GULL (KEEYASK) PROJECT

Generating Station

March 2004

Report # 02-10

Aquatic Macrophyte and Associated Epiphytic Invertebrate Data Collected in Gull Lake and Portions of the Nelson River between Birthday Rapids and Gull Rapids, Manitoba, Fall 2002

Draft

ENVIRONMENTAL STUDIES PROGRAM

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AQUATIC MACROPHYTE AND ASSOCIATED EPIPHYTIC INVERTEBRATE DATA COLLECTED IN GULL LAKE AND PORTIONS OF THE NELSON RIVER BETWEEN BIRTHDAY RAPIDS AND GULL RAPIDS, MANITOBA, FALL 2002

Draft Report Prepared for Manitoba Hydro

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OVERVIEW

Manitoba Hydro and its potential partners (Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation, and York Factory First Nation) are currently looking into building a hydroelectric generating station at Gull Rapids on the Nelson River. Studies are being done to support predictions of possible effects of this generating station on the environment. This information is required to prepare an Environmental Impact Statement (EIS), a document required by government for its consideration when deciding about licensing the generating station. The aquatic part of these studies is looking at the water, algae (microscopic plants in the water), weeds, bugs, and fish. The area being studied includes Split, Stephens, Clark, Gull, and Assean lakes and adjoining parts of the rivers (Burntwood, Nelson, Aiken, and Assean) and the streams that flow into them. Separate reports are being issued on each topic and for each different area.

This report presents the results of the second year of aquatic macrophyte and epiphytic invertebrate sampling in Gull Lake, including portions of the Nelson River between Birthday and Gull rapids during the 2002 open-water season. Aquatic macrophytes are plants that grow in shallow water and provide shelter for fish. Epiphytic invertebrates are small animals that live among the plants and are an important food source for many fish. Aquatic macrophyte and epiphytic invertebrate sampling was also conducted in Gull Lake in 2003.

TECHNICAL SUMMARY

Manitoba Hydro and its potential partners (Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation, and York Factory First Nation) are currently investigating the feasibility of developing a **hydroelectric generating station*** at Gull Rapids located at the upstream end of Stephens Lake on the Nelson River (Figure 1). An Environmental Studies Program has been developed to provide the data and information required for an **environmental impact assessment** of the above-mentioned hydroelectric **Project**, should a decision be made to proceed with a licensing submission to **regulatory authorities**. Manitoba Hydro and the potential partners have established a cooperative approach to assessing the potential effects of future development on the **environment** and for producing the information required for regulatory review and impact **monitoring**.

The Gull (Keeyask) **aquatic monitoring** and impact assessment program was designed to investigate and document interrelated components of the Burntwood, Nelson, Aiken, and Assean rivers as well as the associated lake (Split, Stephens, Clark, Gull, and Assean) aquatic **ecosystems**. Investigations of physical **habitat**, **water quality**, **detritus**, **algae**, aquatic **macrophytes**, **aquatic invertebrates**, and fish were to be undertaken. Individual reports are being prepared and issued on each topic and for specific waterbodies.

The following report presents information collected from aquatic macrophytes and **epiphytic invertebrate** sampling conducted in Gull Lake, and portions of the Nelson River between Birthday and Gull rapids, during the 2002 open-water season. Specific objectives of the program were to provide a description of the aquatic macrophyte and epiphytic invertebrate communities in terms of abundance, composition, and distribution within the Gull Lake area.

Aquatic macrophyte samples were collected from five areas in Gull Lake and portions of the Nelson River between Birthday and Gull rapids during the fall 2002 sampling period. Within each area, sites were selected to represent specific aquatic habitats, including a shoreline, a mid-bay, and an outer-bay site. Epiphytic invertebrates were collected in conjunction with aquatic macrophyte sampling.

Four macrophyte taxa and eleven epiphytic invertebrate taxa were identified from samples collected in Area 1 of the Gull Lake area during the fall 2002 sampling period. The dominant macrophyte taxa within Area 1 were *Myriophyllum sibiricum*, *Lemna trisulca*, and *Stuckenia vaginatus*. Crustacea accounted for the majority of invertebrates associated with aquatic macrophytes collected during the fall, 2002.

* *Definitions for words appearing in bold are provided in the glossary (see Section 5.0).*

Three macrophyte taxa and ten epiphytic invertebrate taxa were identified from samples collected in Area 2 of the Gull Lake area during the fall 2002 sampling period. *S. vaginatus* and *Potamogeton richardsonii* composed the majority of aquatic macrophytes collected from samples in Area 2. Insects accounted for the majority of invertebrates associated with aquatic macrophytes collected during the fall, 2002.

Six macrophyte taxa and twelve epiphytic invertebrate taxa were identified from samples collected in Area 3 of the Gull Lake area during the fall 2002 sampling period. The dominant macrophyte taxa identified in Area 3 included *L. trisulca* and *P. richardsonii*. Crustacea and Insects accounted for the majority of epiphytic invertebrates associated with aquatic macrophytes collected during the fall, 2002.

Four macrophyte taxa and ten epiphytic invertebrate taxa were identified from samples collected in Area 4 of the Gull Lake area during the fall 2002 sampling period. Macrophyte samples collected in Area 4 were comprised of *Potamogeton* sp.1, *P. richardsonii*, and *S. vaginatus*. Mollusca accounted for the majority of epiphytic invertebrates associated with aquatic macrophytes collected during the fall, 2002.

Four macrophyte taxa and fourteen epiphytic invertebrate taxa were identified from samples collected in Area 5 of the Gull Lake area during the fall 2002 sampling period. All vascular macrophytes identified in samples collected from Area 5 belonged to the *Potamogeton* genus, with *Potamogeton* sp. 1 dominating at all three sites. Similar to Area 4, Mollusca accounted for the majority of epiphytic invertebrates associated with aquatic macrophytes. Unlike other areas sampled within the Gull Lake area, Annelida were relatively abundant and Crustacea were virtually absent from samples collected during the fall, 2002.

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1.0 INTRODUCTION

Manitoba Hydro and its potential partners (Tataskweyak Cree Nation [TCN], War Lake First Nation [WLFN], Fox Lake Cree Nation [FLCN], and York Factory First Nation [YFFN]) are currently investigating the feasibility of developing a **hydroelectric generating station**[*] at Gull Rapids located at the upstream end of Stephens Lake on the Nelson River (Figure 1). An Environmental Studies Program has been developed to provide the data and information required for an **environmental impact assessment** of the above-mentioned hydroelectric **Project** (hereafter referred to as the Project), should a decision be made to proceed with a licensing submission to **regulatory authorities**. Manitoba Hydro and the potential partners have established a cooperative approach to assessing the potential effects of the Project on the **environment** and for producing the information required for regulatory review and impact **monitoring**.

The broad objectives of the Environmental Studies Program are the following:

- to describe the **existing environment** of the Study Area using an **ecosystem**-based approach;
- to provide data and information to assist in the planning of the Project;
- to provide data and information to enable assessment of the potential adverse effects that may result from the Project; and
- to provide the basis for monitoring environmental change resulting from development, should the Project proceed.

The following report describing the results of aquatic **macrophyte** and **epiphytic invertebrate** sampling in Gull Lake and from portions of the Nelson River between Birthday and Gull rapids (herein referred to as the Gull Lake area) is one of a series of reports produced from the Gull (Keeyask) Environmental Studies Program.

1.1 AQUATIC ECOSYSTEMS MONITORING AND ASSESSMENT

The collection of **baseline information** on the **aquatic environment** was initiated at the Project site in 1999. Manitoba Hydro expanded the program in 2001, and again in 2002, in response to concerns raised by the Cree Nations to include a broader geographic area to better characterize all aspects of the environment that may be affected by development at Gull Rapids. This included the **reach** of the Nelson River between, and including, Split Lake

[*] *Definitions for words appearing in bold are provided in the glossary (see Section 5.0).*

to Stephens Lake, the Burntwood, Aiken, and Assean rivers, as well as the associated lake (Split, Clark, Gull, and Assean) aquatic ecosystems. Biological investigations included measurements of physical **habitat**, **water quality**, **detritus**, **algae**, aquatic macrophytes, **aquatic invertebrates**, and fish.

Individual reports are being prepared and issued on each of these topics and for specific waterbodies. These reports will describe the existing environment, provide information to assist in Project planning, and provide the basis for predicting and assessing the significance of potential adverse effects that may result from construction and operation of the Project.

This report presents the results of the aquatic macrophyte and associated epiphytic invertebrate sampling program conducted in Gull Lake, and portions of the Nelson River between Birthday and Gull rapids, during the 2002 open-water season. The specific objective is as follows:

- to provide a description of the aquatic macrophyte and associated epiphytic invertebrate communities in terms of abundance, composition, and distribution within the Gull Lake area.

2.0 THE GULL (KEEYASK) STUDY SETTING

2.1 STUDY AREA

The Gull (Keeyask) Study Area includes the reach of the Nelson River from Kelsey Generating Station (GS) to Kettle GS, including Split, Clark, Gull, and Stephens lakes; the Burntwood River downstream of First Rapids; the Grass River downstream of Witchai Lake Falls; the Assean River **watershed**, including Assean Lake; and all other tributaries to the above stated reach of the Nelson River (Figure 1).

The entire Study Area lies within the High **Boreal** Land Region characterized by a mean annual temperature of –3.4ºC and annual precipitation range of 415 to 560 mm. **Topography** is bedrock controlled overlain with fine-grained **glacio-lacustrine deposits** of clays and gravels. Depressional areas have **peat** plateaus and patterned **fens** with **permafrost** present. Black spruce/moss/sedge associations are the dominant vegetation (Canada-Manitoba Soil Survey 1976).

Split Lake, which is immediately downstream of the Kelsey GS at the **confluence** of the Burntwood and Nelson rivers, is the second largest waterbody in the Study Area. Due to the large inflows from the Nelson and Burntwood rivers, the lake has detectable current in several locations. Split Lake has maximum and mean depths of 28.0 m and 3.9 m, respectively, at a water surface elevation of 167.0 m **ASL** (Lawrence et al. 1999). The surface area of Split Lake was determined to be 26,100 ha (excluding islands), with a total shoreline length, including islands, of 940.0 km (Lawrence et al. 1999). The numerous islands in Split Lake represent 411.6 km of the total shoreline.

The reach of the Nelson River between Split Lake and Stephens Lake is characterized by: i) narrow sections with swiftly flowing water (including Birthday and Gull rapids); and ii) wider more **lacustrine** sections, including Clark and Gull lakes. Mean winter flow in the reach is 3,006 m^3/s and mean summer flow is 2,812 m^3/s (Manitoba Hydro 1996a).

The Assean River system is north of Split Lake and drains into Clark Lake (Figure 1). Except for the mouth of the Assean River, the **hydrology** of the watershed has not been affected by hydroelectric development.

Stephens Lake, the largest lake in the Study Area, is located downstream of Gull Rapids and was created through the development of the Kettle GS. Stephens Lake has a surface area of 29,930 ha (excluding islands) and a total shoreline length, including islands, of 740.8 km. The numerous islands encompass an area of 3,340 ha and 336.2 km of shoreline. There is no

detectable current throughout most of this large lake, except for the old Nelson River channel.

Communities in the Study Area include the First Nations communities of Split Lake (TCN) and York Landing (YFFN), both located on Split Lake (Figure 1). Members of WLFN reside in Ilford south of the Nelson River while some members of FLCN reside in Gillam on the south shore of Stephens Lake. Gillam, the largest community in the Study Area; is the regional headquarters for Manitoba Hydro's northern operations.

The names assigned to some of the features described in Section 2.3 and illustrated in Figure 1 may be inconsistent with local names, topographic maps, and/or the Gazetteer of Canada. When field programs were initiated in spring, 2001, names of several features within the Study Area were unknown to North/South Consultants Inc. (NSC) biologists and First Nation assistants. Therefore, some features for which no name was known were assigned names by field personnel. Chief and council of TCN, YFFN, WLFN, and FLCN or the Canadian Permanent Committee on Geographical Names have not approved names of features described within this document.

2.2 PREVIOUS HYDROELECTRIC DEVELOPMENT

The Study Area is bounded by two Manitoba Hydro hydroelectric generating stations on the Nelson River; the Kelsey GS just upstream of Split Lake and Kettle GS downstream of Stephens Lake. The Kelsey GS came into service in 1961 and is operated as a **run-of-river plant** with very little storage or re-regulation of flows (Manitoba Hydro 1996a).

The Kettle GS was completed in 1974, which raised the water level at the structure by 30.0 m and created a backwater effect upstream to Gull Rapids. Approximately 22,055 ha of land were flooded in creating Stephens Lake (Manitoba Hydro 1996a). Kettle GS is operated as a **peaking-type plant**, cycling its **forebay** on a daily, weekly, and seasonal basis. The forebay is operated within an annual water level range from 141.1 m to 139.5 m ASL (Manitoba Hydro 1996a).

Since 1976, two water management projects, the Churchill River Diversion (CRD) and Lake Winnipeg Regulation (LWR), have influenced water levels and flows within the Study Area. These two projects augment and alter flows to generating stations on the lower Nelson River by diverting additional water into the drainage from the Churchill River (CRD) (Manitoba Hydro 1996b) and managing outflow from Lake Winnipeg (LWR). The CRD and LWR projects reversed the Nelson River pre-Project seasonal water level and flow patterns in the Gull (Keeyask) Study Area by increasing water levels and flow during periods of ice cover

and reducing flows during the open-water period. Overall, there has been a net increase of 246 m^3/s in average annual flow at Gull Rapids since CRD and LWR (Manitoba Hydro 1996a). The historic and current flow regimes are described in "History and First Order Effects, Split Lake Cree Post-Project Environmental Review", Volume Two (Manitoba Hydro 1996a).

2.3 REPORT SPECIFIC STUDY AREA

The majority of the reach of the Nelson River between Birthday Rapids and Gull Lake lies within a landscape of well-drained mineral **soils**, dominated by black spruce forest. Immediately upstream of Gull Lake, the land adjacent to the south shore of the Nelson River is generally poorly drained, and is dominated by **organic** soils, and black spruce **bogs**, peatlands, and fens. Trembling aspen occurs occasionally along the shores of the Nelson River in areas that are well-drained. Exposed bedrock occurs along the north shore and upstream portions of the south shore of the Nelson River, particularly within the first 2 km downstream of Birthday Rapids. Permafrost is **discontinuous** to **sporadic** adjacent this section of the river (Agriculture and Agri-Food Canada 2003).

Birthday Rapids is located approximately 10 km downstream of Clark Lake and 30 km upstream of Gull Rapids on the Nelson River (Figure 1). The drop in elevation from the upstream to downstream side of Birthday Rapids is approximately 5 m. The 14 km reach of the Nelson River between Birthday Rapids and Gull Lake is characterized as a large somewhat uniform channel with medium to high water **velocity**. A series of exposed shoals and boulders are located within the first 7 km downstream of Birthday Rapids, after which **run** habitat dominates the river. There are a few large bays with reduced water velocity and a number of small tributaries that drain into the Nelson River between Birthday Rapids and Gull Lake. River **substrates** are typically bedrock, boulder, cobble, and sand, with some fine **sediment** in areas with reduced current. The shoreline in this section of the river contains large sections of bedrock and some areas of fine sediments. **Riparian** vegetation includes willow and alder, black spruce, tamarack, and trembling aspen. Aquatic vegetation is restricted to bays that are removed from the major river current.

Gull Lake is situated within a landscape of well-drained mineral soils, dominated by black spruce forest. Trembling aspen occurs sporadically along the shores of Gull Lake and in areas that are well drained. Permafrost is sporadically distributed along this section of the river (Agriculture and Agri-Food Canada 2003).

Gull Lake is a section of the Nelson River where the river widens and is lacustrine in nature with moderate to low water velocity featuring numerous bays. Gull Lake is herein defined as

the reach of the Nelson River beginning approximately 17 km upstream of Gull Rapids and 14 km downstream of Birthday Rapids, where the river widens to the north into a bay around a large point of land (Figure 1), and extending downstream to the downstream end of Caribou Island, approximately 3 km upstream of Gull Rapids. Gull Lake has three distinct **basins**, the first extending from the upstream end of the lake downstream approximately 6 km to a large island; the second extending from the large island to Morris Point (a constriction in the river immediately upstream of Caribou Island); and the third extending from Morris Point to the downstream end of Caribou Island. Water velocity in the third basin is somewhat faster than in the first two, particularly under low flow scenarios, as the river channel flows around Caribou Island. Gull Lake has numerous small tributaries, with the majority being **ephemeral**. Lake substrates are predominantly **silt** and sand with some cobble and boulder in the first two basins where current is slow, and predominantly cobble, boulder, and bedrock in the third basin, with soft substrates in off-current areas. Riparian vegetation includes willow and alder, black spruce, tamarack, and trembling aspen. Aquatic vegetation is restricted to bays that are removed from the major river channel.

The landscape between Gull Lake and Gull Rapids consists of well-drained mineral soils, with bedrock outcrops. Black spruce is the dominant forest cover, with trembling aspen occurring sporadically along the shore. Permafrost is sporadically distributed adjacent to this section of the river (Agriculture and Agri-Food Canada 2003).

This 3 km reach of the Nelson River is characterized by a steep gradient with high water velocity. The river channel is separated into two by a large island at the upstream end of Gull Rapids (Figure 1). The substrate is bedrock, boulder, and cobble with small amounts of clay and silt in off current bays. Aquatic vegetation is restricted to a bay on the south shore.

3.0 METHODS

3.1 MACROPHYTE SAMPLING LOCATIONS

Aquatic macrophytes and associated epiphytic invertebrate sampling was conducted between Birthday and Gull rapids, including Gull Lake, from 28 to 31 August, 2002, within the following five areas (Figure 2):

- Area 1: Pahwaybanic Bay, located approximately 8.2 km downstream of Birthday Rapids, off the mainstem of the Nelson River;
- Area 2: John Garson Bay, located approximately 11.4 km upstream of Gull Rapids, off the mainstem of the Nelson River;
- Area 3: Kahpowinic Bay, located approximately 15.5 km downstream of Birthday Rapids, off the mainstem of the Nelson River;
- Area 4: Tub Bay, located approximately 4.6 km upstream of Gull Rapids, off the mainstem of the Nelson River; and,
- Area 5: Gull Lake at Caribou Island, located approximately 8.0 km upstream of Gull Rapids.

Within each area, three sites were selected to represent specific aquatic habitats, including a shoreline site, a mid-bay site, and an outer-bay site. Within each site, random locations with abundant aquatic vegetation and water depth no greater than 2 m were sampled in replicate; one sample was taken from the left side of the boat and one from the right. At each site, UTM coordinates were taken using a navigation quality Global Positioning System unit and water depth was measured using a weighted rope graduated to the nearest 10 cm.

3.2 MACROPHYTE FIELD SAMPLING

Aquatic macrophytes and associated epiphytic invertebrates were collected with a custom-designed sampler constructed of industrial ABS grade material. The frame measured 0.6 x 0.7 m in depth, 1.4 m in height, with a surface area of 0.42 m^2, and an attached 1.5 m cod-end. The sampler was placed into the water with the retractable cutter blade engaged and lowered to the bottom, disturbing the aquatic vegetation as little as possible. The cutter blade was then pulled across the bottom of the sampler, severing the rooted macrophytes above the sediment surface. All plants and associated invertebrates were retained within the sampler.

Once the sampler was pulled to the surface, macrophytes were thoroughly rinsed. Replicate samples were kept separated and macrophytes were put into labelled bags. The rinse water

was sieved through a 500 µm sieve to collect epiphytic invertebrates, which were then preserved in 10% formalin. Macrophyte samples were frozen immediately and transported to North/South Consultants Inc. laboratory in Winnipeg for further processing.

3.3 LABORATORY AND DATA ANALYSIS

Macrophytes were thawed in the laboratory in cold water, identified to the lowest **taxonomic** group (usually genus or **species**), and sorted. Macrophyte samples were sorted and identified based on Fassett 1957, Flora of North America Editorial Committee 2000, Johnson et al. 1999, Scoggan 1978, and personal communication with Jackie Krindle (Calyx Consulting).

Species level identification of certain aquatic macrophyte samples was difficult due to the time of year samples were collected (i.e., lack of flowering parts in early fall). Consequently, these macrophytes were sorted into groups with similar appearances and are referred to as *Potamogeton* sp. 1, *Potamogeton* sp. 2, *Potamogeton* sp. 3. Any macrophyte material that could not be identified was grouped as unidentified.

The wet weight (g) of macrophyte samples was determined by weighing plant material in pre-weighed aluminum pans. Samples were subsequently dried in a Fisher Scientific Isotemp drying oven for approximately 24 hours at a temperature of 106 °C and a dry-weight (g) was determined for each plant group (g; dry-weight/group). Dried samples were discarded. Aquatic macrophyte biomass (g; dry-weight of group/m^2) was determined using the following formula:

dry-weight of groups per sample (g) / surface area of sampler (0.42 m^2).

In the laboratory, epiphytic invertebrate samples were transferred to 70% ethanol, sorted under a magnifying lamp, identified to major groups, and enumerated. Any remaining invertebrates found on macrophytes in the lab that were not initially rinsed off in the field were included in the analysis. Epiphytic invertebrate abundance (individuals/m^2) was determined using the following formula:

individuals per sample / surface area of sampler (0.42 m^2).

4.0 RESULTS

Sampling sites for each of the five areas in Gull Lake and portions of the Nelson River between Birthday and Gull rapids are presented in Figure 2. Site-specific location, sampling date, and water depth is presented for each area in Table 1.

4.1 AREA 1

Four taxa of **vascular** macrophytes were identified from samples collected at three sites in Area 1 of the Gull Lake area during 2002. Dry weights of macrophyte samples are presented in Table 2 and Figure 3. *Myriophyllum sibiricum* was found at all three sites, dominating Site 1 (mid-bay) with a mean percent dry weight of 93.2% (Table 2; Figure 3). At Site 2 (shoreline), *Lemna trisulca* dominated, with a mean percent dry weight of 51.1%. *Stuckenia vaginatus* contributed notably to the overall biomass of Site 3 (outer-bay) within Area 1, having a mean percent dry weight of 97.6% (Table 2). **Nonvascular** macrophytes collected in Area 1 included epiphytic algae/cyanophytes and unidentified macrophytes, each contributing less than 5% of the total dry weight collected at each site (Table 2). Overall, samples collected in Area 1 during the fall 2002 indicated that Site 1 had a greater density of aquatic macrophytes (130.4 g/m^2) compared to sites 2 and 3 (99.4 and 79.3 g/m^2, respectively) (Table 2; Figure 3).

Eleven epiphytic invertebrate taxa were identified from samples collected in Area 1 of the Gull Lake area during the fall of 2002. Mean invertebrate abundance and percent composition are summarized in Table 3 and Figure 4. Overall, the most common invertebrate **taxon** in the samples was Crustacea (exclusively Amphipoda), followed by Insecta (chironomid larvae and Hemiptera) and Mollusca (Pisidiidae and Gastropoda) (Table 3; Figure 4). Mean total epiphytic invertebrate abundance varied between sites sampled in Area 1. Overall, the mean total invertebrate abundance was 584 individuals/m^2, with samples collected at Site 1 having a higher invertebrate abundance (825 individuals/m^2) than sites 2 and 3 (431and 496 individuals/m^2, respectively) (Table 3).

At Site 1, Crustacea (Amphipoda) dominated as the most abundant invertebrate taxon associated with aquatic macrophyte samples, followed by Mollusca (Gastropoda and Pisidiidae) and Insecta, with average invertebrate abundances of 564, 164, and 93 individuals/m^2, respectively. At sites 2 and 3, Insecta dominated as the most abundant invertebrate taxon with average abundances of 183 and 335 individuals/m^2, respectively (Figure 4; Appendix 1).

4.2 AREA 2

Three taxa of vascular macrophytes were identified from samples collected in Area 2 of the Gull Lake area during the fall of 2002. Dry weight of macrophyte samples are presented in Table 2 and Figure 3. At Site 4 (mid-bay), *Stuckenia vaginatus* was the only plant identified with a mean dry weight of 30.5 g/m^2. Two vascular macrophyte taxa were identified from samples collected at Site 5 (shoreline) and Site 6 (outer-bay) with *Potamogeton richardsonii* dominating in mean percent dry weight (98.4 and 82.2%, respectively) (Table 2; Figure 3). In addition to vascular macrophytes, aquatic moss was collected at Site 2, contributing 1.4% of the total dry weight (Table 2). Overall, sampling in Area 2 during the fall of 2002 revealed sites 5 and 6 as having a greater density of aquatic macrophytes (94.5 and 85.2 g/m^2, respectively) than Site 4 (30.5 g/m^2)(Table 2).

Ten epiphytic invertebrate taxa were identified from samples collected in Area 2 of the Gull Lake area during the fall of 2002. Mean invertebrate abundance and percent composition are summarized in Table 3 and Figure 4. Overall, the most common invertebrate taxon in the samples was Insecta (predominantly chironomid larvae), followed by Mollusca (largely Gastropoda) and Crustacea (predominantly Amphipoda) (Table 3; Figure 4). Mean total epiphytic invertebrate abundance varied between sites sampled in Area 2. Overall, mean total invertebrate abundance was 137 individuals/m^2, with Site 5 dominating in total mean invertebrate abundance (287 individuals/m^2) compared to sites 4 and 6 (57 and 68 individuals/m^2, respectively) (Table 3).

At Site 4, Insecta (predominately chironomid larvae) was the most abundant invertebrate taxon associated with aquatic macrophyte samples, followed by Crustacea (Amphipoda) and Mollusca (Gastropoda), with average abundances of 29, 20, and 7 individuals/m^2, respectively (Figure 4; Appendix 1). At Site 5, Mollusca (predominantly Gastropoda), followed by Insecta (predominantly chironomid larvae) and Crustacea (Amphipoda) were the most abundant epiphytic invertebrate taxa identified, with average abundances of 120, 94, and 69 individuals/m^2, respectively. At Site 6, Insecta (predominantly chironomid larvae) was the most abundant epiphytic invertebrate taxon identified, with an average abundance of 46 individuals/m^2 (Figure 4; Appendix 1).

4.3 AREA 3

Six taxa of vascular macrophytes were identified from samples collected at sites 7 (mid-bay), 8 (shoreline), and 9 (outer-bay) in Area 3 of the Gull Lake area during the fall of 2002. Dry weights of macrophyte samples are presented in Table 2 and Figure 3. Two vascular macrophyte taxa were found at Site 7, *Potamogeton richardsonii* and *Lemna trisulca*, the

latter dominating in mean percent dry weight (69.0%) (Table 2). At Site 8, four vascular macrophytes taxa were identified with *L. triscula* dominating in mean percent dry weight (51.2%), followed by *Myriophyllum sibiricum* (22.1%) (Table 2; Figure 3). At Site 9, *P. richardsonii* was the dominant vascular macrophyte of the two taxa identified from the sample (63.4%) (Table 2; Figure 3). Non-vascular macrophytes collected in Area 3 of the Gull Lake area include aquatic moss, filamentous algae, and epiphytic algae/cyanophytes (Table 2) with the latter two taxa found in a relatively high abundance at Site 8 (9.5 and 10.0%, respectively) (Table 2). Overall, aquatic macrophyte sampling in Area 3 during the fall of 2002 revealed that although Site 8 had a more diverse assemblage of aquatic macrophytes, it had the least quantity collected (15.7 g/m^2) (Table 2).

Twelve epiphytic invertebrate taxa were identified from samples collected in Area 3 of the Gull Lake area during the fall of 2002. Mean invertebrate abundance and percent composition are summarized in Table 3 and Figure 4. Overall, the two most common invertebrate taxa in the samples were Crustacea (exclusively Amphipoda) and Insecta (predominantly chironomid larvae), followed by Mollusca (predominately Gastropoda) and Annelida (Table 3; Figure 4). Mean total epiphytic invertebrate abundance varied between and within sites sampled in Area 3. Overall, mean total invertebrate abundance was 255 individuals/m^2, with samples collected at sites 7, 8, and 9 having comparable total invertebrate abundances (289, 218, and 257 individuals/m^2, respectively) (Table 3).

At Site 7, Insecta (predominantly chironomid larvae) was the most abundant invertebrate taxon associated with aquatic macrophyte samples, followed by Crustacea (exclusively Amphipoda) and Mollusca (exclusively Gastropoda), with mean invertebrate abundances of 156, 83, and 45 individuals/m^2, respectively (Figure 4; Appendix 1). At Site 8, epiphytic invertebrate samples were composed primarily of Crustacea (Amphipoda), with a mean abundance of 124 individuals/m^2 (Figure 4; Appendix 1). Less abundant taxa included Insecta (largely chironomid larvae) and Mollusca (predominately Gastropoda) (52 and 33 individuals/m^2, respectively). Similar to Site 8, Crustacea (Amphipoda) was the most abundant epiphytic invertebrate taxon identified in Site 9, followed by Insecta (predominantly chironomid larvae) and Mollusca (Gastropoda), with mean abundances of 88, 85, and 67 individuals/m^2, respectively (Figure 4; Appendix 1).

4.4 AREA 4

Four taxa of vascular macrophytes were identified from samples collected at sites 10 (shoreline), 11 (mid-bay), and 12 (outer-bay) in Area 4 of the Gull Lake area during the fall of 2002. Dry weights of macrophyte samples are presented in Table 2 and Figure 3. *Potamogeton* sp. 1 was found at all three sites and had the highest mean percent dry weight

at Site 10 (91.6%) (Table 2; Figure 3). Three vascular macrophytes taxa were identified at Site 11 with *Potamogeton richardsonii* dominating in mean percent dry weight (95.3%) (Table 2; Figure 3). *Stuckenia vaginatus* and *Potamogeton* sp. 1. were identified at Site 12, having mean percent dry weights of 66.0 and 33.7%, respectively (Table 2). Overall, macrophyte sampling in Area 4 during the fall of 2002 indicated Site 11 as having a greater density of aquatic macrophytes (78.0g/m^2) compared to sites 10 and 12 (38.9 and 40.9 g/m^2, respectively) (Table 2).

Ten epiphytic invertebrate taxa were identified from samples collected in Area 4 of the Gull Lake area during the fall of 2002. Mean invertebrate abundance and percent composition are summarized in Table 3 and Figure 4. Overall, the most common invertebrate taxon in the samples was Mollusca (predominantly Gastropoda), followed by Crustacea (exclusively Amphipoda) and Insecta (predominantly chironomid larvae) (Table 3; Figure 4). Mean total epiphytic invertebrate abundance varied between sites sampled in Area 4. Overall, mean total invertebrate abundance was 295 individuals/m^2, with samples collected at Site 10 and 11 having higher mean total invertebrate abundances (310 and 315 individuals/m^2, respectively) than Site 12 (260 individuals/m^2) (Table 3).

At Site 10, Mollusca was the most abundant invertebrate taxon associated with aquatic macrophyte samples, with a mean abundance of 224 individuals/m^2 (Figure 4; Appendix 1). At Site 11, epiphytic invertebrate samples were largely composed of Crustacea and Mollusca (167 and 117 individuals/m^2, respectively) (Figure 4; Appendix 1). Insecta was the most abundant epiphytic invertebrate at Site 12 with a mean abundance of 129 individuals/m^2, followed by Mollusca (predominantly Gastropoda) and Crustacea (exclusively Amphipoda) (87 and 42 individuals/m^2, respectively) (Figure 4; Appendix 1).

4.5 AREA 5

Four taxa of vascular aquatic macrophytes were identified from samples collected at three sites in Area 5 of the Gull Lake area during the fall of 2002. Dry weights of macrophyte samples are presented in Table 2 and Figure 3. All of the vascular macrophytes identified in samples collected from Area 5 belonged to the *Potamogeton* genus. *Potamogeton* sp. 1 was the only taxon identified at all three sites, dominating in mean percent dry weight at all three sites as well (97.8, 52.8, and 100% for sites 13, 14, and 15, respectively). Less abundant taxa collected in Area 5 of the Gull Lake area included *Potamogeton richardsonii*, *Potamogeton* sp. 2, and *Potamogeton* sp. 3 (Table 2). Overall, the macrophyte samples collected in Area 5 during the fall of 2002 identified sites 13 and 15 as having a greater density of aquatic macrophytes (88.3 and 87.5 g/m^2, respectively) compared to Site 14, which had a greater diversity but lower density of aquatic macrophytes (64.2 g/m^2) (Table 2).

Fourteen epiphytic invertebrate taxa were identified from samples collected in Area 5 of the Gull Lake are during the fall of 2002. Mean invertebrate abundance and percent composition are summarized in Table 3 and Figure 4. Overall, the most common invertebrate taxon in the samples was Mollusca (predominantly Gastropoda), followed by Insecta (predominantly chironomid larvae) and Annelida (predominantly Oligochaeta) (Table 3; Figure 4). Unlike the other four areas sampled for epiphytic invertebrates in the Gull Lake area, Crustacea were minimal in samples collected in Area 5. Mean total epiphytic invertebrate abundance varied between and within sites sampled in Area 5. Overall, mean total invertebrate abundance was 1,145 individuals/m^2, with samples collected at sites 13 and14 having greater invertebrate abundances (1,220 and 1,627 individuals/m^2, respectively) than Site 15 (587 individuals/m^2) (Table 3).

At Site 13, Mollusca (Gastropoda) was the most abundant invertebrate taxon associated with aquatic macrophyte samples, followed by Insecta (predominantly chironomid larvae) and Annelida (predominantly Oligochaeta), with mean invertebrate abundances of 508, 458, and 251 individuals/m^2, respectively (Figure 4; Appendix 1). At Site 14, Mollusca (largely Gastropoda), followed by Insecta (predominately chironomid larvae) and Annelida (mainly Oligochaeta) dominated the samples, with mean invertebrate abundances of 631, 530, and 462 individuals/m^2 (Figure 4; Appendix 1). As with sites 13 and 14, samples collected from Site 15 were dominated by Mollusca (predominantly Gastropoda), Insecta (predominantly chironomid larvae), and Annelida (exclusively Oligochaeta), with mean total invertebrate abundances of 225, 215, and 143 individuals/m^2, respectively (Figure 4; Appendix 1).

5.0 GLOSSARY

Algae − a group of simple plant-like aquatic ***organisms*** possessing ***chlorophyll*** and capable of ***photosynthesis***; they may be attached to surfaces or free-floating; most freshwater ***species*** are very small in size.

Aquatic – living or found in water.

Aquatic environment − areas that are permanently under water, or that are under water for a sufficient period to support ***organisms*** that remain for their entire lives, or a significant portion of their lives, totally immersed in water.

Aquatic invertebrate (s) − an animal lacking a backbone that lives, at least part of its life, in the water (e.g., aquatic insect, mayfly, clam, aquatic earthworm, crayfish).

Aquatic monitoring – the primary goal of long term ***monitoring*** of lakes and rivers is to understand how ***aquatic*** communities and ***habitats*** respond to natural processes and to be able to distinguish differences between human-induced disturbance effects to aquatic ***ecosystems*** and those caused by natural processes.

Aquatic plants – multi-celled plants living in the water.

ASL – Above Sea Level.

Baseline information − information about an area, over a period of time, that is used as background for detecting and/or comparing potential future changes.

Basin (s) – a distinct section of a lake, separated from the remainder of the lake by a constriction.

Bog (s) – wetland ***ecosystem*** characterized by an accumulation of ***peat***, acid conditions, and a plant community dominated by sphagnum moss.

Boreal – of or relating to the forest areas of the North Temperate Zone, dominated by coniferous trees such as spruce, fir, or pine.

Chlorophyll - a group of green pigments present in plant and algal cells that are necessary in the trapping of light energy during ***photosynthesis***.

Confluence – the meeting place of two streams or rivers.

Detritus – particulate and dissolved ***organic*** matter that is produced by the decomposition of plant and animal matter.

Discontinuous – the occurrence of ***permafrost*** in 35-85% of a geographic area.

Ecosystem − all living ***organisms*** in an area and the non-living parts of the ***environment*** upon which they depend, as well as all interactions, both among living and non-living components of the ecosystem.

Environment − 1) the total of all the surrounding natural conditions that affect the existence of living ***organisms*** on earth, including air, water, soil, minerals, climate, and the organisms themselves; and, 2) the local complex of such conditions that affects a particular organism and ultimately determines its physiology and survival.

Environmental impact assessment − an evaluation of the likely adverse environmental effects of a project that will contribute to decisions about whether to proceed with a project.

Ephemeral − a stream that flows only in direct response to precipitation, and thus discontinues its flow during dry seasons.

Epiphytic invertebrate – an ***invertebrate*** found on ***aquatic plants***, using the plant for food or shelter.

Existing environment − the present condition of a particular area; generally assessed prior to the construction of a proposed project.

Fen (s) – a peatland with the water table usually at or just above the surface; often stagnant and alkaline.

Forebay – the portion of a reservoir immediately upstream of a hydroelectric facility.

Glacio-lacustrine deposits − soil that originates from lakes that were formed by melting glaciers.

Habitat − the place where a plant or animal lives; often related to a function such as spawning, feeding, etc.

Hydroelectric generating station − a generating station that converts the potential energy of elevated water or the kinetic energy of flowing water into electricity.

Hydrology – the branch of physical geography that deals with the waters of the Earth, their distribution, characteristics, and effects relative to human activities.

Invertebrate (s) – animals without a spinal column.

Lacustrine − referring to freshwater lakes; ***sediments*** generally consisting of stratified fine sand, ***silt***, and clay deposits on a lake bed.

Macrophyte (s) − multi-celled ***aquatic*** and ***terrestrial*** plants.

Monitoring − measurement or collection of data to determine whether change is occurring in something of interest.

Nonvascular – referring to the lower plants (e.g., moss and ***algae***).

Organic – the compounds formed by living ***organisms***.

Organism(s) – an individual living thing.

Peaking-type plant – a ***hydroelectric generating station*** that is designed to supply power during high demand periods and is generally operated to serve that purpose.

Peat − material consisting of non-decomposed and only slightly decomposed ***organic*** matter found in extremely moist areas.

Permafrost – subsoil that remains below the freezing point throughout the year, as in an Arctic environment.

Photosynthesis – a process which occurs in plants and ***algae*** where, in the presence of light, carbon dioxide and water are turned into a useable form of energy (sugar) and oxygen.

Project − proposed ***hydroelectric generating station*** on the Nelson River, upstream of Stephens Lake.

Reach − any length of stream or river under study, often with similar features along its length.

Regulatory authorities − a decision-making body such as a government department.

Riparian – along the banks of rivers and streams.

Run – an area of a stream with uniform, swiftly flowing water without surface breaks.

Run-of-river plant − a ***hydroelectric generating station*** that has no upstream storage capacity and must pass all water flows as they come.

Sediment (s) – material, usually soil or ***organic detritus***, which is deposited in the bottom of a waterbody.

Silt – a very small rock fragment or mineral particle, smaller than a very fine grain of sand and larger than coarse clay; usually having a diameter of 0.002 to 0.06 mm; the smallest soil material that can be seen with the naked eye.

Soil (s) – 1) all loose, unconsolidated, weathered, or otherwise altered rock material above bedrock; and 2) a natural accumulation of ***organic*** matter and inorganic rock material that is capable of supporting the growth of vegetation.

Species – a group of ***organisms*** that can interbreed to produce fertile offspring.

Sporadic(ally) – the occurrence of isolated patches of ***permafrost***, 10-35% of a geographic region.

Substrate (s) – the material forming the streambed; also solid material upon which an ***organism*** lives or to which it is attached.

Taxon – any valid taxonomic category (e.g., order, family, genus, species) defined according to hierarchical level.

Taxonomic – pertaining to the classification of plants and animals into groups.

Terrestrial – belonging to, or inhabiting the land or ground.

Topography − the general configuration of the land surface including relief and position of natural and man-made features.

Vascular – referring to the higher plants (e.g., flowering plants).

Velocity – a measurement of speed of flow.

Water quality − measures of substances in the water such as nitrogen, phosphorus, oxygen, and carbon.

Watershed − the area within which all water drains to collect in a common channel or lake.

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6.1 PERSONAL COMMUNICATION

KRINDLE, J. Calyx Consulting, Winnipeg, Manitoba. Aquatic/Terrestrial Botanist, October – November, 2002.

TABLES AND FIGURES

Table 1. Survey information of sampling locations within Gull Lake and portions of the Nelson River between Birthday and Gull rapids, fall 2002.

Date	Area	Site	Replicate	Habitat	Location (UTM/Datum WGS 84)			Water
					Zone	Easting	Northing	Depth (m)
31-Aug-02	1	1	A	mid-bay	15V	0339666	6244952	1.10
31-Aug-02	1	1	B	mid-bay	15V	0339666	6244952	1.10
31-Aug-02	1	2	A	shoreline	15V	0339769	6245115	0.75
31-Aug-02	1	2	B	shoreline	15V	0339769	6245115	0.75
31-Aug-02	1	3	A	outer-bay	15V	0339176	6245367	1.10
31-Aig-02	1	3	B	outer-bay	15V	0339176	6245367	1.10
30-Aug-02	2	4	A	mid-bay	15V	0355649	6243856	1.70
30-Aug-02	2	4	B	mid-bay	15V	0355649	6243856	1.70
30-Aug-02	2	5	A	shoreline	15V	0355595	6243560	0.81
30-Aug-02	2	5	B	shoreline	15V	0355595	6243560	0.81
30-Aug-02	2	6	A	outer-bay	15V	0355272	6244081	2.15
30-Aug-02	2	6	B	outer-bay	15V	0355272	6244081	2.15
31-Aug-02	3	7	A	mid-bay	15V	0344728	6245386	0.96
31-Aug-02	3	7	B	mid-bay	15V	0344728	6245386	0.96
31-Aug-02	3	8	A	shoreline	15V	0345072	6245534	0.87
31-Aug-02	3	8	B	shoreline	15V	0345072	6245534	0.87
31-Aug-02	3	9	A	outer-bay	15V	0345472	6245288	1.26
31-Aug-02	3	9	B	outer-bay	15V	0345472	6245288	1.26
28-Aug-02	4	10	A	shoreline	15V	0360221	6245458	1.35
28-Aug-02	4	10	B	shoreline	15V	0360221	6245458	1.35
28-Aug-02	4	11	A	mid-bay	15V	0360489	6245321	1.16
28-Aug-02	4	11	B	mid-bay	15V	0360489	6245321	1.16
28-Aug-02	4	12	A	outer-bay	15V	0360331	6245402	1.33
28-Aug-02	4	12	B	outer-bay	15V	0360331	6245402	1.33
28-Aug-02	5	13	A	mid-bay	15V	0356702	6247607	1.00
28-Aug-02	5	13	B	mid-bay	15V	0356702	6247607	1.00
28-Aug-02	5	14	A	shoreline	15V	0356727	6247779	1.00
28-Aug-02	5	14	B	shoreline	15V	0356727	6247779	1.00
28-Aug-02	5	15	A	outer-bay	15V	0356688	6247923	1.32
28-Aug-02	5	15	B	outer-bay	15V	0356688	6247923	1.32

Table 2. Total dry weight (g/m^2) and percent dry weight (%) of vascular and non-vascular macrophyte samples collected in Gull Lake and portions of the Nelson River between Birthday and Gull rapids, fall 2002. Individual abundances may not add up to totals due to rounding.

Area	**1**											
Site	**1**				**2**				**3**			
	Dry Weight			**%**	**Dry Weight**			**%**	**Dry Weight**			**%**
Replicate Samples	**A**	**B**	**Mean**	**Mean**	**A**	**B**	**Mean**	**Mean**	**A**	**B**	**Mean**	**Mean**
Lemna trisulca	7.162	0.264	3.713	2.8	34.886	66.717	50.8	51.1	0.000	0.000	0.0	0.0
Myriophyllum sibiricum	135.071	107.914	121.5	93.2	52.150	36.924	44.5	44.8	0.162	0.000	0.1	0.1
Potamogeton richardsonii	0.000	0.000	0.0	0.0	0.000	6.188	3.1	3.1	0.000	0.000	0.0	0.0
Stuckenia vaginatus	0.000	0.000	0.0	0.0	0.000	0.000	0.0	0.0	88.807	65.862	77.3	97.6
Vascular Plant Sub-total	**142.233**	**108.178**	**125.2**	**96.0**	**87.036**	**109.829**	**98.4**	**99.0**	**88.969**	**65.862**	**77.4**	**97.7**
epiphytic algae / cyanophytes	0.000	0.000	0.0	0.0	0.000	0.000	0.0	0.0	2.695	1.010	1.9	2.3
unidentified macrophytes	3.448	6.910	5.2	4.0	1.583	0.405	1.0	1.0	0.000	0.000	0.0	0.0
TOTAL	**145.681**	**115.088**	**130.4**	**100**	**88.619**	**110.234**	**99.4**	**100**	**91.664**	**66.872**	**79.3**	**100**

Table 2. Continued.

Area	**2**											
Site	**4**				**5**				**6**			
	Dry Weight			**%**	**Dry Weight**			**%**	**Dry Weight**			**%**
Replicate Samples	**A**	**B**	**Mean**	**Mean**	**A**	**B**	**Mean**	**Mean**	**A**	**B**	**Mean**	**Mean**
Lemna trisulca	0.000	0.000	0.0	0.0	0.376	0.000	0.2	0.2	0.000	0.000	0.0	0.0
Potamogeton richardsonii	0.000	0.000	0.0	0.0	121.640	64.295	93.0	98.4	140.095	0.000	70.0	82.2
Stuckenia vaginatus	31.186	29.845	30.5	100.0	0.000	0.000	0.0	0.0	0.000	30.338	15.2	17.8
Vascular Plant Sub-total	**31.186**	**29.845**	**30.5**	**100.0**	**122.016**	**64.295**	**93.2**	**98.6**	**140.095**	**30.338**	**85.2**	**100.0**
aquatic moss	0.000	0.000	0.0	0.0	2.688	0.000	1.3	1.4	0.000	0.000	0.0	0.0
TOTAL	**31.186**	**29.845**	**30.5**	**100**	**124.704**	**64.295**	**94.5**	**100**	**140.095**	**30.338**	**85.2**	**100**

Table 2. Continued.

Area	**3**											
Site	**7**				**8**				**9**			
	Dry Weight			**%**	**Dry Weight**			**%**	**Dry Weight**			**%**
Replicate Samples	**A**	**B**	**Mean**	**Mean**	**A**	**B**	**Mean**	**Mean**	**A**	**B**	**Mean**	**Mean**
Equisetum fluviatile	0.000	0.000	0.0	0.0	0.814	0.000	0.4	2.6	0.000	0.000	0.0	0.0
Lemna trisulca	3.755	91.574	47.7	69.0	3.452	12.576	8.0	51.2	0.000	0.000	0.0	0.0
Myriophyllum sibiricum	0.000	0.000	0.0	0.0	0.176	6.748	3.5	22.1	0.000	0.000	0.0	0.0
Potamogeton sp.1	0.000	0.000	0.0	0.0	0.117	0.157	0.1	0.9	0.000	0.000	0.0	0.0
Potamogeton richardsonii	16.852	25.600	21.2	30.7	0.000	0.000	0.0	0.0	2.764	21.574	12.2	63.4
Stuckenia vaginatus	0.000	0.000	0.0	0.0	0.000	0.000	0.0	0.0	13.862	0.000	6.9	36.1
Vascular Plant Sub-total	**20.607**	**117.174**	**68.9**	**99.7**	**4.559**	**19.481**	**12.0**	**76.7**	**16.626**	**21.574**	**19.1**	**99.5**
aquatic moss	0.000	0.000	0.0	0.0	0.000	0.414	0.2	1.3	0.000	0.000	0.0	0.0
filamentous algae	0.000	0.000	0.0	0.0	2.988	0.000	1.5	9.5	0.000	0.000	0.0	0.0
epiphytic algae/cyanophytes	0.071	0.000	0.0	0.0	0.524	2.602	1.6	10.0	0.000	0.186	0.1	0.5
unidentified macrophytes	0.386	0.000	0.2	0.3	0.202	0.562	0.4	2.4	0.000	0.000	0.0	0.0
TOTAL	**21.064**	**117.174**	**69.1**	**100**	**8.273**	**23.059**	**15.7**	**100**	**16.626**	**21.760**	**19.2**	**100**

Table 2. Continued.

Area	4											
Site	10				11				12			
	Dry Weight			%	Dry Weight			%	Dry Weight			%
Replicate Samples	A	B	Mean	Mean	A	B	Mean	Mean	A	B	Mean	Mean
Lemna trisulca	0.000	0.000	0.0	0.0	0.000	7.083	3.5	4.5	0.000	0.000	0.0	0.0
Potamogeton richardsonii	0.000	6.424	3.2	8.3	121.486	27.164	74.3	95.3	0.000	0.000	0.0	0.0
Stuckenia vaginatus	0.000	0.000	0.0	0.0	0.000	0.000	0.0	0.0	53.969	0.000	27.0	66.0
Potamogeton sp.1	42.138	29.150	35.6	91.6	0.000	0.214	0.1	0.1	0.000	27.524	13.8	33.7
Vascular Plant Sub-total	**42.138**	**35.574**	**38.9**	**99.9**	**121.486**	**34.461**	**78.0**	**100.0**	**53.969**	**27.524**	**40.7**	**99.7**
epiphytic algae/cyanophytes	0.000	0.000	0.0	0.0	0.000	0.000	0.0	0.0	0.217	0.000	0.1	0.3
TOTAL	**42.138**	**35.574**	**38.9**	**100**	**121.486**	**34.461**	**78.0**	**100**	**54.186**	**27.524**	**40.9**	**100**

Table 2. Continued.

Area	5											
Site	13				14				15			
	Dry Weight			%	Dry Weight			%	Dry Weight			%
Replicate Samples	A	B	Mean	Mean	A	B	Mean	Mean	A	B	Mean	Mean
Potamogeton richardsonii	0.000	3.843	1.9	2.2	0.000	41.250	20.6	32.1	0.000	0.000	0.0	0.0
Potamogeton sp.1	73.948	98.893	86.4	97.8	67.795	0.000	33.9	52.8	123.048	51.976	87.5	100.0
Potamogeton sp.2	0.000	0.000	0.0	0.0	7.195	0.000	3.6	5.6	0.000	0.000	0.0	0.0
Potamogeton sp.3	0.000	0.000	0.0	0.0	12.071	0.000	6.0	9.4	0.000	0.000	0.0	0.0
TOTAL	**73.948**	**102.736**	**88.3**	**100**	**87.061**	**41.250**	**64.2**	**100**	**123.048**	**51.976**	**87.5**	**100**

Table 3. Summary of mean abundance (individuals/m^2) and percent composition (%) of major epiphytic invertebrate groups collected in association with macrophytes from Gull Lake and portions of the Nelson River between Birthday and Gull rapids, fall 2002. Individual abundances may not add up to totals due to rounding.

Area	**1**							
Site	**1**		**2**		**3**		**OVERALL**	
	Individuals/m^2	**%**	**Individuals/m^2**	**%**	**Individuals/m^2**	**%**	**Individuals/m^2**	**%**
Annelida	4	0.4	1	0.3	1	0.2	**2**	**0.3**
Crustacea	564	68.4	161	37.3	110	22.1	**278**	**47.6**
Arachnida	0	0.0	0	0.0	0	0.0	**0**	**0.0**
Insecta	93	11.3	183	42.5	335	67.4	**204**	**34.9**
Mollusca	164	19.9	86	19.9	51	10.3	**100**	**17.2**
Nemata	0	0.0	0	0.0	0	0.0	**0**	**0.0**
Platyhelminthes	0	0.0	0	0.0	0	0.0	**0**	**0.0**
Hydrozoa	0	0.0	0	0.0	0	0.0	**0**	**0.0**
TOTAL INVERTEBRATES	**825**	**100**	**431**	**100**	**496**	**100**	**584**	**100**

Table 3. Continued.

Area	2							
Site	4		5		6		OVERALL	
	Individuals/m^2	%	Individuals/m^2	%	Individuals/m^2	%	Individuals/m^2	%
Annelida	1	2.1	4	1.2	2	3.5	**2**	**1.7**
Crustacea	20	35.4	69	24.1	7	10.5	**32**	**23.4**
Arachnida	0	0.0	0	0.0	0	0.0	**0**	**0.0**
Insecta	29	50.0	94	32.8	46	68.4	**56**	**41.0**
Mollusca	7	12.5	120	41.9	12	17.5	**46**	**33.8**
Nemata	0	0.0	0	0.0	0	0.0	**0**	**0.0**
Platyhelminthes	0	0.0	0	0.0	0	0.0	**0**	**0.0**
Hydrozoa	0	0.0	0	0.0	0	0.0	**0**	**0.0**
TOTAL INVERTEBRATES	**57**	**100**	**287**	**100**	**68**	**100**	**137**	**100**

Table 3. Continued.

Area	3							
Site	7		8		9		OVERALL	
	Individuals/m^2	%	Individuals/m^2	%	Individuals/m^2	%	Individuals/m^2	%
Annelida	5	1.6	5	2.2	18	6.9	**9**	**3.6**
Crustacea	83	28.8	124	56.8	88	34.3	**98**	**38.6**
Arachnida	0	0.0	4	1.6	0	0.0	**1**	**0.5**
Insecta	156	53.9	52	24.0	85	32.9	**98**	**38.3**
Mollusca	45	15.6	33	15.3	67	25.9	**48**	**19.0**
Nemata	0	0.0	0	0.0	0	0.0	**0**	**0.0**
Platyhelminthes	0	0.0	0	0.0	0	0.0	**0**	**0.0**
Hydrozoa	0	0.0	0	0.0	0	0.0	**0**	**0.0**
TOTAL INVERTEBRATES	**289**	**100**	**218**	**100**	**257**	**100**	**255**	**100**

Table 3. Continued.

Area	4							
Site	10		11		12		OVERALL	
	Individuals/m^2	%	Individuals/m^2	%	Individuals/m^2	%	Individuals/m^2	%
Annelida	11	3.5	0	0.0	2	0.9	**4**	**1.5**
Crustacea	40	13.1	167	52.8	42	16.1	**83**	**28.1**
Arachnida	0	0.0	0	0.0	0	0.0	**0**	**0.0**
Insecta	35	11.2	32	10.2	129	49.5	**65**	**22.1**
Mollusca	224	72.3	117	37.0	87	33.5	**142**	**48.3**
Nemata	0	0.0	0	0.0	0	0.0	**0**	**0.0**
Platyhelminthes	0	0.0	0	0.0	0	0.0	**0**	**0.0**
Hydrozoa	0	0.0	0	0.0	0	0.0	**0**	**0.0**
TOTAL INVERTEBRATES	**310**	**100**	**315**	**100**	**260**	**100**	**295**	**100**

Table 3. Continued.

Area	5							
Site	13		14		15		OVERALL	
	Individuals/m^2	%	Individuals/m^2	%	Individuals/m^2	%	Individuals/m^2	%
Annelida	251	20.6	462	28.4	143	24.3	**285**	**24.9**
Crustacea	1	0.1	5	0.3	2	0.4	**3**	**0.2**
Arachnida	0	0.0	0	0.0	0	0.0	**0**	**0.0**
Insecta	458	37.6	530	32.6	215	36.7	**401**	**35.0**
Mollusca	508	41.7	631	38.8	225	38.3	**455**	**39.7**
Nemata	0	0.0	0	0.0	1	0.2	**0**	**0.0**
Platyhelminthes	1	0.1	0	0.0	0	0.0	**0**	**0.0**
Hydrozoa	0	0.0	0	0.0	0	0.0	**0**	**0.0**
TOTAL INVERTEBRATES	**1220**	**100**	**1627**	**100**	**587**	**100**	**1145**	**100**

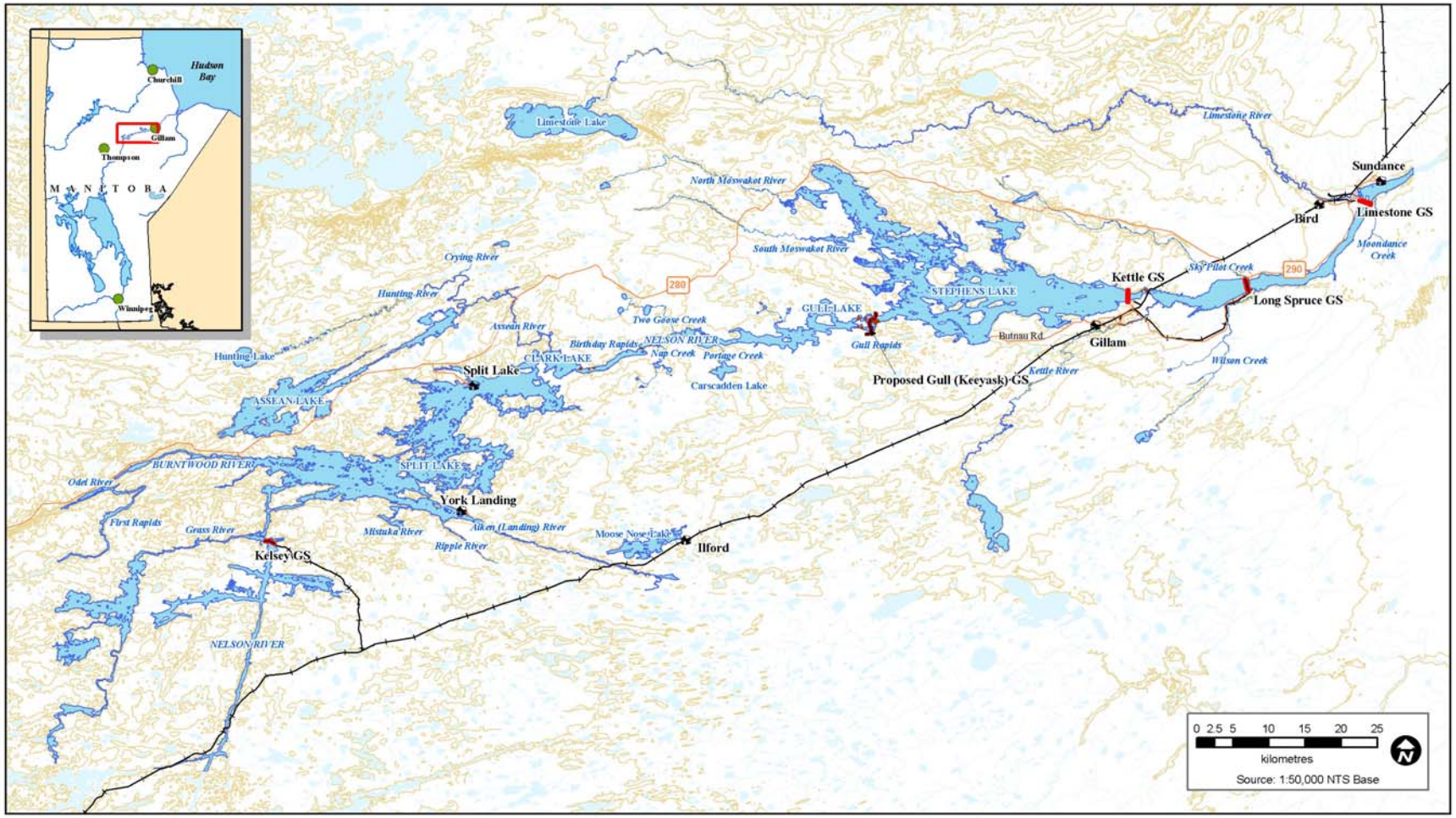

Figure 1. Map of the Gull (Keeyask) Study Area showing proposed and existing hydroelectric development.

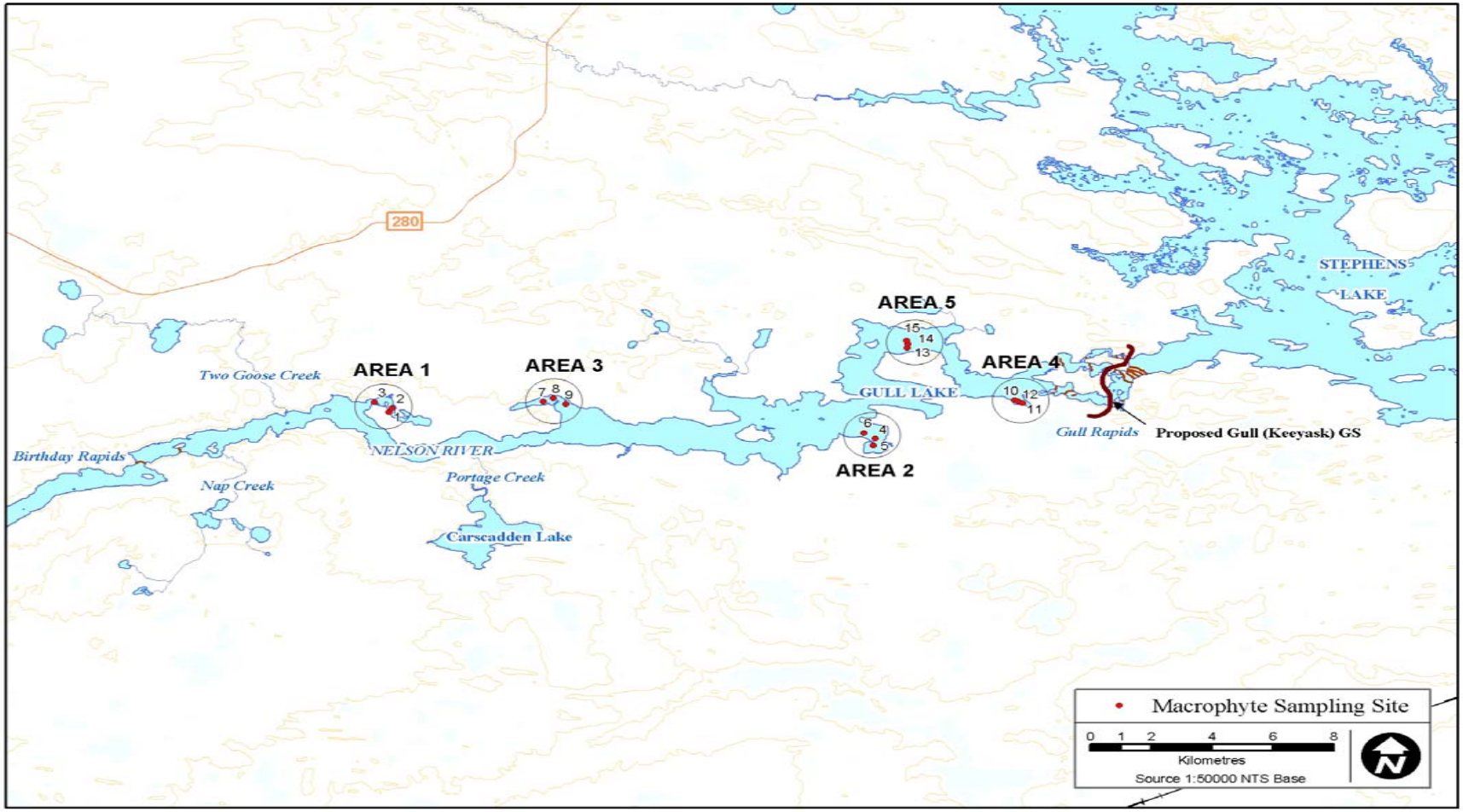

Figure 2. Aquatic macrophyte and associated epiphytic invertebrate sampling sites in Gull Lake and portions of the Nelson River between Birthday and Gull rapids, fall 2002.

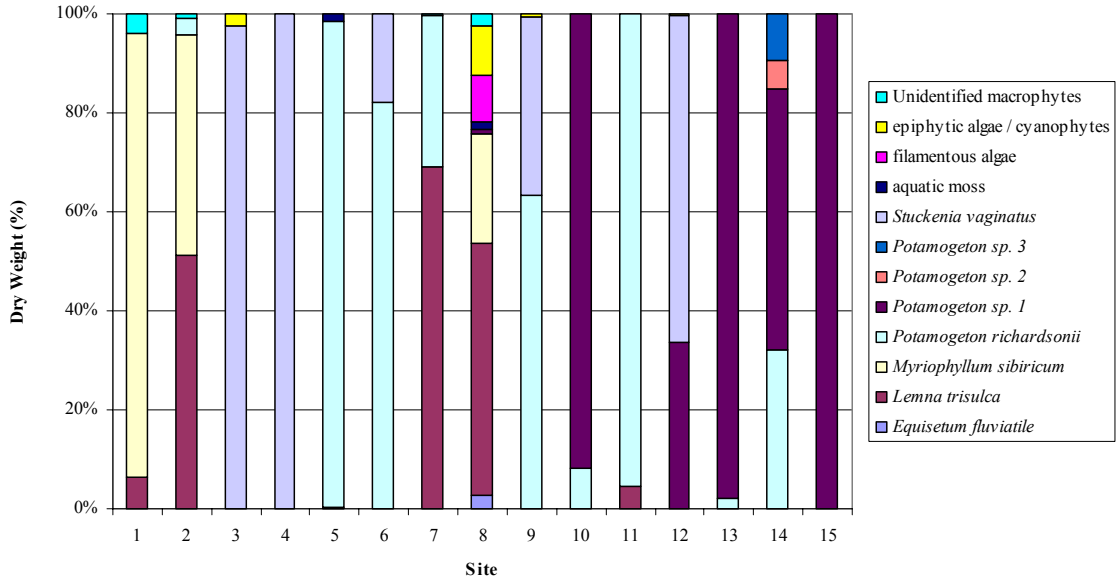

Figure 3. Percent dry weight (%) of vascular and non-vascular macrophyte samples collected in Gull Lake and portions of the Nelson River between Birthday and Gull rapids, 2002.

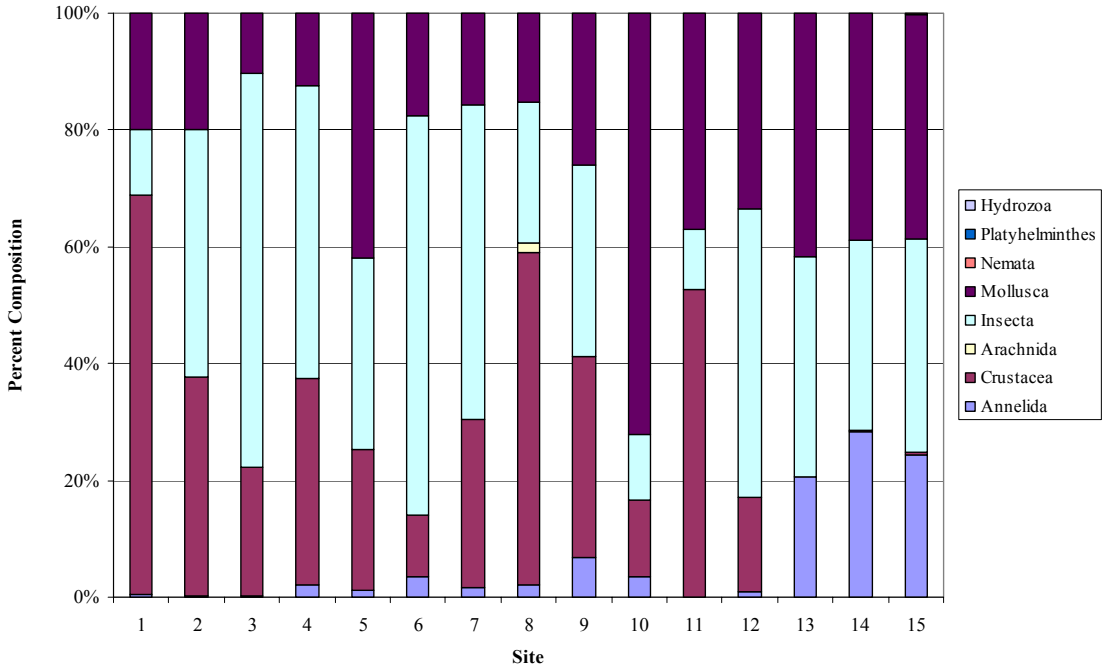

Figure 4. Percent composition (%) of major epiphytic invertebrate groups collected in association with macrophytes from Gull Lake and portions of the Nelson River between Birthday and Gull rapids, fall 2002.

APPENDIX 1.
DETAILED ABUNDANCE AND COMPOSITION OF EPIPHYTIC INVERTEBRATE DATA COLLECTED IN GULL LAKE AND PORTIONS OF THE NELSON RIVER BETWEEN BIRTHDAY AND GULL RAPIDS, FALL 2002.

Table A1-1. Abundance (individuals/m^2) and percent composition (%) of epiphytic invertebrates collected in Gull Lake and portions of the Nelson River between Birthday and Gull rapids, fall 2002. Individual abundances may not add up to totals due to rounding.

Area	**1**													
Site	**1**				**2**				**3**				**Overall**	
	Individuals/m^2			**%**	**Individuals/m^2**			**%**	**Individuals/m^2**			**%**	**Individuals/m^2**	**%**
Replicate Samples	**A**	**B**	**Mean**	**Mean**	**A**	**B**	**Mean**	**Mean**	**A**	**B**	**Mean**	**Mean**	**Mean**	**Mean**
Annelida														
Oligochaeta	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Hirudinea	5	2	4	0.4	2	0	1	0.3	2	0	1	0.2	2	0.3
Total Annelida	**5**	**2**	**4**	**0.4**	**2**	**0**	**1**	**0.3**	**2**	**0**	**1**	**0.2**	**2**	**0.3**
Crustacea														
Ostracoda	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Amphipoda	540	588	564	68.4	102	219	161	37.3	126	93	110	22.1	278	47.6
Conchostraca	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Mysida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Decapoda	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Cyclopoida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Calanoida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Cladocera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Total Crustacea	**540**	**588**	**564**	**68.4**	**102**	**219**	**161**	**37.3**	**126**	**93**	**110**	**22.1**	**278**	**47.6**
Arachnida														
Acarina	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Insecta														
Megaloptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Odonata														
Anisoptera	0	0	0	0.0	0	2	1	0.3	0	0	0	0.0	0	0.0
Zygoptera	0	5	2	0.3	0	2	1	0.3	19	14	17	3.4	7	1.2
Coleoptera	2	2	2	0.3	2	5	4	0.8	0	0	0	0.0	2	0.3

Table A1-1. Continued.

Area	1													
Site	1				2				3				Overall	
	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2	%
Replicate Samples	A	B	Mean	Mean	A	B	Mean	Mean	A	B	Mean	Mean	Mean	Mean
Hemiptera	21	24	23	2.7	14	10	12	2.8	174	302	238	48.0	91	15.6
Ephemeroptera	0	2	1	0.1	0	0	0	0.0	0	0	0	0.0	0	0.0
Trichoptera	10	7	8	1.0	7	17	12	2.8	5	2	4	0.7	8	1.4
Plecoptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Diptera														
Chironomidae														
larva	60	52	56	6.8	136	171	154	35.6	62	88	75	15.1	95	16.2
pupa	0	0	0	0.0	0	0	0	0.0	0	2	1	0.2	0	0.0
Ceratopogonidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Tipulidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Chaoboridae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Total Insecta	**93**	**93**	**93**	**11.3**	**160**	**207**	**183**	**42.5**	**260**	**410**	**335**	**67.4**	**204**	**34.9**
Mollusca														
Bivalvia														
Unionidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Pisidiidae	50	83	67	8.1	12	45	29	6.6	0	2	1	0.2	32	5.5
Gastropoda	110	86	98	11.8	50	64	57	13.3	48	52	50	10.1	68	11.7
Total Mollusca	**160**	**169**	**164**	**19.9**	**62**	**110**	**86**	**19.9**	**48**	**55**	**51**	**10.3**	**100**	**17.2**
Nemata	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
Platyhelminthes	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
Hydrozoa	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
TOTAL INVERTEBRATES	**798**	**852**	**825**	**100**	**326**	**536**	**431**	**100**	**436**	**557**	**496**	**100**	**584**	**100**

Table A1-1. Continued.

Area	2													
Site	4				5				6				Overall	
	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2	%
Replicate Samples	A	B	Mean	Mean	A	B	Mean	Mean	A	B	Mean	Mean	Mean	Mean
Annelida														
Oligochaeta	2	0	1	2.1	0	2	1	0.4	2	2	2	3.5	2	1.2
Hirudinea	0	0	0	0.0	5	0	2	0.8	0	0	0	0.0	1	0.6
Total Annelida	**2**	**0**	**1**	**2.1**	**5**	**2**	**4**	**1.2**	**2**	**2**	**2**	**3.5**	**2**	**1.7**
Crustacea														
Ostracoda	0	0	0	0.0	0	2	1	0.4	0	0	0	0.0	0	0.0
Amphipoda	33	7	20	35.4	79	57	68	23.7	14	0	7	10.5	32	23.1
Conchostraca	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Mysida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Decapoda	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Cyclopoida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Calanoida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Cladocera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Total Crustacea	**33**	**7**	**20**	**35.4**	**79**	**60**	**69**	**24.1**	**14**	**0**	**7**	**10.5**	**32**	**23.4**
Arachnida														
Acarina	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Insecta														
Megaloptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Odonata														
Anisoptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Zygoptera	0	0	0	0.0	2	2	2	0.8	0	0	0	0.0	1	0.6
Coleoptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0

Table A1-1. Continued.

Area	2													
Site	4				5				6				Overall	
	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2	%
Replicate Samples	A	B	Mean	Mean	A	B	Mean	Mean	A	B	Mean	Mean	Mean	Mean
Hemiptera	7	0	4	6.3	14	5	10	3.3	7	0	4	5.3	6	4.0
Ephemeroptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Trichoptera	0	0	0	0.0	0	5	2	0.8	0	0	0	0.0	1	0.6
Plecoptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Diptera														
Chironomidae														
larva	21	21	21	37.5	76	79	77	27.0	45	31	38	56.1	46	33.2
pupa	5	2	4	6.3	0	5	2	0.8	5	5	5	7.0	4	2.6
Ceratopogonidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Tipulidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Chaoboridae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Total Insecta	**33**	**24**	**29**	**50.0**	**93**	**95**	**94**	**32.8**	**57**	**36**	**46**	**68.4**	**56**	**41.0**
Mollusca														
Bivalvia														
Unionidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Pisidiidae	0	0	0	0.0	2	7	5	1.7	0	0	0	0.0	2	1.2
Gastropoda	12	2	7	12.5	131	100	115	40.2	19	5	12	17.5	45	32.7
Total Mollusca	**12**	**2**	**7**	**12.5**	**133**	**107**	**120**	**41.9**	**19**	**5**	**12**	**17.5**	**46**	**33.8**
Nemata	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
Platyhelminthes	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
Hydrozoa	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
TOTAL INVERTEBRATES	**81**	**33**	**57**	**100**	**310**	**264**	**287**	**100**	**93**	**43**	**68**	**100**	**137**	**100**

Table A1-1. Continued.

Area	3													
Site	7				8				9				Overall	
	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2	%
Replicate Samples	A	B	Mean	Mean	A	B	Mean	Mean	A	B	Mean	Mean	Mean	Mean
Annelida														
Oligochaeta	0	0	0	0.0	7	2	5	2.2	14	21	18	6.9	8	3.0
Hirudinea	0	10	5	1.6	0	0	0	0.0	0	0	0	0.0	2	0.6
Total Annelida	**0**	**10**	**5**	**1.6**	**7**	**2**	**5**	**2.2**	**14**	**21**	**18**	**6.9**	**9**	**3.6**
Crustacea														
Ostracoda	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Amphipoda	40	126	83	28.8	93	155	124	56.8	131	45	88	34.3	98	38.6
Conchostraca	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Mysida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Decapoda	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Cyclopoida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Calanoida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Cladocera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Total Crustacea	**40**	**126**	**83**	**28.8**	**93**	**155**	**124**	**56.8**	**131**	**45**	**88**	**34.3**	**98**	**38.6**
Arachnida														
Acarina	0	0	0	0.0	7	0	4	1.6	0	0	0	0.0	1	0.5
Insecta														
Megaloptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Odonata														
Anisoptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Zygoptera	0	2	1	0.4	0	0	0	0.0	0	0	0	0.0	0	0.0
Coleoptera	2	0	1	0.4	0	2	1	0.5	0	0	0	0.0	1	0.3

Table A1-1. Continued.

Area	3													
Site	7				8				9				Overall	
	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2	%
Replicate Samples	A	B	Mean	Mean	A	B	Mean	Mean	A	B	Mean	Mean	Mean	Mean
Hemiptera	5	7	6	2.1	0	0	0	0.0	0	2	1	0.5	2	0.9
Ephemeroptera	0	7	4	1.2	0	0	0	0.0	0	5	2	0.9	2	0.8
Trichoptera	0	0	0	0.0	0	2	1	0.5	0	2	1	0.5	1	0.3
Plecoptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Diptera														
Chironomidae														
larva	105	183	144	49.8	48	52	50	23.0	81	74	77	30.1	90	35.5
pupa	0	0	0	0.0	0	0	0	0.0	0	5	2	0.9	1	0.3
Ceratopogonidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Tipulidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Chaoboridae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Total Insecta	**112**	**200**	**156**	**53.9**	**48**	**57**	**52**	**24.0**	**81**	**88**	**85**	**32.9**	**98**	**38.3**
Mollusca														
Bivalvia														
Unionidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Pisidiidae	0	0	0	0.0	0	2	1	0.5	0	0	0	0.0	0	0.0
Gastropoda	26	64	45	15.6	48	17	32	14.8	52	81	67	25.9	48	18.8
Total Mollusca	**26**	**64**	**45**	**15.6**	**48**	**19**	**33**	**15.3**	**52**	**81**	**67**	**25.9**	**48**	**19.0**
Nemata	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
Platyhelminthes	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
Hydrozoa	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
TOTAL INVERTEBRATES	**179**	**400**	**289**	**100**	**202**	**233**	**218**	**100**	**279**	**236**	**257**	**100**	**255**	**100**

Table A1-1. Continued.

Area	4													
Site	10				11				12				Overall	
	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2	%
Replicate Samples	A	B	Mean	Mean	A	B	Mean	Mean	A	B	Mean	Mean	Mean	Mean
Annelida														
Oligochaeta	2	14	8	2.7	0	0	0	0.0	2	2	2	0.9	4	1.2
Hirudinea	2	2	2	0.8	0	0	0	0.0	0	0	0	0.0	1	0.3
Total Annelida	**5**	**17**	**11**	**3.5**	**0**	**0**	**0**	**0.0**	**2**	**2**	**2**	**0.9**	**4**	**1.5**
Crustacea														
Ostracoda	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Amphipoda	36	45	40	13.1	167	167	167	52.8	45	38	42	16.1	83	28.1
Conchostraca	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Mysida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Decapoda	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Cyclopoida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Calanoida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Cladocera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Total Crustacea	**36**	**45**	**40**	**13.1**	**167**	**167**	**167**	**52.8**	**45**	**38**	**42**	**16.1**	**83**	**28.1**
Arachnida														
Acarina	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Insecta														
Megaloptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Odonata														
Anisoptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Zygoptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Coleoptera	0	0	0	0.0	2	0	1	0.4	0	0	0	0.0	0	0.0

Table A1-1. Continued.

Area	4													
Site	10				11				12				Overall	
	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2	%
Replicate Samples	A	B	Mean	Mean	A	B	Mean	Mean	A	B	Mean	Mean	Mean	Mean
Hemiptera	14	5	10	3.1	2	10	6	1.9	7	17	12	4.6	9	3.1
Ephemeroptera	0	2	1	0.4	0	0	0	0.0	0	0	0	0.0	0	0.0
Trichoptera	7	7	7	2.3	5	7	6	1.9	0	14	7	2.8	7	2.3
Plecoptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Diptera														
Chironomidae														
larva	17	17	17	5.4	12	19	15	4.9	179	21	100	38.5	44	14.9
pupa	0	0	0	0.0	2	5	4	1.1	17	2	10	3.7	4	1.5
Ceratopogonidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Tipulidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Chaoboridae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Total Insecta	**38**	**31**	**35**	**11.2**	**24**	**40**	**32**	**10.2**	**202**	**55**	**129**	**49.5**	**65**	**22.1**
Mollusca														
Bivalvia														
Unionidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Pisidiidae	5	0	2	0.8	0	7	4	1.1	0	2	1	0.5	2	0.8
Gastropoda	307	136	221	71.5	152	74	113	35.8	31	140	86	33.0	140	47.5
Total Mollusca	**312**	**136**	**224**	**72.3**	**152**	**81**	**117**	**37.0**	**31**	**143**	**87**	**33.5**	**142**	**48.3**
Nemata	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
Platyhelminthes	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
Hydrozoa	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
TOTAL INVERTEBRATES	**390**	**229**	**310**	**100**	**343**	**288**	**315**	**100**	**281**	**238**	**260**	**100**	**295**	**100**

Table A1-1. Continued.

Area	5													
Site	13				14				15				Overall	
	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2	%
Replicate Samples	A	B	Mean	Mean	A	B	Mean	Mean	A	B	Mean	Mean	Mean	Mean
Annelida														
Oligochaeta	248	250	249	20.4	767	145	456	28.0	174	112	143	24.3	283	24.7
Hirudinea	5	0	2	0.2	10	2	6	0.4	0	0	0	0.0	3	0.2
Total Annelida	**252**	**250**	**251**	**20.6**	**776**	**148**	**462**	**28.4**	**174**	**112**	**143**	**24.3**	**285**	**24.9**
Crustacea														
Ostracoda	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Amphipoda	0	2	1	0.1	5	5	5	0.3	2	2	2	0.4	3	0.2
Conchostraca	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Mysida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Decapoda	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Cyclopoida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Calanoida	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Cladocera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Total Crustacea	**0**	**2**	**1**	**0.1**	**5**	**5**	**5**	**0.3**	**2**	**2**	**2**	**0.4**	**3**	**0.2**
Arachnida														
Acarina	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Insecta														
Megaloptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Odonata														
Anisoptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Zygoptera	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Coleoptera	0	0	0	0.0	5	0	2	0.1	0	0	0	0.0	1	0.1

Table A1-1. Continued.

Area	5													
Site	13				14				15				Overall	
	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2			%	Individuals/m^2	%
Replicate Samples	A	B	Mean	Mean	A	B	Mean	Mean	A	B	Mean	Mean	Mean	Mean
Hemiptera	0	40	20	1.7	7	2	5	0.3	7	10	8	1.4	11	1.0
Ephemeroptera	0	2	1	0.1	0	0	0	0.0	0	0	0	0.0	0	0.0
Trichoptera	17	21	19	1.6	33	29	31	1.9	17	12	14	2.4	21	1.9
Plecoptera	0	2	1	0.1	0	0	0	0.0	0	0	0	0.0	0	0.0
Diptera														
Chironomidae														
larva	343	467	405	33.2	660	307	483	29.7	202	152	177	30.2	355	31.0
pupa	7	14	11	0.9	10	7	8	0.5	14	17	15	2.6	12	1.0
Ceratopogonidae	2	0	1	0.1	0	0	0	0.0	0	0	0	0.0	0	0.0
Tipulidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Chaoboridae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Total Insecta	**369**	**548**	**458**	**37.6**	**714**	**345**	**530**	**32.6**	**240**	**190**	**215**	**36.7**	**401**	**35.0**
Mollusca														
Bivalvia														
Unionidae	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0
Pisidiidae	0	0	0	0.0	2	0	1	0.1	0	0	0	0.0	0	0.0
Gastropoda	336	681	508	41.7	757	502	630	38.7	229	221	225	38.3	454	39.7
Total Mollusca	**336**	**681**	**508**	**41.7**	**760**	**502**	**631**	**38.8**	**229**	**221**	**225**	**38.3**	**455**	**39.7**
Nemata	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**2**	**1**	**0.2**	**0**	**0.0**
Platyhelminthes	**2**	**0**	**1**	**0.1**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
Hydrozoa	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**0.0**	**0**	**0.0**
TOTAL INVERTEBRATES	**960**	**1481**	**1220**	**100**	**2255**	**1000**	**1627**	**100**	**645**	**529**	**587**	**100**	**1145**	**100**