shipping

2.9 Macroinvertebrate habitat data

Estimates of the relative proportion of vegetation will be made within the 5 x 5 m quadrat in the emergent zone. The percent cover and the maximum height of each plant species will be measured. The 5 x 5 m quadrat will be marked with cedar stakes. If no botanist is available at time of sampling, unknown species type will be collected, bagged and preserved for later identification (Bailey and Reynoldson 2009). Collection, handling, and pressing methods are outlined in BC Ministry of Forests (1996) and Warrington (1994). Ryan Durand will carry out identifications of pressed species.

2.10 Taxonomic identifications of macroinvertebrates

Rhithron, a professional taxonomist based in Missoula, Montana will be used for the identification work. Samples collected for the CABIN database will be sent to a certified taxonomist that follow procedures outlined in Environment Canada (2012). All laboratory techniques and quality control will be carried out according to CABIN methods (Environment Canada 2012). Sorting efficiencies and subsampling techniques (Environment Canada 2012) will be well documented.

In addition, the taxonomist will ship a collection of specimens to the Royal BC Museums. Project methods meet museum specifications for collection, taxonomic identification and storage of specimens (CABIN 2007 & 2012). In addition to assessing the health of wetlands, this project will help to increase our understanding of the Slocan River watershed and improve our knowledge on the biodiversity of invertebrates in British Columbia.

Table 1: Types of macroinvertebrate samples collected under SWAMP

Taxonomy Level	Purpose	Professional taxonomist Used	Data submitted to Environment Canada	Number of samples per wetland
High -To <i>Genus</i> level or lowest practical taxa	-Potential future development of RCA approach, biotic integrity & other statistical methods -Data to be used in development of National protocols under CABIN	-100% of samples	Yes	1 sample per wetland in the preliminary assessment, with at least 10% of wetlands with replicated sites

2.11 Water and sediment physio-chemistry

Field measurements of water quality and surface water samples will be collected prior to other sampling to prevent contamination of samples using methods of Duncan and Duncan (2012), Uzarski et al. (2011), Bailey and Reynoldson (2009), and Clark (2003). Field measurements of water quality will include: temperature, pH, conductivity, dissolved oxygen and turbidity carried out using a multi-meter and Hach field kit. These parameters will be taken at each of the emergent zone stations. Surface water samples will be collected for the following parameters (Environment Canada 2007) including:

- Phosphorus (measured as total unfiltered Phosphorus)
- Nitrogen (Total Keldhal Nitrogen, Nitrate, Nitrite, Ammonia)
- Alkalinity
- Major ions (e.g. Ca, Mg, Na, K) eg Hardness titration as CaCo₃
- Total Suspended Solids (TSS)
- Salinity
- Sulphate
- Chlorine
- Dissolved Organic Carbon

Heavy metals concentrations will be measured in either water or sediment samples along with grain size, and carbon content if possible for sediment. Grab samples or cores of surface sediment will be collected using methods described in Duncan and Duncan (2012), Marvin-DiPasquale (2009), and Clark (2003).

Table 2: Parameters to be monitored in sediment samples collected for metals

Parameters			
Aluminium	Barium	Manganese	Strontium
Antimony	Chromium	Mercury	Sulphur
Arsenic	Cobalt	Molybdenum	Thallium
Barium	Copper	Nickel	Tin
Beryllium	Fluorine	Potassium	Titanium
Boron	Iron	Selenium	Uranium
Bromine	Lead	Silicon	Vanadium
Cadmium	Lithium	Silver	Zinc

3. Discussion

This document provides an outline of methodologies for macroinvertebrate sampling as part of the SWAMP project. The adoption of this methodology should enhance the findings and relevance of the existing program but will also require additional fieldwork. Further development and research will further aid in the optimization of this methodology to the SWAMP program.

4. Safety

The safety of all volunteers at both professional, technician and citizen science levels is addressed at each survey site. Safe practises will be used when moving between field sites and when working near or in the water. All volunteers will be briefed as to safe operating procedures, hazards and control measures and a field activity sheet should be filled out for each field trip (Appendix 2). The safety and first aid training of all volunteers in the field will be identified. Wading in wetlands can be dangerous if mats of floating vegetation or unconsolidated material are broken through while crossing or if the soft sediments in shallow ponds are quite deep. Volunteers will always work in pairs when wading in wetlands. In addition, a PFD, reach-assist, throw-rope and a Styrofoam board (to distribute weight over mudflat) will always be available. Always check the depth of water and soft sediments with a wading pole before entering (Eaton 2005).

5. Sampling Task List

Pre-work

- Select sites and sampling points
- Collect and organize equipment
- Coordinate on timing, sampling locations and background information with Ryan Durand's field team
- Double check that all bottles required are available
- Label bottles and forms
- Ensure field forms are available on write-in-rain paper

At field site

- Meet volunteer crew and conduct safety talk, review hazards, sign waivers and photo releases
- Review methods with volunteers
- Measure wetland and zone dimensions if needed
- Make sketch of wetland
- Record GPS points
- Stake 5 x 5 m quadrat
- Measure depth of zones
- Take water and sediment samples, meter water chemistry variables
- Sample emergent vegetation
- Sample macroinvertebrates, rinse sediment from sample and preserve with 80% ethanol
- Take precautions in handling amphibians if needed (BC Ministry of Environment 2008)
- Measure dimensions, record general observations and take photos, complete field sheet
- Disinfect all sampling gear (boat, gloves, boots, waders, sampler)

Immediately following field work

- Ship water quality and sediment samples to laboratory for analysis
- Remove preservative from macroinvertebrate samples and replace with 80% ethanol upon return to laboratory and 48 hours after field sampling
- Further reduce macroinvertebrate sample size, remove aquatic plants and sediment if needed.
- Ship macroinvertebrate samples to laboratory for analysis
- Enter field data to spread sheets, ensure back-up of all data

6. Equipment List

- Topographic maps, air photos
- 2 m folding measuring stick
- Tape measure
- GPS unit
- Cell phone
- Bottles for water chemistry pre-labelled,
- Cooler & ice packs
- Multiprobe meter
- Hach kit
- Field data sheets
- Bottles for preserving plants
- Plant press
- Bags
- Invertebrate sampled bottles
- Pre-labelled, labels for inside jar
- Ethanol, funnel
- CABIN sweep net
- Sieves
- Buckets
- Squeeze bottle
- Forceps
- Pipettes
- Ice cube tray
- First aid kit
- Gloves
- Bleach
- Spray bottle

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3 Appendices

3.1 Appendix 1: Site Locations

Wetland sites sampled in 2014 and 2015

Invertsample.date	Site.name	Disturbances	Type	Duration	Northing	Easting	Elevation (m)
25/8/2014	Pass Creek Wetland	Residential	Riverine	Permenant	5474295	454778	567
26/8/2014	Seaton Creek lower	Metals, mining	Riverine	Permenant	5541616	483515	962
27/8/2014	Little Slocan Lakes -north lake,	Potential Reference	Lacustrine	Permenant	5506336	464767	611
8/9/2014	Beaver Lake complex	Potential Reference	Riverine	Permenant	5561188	464335	867
29/6/2015	FOMI's wetland	Roads/Rail bed, chloride	Riverine	Temporary	5496615	460192	519
30/6/2015	Winlaw wetland lower	Potential Reference	Palustrine	Permenant	5494995	461820	976
30/6/2015	Winlaw wetland upper	Potential Reference	Palustrine	Temporary	5495161	462757	1028
9/7/2015	Gander Crk fen, upper wetland	Potential Reference	Palustrine	Permenant	5480369	452213	1571
9/7/2015	Gander Crk shallow-water	Potential Reference	Palustrine	Permenant	5479637	452715	1580
9/7/2015	Cooley Lake	Potential Reference	Lacustrine	Permenant	5482407	453242	1515
10/7/2015	Hay's wetland, 2329 Cunningham Road	Canary Reed Grass, road, residential	Riverine	Permenant	5482263	457573	496
10/7/2015	Tyson Ehler's pond	Canary Reed Grass, residential	Riverine	Permenant	5492796	455562	513
10/7/2015	Frank Zalewski's Oxbow	Cattle	Riverine	Permenant	5492379	455226	507
13/7/2015	Krispen Elder's pond	Canary Reed Grass, residential	Riverine	Permenant	5502111	462894	521
14/7/2015	Bear Lake outflow, south of Hwy 31A	Highway, lake outflow,	Riverine	Permenant	5543400	486333	1080
14/7/2015	Seaton Crk upper	Metals, legacy mining	Riverine	Permenant	5542680	485047	1035
15/7/2015	Little Slocan Lakes -South lake	Potential Reference	Lacustrine	Permenant	5501110	451350	653
21/7/2015	Summit Lake outflow-lower complex	Highway, rail, lake outflow	Riverine	Permenant	5555073	456568	702
21/7/2015	Summit Lake outflow-edge of lake	Lake influence, recreation, residential	Lacustrine	Permenant	5555285	455800	765
21/7/2015	Bonanza Crk marsh, east side	Potential Reference	Lacustrine	Permenant	5549023	466568	576
29/7/2015	Little Wilson Lake	Potential Reference	Lacustrine	Permenant	5564499	459540	906
29/7/2015	Beaver Lakes	Potential Reference	Riverine	Permenant	5560619	464692	887
29/7/2015	Beaver Lakes complex, fen	Potential Reference	Riverine	Permenant	5560293	464563	891
6/8/2015	Seaton Crk, mid	Metals, legacy mining	Riverine	Permenant	5542111	484088	1008

3.2 Work Plan

Activity	Proposed Start Date	Proposed End Date	Lead
Refinement of field work for 2016	2016-01-01	2016-05-30	Darcie Quamme
Consult with U. of Waterloo & Environment Canada	2016-01-01	2016-05-30	Darcie Quamme
Field preparation	2016-05-01	2016-08-31	Darcie Quamme
Sample prep. & handling			Darcie Quamme, Rhia MacKenzie
Emergent Plant Identifications			Ryan Durand & Tyson Ehlers
Water/sediment sent to CARO & Passmore Labs			Darcie Quamme, Rhia MacKenzie
Invertebrates sent to Rhithron			Darcie Quamme, Rhia MacKenzie
Voucher collection to Royal BC Museum			Darcie Quamme, Rhithron
Outreach	Ongoing		All SWAMP groups
Wetland days	2016-07-01	2016-08-31	Slocan River Streamkeepers Soc. (SRSS)
Web site development	Ongoing		Quamme/SRSS
Restoration project follow-up	2016-01-01	2017-01-01	SRSS
Analysis & Reporting	2016-09-01	2017-03-31	Darcie Quamme
Water & sediment chemistry			
Habitat data			
Emergent plant composition			
Stressor gradient			
Recommendations			
Priorities Framework			
Performance indicators			
Updates & Presentations	2016-01-01	2017-03-31	Darcie Quamme, Rhia MacKenzie, Marcy Mahr
Administration	2016-05-01	2017-03-31	Rhia MacKenzie, SRSS

3.3 Appendix 4: Letters of support



MAY 05 2015

Ms. Rhia MacKenzie
Slocan Solutions Society
P.O. Box 91
Slocan BC V0G 2C0

Dear Ms. MacKenzie:

I am pleased to congratulate you on the approval of funding for your organization's project "Slocan Valley Wetland Invertebrate Assessment Tool." This funding has been approved for a total value of up to \$35,870, payable up until March 31, 2016.

Our government is committed to working with Canadians to conserve and restore Canada's rich natural heritage. The National Conservation Plan, launched on May 15, 2014, provides a national vision to advance conservation efforts across the country. Under the Plan, additional investments of \$252 million over five years will be made in three priority areas: conserving Canada's lands and waters, restoring Canada's ecosystems, and connecting Canadians to nature.

Please note that this offer of funding is conditional on the successful negotiation of the project details and the signature of a contribution agreement by your organization and Environment Canada. My officials will contact you to advise on the next steps and to work out the agreement details.

Specific administrative information associated with this contribution is enclosed.

I wish you every success in carrying out this important initiative for a healthy environment.

Sincerely,

The Honourable Leona Aglukkaq, P.C., M.P.
Minister of the Environment

Enclosure



Canada

To Whom It May Concern:

Re: Slocan Valley Wetland Invertebrate Assessment Tool

The Royal BC Museum, in collaboration with the Slocan Wetland Assessment and Monitoring Project (SWAMP), is offering to maintain and house a voucher collection of macroinvertebrates from Slocan Valley wetlands. A reference collection of specimens from the Slocan watershed maintained by the museum will provide improved quality control of the SWAMP project through ensuring verification, taxonomic consistency, and repeatability. It will also allow for comparisons to other similar projects in the future.

The SWAMP invertebrate project aligns with the Royal BC Museum's goals under the Museum Act. The Royal BC Museum is mandated to increase and communicate knowledge of the natural history and human history of British Columbia by conducting sound research and communicating results to the public through articles, symposia and special presentations.

- In addition, the Royal BC Museum collection priorities include identification, research and monitoring aquatic invertebrate species from areas of British Columbia where information or coverage is meager. This includes interior British Columbia, the Kootenays and the Slocan Valley.
- Sensitive freshwater wetland habitats are also prioritized because they are at the forefront of ecological change with regards to climate warming.

The goals of the SWAMP invertebrate project are to provide information on the health of wetlands in the region and to prioritize wetlands for restoration and conservation. The project has been developed under the guidance of Environment Canada using modified Canadian Aquatic Biomonitoring Network (CABIN) protocols. These methods meet museum specifications for collection, taxonomic identification and storage of specimens (CABIN 2007 & 2012). This project will help to increase our understanding of the Slocan River watershed and improve our knowledge on the biodiversity of British Columbia.

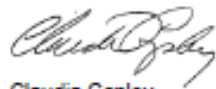
The Royal BC Museum's in-kind support for this project includes:

- approximately \$5000 curation supplies (vial storage cabinets, ethanol, label paper, unit trays)
- 30 days per year of staff time for the curation of the material (approximately \$10,000)
- long - term storage of the voucher specimens, costing approximately \$100 per year.

Specimens curated through this work into the Royal British Columbia Museum holdings will be available in perpetuity for further research and public inquiry.

Please contact me if you have any questions.

Sincerely,



Claudia Copley
Senior Collections Manager, Entomology
Tel (250) 952-0898
E-mail <ccopley@royalbcmuseum.bc.ca>

Environment Canada. April 2007. CABIN Field Manual for Streams. Reynoldson, T.B., C. Logan, T. Pascoe, S. Thompson, S. Sylvestre, C. Mackinnon, and H. McDermott.
Environment Canada. April 2012. CABIN Laboratory Methods: Processing, taxonomy and quality control of benthic macroinvertebrates. H. McDermott, T. Paul and S. Strachan.

Royal BC Museum 678 Belleville Street Victoria BC V8W 9W2 royalbcmuseum.bc.ca





File: 39000-01

October 8, 2015

To Whom It May Concern:

Re: Slocan Valley Wetlands Assessment and Mapping Project (SWAMP)

Please consider this letter of support for the Slocan Valley Wetlands Assessment and Mapping project (SWAMP). This project aligns with the Forests, Lands and Natural Resource Operations (FLNRO) – Resource Management Divisions goals and strategies. One of FLNRO's primary purposes under the Fish, Wildlife and Habitat Management Branch is to conserve and manage important habitat for the benefit of regionally or internationally significant fish and wildlife species. This includes habitat that is vital for:

- Sensitive, vulnerable, or at-risk species.
- Critical species life-cycle phases such as spawning, rearing, nesting, or winter feeding.
- Species migration routes or other movement corridors.
- Supporting unusually high species productivity or diversity.

The wetlands of the Slocan Valley are sensitive freshwater habitats that have been identified as a priority at a local level priority as well as at a provincial and national level, as demonstrated by partnerships with the BC Royal Museum, Environment Canada's National Wetland Conservation Fund, Columbia Basin Fish and Wildlife Compensation Fund, guidance from Environment Canada's Canadian Aquatic Biomonitoring Network and support from the BC Wildlife Federation.

SWAMP has also identified a possible restoration site based on successful restoration work funded by the Columbia Power Corporation under the Slocan River Riparian Restoration Program, and BC Agriculture, Research, and Development Corporation that led to community-based dialogue and support by the private land-owner.

Ministry of Forests, Land and
Natural Resource Operations

Resource Management
Kootenay-Boundary

Mailing/Location Address:
#401 313 Victoria Street
Nelson BC V1L 6K3

Telephone: 250 354-6333
Facsimile: 250 354-6332
Website: www.env.gov.bc.ca/fw

The Wetland Invertebrate Assessment Tool uses a modified protocol developed by Environment Canada under their Canada Aquatic Biomonitoring Network (CABIN). I have reviewed the project's methods and site selection procedures which will help to increase our understanding of the Slocan River watershed wetlands. As well, recent interest in collaboration by Rebecca Rooney of the University of Waterloo may further this project over time.

Please contact me if you have any questions.

Yours truly,

A handwritten signature in black ink, appearing to read 'Kristen Murphy', written in a cursive style.

Kristen Murphy
Habitat Biologist, Resource Management Division

KM:ar



Columbia Basin Watershed Network

c/o Box 857, Kaslo BC V0G 1M0

cbwn.coordinator@gmail.com

250-353-2697

www.cbwn.ca

October 14, 2015

To Whom It May Concern

RE: Slocan Valley Wetland and Mapping Project (SWAMP): Invertebrate assessment component

The Columbia Basin Watershed Network (CBWN) supports the Invertebrate Assessment Component of the Slocan Valley Wetland and Mapping Project. The collaborative and innovative research program is of importance locally and nationally. As a regional network of water stewardship groups, improved understanding of the health and ecological function of wetlands is of vital importance to our groups' interests.

The CBWN is made up of over fifty watershed stewardship groups in the Columbia Basin. The mission of the CBWN is to water stewardship by sharing knowledge, building skills, and facilitating community action in the Columbia Basin. The CBWN works to promote effective communication and networking among communities, watershed groups, NGO's, public agencies, First Nations, academic institutions, and the private sector.

The SWAMP and its member groups are members of the Columbia Basin Watershed Network. SWAMP and its member groups share information and expertise with the other members of the Network.

CBWN will help SWAMP to share information with stewardship groups across the Basin. As the invertebrate assessment tool is developed for wetlands, CBWN members will want to keep informed of the potential for evaluating wetlands in their own backyards.

The CBWN appreciates your enthusiastic support of this scientifically credible, collaborative and innovative project.

On behalf of the CBWN Steering Committee,

A handwritten signature in black ink that reads "Tara Clapp". The signature is written in a cursive, flowing style.

Tara Lynne Clapp

Coordinator

Columbia Basin Watershed Network



October 15, 2015

To Whom It May Concern:

The Ministry of Environment (Water Quality Section) supports the Slocan Wetland Assessment and Monitoring Project (SWAMP) working with Darcie Quamme of Integrated Ecological Research to monitor macroinvertebrates within the wetland areas of the Slocan River watershed. This project is aligned with the Ministry's goals for healthy and diverse native species and ecosystems.

The Ministry is a strong supporter of the Canadian Aquatic Biomonitoring Network (CABIN) protocols, which use macroinvertebrate communities to evaluate ecosystem health in flowing waters. However, there are currently no approved CABIN protocols to evaluate macroinvertebrate communities within wetlands. The proposed SWAMP project will provide data and examine the feasibility of such a protocol for wetlands. The project will be developed under the guidance of Environment Canada using modified Canadian Aquatic Biomonitoring Network (CABIN) protocols that includes a high level of quality control.

The members of the project have continued to demonstrate a strong commitment to improving and preserving aquatic systems in the Slocan River watershed. I believe this project will help to increase community awareness of the importance of wetlands to the ecological integrity of the Slocan River watershed.

Yours truly,

Jolene Raggett, R.P.Bio.
Environmental Assessment Biologist - Water Quality
Environmental Protection Division, Ministry of Environment
Phone: 250-354-6357

Ministry of Environment	Monitoring, Assessment and Stewardship Environmental Protection Division	Mailing Address: 401 - 333 Victoria Street Nelson BC V1L 4K3	Telephone: 250 354-6333 Facsimile: 250 354-6332 Website: www.gov.bc.ca/ewr
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