KEEYASK PROJECT

Generating Station

February 2005

Report # 02-19

Lake Sturgeon Investigations in the Keeyask Study Area, 2002

ENVIRONMENTAL STUDIES PROGRAM

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LAKE STURGEON INVESTIGATIONS IN THE KEEYASK STUDY AREA, 2002

Draft Report Prepared for Manitoba Hydro

by
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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 Cree Nation) are currently looking into building a hydroelectric generating station (GS) 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 lake sturgeon investigations in the Keeyask Study Area. The 2002 investigations were conducted at the same four general locations sampled in 2001, including: the Burntwood River downstream of First Rapids; the Nelson River and Grass River in the vicinity of Kelsey GS; the Nelson River between Birthday and Gull rapids; and Stephens Lake downstream of Gull Rapids. Gill nets and larval drift nets were used to sample lake sturgeon and lake sturgeon eggs and larvae, respectively. To provide information on lake sturgeon movements, radio and acoustic transmitters that were applied to lake sturgeon in 2001 were monitored in 2002. Lake sturgeon investigations were also conducted in 2003 and 2004 and will be the subject of future reports.

TECHNICAL SUMMARY

Manitoba Hydro and its potential partners (Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation, and York Factory Cree 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 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 during lake sturgeon (*Acipenser fulvescens*) investigations conducted in the Keeyask Study Area in 2002. Specific objectives of the program were:

- to gain a better understanding of lake sturgeon biology;
- to identify lake sturgeon spawning areas;
- to better describe present lake sturgeon abundance and habitat use;
- to identify any important habitats;
- to better understand the timing and spatial extent of lake sturgeon movements; and
- to determine whether lake sturgeon presently ascend Birthday Rapids and/or Gull Rapids.

Lake sturgeon investigations were conducted at four locations in the Keeyask Study Area during 2002, including: the Burntwood River downstream of First Rapids; the Nelson and Grass rivers in the vicinity of Kelsey GS; the Nelson River between Birthday and Gull rapids; and Stephens Lake downstream of Gull Rapids. Gill nets were used to capture lake

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

sturgeon at each location. Drift nets were used to sample **larval** lake sturgeon at each location, with the exception of the Nelson and Grass rivers in the vicinity of Kelsey GS.

Ninety-two individual lake sturgeon were captured in gill nets set in the Keeyask Study Area during spring (prior to 18 July), 2002. The majority of these sturgeon were captured in the Nelson River between Birthday and Gull rapids (n=67), followed by the Burntwood River (n=16), the Nelson and Grass rivers in the vicinity of the Kelsey GS (n=5) and Stephens Lake (n=4). The largest lake sturgeon captured during this program was captured in the Nelson River between Birthday and Gull rapids on 5 July and measured 1,543 mm in total length and weighed approximately 34 kg.

Lake sturgeon eggs and/or larvae were not captured in drift nets at any location sampled and therefore a successful lake sturgeon hatch was not documented in 2002. However, male lake sturgeon in spawning condition (either preparing to spawn, **ripe**, or **spent**) were captured in the Burntwood River, in the Nelson River between Birthday and Gull rapids, and downstream of Gull Rapids. No female lake sturgeon were identified at any of the locations sampled.

In 2001, many lake sturgeon in spawning condition were captured at the base of Birthday Rapids, suggesting that this may be a lake sturgeon spawning area. However, few lake sturgeon were captured at this location in 2002 despite similar net set locations and gillnetting effort. In 2002, eight male lake sturgeon in spawning condition (either pre-spawn, ripe and/or spent) were captured within 3 km of Birthday Rapids. These data suggest that lake sturgeon may not have spawned at the base of Birthday Rapids in 2002, but further downstream within 3 km of the rapids.

Monitoring of 20 acoustic and 12 radio transmitters applied to lake sturgeon in the Study Area during 2001 continued in 2002. In general, it appears that lake sturgeon may be attracted to areas of higher water velocity during spring, deep areas with low water velocity during summer and deep areas with medium velocity during fall. Relocation data indicates that lake sturgeon make frequent localized movements during spring and summer.

In 2002, three lake sturgeon (one tagged with a radio transmitter and two tagged with acoustic transmitters) moved upstream over Gull Rapids. In addition, one lake sturgeon moved upstream and two moved downstream over Birthday Rapids.

The congregation of acoustic-tagged lake sturgeon in an area of Gull Lake during both fall 2001 and 2002 suggests that this area is an important overwintering site. The habitat

characteristics of the area include depths in excess of 7.0 m, water velocities between 0.5 and 1.5 m/s, and hard substrates.

ACKNOWLEDGEMENTS

I would like to thank Manitoba Hydro for the opportunity and resources to conduct this study.

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The collection of biological samples described in this report was authorized by Manitoba Conservation, Fisheries Branch under terms of Scientific Collection Permit # 25-02.

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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 Cree Nation [YFCN]) 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 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 results of lake sturgeon (*Acipenser fulvescens*) investigations conducted in the Keeyask Study Area during 2002, is one of a series of reports produced from the 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 requests from 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 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

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

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.

The purpose of this report is to document results of lake sturgeon studies conducted in the Keeyask Study Area during 2002. Specific objectives of the lake sturgeon investigations were:

- to gain a better understanding of lake sturgeon biology;
- to identify lake sturgeon spawning areas;
- to better describe present lake sturgeon abundance and habitat use;
- to identify any important habitats;
- to better understand the timing and spatial extent of lake sturgeon movements; and
- to determine whether lake sturgeon presently ascend Birthday Rapids and/or Gull Rapids.

2.0 THE KEEYASK STUDY SETTING

2.1 STUDY AREA

The 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 an 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 (YFCN), 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, YFCN, 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 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

2.3.1 Split Lake to Birthday Rapids

Split Lake is located along the Nelson River approximately 7 km downstream of Kelsey GS (Figure 1). Immediately downstream of the Kelsey GS the Grass River flows into the Nelson River and the Burntwood River flows into Split Lake in the western portion of the lake. The Aiken (Landing) River enters Split Lake in the southern-most portion of the lake adjacent to the community of York Landing. The Ripple and Mistuska rivers enter Split Lake along the southern shore west of the Aiken River.

Split Lake is situated in a landscape with poor drainage, dominated by black spruce forest in upland areas, and black spruce **bogs**, peatlands, and fens in lowland areas. The shoreline is stable and largely bedrock controlled interspersed with bog and marsh areas. **Riparian** vegetation includes willow and alder, black spruce, and trembling aspen. Riparian vegetation extends to the water line along portions of the shoreline. Mineral and **organic soils** occur adjacent to Split Lake, with **sporadically** distributed permafrost (Agriculture and Agri-Food Canada 2003). Lake **substrates** are primarily composed of fine mineral **sediments** (clay and **silt**) with small amounts of organic material. Ice typically forms on the lake during November and break-up occurs in April. Following break-up, the surface of the lake warms to 20°C by mid-July.

As discussed in Section 2.2, Split Lake hydrology has been affected by both LWR and by CRD. Split Lake receives its largest inflow from the Nelson River, with an annual average discharge at Kelsey GS of 2,150 m^3/s, about 68% of the total inflow for Split Lake. Inflow from the Burntwood River prior to CRD was estimated at 90.0 m^3/s at First Rapids, and following CRD increased nearly 10-fold to 849.0 m^3/s or about 29% of inflow to Split Lake (Manitoba Hydro 1996b). This large increase in river discharge resulted in extensive **erosion** of clay and silt sediments along the existing shoreline at First Rapids, as well as an increase in the surface area of Split Lake by approximately 100 ha (Environment Canada and Department of Fisheries and Oceans 1992; Manitoba Hydro 1996b). The Grass River watershed, not affected by hydroelectric development, has an average annual discharge of 66.5 m^3/s at Standing Stone Falls (approximately 40 km upstream of Witchai Lake Falls).

The remainder of the inflow to Split Lake is from the Aiken (Landing) River and other small tributaries such as the Ripple and Mistuska rivers.

The land adjacent to Clark Lake and the Nelson River downstream to Birthday Rapids is well-drained and dominated by black spruce forest, with stands of trembling aspen sporadically distributed. Mineral soils are predominant in the area with permafrost distributed sporadically and bedrock outcrops near Birthday Rapids (Agriculture and Agri-Food Canada 2003).

Clark Lake is located immediately downstream of Split Lake, and approximately 42 km upstream of Gull Rapids on the Nelson River (Figure 1). Current is restricted to the main section of the lake, with off-current bays outside the main channel. Lake substrates are composed of fine mineral sediments and areas of bedrock. The shoreline is stable and largely bedrock with areas of mineral and organic sediments. Riparian vegetation includes willow, alder, and black spruce. Aquatic vegetation is restricted to, and abundant in, shallow off-current bays. The Assean River is the only major **tributary** to Clark Lake, flowing into the north side of the lake. Two small **ephemeral** creeks also flow into the north shore of Clark Lake.

Downstream from the outlet of Clark Lake, the Nelson River narrows and water **velocity** increases significantly for a 3 km stretch, with numerous rapids that are largely confined within bedrock shorelines. The substrate and shoreline features of this section of the river are largely bedrock and boulder/cobble. For the next 7 km the river widens, velocity decreases, and fine sediments become predominant. Five small ephemeral creeks including Fork Creek (Figure 1) drain into the Nelson River between Clark Lake and Birthday Rapids.

2.3.2 Nelson River: Birthday Rapids to Gull Lake

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 to 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.

2.3.3 Nelson River: Gull Lake

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 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.

2.3.4 Nelson River: Gull Lake to Gull Rapids

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.

2.3.5 Nelson River: Gull Rapids

Gull Rapids is located approximately 3 km downstream of Caribou Island on the Nelson River (Figure 1). Two large islands and several small islands are located within the rapids, prior to the river narrowing. The rapids are approximately 2 km in length, and the river elevation drops approximately 19 m from the downstream end of Gull Lake to the downstream end of Gull Rapids. The substrate and shoreline of Gull Rapids are composed of bedrock and boulders. Gull Rapids Creek is a small tributary that flows into the south side of Gull Rapids, approximately 1 km downstream from the upstream end of Gull Rapids. This tributary is approximately 2.5 km long, and is fed by bogs and fens.

2.3.6 Stephens Lake

The land bordering Stephens Lake includes areas of poor, moderate, and well-drained soils, dominated by black spruce forest in upland areas and black spruce bogs, peatlands, and fens in lowland areas. Trembling aspen occurs sporadically along the shoreline of Stephens Lake in areas that are well-drained. Soils are predominantly organic along the north shore, but include a section of mineral soil surrounding the north arm, and both mineral and organic soils along the south shore. Permafrost is discontinuous and sporadic, and exposed bedrock occurs at the west end of the lake (Agriculture and Agri-Food Canada 2003).

As discussed in Section 2.2, construction of the Kettle GS resulted in extensive flooding immediately upstream of the GS. Moose Nose Lake (north arm) and several other small lakes that previously drained into the Nelson River became continuous with the Nelson River to form Stephens Lake. Flooded **terrestrial** habitats compose a large portion of the existing lake substrates, and include organic sediments as well as areas of clay and silt. Woody **debris** is abundant due to the extensive flooding of the treed areas. Outside the flooded terrestrial areas, substrates are dominated by fine clay and silt. Sand, gravel, cobble, and

areas of organic material dominate the shoreline, with much of the shoreline being prone to erosion. Riparian vegetation includes willow and alder, black spruce, tamarack, and scattered stands of trembling aspen.

Major tributaries of Stephens Lake include the North and South Moswakot rivers that enter the north arm of the lake. The only other major tributary of Stephens Lake was the Butnau River. However, during construction of the Kettle GS an earth dyke was constructed at the inlet of the Butnau River at Stephens Lake, and a channel developed to divert the Butnau River through Cache Lake into the Kettle River (Manitoba Hydro 1996a). Looking Back Creek is a second order ephemeral stream that drains into the north arm of Stephens Lake.

3.0 METHODS

During spring 2002, lake sturgeon investigations were conducted at the same four locations sampled in the Keeyask Study Area during 2001, including: the Burntwood River downstream of First Rapids (Figure 2); the Nelson and Grass rivers in the vicinity of the Kelsey GS (Figure 3); the Nelson River between Birthday and Gull rapids (figures 4 and 5); and Stephens Lake downstream of Gull Rapids (Figure 6). These studies were conducted using similar sampling methodologies and gear types as those employed during 2001 investigations. Gill nets were used to capture lake sturgeon at each location. Sampling for lake sturgeon eggs and larvae was conducted with larval drift nets at each location, with the exception of the Nelson and Grass rivers in the vicinity of the Kelsey GS. A summary of the start and completion dates of sampling programs is provided in Table 1.

A lake sturgeon investigation was also conducted in Gull Lake during fall 2002. Relocation data collected from acoustic tagged lake sturgeon in 2001 indicated that many lake sturgeon had congregated in a small area of Gull Lake during fall. As such, attempts were made to capture lake sturgeon in this area using gillnets in fall 2002. The start and completion dates for this investigation are provided in Table 1.

3.1 FIELD MEASUREMENTS

Water temperature was measured (± 0.2°C) at 6.0 hour intervals with a HOBO Water Temperature Pro data logger. Two data loggers were located in the Nelson River (immediately downstream of Birthday and Gull rapids) and one was located in the Burntwood River (immediately downstream of First Rapids). Each data logger was set approximately 1-2 m below the surface. Prior to deployment, the launch date, time, and measurement interval were set using a desktop computer. Data loggers were set on 25 May and removed from the water on 4 October.

The water temperature of the Nelson River in the vicinity of the Kelsey GS was measured with a hand-held thermometer (± 0.5ºC).

3.2 SAMPLING GEAR

3.2.1 Gill Nets

Gillnets with similar mesh size were used during both 2001 and 2002 lake sturgeon investigations with the exception of the 140 mm (5.5 inch) mesh gillnet that was used in the Burntwood River, in the vicinity of the Kelsey GS, and in Stephens Lake in 2001. Because lake sturgeon were not captured in the 140 mm (5.5 inch) mesh panel at any location

sampled, and since its use increased the mortality of non-target fish **species**, it was not used during 2002 studies.

3.2.1.1 Burntwood River

Thirty sites in the Burntwood River between First Rapids and the confluence of the Odei River were fished from 5 June to 18 July, 2002[1] (Table 1; Figure 7). Between four and six gillnet gangs, consisting of two 22.9 m (25 yd) long, 2.5 m (2.7 yd) deep, panels (203 and 254 mm [8 and 10 inch]) of twisted nylon stretched mesh were used to capture lake sturgeon. Weather permitting, gill nets were checked approximately every 24 hours. Gillnetting sites were selected based on their suitability for capturing lake sturgeon that may be spawning in or near First Rapids. Because the reach of the Burntwood River between First Rapids and its confluence with the Odei River has physical characteristics that make it difficult to gillnet for lake sturgeon (water depths between 5 and 10 m; high water velocities [>1.5 m/s]); highly turbulent water; and hard substrates), gill nets were set in eddies or along current breaks to maximize efficiency.

3.2.1.2 Nelson River and Grass River in the Vicinity of the Kelsey GS

A total of 26 sites were fished with gill nets in the Nelson and Grass rivers in the vicinity of Kelsey GS from 8 June to 10 July, 2002 (Table 1; Figure 8). Twenty-one of the sites were located in the Nelson River downstream of Kelsey GS and five were in the lower reaches of the Grass River (Figure 8). Four gillnet gangs were used on a daily basis and checked approximately every 24 hours, weather permitting. Gillnet gangs were 2.5 m (2.7 yd) deep and consisted of two 22.9 m (25 yd) long panels (203 and 254 mm [8 and 10 inch]) of twisted nylon stretched mesh. As in 2001, gillnetting sites were selected based on their proximity to potential spawning locations. Due to high water velocities and turbulent water, most gill nets were set in eddies, along current breaks, or angled back slightly with the current to maximize their efficiency.

3.2.1.3 Nelson River between Birthday and Gull rapids

A total of 19 gillnetting sites were fished in the Nelson River between Birthday and Gull rapids from 7 June to 15 July, 2002[1] (Table 1; Figure 9). Each gillnet gang consisted of two 22.9 m (25 yd) long, 2.5 m (2.7 yd) deep panels of either 203, 228, 254 and 304 mm (8, 9, 10 or 12 inch) twisted nylon stretched mesh. Gillnets were checked approximately every 24 hours, weather permitting. Gillnetting sites were selected based on: a) proximity to potential

[1] Field investigations were halted at all locations with the exception of the Kelsey GS from 17 to 21 June

spawning areas; b) locations suspected to yield high numbers of lake sturgeon; and c) previous sites fished during 2001 investigations.

Between 1 and 10 October, gill nets were set at seven sites in Gull Lake (Figure 10). Each gillnet gang consisted of two 22.9 m (25 yd) long, 2.5 m (2.7 yd) deep panels (203 and 254 mm [8 and 10 inch]) of twisted nylon stretched mesh that were checked every 24 hours, weather permitting. Gillnetting sites were selected based on the results of the 2001 acoustic telemetry studies which indicated that large numbers of lake sturgeon congregate in this area of Gull Lake during fall.

3.2.1.4 Stephens Lake

Fifteen gillnetting sites were fished in Stephens Lake, downstream of Gull Rapids, from 12 June to 15 July, 2002[1] (Table 1; Figure 11). Each gillnet gang was 45.8 m (50 yd) long, 2.5 m (2.7 yd) deep, and consisted of two 22.9 m (25 yd) long panels of either 203 mm, 228 mm, 254 mm or 304 mm (8, 9, 10 or 12 inch) twisted nylon stretched mesh. Each gang was checked approximately every 24 hours. Because the area immediately downstream of Gull Rapids can be characterized by highly turbulent water and high water velocities, gill nets were set along current breaks, in eddies, or angled back with the current adjacent to shore.

3.2.2 Index Gillnetting

A lake sturgeon index gillnetting program was conducted in the Nelson River between Birthday and Gull rapids from 4 July to 14 July, 2002 using the same sites, gear types and methodologies used during the 2001 study (Table 1) (Barth and Mochnacz 2004). Twenty gillnetting sites were fished for two 24-hour periods (Figure 12). Four gillnet gangs, consisting of one 22.9 m (25 yd) long panel of 203 mm (8 inch) twisted nylon stretched mesh and one 22.9 m (25 yd) long panel of 254 mm (10 inch) twisted nylon stretched mesh, were set daily. Gillnet gangs were pulled and moved to different sites each day so that a given site was not fished on consecutive days. Habitat information, including water depth, relative water velocity[2], and substrate composition and compaction, was recorded at each site.

3.2.3 Drift Nets

Drift nets were set in the Burntwood River downstream of First Rapids; in the Nelson River between Birthday and Gull rapids; and within and immediately downstream of Gull Rapids between 25 June and 20 July, 2002. Drift nets were placed in suspected lake sturgeon spawning areas to sample for lake sturgeon eggs and larvae. Each drift net consisted of a 3

[2] Water velocity was based on observation of surface conditions and classified as low (< 0.5 m/s), medium (0.5-1.5 m/s), or high (> 1.5 m/s).

m long, 954 µm Nitex screen bag, with a 43 cm x 85 cm opening that tapered into a 9 cm diameter removable ABS pipe cod-end (Figure 13). The opening of each drift net was inserted into a metal frame weighing approximately 25 kg, which kept it anchored to the river bottom and open facing the current. Drift nets were set in either shallow (<1 m) or deep water (≥ 1 m). For shallow water sets, each drift net frame was held in place by two t-bars pounded into the river bottom. Shallow water drift nets were checked by wading out to the net. For deep water sets, each drift net frame was attached to a large anchor that was tied to the lower edge of the frame by approximately 20 m of sideline and two large floats were tied through two loops on either side of the metal drift net frame with at least 10 m of excess line, depending on depth of the drift net (Figure 14). To retrieve the drift net, a boat was positioned near the floats attached to either side of the drift net frame. Each float was then grabbed by a study team member and the lines were pulled into the boat at similar speeds. As the lines were retrieved, the frame raised upward and pivoted on the anchor. Once at the surface, the drift net frame was placed on the bow of the boat and contents of the Nitex screen bag were washed towards the cod-end. For both shallow and deep water sets, the ABS cod-end container was emptied into a sample jar and rinsed at least once before being reset. Weather permitting, each drift net was emptied approximately every 24 hours.

Drift samples were preserved in 10% formalin. All samples were returned to the North/South Consultants Inc. laboratory in Winnipeg where all fish larvae and eggs were sorted and identified to species. Due to high densities, sucker (*Catostomus spp*.) eggs and larvae were not enumerated.

3.2.3.1 Burntwood River

Three drift nets were set in the Burntwood River downstream of First Rapids on 25 June and checked daily until 18 July, 2002 (Figure 15). All three drift nets were located within 300 m of First Rapids.

3.2.3.2 Nelson River (between Birthday and Gull rapids)

Six drift nets were set in the reach of the Nelson River between Birthday and Gull rapids from 26 June to 20 July, 2002 (Figure 16). All six drift nets were located within 2 km of Birthday Rapids.

3.2.3.3 Gull Rapids

Five drift nets were set in and immediately downstream of Gull Rapids on 27 June and monitored until 20 July, 2002 (Figure 17). Two drift nets were set at the base of the north

channel of Gull Rapids and two nets were set at the base of the south channel of the rapids. The remaining drift net was set in the middle channel of the rapids.

3.3 LAKE STURGEON SAMPLING

All lake sturgeon captured in gill nets were enumerated, measured for fork length and total length (± 1 mm), weighed, and marked with an individually numbered plastic 'Floy' FD-94 T-bar anchor tag. Floy-tags were inserted between the **basal pterygiphores** of the dorsal fin using a Dennison Mark II tagging gun. To minimize fish injury, ageing structures were not collected from lake sturgeon.

Where possible, sex and state of maturity were determined for individual lake sturgeon by applying pressure to the ventral surface of the fish to express **gametes**. If no gametes were expressed sex and maturity codes were not assigned. The following sexual maturity codes were used:

Females (F)	Males (M)
2 – maturing to spawn	7 – maturing to spawn
3 – **ripe**	8 – ripe
4 – **spent**	9 – spent

Each lake sturgeon recaptured during the study was re-examined for sex and maturity and the Floy-tag was inspected to confirm its security and to ensure it was not causing any damage to the fish around the attachment area (e.g., lesion).

All other fish species captured during gillnetting were measured for fork length (±1 mm). Northern pike (*Esox lucius*), walleye (*Sander vitreum*), and lake whitefish (*Coregonus clupeaformis*) greater than 250 mm in fork length were marked with a Floy-tag before being released. These data are not presented in this report and are included in Holm and Remnant (2004), Johnson and Parks (2005) and Pisiak (2005), for fish captured in the Burntwood River and Nelson River in the vicinity of the Kelsey GS, in the Nelson River between Birthday and Gull Rapids, and in Stephens Lake, respectively.

3.4 ACOUSTIC AND RADIO TELEMETRY

3.4.1 Acoustic Telemetry

Twenty acoustic transmitters were applied to lake sturgeon in the Study Area during 2001. Five of these transmitters were applied to lake sturgeon downstream of Gull Rapids, and 15 of the transmitters were applied in the Nelson River between Birthday and Gull rapids. For a description of transmitter specifications, transmitter application, site-specific tagging

locations and biological information for all tagged fish see Barth and Mochnacz (2004). Transmitters have been monitored since their date of application in 2001.

3.4.1.1 Acoustic Transmitter Relocation

Movements of lake sturgeon tagged with acoustic transmitters were monitored via two methods: a) stationary VR1 or VR2 receivers; and b) manual tracking with a VR-60 ultrasonic receiver.

Stationary (VR1 or VR2) Receivers

Eight stationary VR1 and two stationary VR2 submersible acoustic receivers manufactured by VEMCO LTD. were used during the 2002 investigation. The VR1 and VR2 submersible receivers are similar in their mode of operation, but VR2 receivers have a greater memory capacity. The VR1 and VR2 receivers are equipped with an omni-directional hydrophone and internal data logger. The omni-directional hydrophone detects signals emitted from active transmitters within its range of detection. The transmitter code number, as well as the date and time of each detection, are stored in the data logger. Data are retrieved by downloading each receiver with an IBM/PC/AT computer, operating with a VR1PC computer interface, also manufactured by VEMCO LTD. Data were downloaded from each receiver on a weekly to bi-weekly basis.

Nine stationary receivers were used to monitor lake sturgeon movements in 2001. In 2002, one additional receiver was added to the receiver array and placed at the upstream end of Gull Lake (Figure 18). The purpose of arranging the stationary receivers in this fashion was to monitor fish movements in relation to Birthday and Gull rapids. Although the entire area immediately upstream and downstream of Birthday and Gull rapids could not be monitored (due to noise interference from turbulent water), it is thought that any fish moving upstream over the rapids would first enter the calmer water at the base of the rapids where the receivers were placed. Although the receivers detect the presence of a transmitter in the area, they do not discern the direction that the fish may be moving.

Each stationary receiver was deployed on 9 June. Stationary receivers were completely submersed in water, anchored to the bottom, and held vertically in the water column (above the river bottom) with a float attached to the hydrophone end (Figure 19). Each stationary receiver was removed from the water on 15 October to avoid being damaged by ice.

Manual Tracking

Manual tracking was conducted from a boat using a battery powered VR-60 ultrasonic receiver and omni-directional hydrophone. The boat was stopped and its motor turned off at fixed points between Birthday and Gull rapids and allowed to drift downstream with the current. The omni-directional hydrophone was lowered approximately 1 m into the water and held there for 1.0 to 1.5 minutes. Upon detection, the code number of the transmitter was displayed on an LCD screen on the face of the VR-60 and attempts were made to find the area with the strongest signal. The date, time, and location of each detection were recorded. During testing, the range of the VR-60 was estimated at 500 m, but could vary depending on environmental conditions. The optimal conditions for tracking occurred on days with little or no wind. Consequently, manual tracking was conducted on calm days at 9 – 12 day intervals. No tracking was conducted during winter.

3.4.2 Radio Telemetry

Individually coded radio transmitters operating on one of five frequencies were implanted in 12 lake sturgeon during spring, 2001. Six of the transmitters were applied to fish caught in the Nelson River between Birthday and Gull rapids, and the remaining six were applied to fish captured in Stephens Lake downstream of Gull Rapids. For details of radio transmitter application refer to Barth and Mochnacz (2004).

3.4.2.1 Radio Tracking

Radio tracking was conducted from a helicopter using a Lotek SRX-400 receiver equipped with a single 'yagi' antenna. The date and area covered during each tracking flight are provided in Murray and Barth (2005). When a fish was located, tag number (tag frequency and code) and location were recorded.

3.5 DATA ANALYSIS

The maps provided in figures 2-6 were divided into separate geographical zones (red lettering) to differentiate between areas within waterbodies in the Keeyask Study Area and to facilitate discussion of lake sturgeon movements.

Mean length, weight, and condition factor (K) were calculated for all lake sturgeon captured in gill nets. Condition factor was calculated for individual fish based on the following equation (after Fulton 1911, in Ricker 1975):

$$K = W \times 10^5 / L^3$$

where: W = round weight (g); and
L = fork length (mm).

Length-frequency distributions were plotted by 50 mm fork length intervals (e.g., 1000-1049) for lake sturgeon captured at each sampling location.

Weight-length relationships were calculated for the lake sturgeon catch at each location using least squares regression analysis on logarithmic transformations of fork lengths and round weights according to the following relationship:

$Log_{10}W = a + b\ (Log_{10}L)$

where: W = round weight (g);
L = fork length (mm);
a = Y-intercept; and
b = slope of the regression line.

Catch-per-unit-effort (CPUE) was expressed as the number of fish caught in a 45.8 m net set for a 24 hour period. For the index gillnetting program, CPUE values for each set replicate were first averaged before the overall site CPUE was calculated.

4.0 RESULTS AND DISCUSSION

In total, 367 fish comprising 11 fish species were captured in gill nets during lake sturgeon studies conducted at four locations in the Keeyask Study Area between 5 June and 18 July, 2002 (tables 2 and 3). The greatest number of fish were captured in the Nelson River between Birthday and Gull rapids (n=158), followed by Stephens Lake (n=89), in the Nelson and Grass rivers in the vicinity of the Kelsey GS (n=73) and in the Burntwood River (n=47) (Table 3). Data collected during these studies pertaining to fish species other than lake sturgeon are discussed by location in Holm and Remnant (2004) for fish captured in the Burntwood River and in the Nelson and Grass rivers in the vicinity of Kelsey GS, Johnson and Parks (2005) for fish captured in the Nelson River between Birthday and Gull rapids, and Pisiak (2005) for fish captured in Stephens Lake.

Ninety-two lake sturgeon were captured in gill nets set in the Keeyask Study Area during spring[3]. The majority of these sturgeon were captured in the Nelson River between Birthday and Gull rapids (n=67), followed by the Burntwood River (n=16), in the Nelson and Grass rivers in the vicinity of the Kelsey GS (n=5), and Stephens Lake (n=4) (Table 3). The largest lake sturgeon was captured in the Nelson River between Birthday and Gull rapids and measured 1,543 mm in total length and weighed approximately 34 kg (Appendix 1). Date of capture, biological information and Floy-tag information for all lake sturgeon captured in 2002 are presented in Appendix 1.

Eight lake sturgeon were captured in the Study Area following completion of the spring lake sturgeon gillnetting studies (i.e., after 18 July). Two of these were captured in August during the summer index gillnetting program in Split Lake (Holm and Remnant 2004). Similarly, one was captured during the summer index gillnetting program in Gull Lake (Johnson and Parks 2005). The remaining five were captured in Gull Lake during fall. Two of these (Floy-tag #48397 and #48398) were captured incidentally in nets set to capture pre-spawn lake whitefish (Johnson and Parks 2005) (Appendix 1). The remaining three were captured during the Gull Lake fall lake sturgeon gillnetting program discussed in Section 4.1.3.2. Date of capture, biological information, and Floy-tag information associated with these fish are presented in Appendix 1.

4.1 GILLNETTING

Results of lake sturgeon gillnetting studies are discussed by location in the following sections.

[3] Number includes all lake sturgeon captured in gill nets prior to 18 July, 2002 (including those tagged in 2001) and does not include lake sturgeon captured more than once in 2002.

4.1.1 Burntwood River

Thirty gillnetting sites in the reach of the Burntwood River between First Rapids and the Odei River were fished between 5 June and 18 July, 2002, for a total of 2,048.26 hours. In total, 16 lake sturgeon were captured, producing an overall CPUE of 0.19 lake sturgeon/45.8 m net/24 h (Table 4). Thirteen of the 16 lake sturgeon were captured within 5 km of First Rapids in Zone BWR-A and three were captured more than 5 km downstream of First Rapids in Zone BWR-B (Figure 2). Two of these lake sturgeon had been previously captured and marked with a Floy-tag during the 2001 Burntwood River lake sturgeon investigation.

For lake sturgeon captured in the Burntwood River during 2002, mean fork length was 982 mm (range: 644 – 1,315 mm), mean weight was 9,227 g (range: 2,200 – 22,000 g), and mean condition factor was 0.81 (range: 0.71 – 0.92) (Table 5). For the second consecutive year, the mean condition factor was the lowest of all locations sampled suggesting that, on average, lake sturgeon captured in the Burntwood River were less robust than lake sturgeon captured at the other three locations. Only three of the 15 lake sturgeon measured were greater than 1,050 mm in fork length (Figure 20). The weight-length relationship for lake sturgeon captured in the Burntwood River is provided in Appendix 2.

The water temperature of the Burntwood River was 6ºC when gillnetting commenced on 5 June. Excluding current year recaptures, the daily lake sturgeon catch ranged between zero and two, with two lake sturgeon being captured on both 13 and 23 June (Figure 21). Gametes were expressed from four male lake sturgeon captured on either 23 June or 2 July, 2002. Three of these were captured in the same net on 23 June and were all classified as fish preparing to spawn (one of these was originally captured on 13 June 2002, at which time it showed no signs of spawning in the current year). The other male lake sturgeon was captured on 2 July when it was classified as spent (Table 6). No female lake sturgeon were identified from the catch.

Five lake sturgeon that had previously been marked with Floy-tags were recaptured one or more times in 2002. Two of these fish (Floy-tag #46405 and #46445) were originally marked in the Burntwood River during the spring 2001 investigation (Appendix 3) (Barth and Mochnacz 2004). Both were recaptured near their original tagging location approximately one year after being tagged. One of these fish (Floy-tag #46445) was subsequently recaptured a second time near the mouth of the Odei River on 17 July, 2002. The other three recaptured sturgeon were both tagged and subsequently recaptured during spring 2002.

Another lake sturgeon (Floy-tag #46407) that was originally tagged in the Burntwood River in 2001 was recaptured in 2002. This fished moved 50 km from its original tagging location near First Rapids in the Burntwood River into the Nelson River near the Kelsey GS where it was recaptured by a local resource user (Appendix 3).

4.1.2 Kelsey GS

Twenty-six gillnetting sites were fished in the vicinity of the Kelsey GS between 8 June and 10 July, 2002 for a total of 3,856.25 gillnet hours. A total of five lake sturgeon were captured producing an overall CPUE of 0.03 lake sturgeon/45.8 m net/24 hours (Table 4). In the vicinity of the Kelsey GS, three of the lake sturgeon were captured in the Grass River near the mouth, one in the Nelson River immediately downstream of the Kelsey GS, and the remaining sturgeon was captured approximately 12 km downstream of the GS in zone KGS-C (Figure 3).

Mean fork length of the Kelsey GS sturgeon catch was 963 mm (range: 774 – 1,130 mm), mean weight was 9,370 g (range: 4,300 – 18,500 g), and mean condition factor was 0.97 (range: 0.77-1.28) (Table 5). The majority of the lake sturgeon measured less than 1,050 mm in fork length (Figure 22). The weight-length relationship for lake sturgeon captured in the vicinity of Kelsey GS is provided in Appendix 2.

Gillnetting commenced downstream of the Kelsey GS on 8 June, 2002, when the water temperature of the Nelson River was 7.5ºC. The first lake sturgeon was captured on 14 June and the last on 9 July, 2002 (Figure 23). None of the lake sturgeon captured at this location displayed any sign of reproducing during the current year (Table 6).

4.1.3 Nelson River between Birthday and Gull rapids

4.1.3.1 Spring Gillnetting

In total, 67 lake sturgeon were captured in gillnets set in the Nelson River between Birthday and Gull rapids during spring 2002. Of these, eight were captured during the index gillnetting program discussed in Section 4.2.

Nineteen gillnetting sites were fished between Birthday and Gull rapids from 7 June to 15 July, for a total of 4,917.72 hours (Table 4; Figure 9). In total, 59 lake sturgeon were captured producing an overall CPUE of 0.29 lake sturgeon/45.8m net/24 h, the highest lake sturgeon CPUE by location for lake sturgeon studies in the Keeyask Study Area in 2002, but slightly lower than the previous years CPUE (Table 4). Most of the lake sturgeon were

captured in Zone BR-D (n=27), followed by zones GL-B (n=14), GL-A (n=13) and GL-C (n=5) (Figures 4 and 5).

Mean fork length for all lake sturgeon captured (n=67) in gill nets set between 7 June and 15 July, 2002, was 1,055 mm (range: 680 - 1,415 mm), mean weight was 12,198 g (range: 2,722 – 34,020 g), and mean condition factor was 0.97 (range: 0.73 - 1.44) (Table 5). Most of the lake sturgeon measured between 900 and 1,200 mm, with the modal length interval being 1000-1049 mm (Figure 24). A weight-length regression for lake sturgeon captured in the Nelson River between Birthday and Gull rapids is provided in Appendix 2.

Gillnetting for lake sturgeon commenced on 7 June when the water temperature of the Nelson River measured 5.0ºC. Over the following six days the water temperature of the Nelson River increased rapidly from 5.0ºC to 11.0ºC. During this time the catch peaked at ten on 10 June; seven of these fish were captured in one gill net set at the inlet of Gull Lake. However, beginning on 12 June, cool weather which persisted for 10 days kept water temperatures from warming past 12ºC (Figure 25). Few lake sturgeon were captured during this period (n=5). As water temperatures began to rise (i.e., after 23 June), sturgeon catches also began to increase. Thirteen lake sturgeon were captured on 27 and 28 June combined, when water temperatures were 17.0ºC and 18.2ºC, respectively (Figure 25).

Five lake sturgeon captured between 10 and 15 June were classified as males maturing to spawn. An additional two male pre-spawn sturgeon were captured one week later (22 June). Between 23 June and 26 June, none of the lake sturgeon captured showed any sign of spawning during the current year. However, between 27 and 30 June, one male preparing to spawn, one ripe male, and four spent male lake sturgeon were captured at water temperatures that ranged between 17.0ºC and 18.2ºC. No female lake sturgeon were identified from the catch (i.e., eggs were not expressed) (Table 6). All of the spent and the one ripe lake sturgeon were captured within 3 km of Birthday Rapids, whereas the majority (six out of eight) of sturgeon classified as maturing to spawn were captured between 15 km and 23 km downstream of Birthday Rapids (Figure 26). The timing and capture location of the ripe and spent fish suggests that spawning may have occurred between 27 and 30 June.

During the 2001 investigation, many lake sturgeon in spawning condition were captured in gill nets set immediately downstream of Birthday Rapids between 6 and 8 June. These captures suggested that lake sturgeon were spawning in the immediate vicinity of Birthday Rapids in 2001 (Barth and Mochnacz 2004). However, despite concentrated fishing effort in the same areas immediately downstream of the rapids, only one lake sturgeon (spent male) suspected of spawning in 2002 was captured. These data suggest that the site or sites where

sturgeon may have spawned in 2002 was likely located downstream of Birthday Rapids within approximately 3 km of the rapids.

Seventeen of the 67 lake sturgeon captured in 2002 had been previously marked with Floy-tags. Four of these fish were lake sturgeon originally tagged during a fisheries investigation conducted by Manitoba Conservation in 1995, while the remaining 13 were previously tagged during the lake sturgeon investigation conducted in 2001. Nearly 20% of the fish captured in 2002 had been previously tagged in 2001. Further lake sturgeon recapture information can be found in Holm et al. (2005).

Three lake sturgeon were originally Floy-tagged and later recaptured in 2002; two of these were recaptured twice (Appendix 3). The maximum distance moved by one of these three fish was 2.5 km.

One lake sturgeon (Floy-tag #47179) that was marked with a Floy-tag during the 2001 investigation was recaptured by a local resource user. The recapture information (including location and date of recapture) and the Floy-tag were provided to North/South Consultants Inc. (Appendix 1).

4.1.3.2 Fall Gillnetting

Seven gillnetting sites were fished in Gull Lake between 1 and 10 October, 2002, for a total of 700.99 hours (Table 4; Figure 10). Four fish were captured in total, including three lake sturgeon and one lake whitefish. The overall CPUE for the lake sturgeon catch was 0.10 lake sturgeon/45.8m net/24 h (Table 4).

4.1.4 Stephens Lake

Fifteen gillnetting sites were fished downstream of Gull Rapids between 12 June and 15 July, 2002, for a total of 3,249.48 gillnet hours (Table 4; Figure 11). In total, four lake sturgeon were captured, producing an overall CPUE of 0.03 lake sturgeon/45.8 m net/24 h. All of the lake sturgeon were captured in Zone STL-A (Figure 6).

For lake sturgeon captured in Stephens Lake, mean fork length was 1,045 mm (range: 1,001-1,100 mm), mean weight was 10,888 g (range: 8,050 – 15,000 g), and mean condition factor was 0.94 (range 0.80-1.13) (Table 5). The length frequency histogram is provided in Figure 27. A weight-length regression equation for lake sturgeon captured in Stephens Lake is provided in Appendix 2.

Gillnetting was initiated in Stephens Lake on 12 June when water temperatures measured 11ºC. All four lake sturgeon were captured between 15 and 25 June when water temperatures ranged between 10.6ºC and 14.5ºC (Figure 28).

Three of the four lake sturgeon captured in Stephens Lake below Gull Rapids were identified as males preparing to spawn (Table 6). The first lake sturgeon captured during the program (Floy-tag #53189) was captured three times in 2002; on 15 June, 25 June and 4 July. On the first two occasions that this fish was captured it was classified as a male sturgeon preparing to spawn. Another lake sturgeon (Floy-tag #53194) was first captured on 16 June and no sex could be determined at that time; however when it was subsequently recaptured nine days later it was identified as a male preparing to spawn. The third pre-spawn male lake sturgeon was first captured on 25 June and was subsequently recaptured at a different location one day later. In summary, each lake sturgeon identified as a male in 2002 was captured at least once between 23 June and 25 June when water temperatures ranged between 12.7ºC and 14.5ºC (Table 6; Figure 28).

None of the lake sturgeon captured at this location during 2002 had been previously tagged during the 2001 investigation. However, as discussed above, three of the four fish captured in 2002 were subsequently recaptured one or two times during the program (Appendix 3). All fish were recaptured less than 1 km from their original capture site.

4.2 INDEX GILLNETTING

Thirty-six fish were captured during the index gillnetting program conducted at 20 sites in the Nelson River between Birthday and Gull rapids in 2002 (Figure 12). Northern pike (n=10) was the most frequently captured species, composing 27.8% of the total catch. The next most numerous were lake sturgeon (n=8), lake whitefish (n=8), and walleye (n=8) with each composing approximately 22% of the total catch (Table 7). One burbot (*Lota lota*) and one freshwater drum (*Aplodinotus grunniens*) were also captured (Table 7). One of the lake sturgeon (Floy-tag #47125) was originally captured during the 2001 investigation. The mean CPUE for lake sturgeon was 0.21 lake sturgeon/45.8 m net/24 h and ranged from zero at several sites to 2.34 at Site 2 (Table 8). Biological information for all sturgeon captured during index gillnetting in the Nelson River between Birthday and Gull rapids is provided in Appendix 1. Biological information for fish species other than lake sturgeon captured during index gillnetting are provided in Johnson and Parks (2005). Habitat information, including water depth, relative water velocity, and substrate composition and compaction, recorded at each site is provided in Appendix 4.

4.3 LARVAL DRIFT

4.3.1 Burntwood River

Larval lake sturgeon were not captured in any of the three larval drift nets set in the Burntwood River during spring 2002 (Figure 15). Data collected from larval drift nets set at this location are presented in Holm and Remnant (2004).

4.3.2 Nelson River between Birthday and Gull rapids

No larval lake sturgeon were captured in any of the drift nets set between Birthday and Gull rapids during spring 2002. Data collected from larval drift nets set at this location are presented in Johnson and Parks (2005).

Although larval lake sturgeon were not captured, one adult lake sturgeon (SLRMB#1098) was captured in DN-2 located mid-channel, approximately 30 meters downstream of Birthday Rapids (Figure 16). This lake sturgeon measured 1,234 mm in fork length, weighed 14,286 g and was classified as a spent male. This fish was not included in the analysis of gillnetting results. Biological and Floy-tag information collected from this lake sturgeon are presented in Appendix 1.

4.3.3 Stephens Lake

Larval lake sturgeon were not captured in drift nets set in and below Gull Rapids in 2002. The information collected from these drift nets is presented in Pisiak (2005).

4.4 RADIO AND ACOUSTIC TELEMETRY

Twenty acoustic and 12 radio transmitters were applied to lake sturgeon in the Keeyask Study Area during 2001. Twenty-one of the transmitters (15 acoustic and six radio) were applied to lake sturgeon in the Nelson River between Birthday and Gull rapids, and 11 (six radio and five acoustic) were applied downstream of Gull Rapids in Stephens Lake. Biological details, site specific tagging locations, and subsequent relocation dates for each individual lake sturgeon in 2001are provided in Barth and Mochnacz (2004). Relocations of lake sturgeon from 1 May, 2002, to 3 April, 2003, are provided on maps in Appendix 5.

The following section provides a summary of movements observed in 2002 and is based on results from gillnetting, Floy-tag recaptures, and telemetry that provide useful information for the analysis of lake sturgeon movements.

4.5 LAKE STURGEON MOVEMENTS 2002

4.5.1 Burntwood River

It has been reported that optimum spawning temperatures for lake sturgeon are between 13ºC and 18ºC (Scott and Crossman 1998). During 2002, the water temperature of the Burntwood River warmed very slowly and water temperatures above 12ºC were not recorded until 22 June. The capture of three male lake sturgeon preparing to spawn on 23 June when the water temperature was 14ºC, and the capture of one spent male lake sturgeon on 2 July, suggests that lake sturgeon were staging downstream of First Rapids and moved into the rapids once water temperatures were appropriate for spawning.

In 2002, four lake sturgeon were captured more than once near First Rapids in June and July. A similar pattern was observed in 2001 when two lake sturgeon were captured more than once in the vicinity of the rapids. In addition, two of the fish tagged downstream of First Rapids in 2001 were recaptured at the base of the rapids in 2002. Given that male sturgeon have a spawning periodicity of two to three years, these data suggest that some lake sturgeon may frequent the rapids during spring when they may not be spawning.

One lake sturgeon that was originally tagged in the Burntwood River in 2001 was recaptured by a local resource user approximately 50 km from its original tagging location in the Nelson River downstream of the Kelsey GS in 2002 (Appendix 3). This movement indicates that individual lake sturgeon utilize both the Nelson and Burntwood rivers.

4.5.2 Kelsey GS

Very little information was collected on lake sturgeon movements in the Nelson and Grass rivers in the vicinity of Kelsey GS during 2002. Gillnet catches in 2002 marked the second consecutive year that fewer than 10 lake sturgeon were captured at this location. No reproductively active fish were captured in 2002.

4.5.3 Nelson River between Birthday and Gull rapids

During spring 2002, twenty-one lake sturgeon were captured in gillnets during the first five days of study (7-12 June), five of which were classified as pre-spawning males. Of these 21 fish, 13 were captured in gillnets set at the inlet to Gull Lake. Additionally, nine acoustic-tagged lake sturgeon were re-located at the inlet of Gull Lake on several days between 9 and 16 June (AT#38, AT#40, AT#43, AT#44, AT#46, AT#47, and AT#50) (Appendix 5). These data suggest that sturgeon may have been attracted to the inlet to Gull Lake during early spring 2002 (water temperatures between 7.0ºC and 11.9ºC). It is thought that lake sturgeon congregated in this area prior to moving further up the river to spawn.

Between 13 and 22 June, 2002, only five lake sturgeon were captured in gillnets in the reach of the Nelson River between Birthday and Gull rapids. Although lake sturgeon studies were halted for five days during this time (between 17 and 21 June), cool weather kept water temperatures relatively constant between 11.0ºC and 12.2ºC (Figure 25). Since lake sturgeon are thought to spawn at water temperatures between 13.0ºC and 18.0ºC, and because male sturgeon in pre-spawn, ripe and spent condition were captured after 21 June, it is probable that lake sturgeon did not spawn during the period that studies were halted. Once studies resumed (22 June), and water temperatures began to increase, lake sturgeon gillnet catches also increased. Between 22 and 30 June, 27 lake sturgeon were captured in gillnets, 17 of which were captured within 3 km of Birthday Rapids. Of these 17, eight were classified as male sturgeon in either pre-spawn, ripe, or spent condition. These data suggest that as water temperatures increased, lake sturgeon moved from staging areas located at the inlet to Gull Lake upstream to spawning areas that appear to be located within 3 km of Birthday Rapids. Data from 2002 indicated that not all sturgeon that moved upstream were spawning fish; non-spawning sturgeon also appeared to move upstream during spring.

During summer, 2002, the majority of lake sturgeon tagged with acoustic transmitters were relocated in Gull Lake (the area of the Nelson River between the inlet to Gull Lake and the upstream end of Gull Rapids) (Appendix 5). Transmitter relocation data indicated that lake sturgeon were very active during summer and made frequent, localized movements (i.e., movements that generally ranged between 1 and 20 km[4]). These movements were likely related to feeding.

In October 2002, ten of the acoustic-tagged sturgeon (AT#37, AT#38, AT#40, AT#41, AT#42, AT#43, AT#44, AT#47, AT#49, AT#50) were located in an area of Gull Lake located approximately 6 to 10 km upstream of Gull Rapids (Figure 29). One radio-tagged lake sturgeon (RT#149.620, Code#1) was also relocated in this area during fall. Although many acoustic-tagged sturgeon were relocated in this area, gillnets set in this area during fall did not yield a large number of sturgeon.

4.5.3.1 Movements Over Birthday Rapids

One lake sturgeon (RT#149.720, Code#4) moved downstream over Birthday Rapids in 2002. This fish was last relocated in Clark Lake during fall 2001. It moved downstream over Birthday Rapids sometime between 8 October, 2001 and 6 July, 2002 (Appendix 5).

[4] Movements greater than 20 km have been observed.

One lake sturgeon (AT#41) moved upstream over Birthday Rapids on 23 June and subsequently moved back downstream over the rapids five days later (Appendix 5).

4.5.4 Stephens Lake

Only four lake sturgeon were captured downstream of Gull Rapids in 2002. As a result, little information is available concerning sturgeon movement in this region in Year 2. However, during both years of study, it was observed that pre-spawn male lake sturgeon were often recaptured one or more times during the same year in this area.

Three acoustic-transmitters were frequently relocated by the stationary receivers downstream of Gull Rapids in 2002. Relocations from three acoustic-tagged lake sturgeon in Stephens Lake (AT#31, AT#32, AT#33) indicate that this species may remain in the vicinity of Gull Rapids for significant portions of the summer and fall (Appendix 5).

Two lake sturgeon (AT#32 and AT#33) were relocated near an island located approximately 3 km downstream of Gull Rapids on 8 October, 2002.

4.5.4.1 Movements Over Gull Rapids

In 2002, three lake sturgeon, one tagged with a radio transmitter (RT#149.620, Code #1) and two tagged with acoustic transmitters (AT#34 and AT#36) moved upstream over Gull Rapids. The radio-tagged fish was located in Stephens Lake on 13 May, 2002, and was relocated upstream of Gull Rapids in Gull Lake on 13 September, 2002 (Appendix 5). The acoustic-tagged fish (AT#34 and AT#36) moved upstream over Gull Rapids between 5 and 10 July and 30 August and 4 September, respectively (Appendix 5). One of these lake sturgeon (AT#36) had moved from Gull Lake, downstream through Gull Rapids into Stephens Lake in 2001, and moved back upstream over Gull Rapids into Gull Lake in 2002.

4.6 MOVEMENT SUMMARY

4.6.1 Burntwood River

Data collected in 2001 and 2002 suggests that sturgeon in the Burntwood River stage downstream of First Rapids and move into the rapids to spawn once water temperatures are preferable for spawning. In 2001, water temperatures were within the preferred range for lake sturgeon between 30 May and 10 June compared to 23 June and 2 July in 2002. As such, catches of spawning lake sturgeon occurred approximately three weeks later in 2002. Once spawning has been completed, data suggests that some lake sturgeon may remain in the vicinity of the rapids well into July.

Evidence suggesting that lake sturgeon in the Burntwood River may move extensively was collected in 2001 and 2002. One lake sturgeon moved approximately 66 km from First Rapids into Split Lake in 12 days during 2001. Another lake sturgeon moved 50 km from the Burntwood River into the Nelson River downstream of the Kelsey GS. This movement indicates that lake sturgeon may utilize both the Burntwood River and Nelson River.

No information has been collected to date with regards to lake sturgeon use of the Burntwood River during late summer, fall, or winter.

4.6.2 Kelsey GS

Data collected during 2001 and 2002 suggests that lake sturgeon do not make extensive use of the Nelson and Grass rivers in the vicinity of the Kelsey GS during spring. Gillnet catches in 2002 marked the second consecutive year that fewer than 10 lake sturgeon were captured at this location. MacDonell (1997) reported that historically, Kelsey Rapids (where Kelsey GS was built) and Witchai Lake Falls (in the Grass River) were identified as spawning areas by commercial sturgeon fishermen. However, to date, none of the fish captured in the vicinity of the Kelsey GS have displayed any sign of reproductive activity.

4.6.3 Nelson River between Birthday and Gull rapids

Since studies began in 2001, a substantial amount of data has been collected on lake sturgeon movements in the reach of the Nelson River between Birthday and Gull rapids. The following generalization is based on two years of gillnetting and acoustic and radio transmitter relocations. It appears as though sturgeon (both spawners and non-spawners) in this reach of the Nelson River are generally attracted to areas of higher water velocity during spring. Therefore, in most instances, lake sturgeon move upstream from overwintering areas to faster-flowing habitat during spring. For spawning fish, it appears as though they will move upstream to spawning areas likely located from Birthday Rapids to a point approximately 3 km downstream of the rapids. For non-spawning sturgeon, some appear to accompany the spawning fish up river to the spawning sites, however, data also suggest that some non-spawning sturgeon remain near the inlet to Gull Lake for the majority of the spring. Once spawning has been completed, and with the onset of summer, most lake sturgeon move downstream to deep, low water velocity habitat in Gull Lake. During summer, sturgeon are highly mobile, with individuals frequently moving between 1 and 20 km (in some cases more) between tracking runs. These movements are most likely associated with feeding. As fall approaches and water temperatures begin to cool, lake sturgeon move to deep, medium velocity habitat. An area of Gull Lake has been identified as an important overwintering location where many fish congregate.

Evidence that sturgeon move over both Birthday and Gull rapids was collected in 2001 and to date, data has indicated that five lake sturgeon have moved upstream of Birthday Rapids and three have moved upstream over Gull Rapids. Similarly, five lake sturgeon have moved downstream through Birthday Rapids and one has moved downstream through Gull Rapids.

4.6.4 Stephens Lake

For two consecutive years spawning lake sturgeon have been captured downstream of Gull Rapids during spring. The information gathered to date suggests that lake sturgeon move into Gull Rapids during spring once water temperatures are appropriate for spawning. During summer, relocations of the fish tagged with acoustic transmitters has suggested that some lake sturgeon remain at the base of the rapids throughout summer. During fall, lake sturgeon that were using the rapids during spring and summer appear to congregate near an island located approximately 3 km downstream of Gull Rapids. This area possesses similar depths and water velocities as the area in Gull Lake where sturgeon have also been found to congregate during fall.

5.0 GLOSSARY

Algae (a; al) − 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 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.

ASL − Above Sea Level.

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).

Basal pterygiophores – form the base of support for the dorsal and anal fin rays.

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 – a distinct section of a lake, separated from the remainder of the lake by a constriction.

Bog – 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, and pine.

Catch-per-unit-effort (CPUE) – the number or weight of fish caught in a given time period with a specific length of net.

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.

Debris – any material, including floating or submerged items (e.g., driftwood, plants), suspended ***sediment***, or bed load, moved by flowing water.

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

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.

Erosion – the wearing away of the Earth's surface by the action of water, wind, current, etc.

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.

Gamete – mature male or female reproductive cell (i.e., sperm, egg).

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.

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

Larva (ae; al) – the early, immature form of an animal when more or less of a ***metamorphosis*** takes place, before the assumption of the mature shape.

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

Metamorphosis – a change in the form or function of a living organism, by a natural process of growth or development.

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

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 − sub***soil*** 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.

Rapids – a section of shallow, fast moving water in a stream made turbulent by totally or partially submerged rocks.

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

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

Riffle – a shallow area of a stream where water flows swiftly over partially or completely submerged materials to produce surface agitation; generally of lower slope and ***velocity*** than ***rapids***.

Riparian – along the banks of rivers and streams.

Ripe – running male (M8) or female (F3) fish ready to spawn immediately.

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 – 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.

Spent – male (M9) or female (F4) fish that has just finished spawning.

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

Standard deviation (Std) – the square root of the variance of a collection of numbers.

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

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

Topography − a graphic representation of the surface features of a place or region on a map, indicating their relative positions and elevations.

Tributary (ies) – a river or stream flowing into a lake or a larger river or stream.

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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TABLES AND FIGURES

Table 1. Summary of start and completion dates, by gear type, for lake sturgeon investigations conducted at four locations in the Keeyask Study Area, 2002.

Location	Gear Type					
	Gill nets		Drift nets		Index gill nets	
	Start date	Completion date	Start date	Completion date	Start date	Completion date
Burntwood River*	05-Jun	18-Jul	25-Jun	18-Jul	-	-
Kelsey (GS)	08-Jun	10-Jul	-	-	-	-
Nelson River (BR-GR)*	07-Jun	15-Jul	26-Jun	20-Jul	04-Jul	14-Jul
	01-Oct	10-Oct	-	-	-	-
Stephens Lake*	12-Jun	15-Jul	27-Jun	20-Jul	-	-

GS = Generating Station
BR-GR = Birthday Rapids to Gull Rapids
*Gill nets were not fished between 17 and 21 June

Table 2. List of fish species captured during lake sturgeon gillnetting studies conducted at four locations in the Keeyask Study Area, 2002.

Common Name	Scientific Name	Abbreviation
Burbot	*Lota lota*	BURB
Carp	*Cyprinus carpio*	CARP
Freshwater drum	*Aplodinotus grunniens*	FRDR
Lake sturgeon	*Acipenser fulvescens*	LKST
Lake whitefish	*Coregonus clupeaformis*	LKWH
Longnose sucker	*Catostomus catostomus*	LNSC
Mooneye	*Hiodon tergisus*	MOON
Northern pike	*Esox lucius*	NRPK
Sauger	*Sander canadense*	SAUG
Walleye	*Sander vitreus*	WALL
White sucker	*Catostomus commersoni*	WHSC

Table 3. Number of fish that were captured in gill nets during lake sturgeon studies conducted in the Keeyask Study Area between 5 June and 18 July, 2002.

Species	Location				Total Captured
	Burntwood River	Kelsey (GS)	Nelson River (BR-GR)	Stephens Lake	
Burbot	1	-	1	-	**2**
Carp	2	-	-	1	**3**
Freshwater drum	1	10	1	1	**13**
Lake sturgeon	16*	5	67*	4	**92**
Lake whitefish	1	-	14	-	**15**
Longnose sucker	-	2	-	-	**2**
Mooneye	1	2	-	1	**4**
Northern pike	21	40	57	65	**183**
Sauger	-	1	1	4	**6**
Walleye	2	12	16	12	**42**
White sucker	2	1	1	1	**5**
Total	**47**	**73**	**158**	**89**	**367**

BR-GR = Birthday Rapids to Gull Rapids
* number includes all fish recaptured (i.e., tagged in previous years) but does not include fish captured more than once during the current year

Table 4. Catch-per-unit-effort (CPUE) (# lake sturgeon/45.8 m net/24 hours) at each of the four locations fished for lake sturgeon in the Keeyask Study Area during 2001 and 2002.

Location	Year	Season	Number of sites	*Total number lake sturgeon	Total gillnet hours	CPUE
Burntwood River	2001	spring	26	23	3950.03	0.14
	2002	spring	30	16	2048.26	0.19
Kelsey (GS)	2001	spring	44	13	5626.70	0.06
	2002	spring	26	5	3856.25	0.03
Nelson River (BR-GR)	2001	spring	37	60	4537.57	0.32
	2002	spring	19	59	4917.72	0.29
	2002	fall	7	3	700.99	0.10
Stephens Lake	2001	spring	18	24	6253.60	0.09
	2002	spring	15	4	3249.48	0.03

BR - GR = Birthday Rapids to Gull Rapids
*Excludes index gillnetting catches from the Nelson River between Birthday and Gull rapids

Table 5. Mean fork length, weight, and relative condition factor (K), by location for lake sturgeon captured in gill nets set in the Keeyask Study Area between 5 June and 18 July, 2002.

Location	Year	Fork Length (mm)				Weight (g)				K		
		n	Mean	Std	Range	n	Mean	Std	Range	n	Mean	Range
Burntwood River	2001	23	945	189	600-1436	22	6620	3279	1600-15600	22	0.76	0.46-1.04
	2002	15	982	173	644-1315	16	9227	5716	2200-22000	15	0.81	0.71-0.92
Kelsey GS	2001	13	940	198	692-1423	12	8334	6522	3200-26000	12	0.92	0.81-1.09
	2002	5	963	144	774-1130	5	9370	5549	4300-18500	5	0.97	0.77-1.28
Nelson River	2001	79*	1022	148	739-1355	78	9984	5059	3500-24000	78	0.88	0.64-1.26
(BR-GR)	2002	67*	1055	149	680-1415	66	12198	6367	2722-34020	66	0.97	0.73-1.44
Stephens Lake	2001	24	1077	181	792-1447	24	13148	9499	4400-40000	24	0.94	0.71-1.56
	2002	4	1045	51	1001-1100	4	10888	2995	8050-15000	4	0.94	0.80-1.13

Std - standard deviation
BR-GR = Birthday Rapids to Gull Rapids
* - Includes fish captured during index gillnetting

Table 6. Number of lake sturgeon identified as sexually mature during gillnetting studies conducted at four locations in the Keeyask Study Area, spring 2001 and 2002.

Location	Year	Sex	Total	Maturing to spawn	Ripe	Spent
Burntwood River	2001	Males	7	7	-	-
		Females	-	-	-	-
		Unknown	16	-	-	-
		Total	23	7	-	-
Burntwood River	2002	Males	4	3	-	1
		Females	-	-	-	-
		Unknown	12	-	-	-
		Total	16	3	-	1
Kelsey (GS)	2001	Males	-	-	-	-
		Females	-	-	-	-
		Unknown	13	-	-	-
		Total	13	-	-	-
Kelsey (GS)	2002	Males	-	-	-	-
		Females	-	-	-	-
		Unknown	5	-	-	-
		Total	5	-	-	-
Nelson River (BR-GR)	2001	Males	16	5	10	1
		Females	3	3	-	-
		Unknown	41	-	-	-
		Total	60	8	10	1
Nelson River (BR-GR)	2002	Males	14*	8	1	5
		Females	-	-	-	-
		Unknown	46	-	-	-
		Total	60*	8	1	5

Table 6. Continued.

Location	Year	Sex	Total	Maturing to spawn	Ripe	Spent
Stephens Lake	2001	Males	5	5	-	-
		Females	4	3	-	-
		Unknown	15	-	-	-
		Total	24	8	-	-
Stephens Lake	2002	Males	3	3	-	-
		Females	-	-	-	-
		Unknown	1	-	-	-
		Total	4	-	-	-

Fish captured during index gillnetting were not included in the totals
BR-GR=Birthday Rapids to Gull Rapids
*One fish was captured in a drift net

Table 7. Number of fish, by species and site, captured during lake sturgeon index gillnetting in the Nelson River between Birthday and Gull rapids, 2002.

Site	BURB[1]	FRDR	LKST	LKWH	NRPK	WALL	Total
1	-	-	-	-	-	-	-
2	-	-	4	-	1	-	5
3	-	-	-	-	1	-	1
4	-	-	-	4	-	-	4
5	-	-	-	-	-	1	1
6	-	-	-	-	-	-	-
7	-	-	-	-	-	1	1
8	-	-	-	-	-	-	-
9	-	-	-	1	1	2	4
10	-	-	-	-	-	-	0
11	-	-	1	3	1	2	7
12	-	-	-	-	-	-	-
13	-	-	-	-	3	-	3
14	-	-	-	-	-	-	-
15	-	-	1	-	1	-	2
16	-	-	-	-	-	-	-
17	-	1	-	-	-	1	2
18	-	-	-	-	1	-	1
19	-	-	1	-	-	1	2
20	1	-	1	-	1	-	3
Total	**1**	**1**	**8**	**8**	**10**	**8**	**36**

[1] See Table 2 for complete species names

Table 8. Site-specific catch-per-unit-effort (CPUE; #fish/45.8 m net/24 hr) summary for the 2002 lake sturgeon index gillnetting program conducted in the Nelson River between Birthday and Gull rapids.

Site	Replicate	Net pull date	Duration (hrs)	n	CPUE	Mean CPUE/site
1	1	10-Jul	21.42	0	0.00	0.00
	2	14-Jul	17.42	0	0.00	
2	1	10-Jul	21.00	0	0.00	2.34
	2	15-Jul	23.25	4	4.13	
3	1	10-Jul	21.33	0	0.00	0.00
	2	14-Jul	19.42	0	0.00	
4	1	10-Jul	21.92	0	0.00	0.00
	2	14-Jul	17.42	0	0.00	
5	1	10-Jul	21.42	0	0.00	0.00
	2	14-Jul	19.58	0	0.00	
6	1	09-Jul	21.00	0	0.00	0.00
	2	13-Jul	19.33	0	0.00	
7	1	09-Jul	21.17	0	0.00	0.00
	2	13-Jul	19.17	0	0.00	
8	1	09-Jul	21.17	0	0.00	0.00
	2	13-Jul	19.17	0	0.00	
9	1	09-Jul	21.08	0	0.00	0.00
	2	13-Jul	19.08	0	0.00	
10	1	09-Jul	21.17	0	0.00	0.00
	2	12-Jul	21.92	0	0.00	
11	1	08-Jul	26.50	0	0.00	0.50
	2	12-Jul	24.08	1	1.00	
12	1	08-Jul	22.83	0	0.00	0.00
	2	12-Jul	23.25	0	0.00	
13	1	08-Jul	23.08	0	0.00	0.00
	2	12-Jul	21.75	0	0.00	
14	1	08-Jul	22.75	0	0.00	0.00
	2	12-Jul	22.67	0	0.00	
15	1	08-Jul	21.25	1	1.13	0.56
	2	11-Jul	22.00	0	0.00	
16	1	07-Jul	27.17	0	0.00	0.00
	2	11-Jul	22.00	0	0.00	
17	1	05-Jul	25.17	0	0.00	0.00
	2	11-Jul	22.00	0	0.00	
18	1	05-Jul	25.08	0	0.00	0.00
	2	11-Jul	22.00	0	0.00	
19	1	05-Jul	25.08	0	0.00	0.26
	2	07-Jul	45.58	1	0.53	
20	1	05-Jul	25.00	1	0.96	0.48
	2	11-Jul	21.67	0	0.00	
Total			**899.35**	**8**	**0.21**	

n = number of fish captured at each site

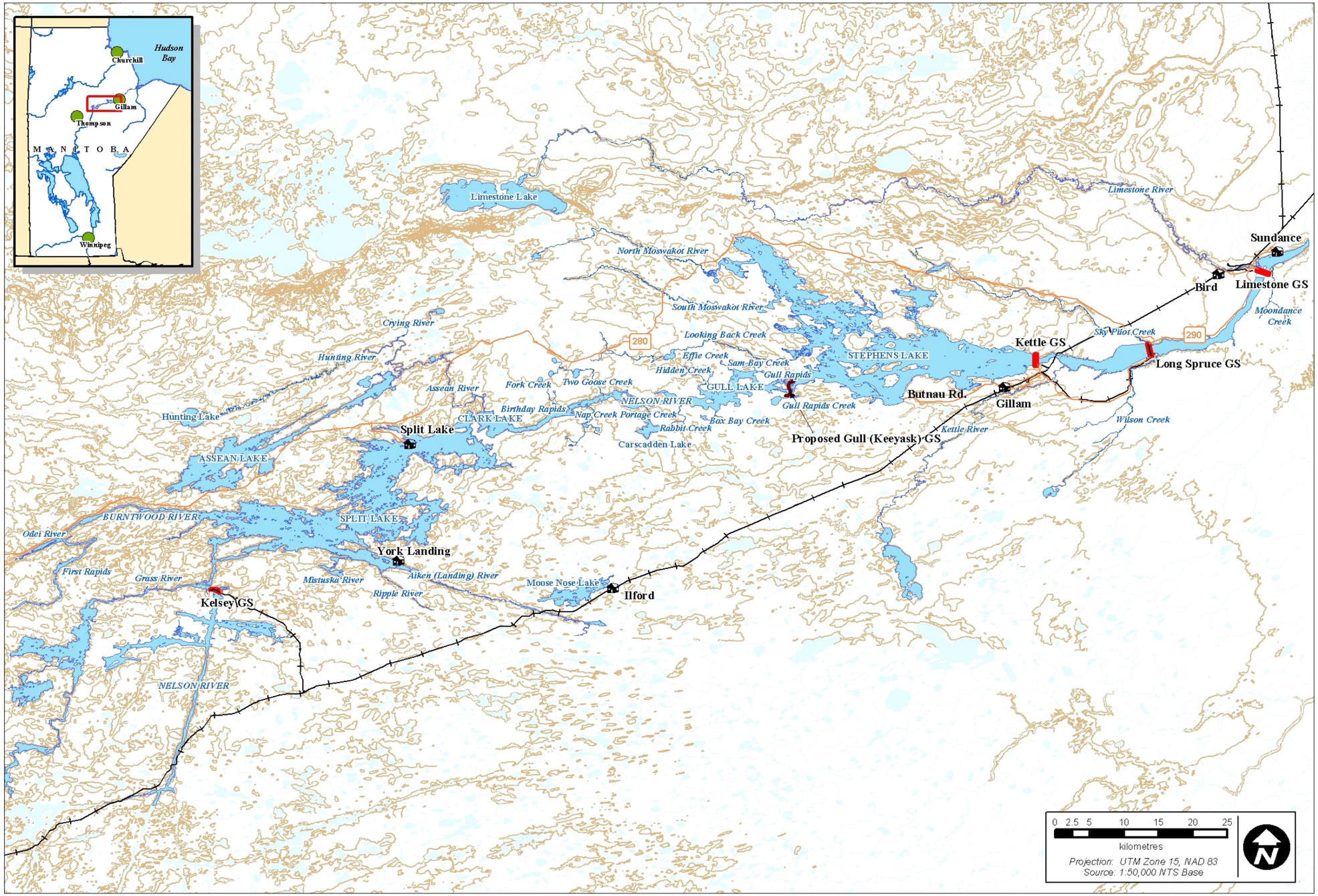

Figure 1. Map of the Keeyask Study Area showing proposed and existing hydroelectric development.

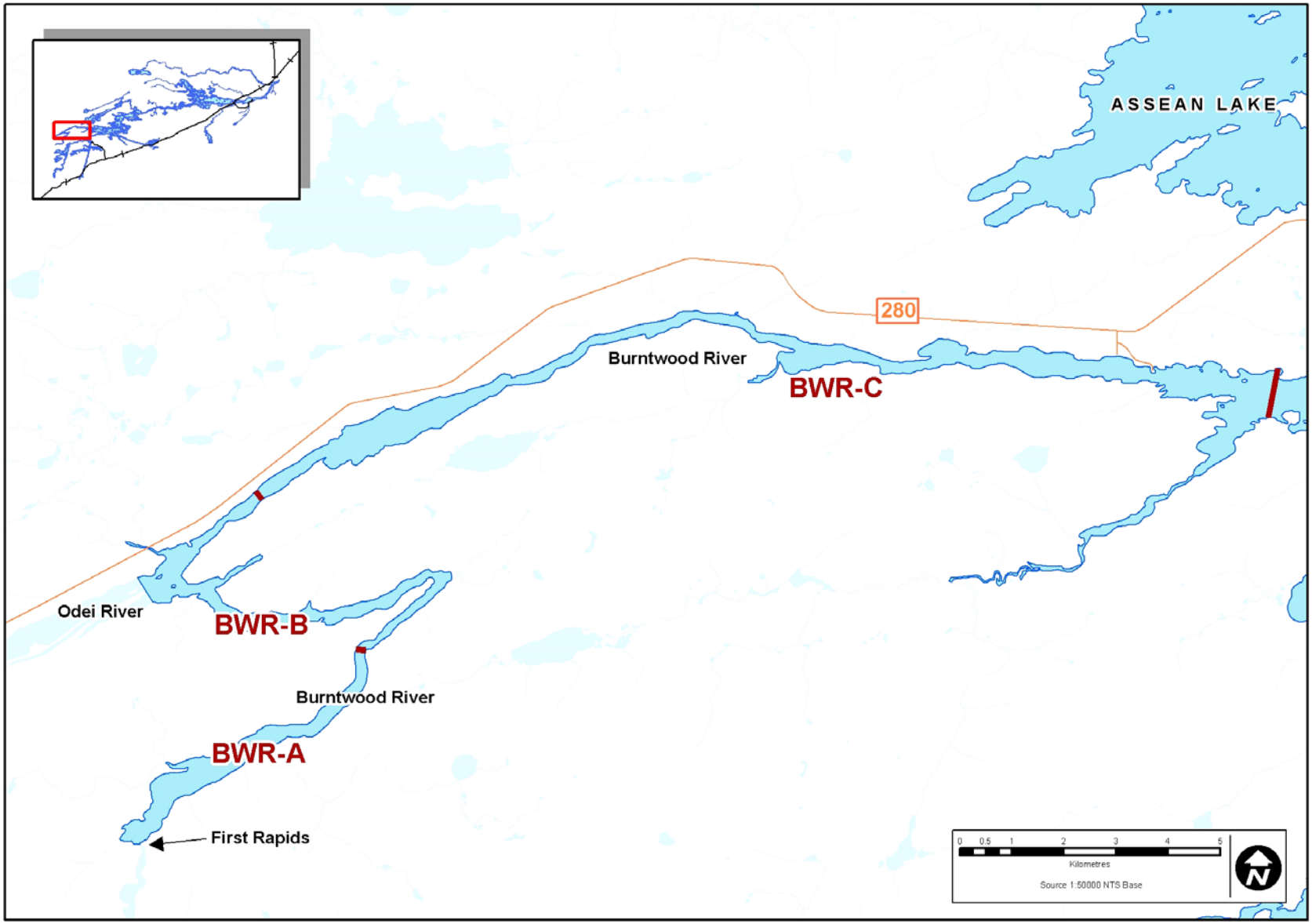

Figure 2. Map of the Burntwood River illustrating zones BWR-A, BWR-B, and BWR-C.

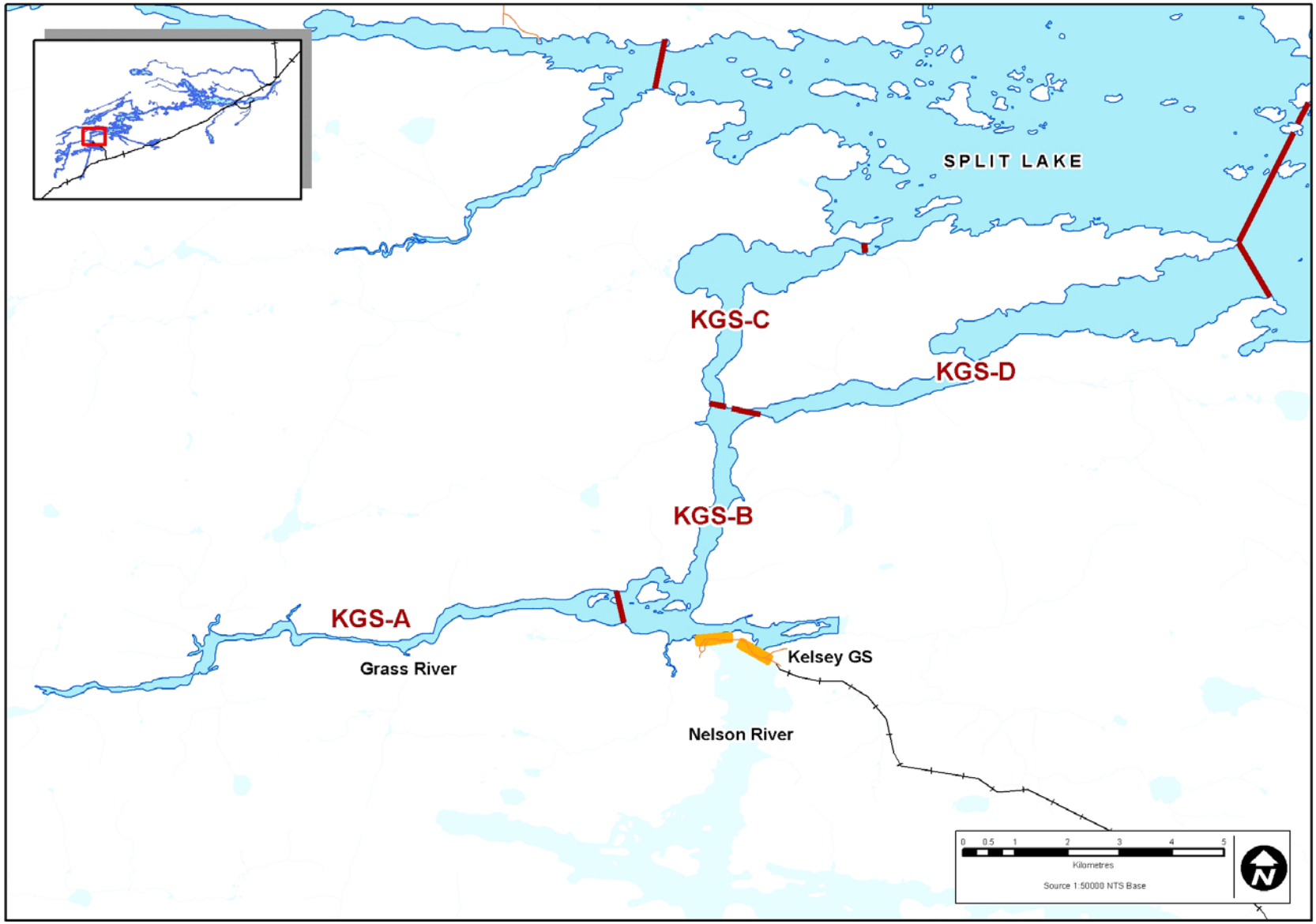

Figure 3. Map of the Nelson River and the Grass River in the vicinity of the Kelsey GS illustrating zones KGS-A to KGS-D.

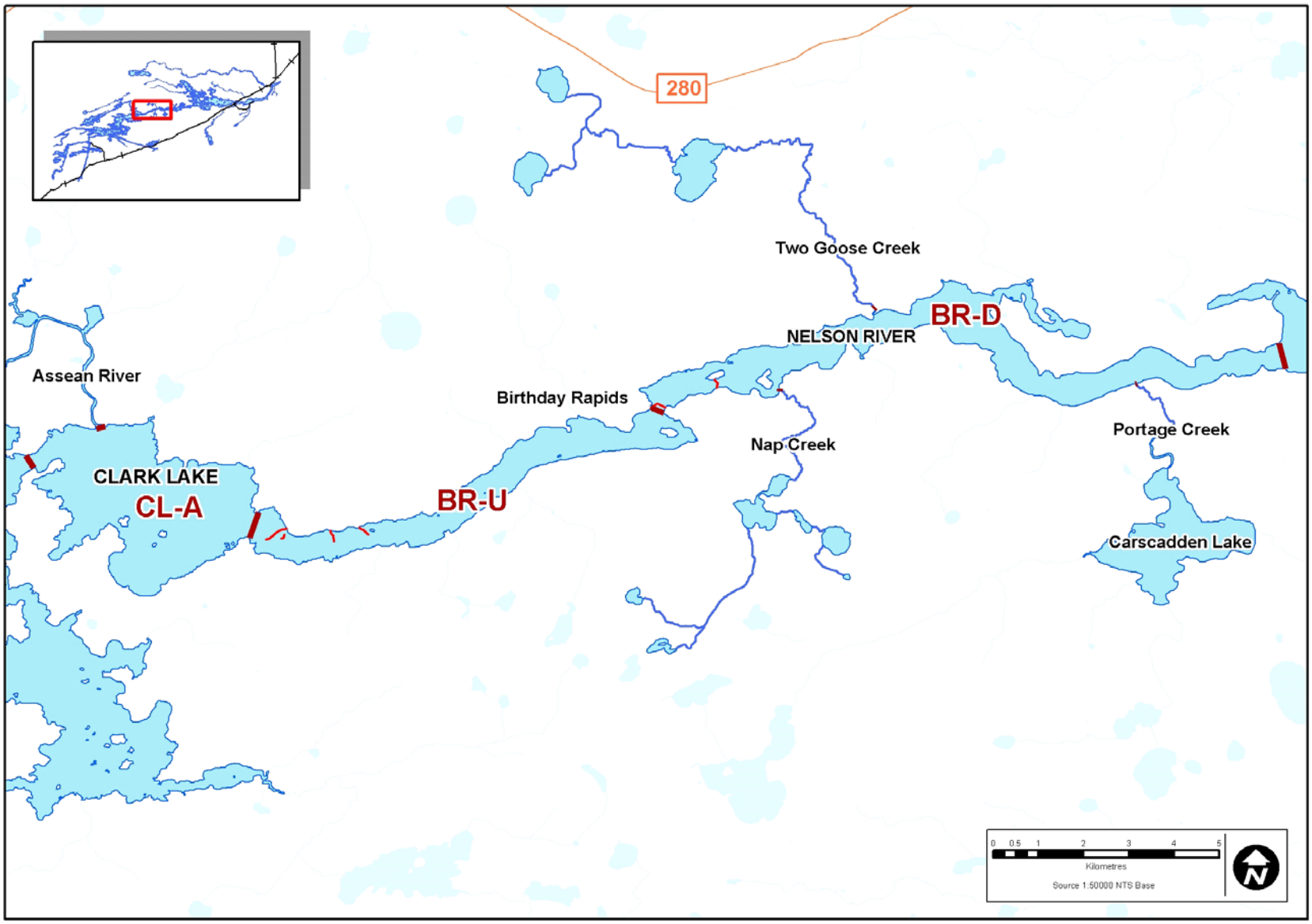

Figure 4. Map of the Nelson River and Clark Lake in the vicinity of Birthday Rapids illustrating zones CL-A, BR-U, and BR-D.

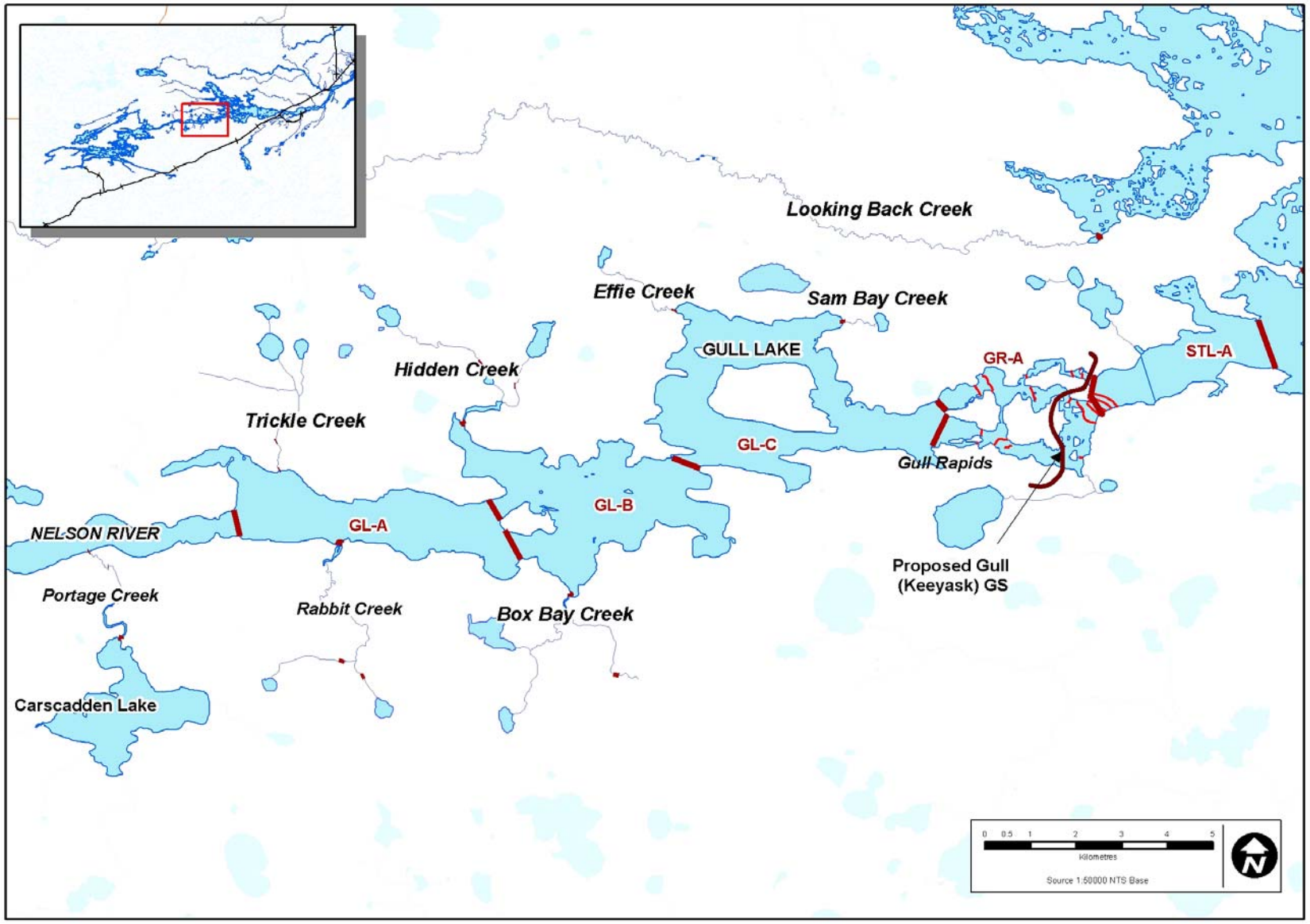

Figure 5. Map of Gull Lake illustrating zones GL-A, GL-B, and GL-C.