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METHODS PAPER: Macrophyte Inventory and Cataloging for the Saint John River Downstream of the Mactaquac Generating Station

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DISCLAIMER

Intended use and technical limitations of the report, "Macrophyte Inventory and Cataloging for the Saint John River Downstream of the Mactaquac Generating Station". This interim report describes the methodologies being developed to quantitatively sample the macrophytes in the Saint John River downstream of the Mactaquac Generating Station. The CRI doesn't assume liability for any use of the included information and data outside the stated scope.

The goals of the macrophyte survey are to generate a list of species and their abundance.

Required equipment:

- Boat capable of maneuvering in shallow, plant-filled water.
- Snorkeling equipment (perhaps SCUBA depending on site).
- Sampling rake:
  - 2 metal landscape rake-heads bolted back-to-back;
  - handles removed and replaced with a rope;
  - bolting a metal plate between the rakes adds weight to help get down through dense stands.
- Plastic bags to transport unidentified plants.
- Large tub to store bags.
- Map of the river and notepaper or data sheets (Rite-in-the-Rain).
- GPS unit.
- Plant press to collect specimens (UNB Herbarium has these to loan).
- Materials for specimen preservation that meet herbarium standards (listed below)

General Methods:

Sampling Sites:
Collection sites are located at offshore edge of the littoral zone. Sites are usually accessed by boat using a hand-held GPS. Sampling should begin by 1 August and be completed by the end of September. In the first year (2014), the best estimate of macrophyte locations from local knowledge and on-river surveys were used to generate the sites to sample (Table 1). A concurrent study is mapping the macrophyte densities using an acoustic survey and this map will be available in 2015.

Relative Abundance:
Once on site, anchor the boat, cast the sampling rake, and gently pull it back in to the boat. Remove vegetation from the rake and place it in a plastic bag with water and label well. Each site has three (3) samples: one from the bow throwing forward, twice from amidships, one to port and one to starboard. Note the relative fullness of the rake and the species collected.

The Samples for the Laboratory:
Always collect as much of the plant as possible include roots, stems, leaves, flowers, and fruits. Plants may be collected by hand-pulling or using the rake. Record as much as possible in your field notes about the plant such as: leaves and flowers are submersed, floating, or emergent; color and odor of flowers; any plant species associated with the collected plant. Wash the plant in clean water to remove algae, debris, and sediment. Take photographs. Keep the plants moist until they can be pressed in the laboratory, i.e., plants should be pressed immediately upon returning from the field. They can be stored in the bag with water in the fridge overnight.

Site Information:
Take several photographs of the site and the macrophtye samples. Record the site information: 1) submersed or emergent species along shore and 2) GPS coordinates; description of physical characteristics (distance offshore, depth, flow (characterize as none, slow, etc.), substrate characteristics (if visible or apparent from raking action); and water temperature.

Species Richness:
Survey a minimum of 25m of the site for additional macrophyte species not collected with the rake by walking (if shallow), snorkeling (<2m deep), or SCUBA (>2m) depending on water depth and river conditions. All SCUBA diving survey procedures are to be conducted according to the University of New Brunswick's Policy for Scientific Diving (http://www.unb.ca/fredericton/environmental-safety/handbook/water/scientific-diving.html) in compliance with the New Brunswick Occupational Health and Safety Regulations; the CSA Standard "Occupational Safety Code for Diving Operations"; as well as the Canadian Association for Underwater Science (CAUS) peer reviewed standards for scientific diving (http://www.caus.ca/resources-and-documents/). For all species encountered, collect entire specimens (roots, shoots and reproductive material). Take photographs. If there is uncertainty with regards to species identification in the field, then return specimens to the laboratory for further examination.

Preservation:
At least one representative of each species at each site is to be preserved. If there is any uncertainty with regards to species delineation, then multiple specimens should be preserved. Identify plants using the reference books - *Invasive Aquatics of Maine*, *Flora of NB* and *Vascular Plants of the Northeastern US and Adjacent Canada*. Preserve each representative specimen according to pressing directions (see below). These are the voucher specimens. Create a list of all the species seen at each location.

Personal Protective Equipment:

All personnel carrying out this protocol should use the following PPE:

- Closed-toed shoes
- Personal floatation device
- There is no known overhead risk and low eye and ear risk; therefore hardhat, safety glasses and hearing protection is optional.

Sampling Schedule:

Whereas some macrophyte species reported for the Saint John River are only present for a limited period during the growing season, sample sites should be examined as frequently as possible during early-, mid- and late-summer. The most complete and extensive surveys should be carried out in the months of August and September when macrophytes will be at their peak biomass, i.e., surveys begin the first week of August and are completed by the end of September.

Sample Sites:

Sample sites reflect our current understanding of macrophyte distributions in the MAES study area (Table 1).

Table 1. Location of macrophyte survey sites in the MAES study area of the Saint John River.

Site	Date Added to Survey	Latitude	Longitude	Easting	Northing
Dam area	2014	45.953924	-66.866552	2471584	7439371
R-DS-1	2014	45.956699	-66.861696	2471961.848	7439677.766
R-DS-10	2014	45.969128	-66.812025	2475817.71	7441042.748
R-DS-11	2014	45.971075	-66.806815	2476222.341	7441257.603
R-DS-12	2014	45.97312	-66.80196	2476599.45	7441483.396
R-DS-13	2014	45.970099	-66.800964	2476675.371	7441147.392
R-DS-14	2014	45.973237	-66.795531	2477097.736	7441494.524
R-DS-15	2014	45.970784	-66.794589	2477169.703	7441221.698
R-DS-16	2014	45.972166	-66.788485	2477643.345	7441373.56
R-DS-17	2014	45.972838	-66.782639	2478096.593	7441446.577
R-DS-18	2014	45.971862	-66.77654	2478568.927	7441336.382
R-DS-19	2014	45.97185	-66.770127	2479065.877	7441333.345
R-DS-2	2014	45.959973	-66.857279	2472305.898	7440040.084
R-DS-20	2014	45.972197	-66.763703	2479563.828	7441370.26
R-DS-21	2014	45.970498	-66.762381	2479665.692	7441181.154
R-DS-22	2014	45.973789	-66.75784	2480018.805	7441545.754
R-DS-23	2014	45.969573	-66.756133	2480149.556	7441076.754
R-DS-24	2014	45.973768	-66.751662	2480497.541	7441541.801
R-DS-25	2014	45.968507	-66.749871	2480634.461	7440956.714
R-DS-26	2014	45.971774	-66.74588	2480944.944	7441318.806
R-DS-27	2014	45.968231	-66.743445	2481132.444	7440924.488
R-DS-28	2014	45.970148	-66.739864	2481410.587	7441136.711
R-DS-29	2014	45.968835	-66.737086	2481625.448	7440990.084
R-DS-3	2014	45.962497	-66.852225	2472698.895	7440318.786
R-DS-30	2014	45.970702	-66.72539	2482532.485	7441194.92
R-DS-31	2014	45.969909	-66.719056	2483023.127	7441105.46
R-DS-32	2014	45.96976	-66.712608	2483522.804	7441087.485
R-DS-33	2014	45.96979	-66.706159	2484022.624	7441089.541
R-DS-34	2014	45.969843	-66.699715	2484522.062	7441094.175
R-DS-35	2014	45.969195	-66.693331	2485016.66	7441020.874

Site	Date Added to Survey	Latitude	Longitude	Easting	Northing
R-DS-36	2014	45.968679	-66.686923	2485513.121	7440962.339
R-DS-37	2014	45.968731	-66.680522	2486009.224	7440967.059
R-DS-38	2014	45.969089	-66.673724	2486536.149	7441005.638
R-DS-39	2014	45.968389	-66.667352	2487029.888	7440926.763
R-DS-4	2014	45.962504	-66.846005	2473180.994	7440317.488
R-DS-40	2014	45.968402	-66.660929	2487527.632	7440927.188
R-DS-41	2014	45.968583	-66.654484	2488027.153	7440946.3
R-DS-42	2014	45.968432	-66.648065	2488524.615	7440928.583
R-DS-43	2014	45.96717	-66.641927	2489000.076	7440787.444
R-DS-44	2014	45.965016	-66.636263	2489438.64	7440547.315
R-DS-45	2014	45.961515	-66.632237	2489750.033	7440157.671
R-DS-46	2014	45.957568	-66.629488	2489962.415	7439718.556
R-DS-47	2014	45.953147	-66.628444	2490042.565	7439227.056
R-DS-48	2014	45.948662	-66.628	2490076.175	7438728.58
R-DS-49	2014	45.94427	-66.626642	2490180.684	7438240.27
R-DS-5	2014	45.961569	-66.839707	2473668.756	7440211.465
R-DS-6	2014	45.960657	-66.833391	2474157.916	7440107.997
R-DS-7	2014	45.960792	-66.827089	2474646.449	7440121.025
R-DS-8	2014	45.963357	-66.821858	2475053.029	7440404.405
R-DS-9	2014	45.966231	-66.816898	2475438.766	7440722.305
R-DS-CH-1	2014	45.969568	-66.821383	2475092.629	7441094.558
R-DS-CH-10	2014	45.987983	-66.822814	2474990.087	7443141.714
R-DS-KES-1	2014	45.991578	-66.819418	2475254.814	7443540.184
R-DS-CH-11	2014	45.973844	-66.779546	2478336.748	7441557.486
R-DS-CH-12	2014	45.976676	-66.774604	2478720.794	7441870.979
R-DS-CH-13	2014	45.980148	-66.770852	2479012.83	7442255.842
R-DS-CH-14	2014	45.970739	-66.732792	2481958.884	7441200.758
R-DS-CH-15	2014	45.973301	-66.738095	2481548.788	7441486.752
R-DS-CH-16	2014	45.976055	-66.743184	2481155.358	7441794.005
R-DS-CH-2	2014	45.973859	-66.823256	2474949.466	7441572.113
R-DS-CH-3	2014	45.976999	-66.819052	2475276.648	7441919.789
R-DS-CH-4	2014	45.979722	-66.815759	2475533	7442221.367
R-DS-CH-5	2014	45.976932	-66.812855	2475756.782	7441910.348
R-DS-CH-6	2014	45.984075	-66.813493	2475710.521	7442704.45
R-DS-CH-7	2014	45.983147	-66.807674	2476161.007	7442599.511
R-DS-CH-8	2014	45.980092	-66.803858	2476455.365	7442258.885

Site	Date Added to Survey	Latitude	Longitude	Easting	Northing
R-DS-CH-9	2014	45.984767	-66.820116	2475197.708	7442783.385
R-DS-KES-2	2014	45.991773	-66.813033	2475749.566	7443559.919
R-DS-KES-11	2014	45.980298	-66.755832	2480176.7	7442268.644
R-DS-KES-12	2014	45.978799	-66.749748	2480647.605	7442100.576
R-DS-KES-13	2014	45.977053	-66.74031	2481378.407	7441904.275
R-DS-KES-14	2014	45.976288	-66.733972	2481869.248	7441817.708
R-DS-KES-15	2014	45.975213	-66.726468	2482450.437	7441696.528
R-DS-KES-16	2014	45.975693	-66.720054	2482947.605	7441748.55
R-DS-KES-17	2014	45.975543	-66.713621	2483446.036	7441730.5
R-DS-KES-18	2014	45.975006	-66.707216	2483942.203	7441669.521
R-DS-KES-19	2014	45.975539	-66.70099	2484424.814	7441727.46
R-DS-KES-20	2014	45.976582	-66.694854	2484900.629	7441842.242
R-DS-KES-21	2014	45.975465	-66.688652	2485380.91	7441716.918
R-DS-KES-3	2014	45.990462	-66.80688	2476225.626	7443412.378
R-DS-KES-22	2014	45.973043	-66.683335	2485792.31	7441446.731
R-DS-KES-23	2014	45.970814	-66.679905	2486057.614	7441198.465
R-DS-KES-4	2014	45.989314	-66.800651	2476707.702	7443282.928
R-DS-KES-5	2014	45.988562	-66.793985	2477223.809	7443197.369
R-DS-KES-6	2014	45.988239	-66.787548	2477722.375	7443159.664
R-DS-KES-7	2014	45.987348	-66.781265	2478208.851	7443058.865
R-DS-KES-8	2014	45.985013	-66.775781	2478632.774	7442797.907
R-DS-KES-9	2014	45.983645	-66.769641	2479108.024	7442644.176
R-DS-KES-10	2014	45.981736	-66.761947	2479703.463	7442430.026

Specimen Preservation (pressing plants):

Materials Needed:

- Plant press – borrowed from the Connell Memorial Herbarium at the University of New Brunswick.
- Herbarium paper
- Packets for extra plant structures (such as seeds), use small envelopes mounted on herbarium paper with the specimen.
- Herbarium glue
- Jay cloths
- Blotting paper/absorbent paper
- Linen tape
- Labels- these should include all of the data relevant to the specimen (identification, collector, site, habitat, date collected, and any additional notes)

- Digital camera

  Note: All specimens collected should be documented with digital photographs. Take several pictures of different macroscopic features on the same specimen. Identification of aquatic plants is easiest with fresh material (before pressing); however, if this is not possible then the photographs may assist identification at a later time. Pressed specimens may also be sent to an expert for identification.

- The best method for pressing aquatic plants is to float the plant directly onto the herbarium sheet. This is accomplished by placing the plant in water with the paper below it. Position the plant on the paper and hold it in place with a finger. Slowly lift the paper plus plant from the water. The water flowing from the paper should separate the leaves while the plant adheres to the wet paper.
- Place a jay cloth over specimen to prevent specimens from sticking to paper other than the herbarium sheet. Then, place the pressed specimen between two sheets of blotting paper and support this between two sheets of corrugated cardboard.
- Several prepared specimens can be stacked in this manner (label or number the plants so you know which plants matches which field notes). Place the stack between two firm pieces of wood and apply an even pressure using straps, bolts or a heavy weight. Place this bundle on its side in the plant dryer at the Connell Memorial Herbarium (UNB) for at least 24 hours. To avoid mildew, change the newspaper periodically (about once per day) until the plants are dry.
- When pressing plants with whorled or finely divided leaves, it is useful to separate a node (the stem section where leaves are attaches) and float that onto a small portion of the paper. This yields a cross section showing the leaf pattern.
- For plants with large bulky stems, roots or leaves, the bulky portion can be split before pressing to facilitate drying, and to prevent uneven pressure in the press.
- If extra flowers, fruits or vegetative parts are collected, these should be pressed, dried, and later placed in the packets. The packets are then glued to the herbarium paper.

Mounting Dehydrated Specimens

- Arrange the plants on a piece of herbarium paper. If the plant is too long, it may be cut into several sections and placed lengthwise on the paper.
- Either glue or tape the specimen to the paper (glue will tend to cause delicate submersed plants to curl; tape may be preferred in such cases).
- Complete a label (identification, collector, site, habitat, date collected, and any additional notes) and adhere to the lower right corner of the paper.

Note: If a specimen identification needs to be verified, send a duplicate pressed, but unmounted specimen with a complete label to an authority on aquatic plants. They will keep this specimen for their collection and notify you of the plant's identity. Once the plant has dried and is identified, it is mounted and kept for future reference.