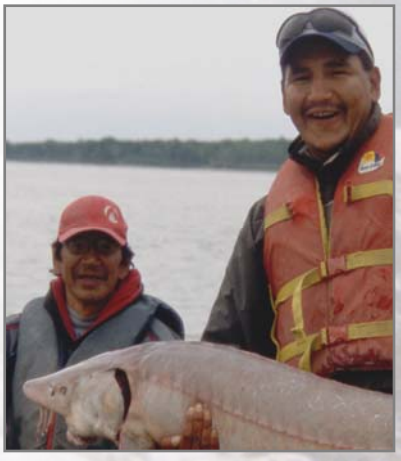
KEEYASK PROJECT

Generating Station

October 2005 Report # 03-08



Lake Sturgeon Investigations in the Keeyask Study Area, 2003

ENVIRONMENTAL STUDIES PROGRAM

KEEYASK PROJECT

Environmental Studies Program
Report # 03-08

LAKE STURGEON INVESTIGATIONS IN THE KEEYASK STUDY AREA, 2003

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 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 third year of lake sturgeon investigations in the Keeyask Study Area. The 2003 investigations were conducted in the Nelson River between the outlet of Clark Lake and upper Stephens Lake (i.e., within approximately 15 km of Gull Rapids). For the purposes of this report, data were analyzed separately for four areas: 1) the Nelson River between the outlet of Clark Lake and Birthday Rapids; 2) the Nelson River between Birthday and Gull rapids; 3) Gull Rapids; and 4) downstream of Gull Rapids (Stephens Lake). 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 sturgeon in 2001 continued to be monitored throughout 2003. Lake sturgeon investigations were also conducted in 2004 and and 2005 and are the subject of other 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 2003. For the purposes of this report, data were analyzed separately for four areas: 1) the Nelson River between the outlet of Clark Lake and Birthday Rapids; 2) the Nelson River between Birthday and Gull rapids; 3) Gull Rapids; and 4) Stephens Lake downstream of Gull Rapids.

Objectives common to all areas studied in 2003 included the following:

- to gain a better understanding of lake sturgeon biology;
- to identify lake sturgeon spawning areas;
- to better describe lake sturgeon abundance and habitat use;
- to identify any critical habitats; and
- to better understand the timing and spatial extent of lake sturgeon movements.

Lake sturgeon investigations were conducted in the Nelson River between the outlet of Clark Lake and upper Stephens Lake (approximately 15 km downstream of Gull Rapids) in 2003.

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

Gill nets were used to capture lake sturgeon at each location. Drift nets were used to sample lake sturgeon **larvae** and eggs in the Nelson River between Birthday Rapids and Stephens Lake.

Twelve sites were fished with gill nets between the outlet of Clark Lake and Birthday Rapids from 24 May to 1 July. Only one lake sturgeon was captured producing an overall **catch-per-unit-effort** (CPUE) of 0.02 lake sturgeon/45.8 m net/24 h, the lowest lake sturgeon CPUE by location recorded for lake sturgeon studies in the Keeyask Study Area during spring.

Thirty gillnetting sites were fished in the Nelson River between Birthday and Gull rapids from 24 May to 23 June. In total, 85 lake sturgeon were captured producing an overall CPUE of 0.27 lake sturgeon/45.8 m net/24 h. Only four of the sturgeon captured were identified as being in spawning condition. This number was substatially lower than numbers captured in 2001 and 2002, despite the fact that nearly 30% more sturgeon were captured in 2003. The reason that fewer lake sturgeon in spawning condition were captured in this reach of the Nelson River in 2003 is unknown.

Due to the low number of spawning fish captured, and because lake sturgeon eggs or larvae were not captured in drift nets, the 2003 data provides limited information on the identification of lake sturgeon spawning habitat in this reach of the Nelson River. However, three of the four lake sturgeon in spawning condition were captured approximately 2 km downstream of Birthday Rapids at a location where sturgeon in spawning condition were captured in 2002.

Nine gillnetting sites were fished in Gull Rapids between 1 and 29 June, 2003. In total, 10 lake sturgeon were captured, producing an overall CPUE of 0.13 lake sturgeon/45.8 m net/24 h. Between 16 and 24 June at water temperatures that ranged between 15.0ºC and 17.5ºC, eight lake sturgeon were captured, three of which were classified as spent males.

Twenty-nine gillnetting sites were fished downstream of Gull Rapids in Stephens Lake between 24 May and 18 July. In total, 24 lake sturgeon were captured, producing an overall CPUE of 0.06 lake sturgeon/45.8 m net/24 h. Similar to what was observed in the Nelson River between Birthday and Gull rapids, few sturgeon were identified as being in spawning condition in 2003. Eggs were expressed from one of these fish marking the first time eggs have been expressed from a female lake sturgeon in the Keeyask Study Area since studies began in 2001.

Four individual lake sturgeon tagged with acoustic transmitters moved over Birthday Rapids in 2003. Two of these fish moved upstream, while three moved downstream (one individual lake sturgeon moved both upstream and downstream). Similarly, two lake sturgeon moved over Gull Rapids. One Floy-tagged lake sturgeon (Floy-tag #46827) that was originally captured and tagged at the base of Gull Rapids in 2001 was recaptured approximately 1.5 km downstream of Birthday Rapids on 24 June, 2003. In addition, one radio-tagged lake sturgeon moved from Gull Lake, downstream through Gull Rapids, into Stephens Lake.

As in 2001 and 2002, lake sturgeon were found to congregate in an area of Gull Lake during fall. However, three of the fish that were relocated in this area during the two previous years were relocated further upstream in Gull Lake in 2003.

ACKNOWLEDGEMENTS

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

Chief and Council of Tataskweyak Cree Nation (TCN), Fox Lake Cree Nation (FLCN) and War Lake First Nation (WLFN) are gratefully acknowledged for their support of this program. We would also like to thank Douglas Kitchekeesik and Victor Spence of TCN, Ray Mayham of FLCN and Phillip Morris of WLFN for arranging logistic support and personnel needed to conduct the field work.

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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 #15-03.

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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** (hereafter referred to as the Project), should a decision be made to proceed with a licensing submission to **regulatory authorities**. Manitoba Hydro and the potential partners have established a cooperative approach to assessing the potential effects of the Project on the **environment** and for producing the information required for regulatory review and impact **monitoring**.

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

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

The following report describing the results of lake sturgeon (*Acipenser fulvescens*) investigations conducted in the Keeyask Study Area during 2003 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.

Baseline studies that focused primarily on lake sturgeon began in the Keeyask Study Area in 2001. These were the first of such studies conducted in the area, with the exception of a gillnetting study conducted in 1995 by Manitoba Conservation in Gull Lake that aimed at providing an initial estimate of the abundance, size, and age structure of the lake sturgeon population in the area. As such, when the 2001 studies began, very little biological information had been collected on lake sturgeon in the Study Area.

The 2001 and 2002 lake sturgeon studies were conducted in the Nelson River between Birthday Rapids and Stephens Lake (the area to be most affected by development of the Project at Keeyask) but also included the Burntwood River (downstream of First Rapids) and the Nelson and Grass rivers downstream of Kelsey GS; two areas that are outside of the anticipated water level effects of the proposed Keeyask development. The objectives of these studies were very broad, and among other objectives, focused on providing an indication of lake sturgeon abundance and on determining if, and where, lake sturgeon spawn in these areas.

Upon completion of the 2001 and 2002 studies, it was determined that several objectives had been realized in some of the areas studied (i.e., in the Burntwood River and in the vicinity of the Kelsey GS). Therefore, no further lake sturgeon investigations were planned in these areas in 2003. However, the previous studies also identified data gaps in areas that had not yet been studied under the Keeyask program (i.e., in Gull Rapids and in the Nelson River between Clark Lake and Birthday Rapids). As a result, these areas were included in 2003 investigations.

The following report presents information collected during lake sturgeon investigations conducted in the Keeyask Study Area during 2003. For the purposes of this report, data were analyzed separately for four areas: 1) the Nelson River between the outlet of Clark Lake and Birthday Rapids; 2) the Nelson River between Birthday and Gull rapids; 3) in Gull Rapids; and 4) in Stephens Lake downstream of Gull Rapids. 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 lake sturgeon abundance and habitat use;
- to identify any critical habitats; and
- to better understand the timing and spatial extent of lake sturgeon movements.

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, 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 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 distributed sproadically. 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 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, 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, is lacustrine in nature with moderate to low water velocity, and features 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, 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 had 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, 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

In 2003, lake sturgeon investigations were conducted in the Nelson River between the outlet of Clark Lake and upper Stephens Lake (i.e., within 15 km of Gull Rapids). For the purposes of this report, data are presented separately for the following locations: 1) the Nelson River between the outlet of Clark Lake and Birthday Rapids (Figure 2); 2) the Nelson River between Birthday Rapids and Gull Rapids (figures 2 and 3); 3) within Gull Rapids (Figure 3) and Stephens Lake (from the base of Gull Rapids to approximately 15 km downstream) (Figure 4). The studies were conducted using similar sampling methodologies and gear types as those employed during the 2001 and 2002 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 in the Nelson River between Birthday Rapids and Stephens Lake. A summary of the start and completion date of each sampling program is provided in Table 1.

3.1 PHYSICAL MONITORING

Water temperature of the Nelson River was measured (± 0.001°C) immediately downstream of Gull Rapids and in an off-current area of Gull Lake at 6.0 hour intervals with a HOBO Water Temperature Pro data logger. Data loggers were set approximately 1-2 m below the surface. Prior to deployment, the date, time, and recording interval was set using a desktop computer. Data loggers were set on 24 May and retrieved on 16 October. A third data logger had been set downstream of Birthday Rapids, but was lost prior to retrieval.

A comparison of temperature data from the logger set in Gull Lake to that set downstream of Gull Rapids indicated that the water temperatures (at similar time intervals) differed slightly between these two areas. Since the data logger in Gull Lake was set in an off-current area, the water temperature data from the data logger set downstream of Gull Rapids was considered to be a more accurate representation of water temperature in the Nelson River mainstem. A comparison between temperature data measured from loggers set at Birthday Rapids and at Gull Rapids in 2002, indicated that water temperatures seldom differed by more than 0.5ºC between these two locations at similar time intervals. It appears that the water temperature of the Nelson River mainstem differs only slightly between locations and therefore, the water temperature data recorded at Gull Rapids were used in all figures included in this report.

3.2 SAMPLING GEAR

3.2.1 Gill Nets

3.2.1.1 Nelson River between the outlet of Clark Lake and Birthday Rapids

Twelve sites in the Nelson River between the outlet of Clark Lake and Birthday Rapids were fished from 24 May to 1 July, 2003 (Table 1; Figure 5). Between two and four gillnet gangs, each consisting of two 22.9 m (25 yd) long, 2.5 m (2.7 yd) deep panels of 203 and 254 mm (8 and 10 inch) twisted nylon stretched mesh were used daily 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 the area. Gillnets were set in eddies or along current breaks to maximize capture efficiency.

3.2.1.2 Nelson River between Birthday Rapids and Gull Rapids

A total of 30 gillnetting sites were fished in the Nelson River between Birthday Rapids and Gull Rapids from 24 May to 23 June, 2003 (Table 1; Figure 6). Each gillnet gang consisted of two 22.9 m (25 yd) long, 2.5 m (2.7 yd) deep panels of any combination of 203, 228, 254, or 304 mm (8, 9, 10, or 12 inch) twisted nylon stretched mesh. Gill nets were checked approximately every 24 hours, weather permitting. Gillnetting sites were selected based on a) proximity to potential spawning areas; and b) locations known to yield high numbers of lake sturgeon based on previous sites fished during 2001 and 2002 investigations.

An additional three sites were fished in Gull Lake from 26 September to 2 October, 2003 (Table 1; Figure 7). Each gillnet gang consisted of two 22.9 m (25 yd) long, 2.5 m (2.7 yd) deep panels of 203 and 254 mm (8 and 10 inch) twisted nylon stretched mesh, which were checked approximately every 24 hours, weather permitting.

3.2.1.3 Gull Rapids

Nine gillnetting sites were fished in Gull Rapids from 1 to 29 June, 2003 (Table 1; Figure 8). 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 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, weather permitting. The relatively low water levels observed in 2003 made it possible to safely set gill nets within the rapids (previously deemed unsafe due to relatively high water levels and flows in 2001 and 2002). Because Gull Rapids is characterized by highly turbulent water, high water velocities, and hard substrates, gill nets were located behind islands or along current breaks to maximize their efficiency.

3.2.1.4 Stephens Lake

Twenty-nine gillnetting sites were fished downstream of Gull Rapids in Stephens Lake, from 24 May to 18 July, 2003 (Figure 9). 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 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 Gill Nets

A lake sturgeon index gillnetting program was conducted in the Nelson River between Birthday and Gull rapids from 25 June to 3 July, 2003, using the same sites, gear type, and sampling methodologies used during the 2001 and 2002 studies (Figure 10) (Barth and Mochnacz 2004 and Barth 2005). Twenty gillnetting sites were fished for two 24-hour periods. Four gillnet gangs consisiting of one 22.9 m (25 yd) long panel of 203 mm (8 inch) 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[1] and substrate composition and compaction were recorded at each site.

3.2.3 Drift Nets

Drift nets were set in the Nelson River between Birthday and Gull rapids, in Gull Rapids, and in Stephens Lake downstream of Gull Rapids between 10 June and 21 July, 2003 (Table 1). Drift nets were located in suspected lake sturgeon spawning areas to capture lake sturgeon eggs and larvae. In 2003, two types of drift nets were used: 1) bottom set drift nets[2] (set on the river bottom); and 2) floating set drift nets (set at the surface of the water).

3.2.3.1 Bottom Set Drift Nets

Bottom set drift nets consisted of a 3 m long, 954 µm Nitex screen bag with a 43 cm by 85 cm opening that tapered into a 9 cm diameter removable ABS pipe cod-end (Figure 11). 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 or deep water. For shallow water sets, each drift net frame was held in place

[1] 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).
[2] These were the same drift nets used during the 2001 and 2002 lake sturgeon investigations.

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 12). To retrieve the drift net, a boat was positioned near the floats and 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 the contents of the Nitex screen bag were washed towards the cod-end. The ABS cod-end container was emptied into a sample jar and was rinsed at least once before the drift net was reset.

3.2.3.2 Floating Drift Nets

Floating drift nets were used in 2003 to improve the chances of capturing larval lake sturgeon in the Nelson River. The floating drift nets were designed after D'Amours et al. (2001).

The drift nets were designed with two 1.83 m (6 ft) long by 15.24 cm (6 inch) diameter L-shaped ABS pontoons attached to each side of the opening of the drift net with sideline (Figure 13). The pontoons were attached to one another by two crossbars and the opening of the drift net was oriented perpendicular to the pontoons, with the cod-end floating freely at the far end. Pontoons were anchored to the river bottom using either a king anchor or a cinder block to ensure the nets remained in position. Similar to the sinking nets, the floating nets were positioned to face into the current. To retrieve the floating nets, the boat approached the crossbar at the anterior end of the pontoons. With the boat continuing to move forward toward the pontoons, study team members grabbed the crossbar and hauled both pontoons and the drift net into the bow of the boat. The sample was obtained as described in Section 3.2.3.1.

3.2.3.3 Drift Net Sampling

Weather permitting, all drift nets were emptied approximately every 24 hours. All drift samples were preserved in 10% formalin and shipped to the North/South Consultants Inc. laboratory in Winnipeg for processing. In Winnipeg, all samples were sieved using a 355 µm mesh, rinsed with water, and sorted under a magnifying lamp. Samples were stored in 70% ethanol if they could not be processed immediately after rinsing and sorting. Every sample was checked in its entirety for larval lake sturgeon and lake sturgeon eggs. All samples were retained at North/South Consultants Inc. in Winnipeg should further analysis be required.

3.2.3.4 Nelson River (between Birthday and Gull rapids)

Drift nets were set at 16 sites in the reach of the Nelson River between Birthday Rapids and Gull Rapids from 19 June to 21 July, 2003 (Figure 14). Of these, nine were bottom sets and seven were floating sets. Sites were selected based on suitable water velocity and proximity to potential lake sturgeon spawning areas.

3.2.3.5 Gull Rapids and Stephens Lake

Drift nets were set at 13 sites in, or at the base of, Gull Rapids between 10 June and 20 July, 2003 (Figure 15). Eight of the sites were bottom set drift nets, and five were floating set drift nets. Sites were selected based on suitable water velocity and proximity to potential lake sturgeon spawning areas.

3.3 LAKE STURGEON SAMPLING

All lake sturgeon captured in gill nets were enumerated, measured for fork length and total length (±1 mm), weighed (with a hand-held scale ± 1 pound; converted to kg for data analysis), 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 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 incidentally during lake sturgeon investigations were measured for fork length (±1 mm) and weight (± 25 g). Northern pike, walleye, and lake whitefish greater than 250 mm in fork length were marked with a Floy-tag before being released.

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 the transmitters were applied to lake sturgeon captured downstream of Gull Rapids, and 15 of the transmitters were applied to sturgeon captured in the Nelson River between Birthday Rapids and Gull Rapids. For a description of transmitter specifications, transmitter application, biological information and relocation positions in 2001 and 2002, refer to Barth and Mochnacz (2004) and Barth (2005), respectively. 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

As in 2002, eight stationary VR1 and two stationary VR2 submersible acoustic receivers manufactured by VEMCO LTD. were used during the 2003 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.

The stationary receivers were arranged in the Study Area as illustrated in Figure 16. The purpose of arranging the stationary receivers in this fashion was to monitor fish movements in relation to Birthday Rapids and Gull Rapids. Although the entire area upstream and downstream of Birthday and Gull rapids could not be monitored (due to 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 direction.

Each stationary receiver was deployed on 25 May. 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 17). 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 Rapids 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, most manual tracking was conducted on calm days at nine – 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). For relocation positions for lake sturgeon in 2001 and 2002, refer to Barth and Mochnacz (2004) and Barth (2005).

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. When a fish was located, tag number (tag frequency and code) and location were recorded.

3.5 DATA ANALYSIS

The maps provided in figures 2-4 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 length intervals (e.g., 1,000-1,049 mm) 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, 878 fish, comprising 11 fish species, were captured in gill nets during lake sturgeon studies conducted at four locations in the Keeyask Study Area between 24 May and 18 July, 2003 (tables 2 and 3). The greatest number of fish were captured in Stephens Lake (n=437), followed by the Nelson River between Birthday and Gull rapids (n=317), Gull Rapids (n=113), and the Nelson River between the outlet of Clark Lake and Birthday Rapids (n=11) (Table 3). Data collected during these studies pertaining to species other than lake sturgeon are discussed in separate reports: Bretecher and Dyck (2005) (fish captured in the Nelson River between Clark Lake and Gull Rapids); and Pisiak (2005) (fish captured in Gull Rapids and Stephens Lake).

One hundred and twenty-eight lake sturgeon were captured in gill nets set in the Keeyask Study Area during spring. The majority of these sturgeon were captured in the Nelson River between Birthday and Gull rapids (n=93), followed by Stephens Lake (n=24), in Gull Rapids (n=10), and in the Nelson River between Clark Lake and Birthday Rapids (n=1) (Table 3). No lake sturgeon were captured in the Nelson River between Birthday and Gull rapids during fall. The largest lake sturgeon was captured in the Nelson River between Birthday and Gull rapids and measured 1,740 mm in total length and weighed approximately 54 kg (Appendix 1). This was the largest fish captured in the Keeyask Study Area since studies began in 2001. The smallest lake sturgeon was captured in Stephens Lake on 8 June and measured 555 mm in fork length and weighed 1.7 kg (Appendix 1). Date of capture, biological information and Floy-tag information for all lake sturgeon captured during 2003 are presented in Appendix 1.

Three lake sturgeon were captured incidentally in the Study Area during other fisheries studies. One (Floy-tag #59519) was captured in a gill net set approximately 2 km downstream of Birthday Rapids on 3 October. The other two were captured in Stephens Lake on 4 and 19 September (Floy-tag #55557 and #52393). Date of capture, biological information, and Floy-tag information associated with these fish are presented in Appendix 1.

4.1 GILL NETS

4.1.1 Nelson River between the outlet of Clark Lake and Birthday Rapids

Twelve sites were fished with gill nets between the outlet of Clark Lake and Birthday Rapids from 24 May to 1 July, for a total of 1,465.60 hours (Table 4). Only one lake sturgeon was captured producing an overall CPUE of 0.02 lake sturgeon/45.8 m net/24 h, the lowest CPUE ever recorded for lake sturgeon studies in the Keeyask Study Area during spring (Table 4). This lake sturgeon was captured on 2 July, and measured 1,178 mm in fork length, and weighed 15.9 kg (Appendix 1). The fish displayed no signs of reproductive activity during the current year.

4.1.2 Nelson River between Birthday and Gull Rapids

4.1.2.1 Spring Gillnetting

In total, 93 lake sturgeon were captured in gill nets set in the Nelson River between Birthday Rapids and Gull Rapids during spring 2003. Of these, eight were captured during index gillnetting and are discussed separately in Section 4.2.

Thirty gillnetting sites were fished in the Nelson River between Birthday and Gull rapids from 24 May to 23 June for a total of 7,564.65 hours (Table 4). During this time, 85 lake sturgeon were captured, producing an overall CPUE of 0.27 lake sturgeon/45.8 m net/24 h, the highest lake sturgeon CPUE for lake sturgeon studies in the Keeyask Study Area in 2003 (Table 4). Most of the lake sturgeon were captured in Zone GL-C (n=44), followed by zones BR-D (n=23), GL-A (n=16) and GL-B (n=2) (Appendix 1; figures 2 and 3).

Mean fork length for all lake sturgeon captured (n=92[3]; including those captured during index gillnetting) was 1,067 mm (range: 700 - 1,540 mm), mean weight was 11,949 g (range: 3,000 - 54,431 g), and mean condition factor was 0.94 (range: 0.67 - 1.49) (Table 5). There was strong representation of the 950 - 999 mm and 1,100-1,149 mm length intervals (Figure 18). A weight-length regression for lake sturgeon captured in the Nelson River between Birthday and Gull rapids is provided in Appendix 2.

Gillnetting commenced on 24 May when the water temperature of the Nelson River measured 7.0ºC (Figure 19). At least one lake sturgeon was captured each day between 29 May and 20 June when water temperatures ranged between 10.0ºC and 17.6ºC. The catch peaked on 24 June when eight fish were captured.

[3] One lake sturgeon was not measured for fork length.

Of the 85 lake sturgeon captured in the Nelson River between Birthday and Gull rapids in 2003, only four could be classified as spawning fish (Table 6). Three of these fish were identified as males preparing to spawn, and the fourth was identified as a female preparing to spawn. The spawning males were captured on 1 June, 7 June, and 13 June, and the female was captured on 11 June.

The number of sturgeon identified in spawning condition in 2003 (n=4) was lower in comparison with the number of spawning sturgeon captured in this reach of the Nelson River in previous years (n=19 in 2001 and n=14 in 2002), despite the fact that nearly 30% more sturgeon were captured in 2003 (Table 6). Moreover, in previous years spawning male sturgeon were often captured on more than one occasion in any given year. These data suggest that that spawning male sturgeon are very active prior to spawning making them very susceptible to capture (Barth and Mochnacz 2004 and Barth 2005). The reason that fewer spawning lake sturgeon were captured in 2003 is unknown.

Due to the low number of fish captured that were identified in spawning condition, and because there were no lake sturgeon eggs or larvae captured in drift nets, the 2003 data provides limited information on the identification of lake sturgeon spawning sites in this area. However, two of the three spawning males, and the one spawning female lake sturgeon were captured approximately 2 km downstream of Birthday Rapids. Sturgeon in spawning condition were also captured at this location in 2002.

Of the 93 lake sturgeon captured in this reach of the Nelson River in 2003, 20 had been previously marked with a Floy-tag during either 2001 (n=10) or 2002 (n=10) studies resulting in a recapture rate of approximately 22% (Appendix 3)[4].

4.1.2.2 Fall Gillnetting

Three gillnetting sites were fished in Gull Lake between 26 September and 2 October, 2003, for a total of 479.80 hours (Table 4). There were no lake sturgeon captured during this study (Table 4). Biological and Floy-tag information associated with the fish captured during the fall gillnetting study are included in Bretecher and Dyck (2005).

[4] One of the lake sturgeon originally tagged in 1995 (SLRMB #1100) was also captured in 2001 and was counted as a fish "marked" in 2001.

4.1.3 Gull Rapids

Nine gillnetting sites were fished in Gull Rapids between 1 and 29 June, 2003, for a total of 1,868.74 gillnet hours (Table 4). In total, 10 lake sturgeon were captured producing an overall CPUE of 0.13 lake sturgeon/45.8 m net/24 h.

Lake sturgeon captured in Gull Rapids had a mean fork length of 1,120 mm (range: 931-1,339 mm), a mean weight of 12,853 g (range: 6,750-22,000 g), and a mean condition factor of 0.87 (range 0.81-0.99) (Table 5). Generally, all the lake sturgeon captured in this area were large, with the majority (60%) of the fish measuring over 1,100 mm (fork length) (Figure 20). A weight-length regression for lake sturgeon captured in Gull Rapids is provided in Appendix 2.

Gillnetting was initiated in Gull Rapids on 1 June when the water temperature of the Nelson River measured 11.3ºC. The first lake sturgeon was captured four days later when the water temperature measured 12.8ºC (Figure 21). This lake sturgeon was classified as a male preparing to spawn. A second lake sturgeon was not captured in this area until 14 June. By this time, the water temperature had warmed to 15.0ºC. Between 16 and 24 June at water temperatures that ranged between 15.0ºC and 17.5ºC, eight lake sturgeon were captured, three of which were classified as spent males (Appendix 1; Table 6).

Of the 10 lake sturgeon captured in Gull Rapids, six had been previously marked with a Floy-tag. One fish (Floy-tag #47183) was originally captured and tagged in Gull Lake in 2001. The other five were originally captured and tagged downstream of Gull Rapids (four in 2001 and one in 2002) (Appendix 3).

4.1.4 Stephens Lake

Twenty-nine gillnetting sites were fished in Stephens Lake downstream of Gull Rapids between 24 May and 18 July for a total of 9,638.07 gillnet hours (Table 4). In total, 24 lake sturgeon were captured, producing an overall CPUE of 0.06 lake sturgeon/45.8 m net/24 h. Seventeen of the lake sturgeon were captured in Zone STL-A and seven were captured in STL-B (Figure 4).

Lake sturgeon captured in Stephens Lake had a mean fork length of 1,018 mm (range: 555-1,340 mm), a mean weight of 11,212 g (range: 1,700 – 26,000), and a mean condition factor of 0.90 (range 0.61-1.20) (Table 5). The length-frequency histogram for the catch is provided in Figure 22. The modal length interval was 1,000 – 1,049 mm. A weight-length regression equation for lake sturgeon captured in Stephens Lake is provided in Appendix 2.

Gillnetting was initiated downstream of Gull Rapids on 24 May when the water temperature measured 7.0ºC (Figure 23). The first lake sturgeon was not captured until 30 May when the water temperature measured 10.1ºC. Two lake sturgeon that were classified as males preparing to spawn were captured on 1 and 6 June. A female, from which eggs were expressed, was captured at the base of the rapids on 10 June when the water temperature measured 13.6ºC (Table 6; Figure 23). The daily catch peaked on 25 June when three lake sturgeon were captured. Another female lake sturgeon (Floy-tag #49040) was also captured on 10 June. This fish was originally captured during fall 2001 and was identified as a female when implanting an acoustic transmitter. Upon recapture in 2003 it could not be determined if this fish was in spawning condition.

This was the first year that attempts were made to capture lake sturgeon in Stephens Lake at distances greater than 5 km downstream from Gull Rapids. Gill nets set between 10 and 15 km from the base of the rapids captured seven sturgeon. These data indicate that at least some lake sturgeon utilize low velocity habitats in Stephens Lake. Although three years of information has been collected from the base of the rapids, not much is known about the abundance of lake sturgeon that may exist in Stephens Lake.

Four fish that had been Floy-tagged previously in 2001 or 2002 were recaptured downstream of Gull Rapids in 2003. Lake sturgeon with Floy-tag #49040 and Floy-tag #49041 were originally captured in Stephens Lake during fall 2001, at which time they were tagged with acoustic transmitters (AT #33 and AT #32, respectively). Another sturgeon (Floy-tag #46856) was originally tagged downstream of Gull Rapids during spring 2001. The fourth recaptured sturgeon (Floy-tag #47183) was originally tagged in Gull Lake during 2001 and was subsequently captured twice in 2003, once on 30 May downstream of Gull Rapids and again on 16 June within Gull Rapids (Appendix 3).

4.2 INDEX GILLNETTING

Fourty-two fish were captured during the index gillnetting program conducted at 20 sites in the Nelson River between Birthday Rapids and Gull Rapids in 2003 (Figure 10). Northern pike (*Esox lucius*) (n=16) was the most frequently captured species, composing 38.0% of the total catch. The next most numerous species were lake whitefish (*Coregonus clupeaformis*) (n=10), lake sturgeon (n=8), walleye (*Sander vitreus*) (n=5), and sauger (*Sander canadensis*) (n=3) (Table 7). Two of the lake sturgeon (Floy-tag #47084 and Floy-tag #47108) were originally captured during 2001 sturgeon investigations and one (Floy-tag #48596) was originally tagged during the 2002 investigation (Appendix 1). The mean CPUE for the lake sturgeon catch was 0.20 lake sturgeon/45.8 m net/24 h, with site-specific values ranging from zero at several sites to 1.55 at Site 13 (Table 8). Biological information for all sturgeon

captured during index gillnetting in the Nelson River between Birthday Rapids and Gull Rapids is provided in Appendix 1. Biological information for fish species other than lake sturgeon captured during index gillnetting are provided in Bretecher and Dyck (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 Nelson River between Birthday Rapids and Gull Rapids

Sixteen drift nets (seven floating and nine bottom set) were set in the Nelson River between Birthday and Gull rapids between 19 June and 21 July, 2003, for a total of 9,461.47 hours (Table 9). Larval lake sturgeon were not captured in 2003 and have not been captured in drift nets set in this area since studies began in 2001. Data collected from larval drift nets set within this reach of the river are presented in Bretecher and Dyck (2005) and Juliano et al. (2005).

4.3.2 Gull Rapids and Stephens Lake

Thirteen drift nets (five floating and eight bottom set) were set in the Nelson River within Gull Rapids and downstream of the rapids in Stephens Lake between 10 June and 20 July, 2003, for a total of 8,763.40 hours (Table 10). Larval lake sturgeon were not captured in drift nets set in and below Gull Rapids in 2003 and have never been captured in this area. The data collected from these drift nets is presented in Juliano et al. (2005) and 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 6 radio) were applied to lake sturgeon in the Nelson River between Birthday Rapids and Gull Rapids, and 11 (6 radio and 5 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 tagged in 2001 are provided in Barth and Mochnacz (2004). Prior to 1 January, 2004, five acoustic transmitters (AT #31, AT #34, AT #37, AT #41, AT #46) and one radio-transmitter were returned to North/South Consultants by local fishers[5], representing a fishing mortality rate of 25% for the acoustic tagged fish and 8% for radio tagged fish. A complete summary of tag status is provided in Appendix 5. Relocations of lake sturgeon from 1 May, 2002, to 3 April, 2003, are provided in Barth (2005). Relocations

[5] AC#31 was returned to North/South Consultants in 2001 and reapplied to a lake sturgeon in Stephens Lake later that year.

of lake sturgeon from 4 April, 2003, to 15 October, 2003, are provided on maps in Appendix 6.

4.5 LAKE STURGEON MOVEMENTS 2003

The following section provides a summary of movements observed in 2003 based on results from gillnetting, Floy-tag recaptures, drift nets, and telemetry.

4.5.1 Nelson River between Clark Lake and Birthday Rapids

This was the first year that lake sturgeon studies have been conducted in the Nelson River between Clark Lake and Birthday Rapids. Since only one lake sturgeon was captured in this area, very little is known about lake sturgeon abundance or movements in this reach of the Nelson River.

4.5.2 Nelson River between Birthday Rapids and Gull Rapids

4.5.2.1 Seasonal Movements

Eight sturgeon (AT #38, AT #40, AT #41, AT #43, AT #44, AT #47, AT #50, and RT #149.720 Code 2) that were tagged with either radio or acoustic transmitters were relocated on at least one day at the inlet to Gull Lake between 23 May and 3 June, at water temperatures that ranged between 6.0ºC and 12.4ºC (Figure 19). Of these, half (AT #41, AT #43, AT #47 and RT #149.720 Code 2) subsequently moved upstream in the Nelson River and were relocated within approximately 5 km of Birthday Rapids in early June. Three of these fish (AT #41, AT #43 and AT #47) were relocated in the same area, approximately 2.5 km downstream of Birthday Rapids, on 5 June (Appendix 6). The lake sturgeon with acoustic code #41 was subsequently recaptured in a gill net on 7 June, at which time it was classified as a male preparing to spawn in 2003. Although all of these fish moved to within 5 km of the rapids, none had moved as far upstream as the base of Birthday Rapids (i.e., were not relocated by the stationary receivers at the base of the rapids).

By the beginning of July, most of the fish that had moved upstream either to the inlet of Gull Lake or further upstream to within a few kilometers of Birthday Rapids had moved downstream into Gull Lake. As in previous years, lake sturgeon were highly mobile in July, August, and September, making several localized movements within Gull Lake. Specifically, two lake sturgeon moved considerable distances during this time. In the four days between 31 July and 3 August, AT #49 moved approximately 40 km from just upstream of Gull Rapids to, and over, Birthday Rapids. Similarly, AT #40 made the same movement over a three day period between 6 and 9 August. The reason for these two fish to make the same

movement, at the same time, is unknown. Movements from Gull Lake upstream to, and over, Birthday Rapids during summer were not observed during the previous two years of monitoring.

As in previous years, lake sturgeon with transmitters were found to congregate in Gull Lake during October. Five lake sturgeon (AT #36, AT #38, AT #42, AT #47 and AT #48) were relocated in this area in early October 2003. An additional three fish (AT #43, AT #44, and AT #50) were relocated approximately 4 km upstream of this location in Gull Lake.

4.5.2.2 Movements over Birthday Rapids

Four individual lake sturgeon tagged with acoustic transmitters moved either upstream or downstream over Birthday Rapids in 2003. Two fish (AT #40 and AT #49) moved upstream over Birthday Rapids, and three (AT #45, AT #48 and AT #40) moved downstream over Birthday Rapids. Interestingly, two of these fish (AT #45 and AT #48) first moved upstream over Birthday Rapids in 2001, were not relocated in 2002, and moved back downstream over Birthday Rapids on 25 July and 26 August, 2003, respectively. Also, one of the lake sturgeon (AT #40) moved upstream over Birthday Rapids on 9 August, and moved back downstream of Birthday Rapids on 7 September. This fish was later relocated in Gull Lake on 22 September.

4.5.2.3 Movement Summary

Barth (2005) suggested that during spring, lake sturgeon (both spawners and non-spawners) in this reach of the Nelson River are generally attracted to areas of higher water velocity. Therefore, in most instances, lake sturgeon move upstream from overwintering areas to areas near fast-flowing water (i.e., the inlet to Gull Lake). Spawning fish appear to move upstream to potential spawning areas located within 3 km of Birthday Rapids. While some non-spawning sturgeon appear to accompany spawning fish upstream to the spawning sites, the data showed that others remained 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 in the area move downstream to deep, low velocity habitats (e.g., Gull Lake). During summer, relocation data indicated that sturgeon made frequent localized movements often moving distances between 1 and 20 km (or more). These movements are most likely associated with feeding. At the end of summer when water temperatures begin to cool, lake sturgeon move to deep, medium velocity habitats. An area of Gull Lake has been identified as a potential overwintering location where many lake sturgeon congregate (Barth 2005).

The data collected in 2003 further supports these generalized sturgeon movement patterns in this reach of the Nelson River. However, some movements were observed in 2003 that differed from what had been observed in previous years. For example, two sturgeon moved 40 km upstream over Birthday Rapids in August within three days of each other. One factor that may have influenced lake sturgeon movements in 2003 was the water levels of the Nelson River, which were relatively low when compared to the 2001 and 2002 water levels (Appendix 7).

4.5.3 Gull Rapids

Data collected in 2001 and 2002 indicated that lake sturgeon pass both upstream and downstream through Gull Rapids. However, prior to 2003, data had not been collected within Gull Rapids, therefore it was unknown how abundant lake sturgeon were within the rapids, or the extent to which lake sturgeon utilize the rapids for spawning or feeding. The relatively low water levels in 2003 facilitated gillnetting within the rapids to attempt to address these questions.

Barth and Mochnacz (2004) suggested that lake sturgeon may stage downstream of Gull Rapids during early spring and move into the rapids once water temperatures become appropriate for spawning (11.0ºC – 17.0ºC) (Scott and Crossman 1998). One sturgeon (Floy-tag #47183) that was originally tagged in Gull Lake in 2001, was first recaptured downstream of Gull Rapids on 30 May, 2003, when the water temperature measured 10.1ºC. This fish was subsequently recaptured within Gull Rapids 17 days later (16 June) when the water temperature had reached 16ºC (Figure 21). Between 1 and 12 June, when the water temperature ranged between 11.3ºC and 14.8ºC, only one lake sturgeon was captured in Gull Rapids. The majority of the sturgeon (n=9) were captured in Gull Rapids between 14 and 24 June, when water temperatures ranged between 15.0ºC and 17.6ºC. These data suggest that lake sturgeon move into Gull Rapids once water temperatures are within their preferred spawning temperature. Two lake sturgeon tagged with radio transmitters (RT #149.620 Code 1 and RT #149.560 Code 2) were also relocated within the rapids on 8 and 15 June, at the time that lake sturgeon may have been spawning in the area (Appendix 6).

Although a spawning area was not positively identified, the capture of three spent male lake sturgeon between 16 and 20 June suggests that lake sturgeon spawn somewhere within the rapids (Table 6).

The June gillnet catch data from within Gull Rapids and the relocation of two lake sturgeon tagged with radio transmitters (RT #149.560 Code 2 and RT #149.620 Code 1) within, or in the vicinity of, the rapids on several occasions in May, June, July, and August suggest that

lake sturgeon also feed within the rapids. One sturgeon (RT#149.620 Code 1) moved frequently between the base of the rapids and into the rapids on multiple occasions during summer.

4.5.4 Stephens Lake

4.5.4.1 Seasonal Movements

As mentioned in Section 4.5.3, movement data suggests that lake sturgeon may move from the base of Gull Rapids into the rapids to spawn and to feed. In 2003, two males and one female (from which eggs were expressed) were captured at the base of Gull Rapids (Table 6). The capture of this ripe female is significant as it suggests that it was preparing to spawn nearby.

For the third consecutive year, data indicate that lake sturgeon may remain at the base of Gull Rapids for extended periods. Three fish tagged with acoustic transmitters were frequently relocated by the stationary receivers downstream of Gull Rapids in 2003 (e.g., AT #31b [July, August, September and October – 78 days detected], AT #32 [May, June, July, August, September and October – 88 days detected], and AT #33 [May and June – 29 days detected]) (Appendix 6). Two sturgeon (AT #32 and AT #33) were recaptured in gill nets set below the rapids in spring. It is unknown if these fish moved into the rapids because there is no way to relocate acoustic transmitters within the rapids.

4.5.4.2 Movements Over Gull Rapids

In 2002, three lake sturgeon moved upstream over Gull Rapids. In 2003, it was determined that one Floy-tagged lake sturgeon (Floy-tag #46827) had moved upstream over Gull Rapids. This fish was originally captured and tagged at the base of Gull Rapids in 2001 and was recaptured approximately 1.5 km downstream of Birthday Rapids on 24 June, 2003; a distance of 39 km from the original tagging location. In addition, one lake sturgeon (RT #149.620 Code 1) moved from Gull Lake through Gull Rapids into Stephens Lake in 2003.

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

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

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

ASL − Above sea level.

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.

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, 2003.

Location	Gear Type					
	Gill nets		Drift nets		Index gill nets	
	Start date	Completion date	Start date	Completion date	Start date	Completion date
Nelson River (CL-BR)	24-May	01-Jul	-	-	-	-
Nelson River (BR-GR)	24-May	23-Jun	19-Jun	21-Jul	25-Jun	03-Jul
	26-Sep	02-Oct	-	-	-	-
Gull Rapids	01-Jun	29-Jun	10-Jun	19-Jul	-	-
Stephens Lake	24-May	18-Jul	27-Jun	20-Jul	-	-

CL-BR = Outlet of Clark Lake to Birthday Rapids
BR-GR = Birthday Rapids to Gull Rapids

Table 2. List of fish species captured during lake sturgeon gillnetting studies conducted at four locations in the Keeyask Study Area, 2003.

Common Name	Scientific Name	Abbreviation
Burbot	*Lota lota*	BURB
Common 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 canadensis*	SAUG
Walleye	*Sander vitreus*	WALL
White sucker	*Catostomus commersoni*	WHSC

Table 3. Number of fish, by species and sampling location, that were captured in gill nets during lake sturgeon studies conducted in the Keeyask Study Area between 24 May and 18 July, 2003.

Species	Nelson River (CL-BR)	Nelson River (BR-GR)	Gull Rapids	Stephens Lake	Total Captured
Burbot	-	2	-	1	**3**
Carp	-	-	-	2	**2**
Freshwater drum	-	2	-	48	**50**
Lake sturgeon*	1	93	10	24	**128**
Lake whitefish	-	18	1	7	**26**
Longnose sucker	-	-	7	1	**8**
Mooneye	-	1	7	-	**8**
Northern pike	10	155	29	178	**372**
Sauger	-	5	-	123	**128**
Walleye	-	41	14	53	**108**
White sucker	-	-	45	-	**45**
Total	**11**	**317**	**113**	**437**	**878**

BR-GR = Birthday Rapids to Gull Rapids
CL-BR = outlet of Clark Lake to Birthday Rapids
* - includes previous year recaptures - but not current year recaptures

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, 2001-2003.

Location	Year	Season	Number of sites	Total number of lake sturgeon	Duration (h)	CPUE (# of LKST/45.8 m/24 hours)
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 (CL-BR)	**2003**	**spring**	**12**	**1**	**1465.60**	**0.02**
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
	2003	**spring**	**30**	**85**	**7564.65**	**0.27**
	2003	**fall**	**3**	**0**	**479.80**	**0.00**
Gull Rapids	**2003**	**spring**	**9**	**10**	**1868.74**	**0.13**
Stephens Lake	2001	spring	18	24	6253.60	0.09
	2002	spring	15	4	3249.48	0.03
	2003	**spring**	**29**	**24**	**9638.07**	**0.06**

BR - GR = Birthday Rapids to Gull Rapids
CL - BR = outlet of Clark Lake to Birthday Rapids
GS = Generating Station
LKST = lake sturgeon
*Excludes index gillnetting catches

Table 5. Mean fork length, weight, and relative condition factor (K), by location, for lake sturgeon captured in gill nets in the Keeyask Study Area between 24 May and 18 July, 2003.

Location	Year	Fork Length (mm)				Weight (g)				K			
		n	Mean	Std	Range	n	Mean	Std	Range	n	Mean	Std	Range
Burntwood River	2001	23	945	189	600-1436	22	6620	3279	1600-15600	22	0.76	0.16	0.46-1.04
	2002	15	982	173	644-1315	16	9227	5716	2200-22000	15	0.81	0.06	0.71-0.92
Kelsey GS	2001	13	940	198	692-1423	12	8334	6522	3200-26000	12	0.92	0.20	0.81-1.09
	2002	5	963	144	774-1130	5	9370	5549	4300-18500	5	0.97	0.20	0.77-1.28
Nelson River (CL-BR)	2003	1	1178	-	-	1	15876	-	-	1	0.97	-	-
Nelson River (BR-GR)	2001	79	1022	148	739-1355	78	9984	5059	3500-24000	78	0.88	0.17	0.64-1.26
	2002	67	1055	149	680-1415	66	12198	6367	2722-34020	66	0.97	0.23	0.73-1.44
	2003	92*	1067	148	700-1540	87	11949	6681	3000-54431	87	0.94	0.13	0.67-1.49
Gull Rapids	2003	10	1120	150	931-1339	10	12853	5437	6750-22000	10	0.87	0.07	0.81-0.99
Stephens Lake	2001	24	1077	181	792-1447	24	13148	9499	4400-40000	24	0.94	0.15	0.71-1.56
	2002	4	1045	51	1001-1100	4	10888	2995	8050-15000	4	0.94	0.14	0.80-1.13
	2003	24	1018	206	555-1340	23	11212	7205	1700-26000	23	0.90	0.16	0.61-1.20

Std - standard deviation
BR-GR = Birthday Rapids to Gull Rapids
CL-BR = outlet of Clark Lake to Birthday Rapids
* Includes index gillnetting results

Table 6. Number of lake sturgeon classified as sexually mature captured during lake sturgeon studies (excluding index gillnetting) conducted in the Keeyask Study Area, 2001 - 2003.

Location	Year	Map Areas	Sex						# Spawning Per Year	Unknown	Total Captured
			Male			Female					
			MS	R	SP	MS	R	SP			
Burntwood R.	2001	BWR(A-D)	7	-	-	-	-	-	7	16	23
	2002	BWR(A-D)	3	-	1	-	-	-	4	12	16
Kelsey GS	2001	KGS(A-D)	-	-	-	-	-	-	0	13	13
	2002	KGS(A-D)	-	-	-	-	-	-	0	5	5
Nelson River (CL-BR)	**2003**	**BR-U**	**-**	**-**	**-**	**-**	**-**	**-**	**0**	**1**	**1**
Nelson River (BR-GR)	2001	BR-D, GL(A-C)	5	10	1	3	-	-	19	41	60
	2002*	BR-D, GL(A-C)	8	1	5	-	-	-	14	46	60
	2003	**BR-D, GL(A-C)**	**3**	**-**	**-**	**1**	**-**	**-**	**4**	**81**	**85**
Gull Rapids	**2003**	**GR-A**	**1**	**-**	**3**	**-**	**-**	**-**	**4**	**6**	**10**
Stephens Lake	2001	STL(A-E)	5	-	-	3	-	-	8	16	24
	2002	STL(A-E)	3	-	-	-	-	-	3	1	4
	2003	**STL(A-E)**	**2**	**-**	**-**	**1**	**-**	**-**	**3**	**21**	**24**
Total			**37**	**11**	**10**	**8**	**-**	**-**	**66**	**259**	**325**

* - Includes one sturgeon captured in a drift net
MS = Maturing to spawn
R = Ripe
SP = Spent

Table 7. Number of fish, by species and site, captured during index gillnetting in the Nelson River between Birthday Rapids and Gull Rapids, 2003.

Site	LKST	LKWH	NRPK	SAUG	WALL	Total
1	-	1	-	-	-	1
2	2	-	-	-	-	2
3	-	-	1	-	-	1
4	-	6	-	-	-	6
5	1	1	2	-	-	4
6	1	-	-	-	-	1
7	-	-	2	-	-	2
8	-	-	-	-	-	-
9	-	-	1	-	-	1
10	-	1	3	2	2	8
11	-	1	1	-	-	2
12	-	-	-	-	2	2
13	3	-	-	1	-	4
14	-	-	-	-	-	-
15	-	-	1	-	1	2
16	-	-	1	-	-	1
17	-	-	-	-	-	-
18	-	-	-	-	-	-
19	-	-	3	-	-	3
20	1	-	1	-	-	2
Total	**8**	**10**	**16**	**3**	**5**	**42**

LKST = Lake sturgeon
LKWH = Lake whitefish
NRPK = Northern pike
SAUG = Sauger
WALL = Walleye

Table 8. Site-specific catch-per-unit-effort (CPUE) (# lake sturgeon/45.8 m net/ 24 hours) summary for the 2003 lake sturgeon index gillnetting program conducted in the Nelson River between Birthday and Gull rapids.

Site	Replicate	Net Pull Date	Duration (h)	n	CPUE	Mean CPUE/site
1	1	26-Jun	24.02	0	0.00	
	2	30-Jun	24.10	0	0.00	0.00
2	1	26-Jun	23.97	2	2.00	
	2	30-Jun	24.07	0	0.00	1.00
3	1	26-Jun	24.23	0	0.00	
	2	30-Jun	23.63	0	0.00	0.00
4	1	26-Jun	24.10	0	0.00	
	2	30-Jun	23.85	0	0.00	0.00
5	1	26-Jun	24.05	1	1.00	
	2	30-Jun	23.53	0	0.00	0.50
6	1	27-Jun	22.15	1	1.08	
	2	01-Jul	22.08	0	0.00	0.54
7	1	27-Jun	22.27	0	0.00	
	2	01-Jul	21.77	0	0.00	0.00
8	1	27-Jun	22.28	0	0.00	
	2	01-Jul	21.55	0	0.00	0.00
9	1	28-Jun	23.02	0	0.00	
	2	01-Jul	21.60	0	0.00	0.00
10	1	28-Jun	23.05	0	0.00	
	2	01-Jul	21.60	0	0.00	0.00
11	1	28-Jun	23.17	0	0.00	
	2	02-Jul	22.58	0	0.00	0.00
12	1	28-Jun	23.33	0	0.00	
	2	02-Jul	22.60	0	0.00	0.00
13	1	28-Jun	23.18	3	3.11	
	2	02-Jul	22.55	0	0.00	1.55
14	1	29-Jun	26.00	0	0.00	
	2	02-Jul	22.73	0	0.00	0.00
15	1	29-Jun	25.97	0	0.00	
	2	02-Jul	22.77	0	0.00	0.00
16	1	29-Jun	25.83	0	0.00	
	2	03-Jul	23.38	0	0.00	0.00
17	1	29-Jun	25.80	0	0.00	
	2	03-Jul	23.42	0	0.00	0.00
18	1	29-Jun	25.78	0	0.00	
	2	03-Jul	23.38	0	0.00	0.00
19	1	29-Jun	25.67	0	0.00	
	2	03-Jul	23.42	0	0.00	0.00
20	1	29-Jun	25.57	0	0.00	
	2	03-Jul	23.43	1	1.02	0.51
Total/Mean			**941.48**	**8**	**0.20**	

n = number of fish captured at each site
LKST = lake sturgeon

Table 9. Summary of start and completion dates and total set duration for drift nets set in the Nelson River between Birthday and Gull rapids, 2003.

Drift Net Number	Type	Start date	Completion date	*Duration (h)
1-S	S	28-Jun-03	18-Jul-03	359.57
2-F	F	19-Jun-03	18-Jul-03	574.37
3-S	S	20-Jun-03	19-Jul-03	645.93
4-F	F	27-Jun-03	21-Jul-03	530.32
5-S	S	20-Jun-03	14-Jul-03	574.53
6-F	F	20-Jun-03	19-Jul-03	692.88
7-S	S	20-Jun-03	17-Jul-03	526.67
8-F	F	20-Jun-03	18-Jul-03	668.15
9-S	S	20-Jun-03	19-Jul-03	694.47
10-S	S	22-Jun-03	17-Jul-03	620.27
11-F	F	20-Jun-03	19-Jul-03	645.92
12-S	S	20-Jun-03	17-Jul-03	550.28
13-F	F	20-Jun-03	18-Jul-03	549.53
14-S	S	22-Jun-03	18-Jul-03	622.70
15-S	S	22-Jun-03	20-Jul-03	639.66
16-F	F	26-Jun-03	20-Jul-03	566.22
Total				**9461.47**

S - denotes bottom set drift net
F - denotes floating drift net
* Duration was included for all traps that collected a sample (independent of size of sample).

Table 10. Summary of start and completion dates and total set duration for drift nets set in Gull Rapids and Stephens Lake, 2003.

Drift Net Number	Start date	Completion date	*Duration (h)
RADT-1	10-Jun-03	28-Jun-03	452.65
DPDT-1	19-Jun-03	19-Jul-03	714.20
DPDT-2	19-Jun-03	19-Jul-03	694.13
DPDT-3	19-Jun-03	19-Jul-03	715.23
DPDT-4	19-Jun-03	19-Jul-03	719.63
DPDT-5	19-Jun-03	19-Jul-03	719.12
DPDT-6	23-Jun-03	19-Jul-03	606.72
DPDT-7	23-Jun-03	19-Jul-03	607.31
FLDT-1	18-Jun-03	19-Jul-03	745.87
FLDT-2	20-Jun-03	19-Jul-03	697.43
FLDT-3	20-Jun-03	19-Jul-03	697.25
FLDT-4	20-Jun-03	19-Jul-03	697.03
FLDT-5	20-Jun-03	19-Jul-03	696.83
Total			**8763.40**

* Duration was included for all traps that collected a sample (independent of size of sample)
DPDT - denotes bottom set drift net
FLDT - denotes floating drift net

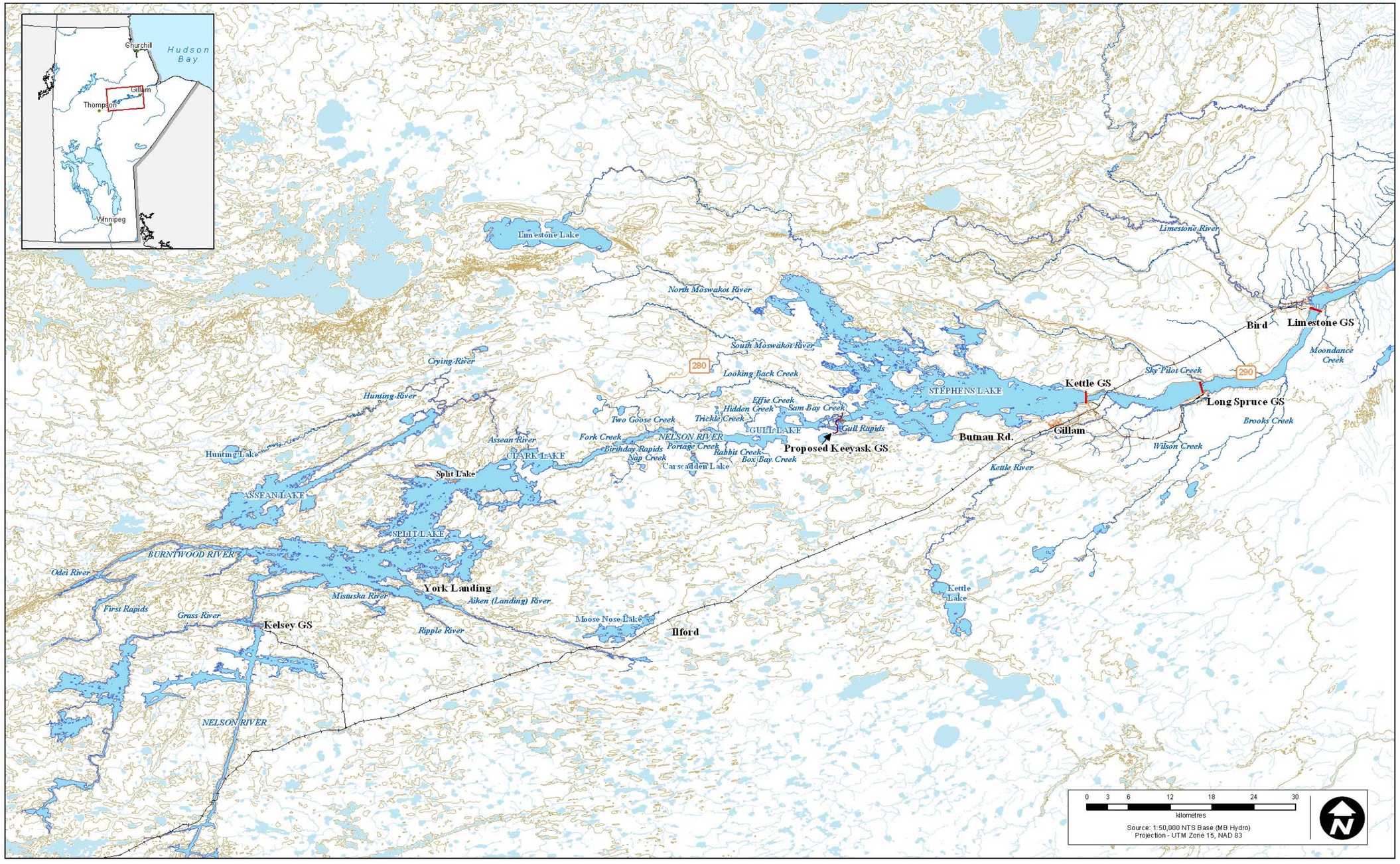

Figure 1. Map of the Keeyask Study Area and proposed and existing hydroelectric developments.

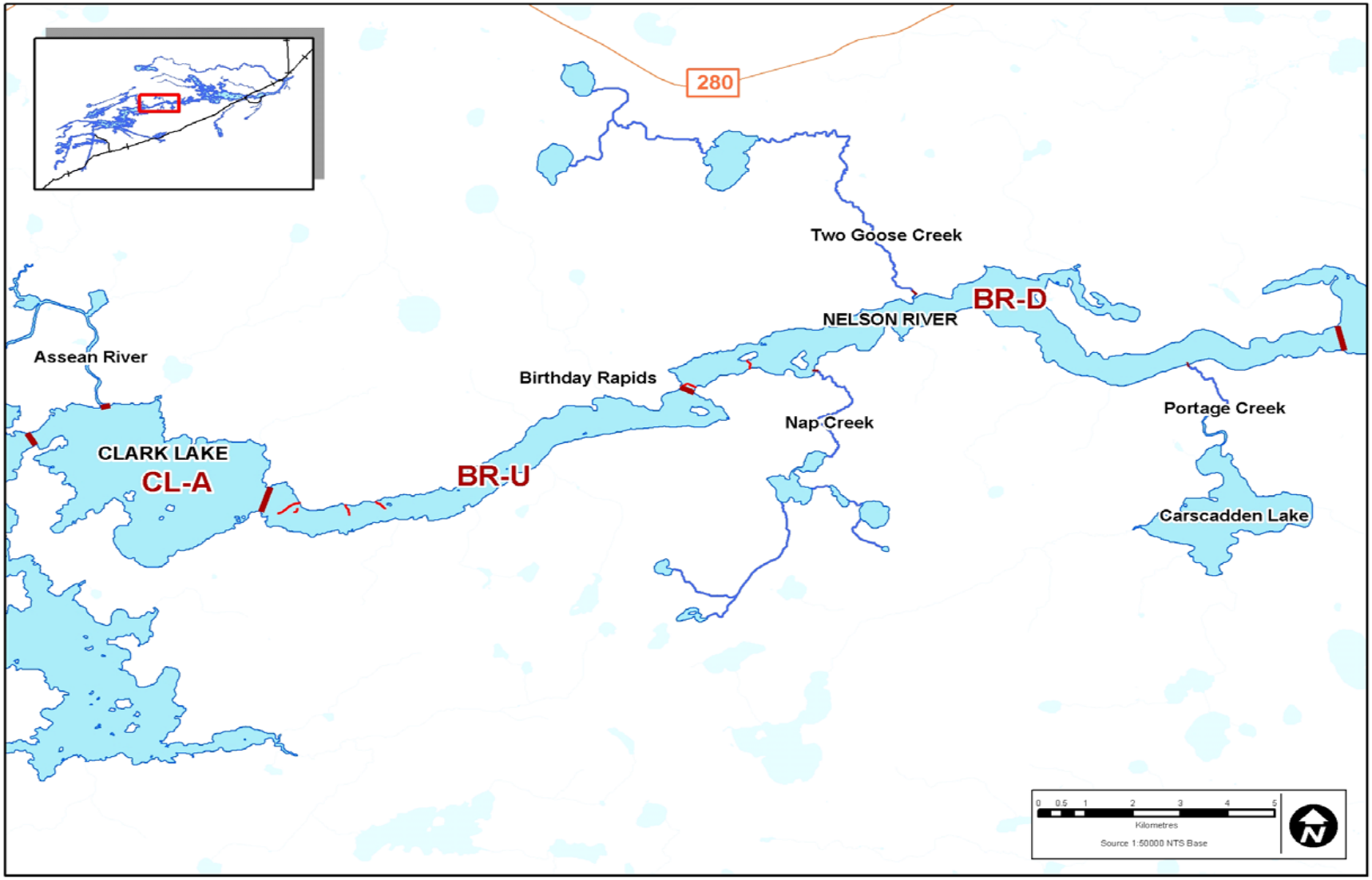

Figure 2. Map of the Nelson River and Clark Lake in the vicinity of Birthday Rapids illustrating zones CL-A, BR-U, and BR-D.

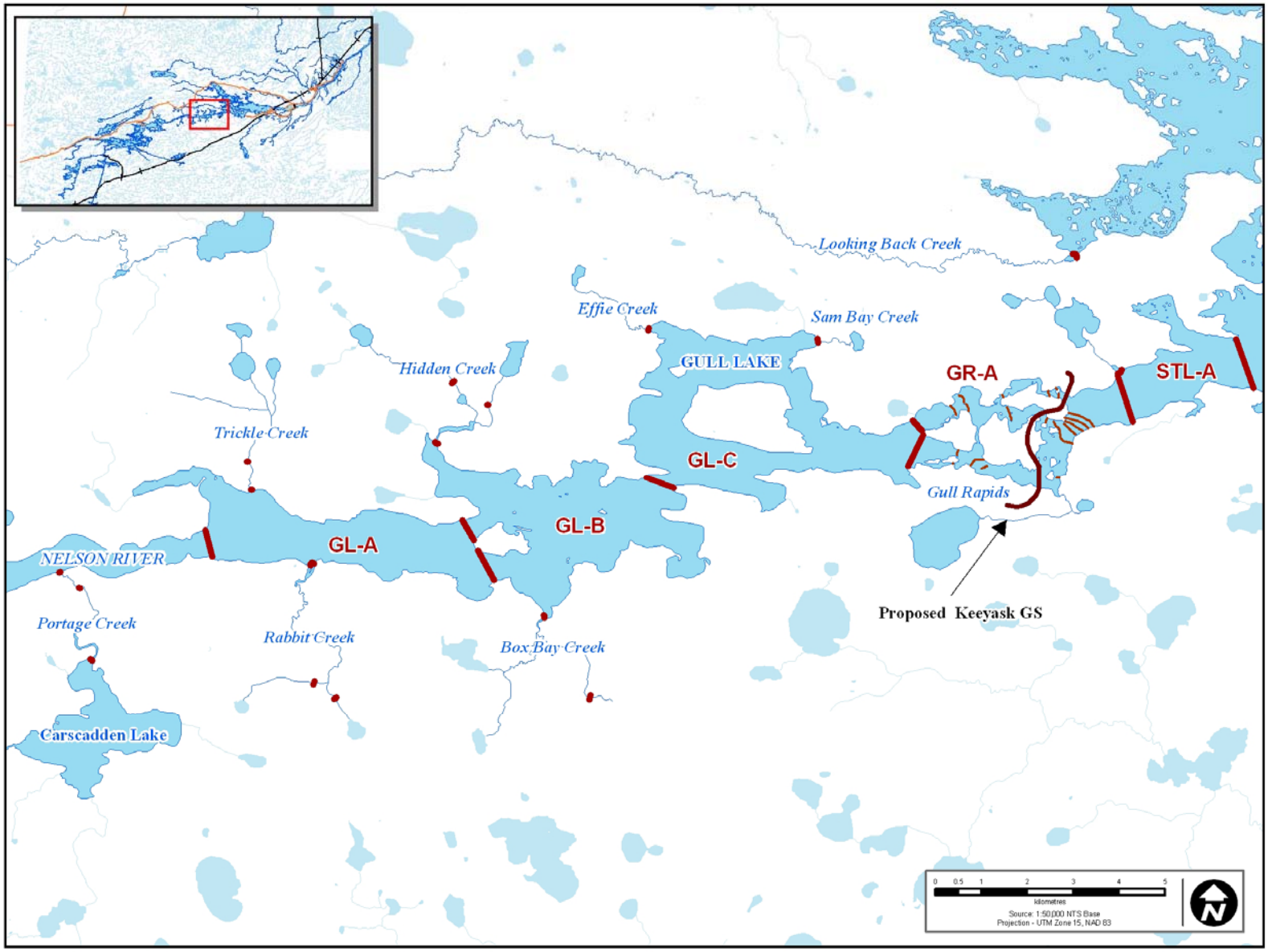

Figure 3. Map of Gull Lake illustrating zones GL-A, GL-B, and GL-C.

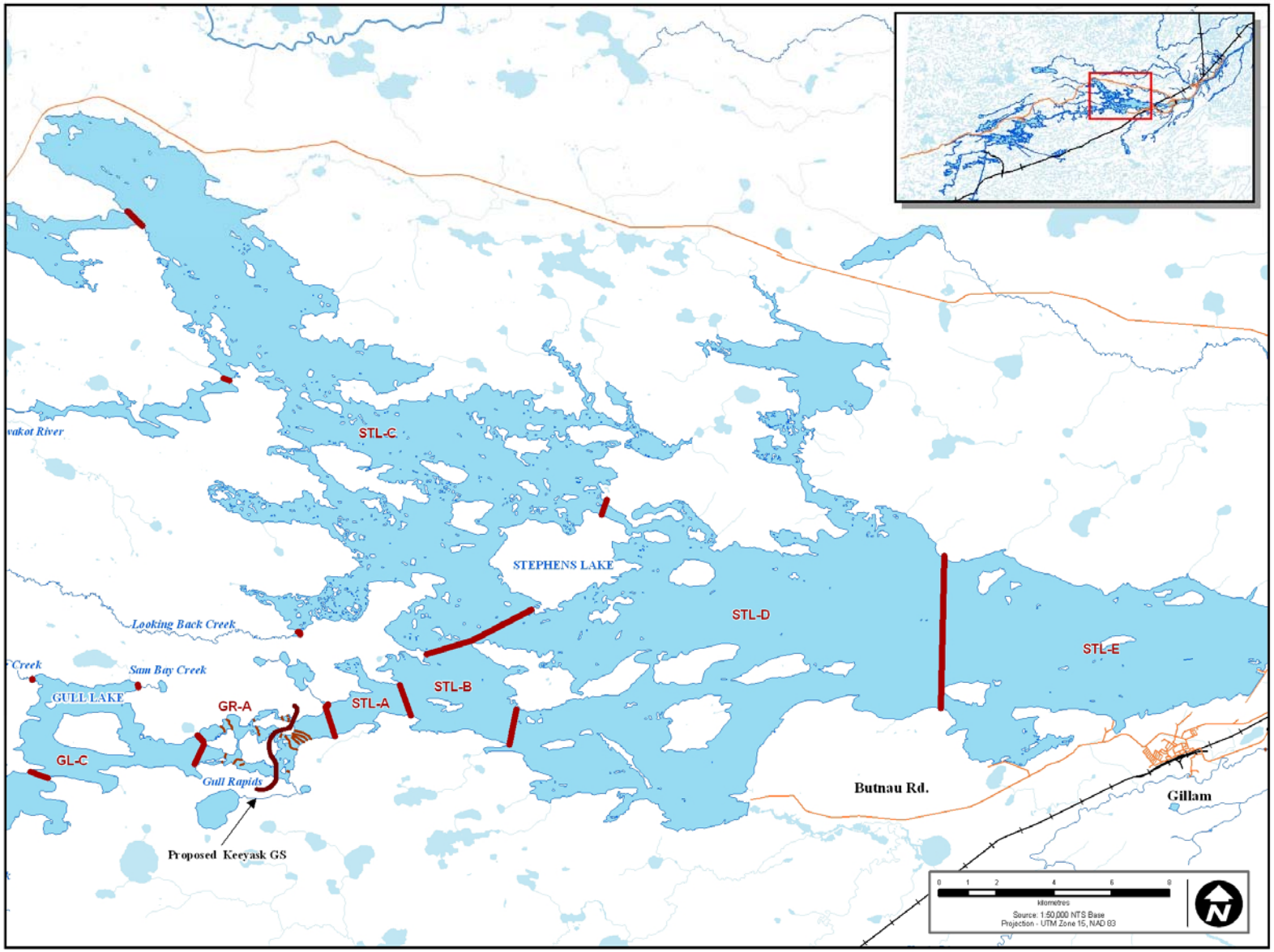

Figure 4. Map of Stephens Lake illustrating zones STL-A to STL-E, and GR-A.

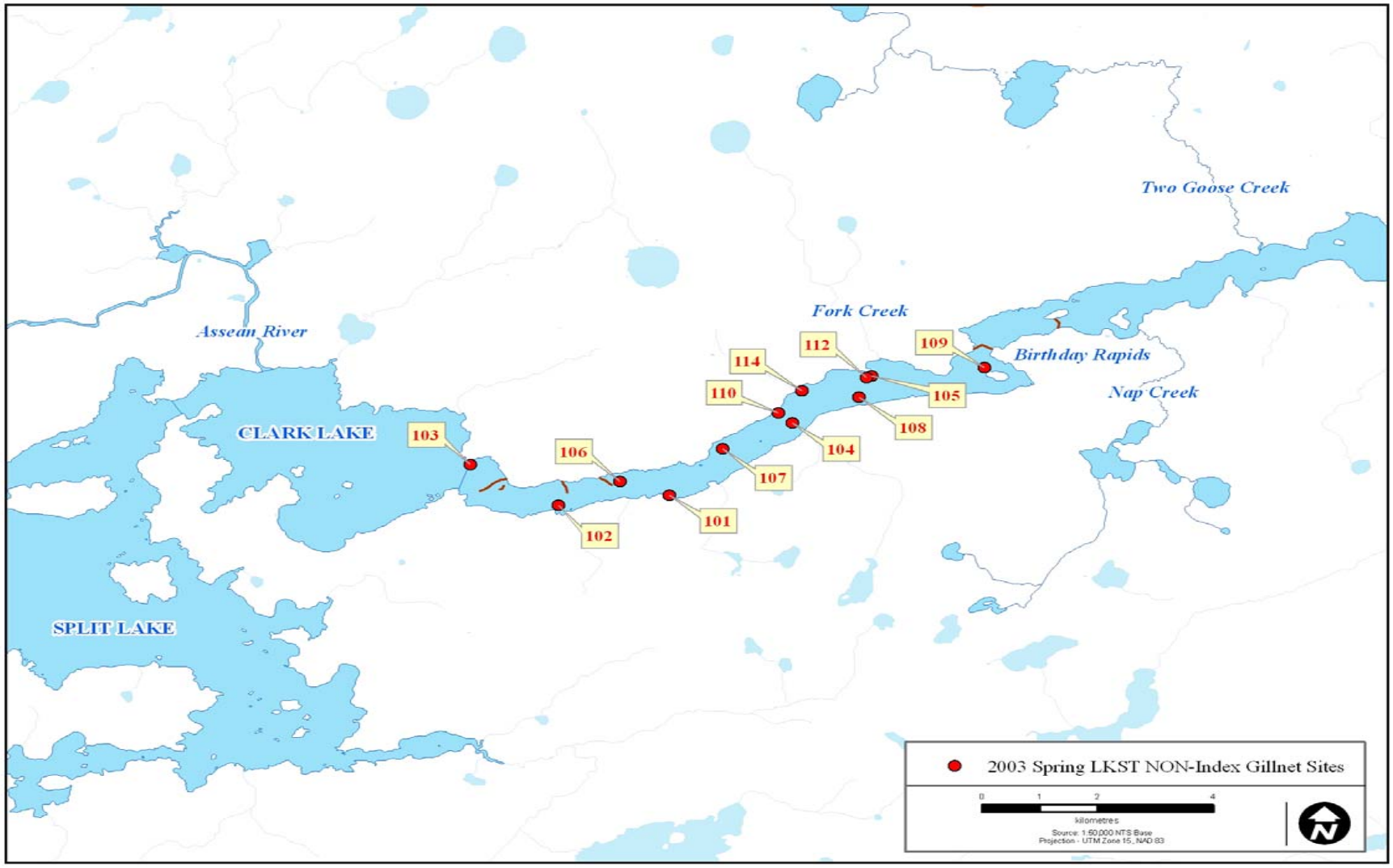

Figure 5. Gillnetting sites fished for lake sturgeon in the Nelson River between Clark Lake and Birthday Rapids between 24 May and 01 July, 2003.

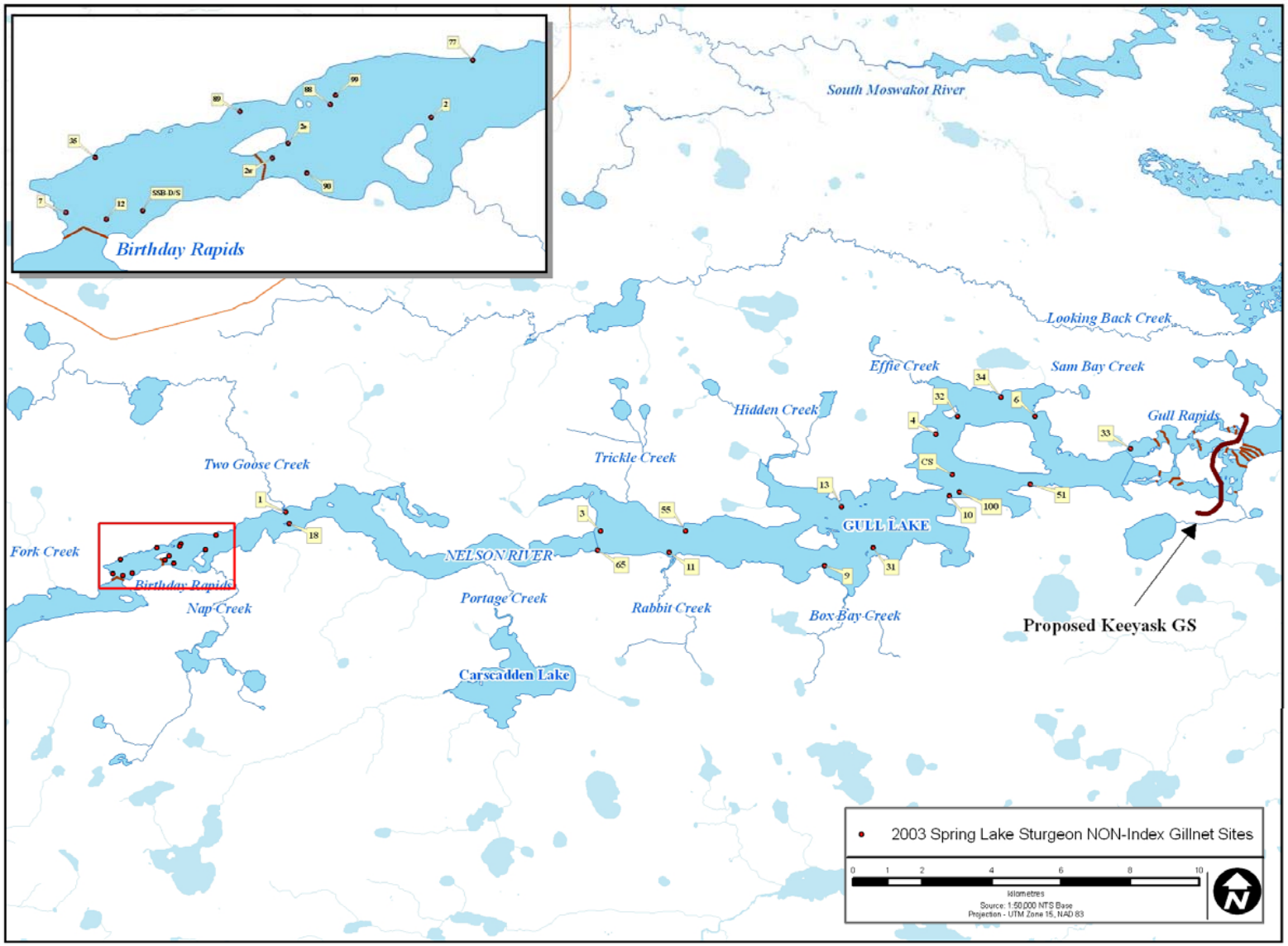

Figure 6. Gillnetting sites fished for lake sturgeon in the Nelson River between Birthday and Gull rapids between 24 May and 23 June, 2003.

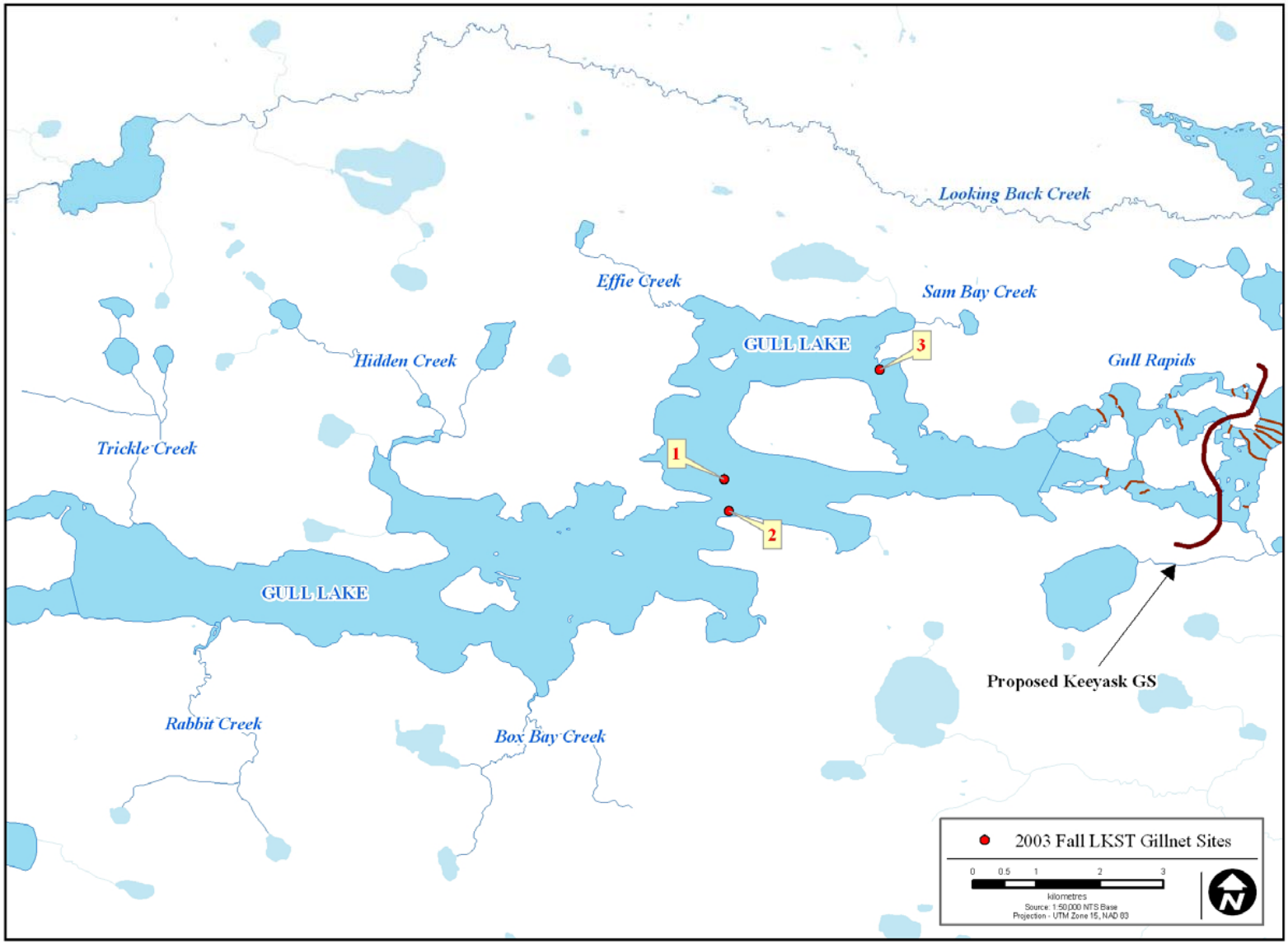

Figure 7. Gillnetting sites fished for lake sturgeon in the Nelson River between Birthday and Gull rapids between 26 September and 02 October, 2003.

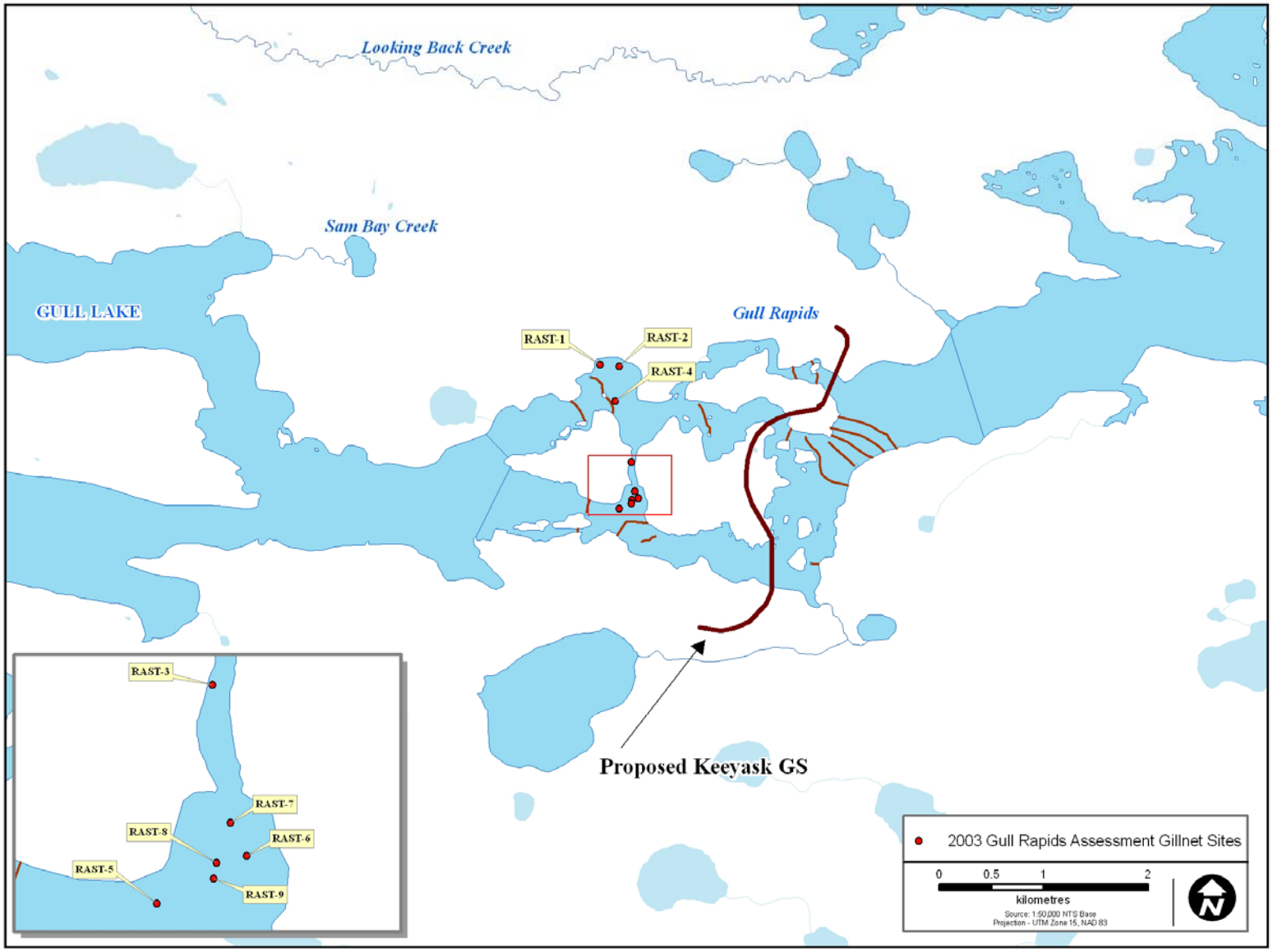

Figure 8. Gillnetting sites fished for lake sturgeon in Gull Rapids between 01 and 29 June, 2003.

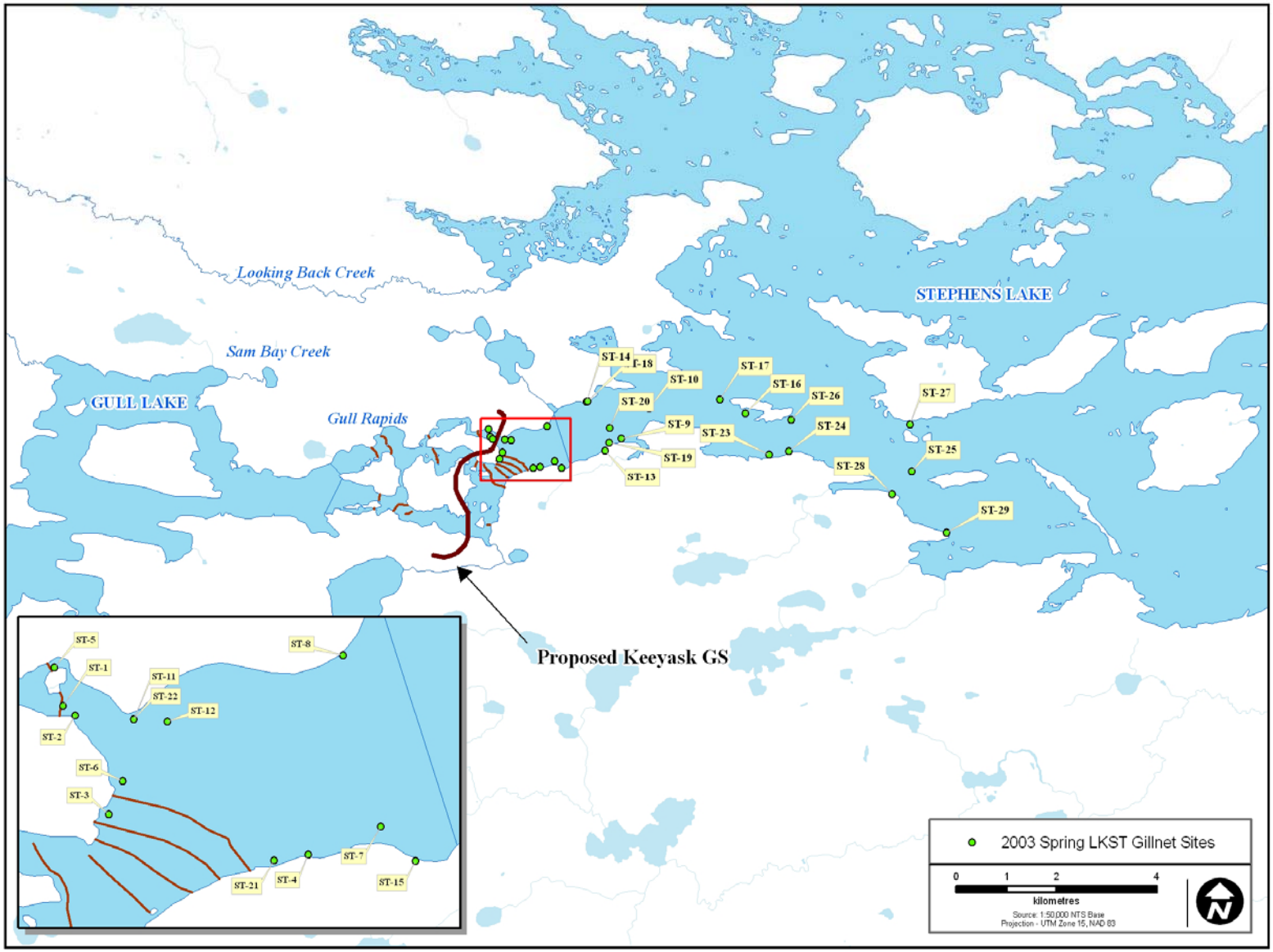

Figure 9. Gillnetting sites fished for lake sturgeon in Stephens Lake between 24 May and 18 July, 2003.

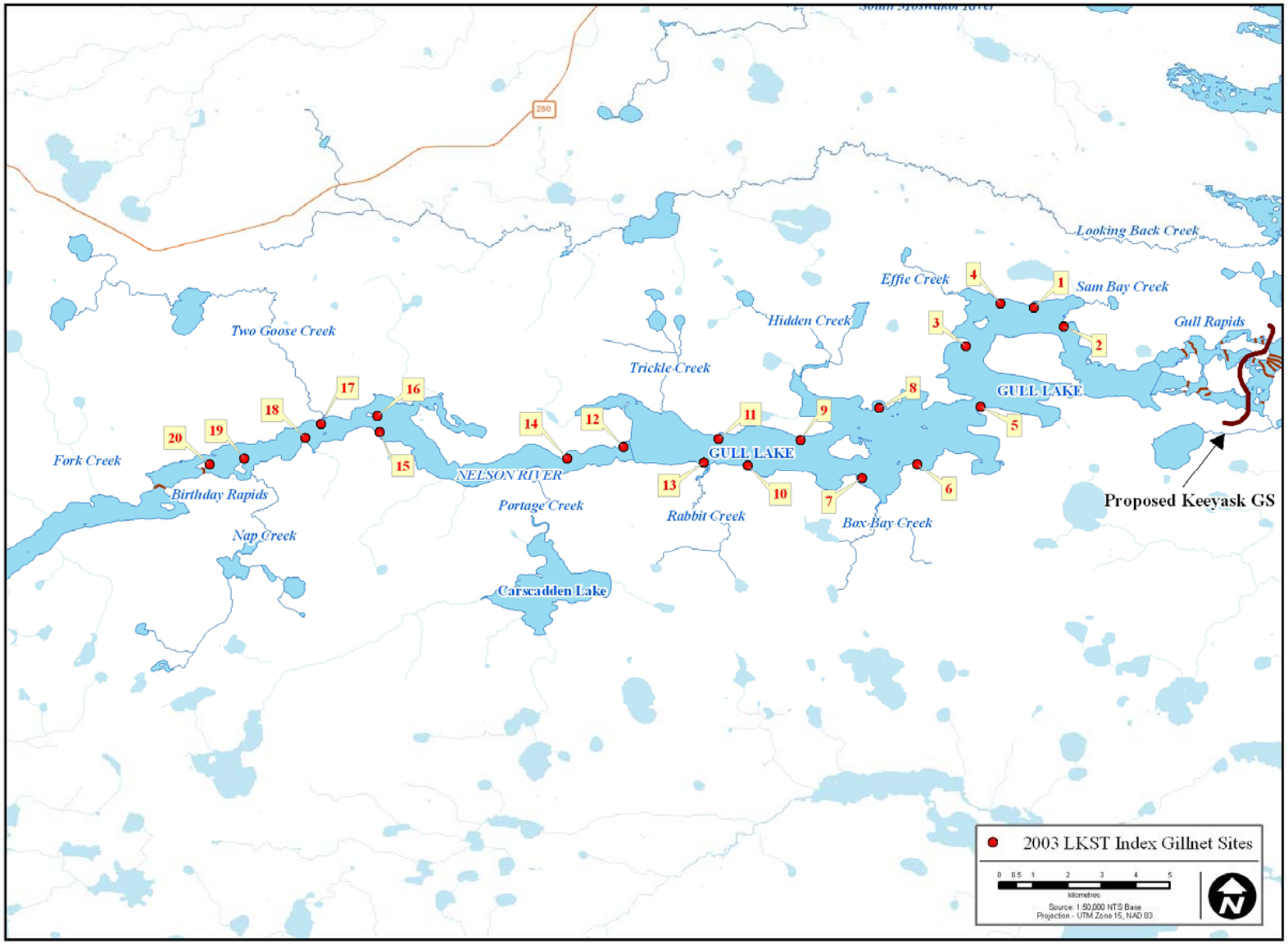

Figure 10. Gillnetting sites fished for lake sturgeon with index gill nets between Birthday and Gull rapids between 25 June and 03 July, 2003.

Figure 11. Photograph of larval drift nets used during lake sturgeon investigations in the Keeyask Study Area, 2003.

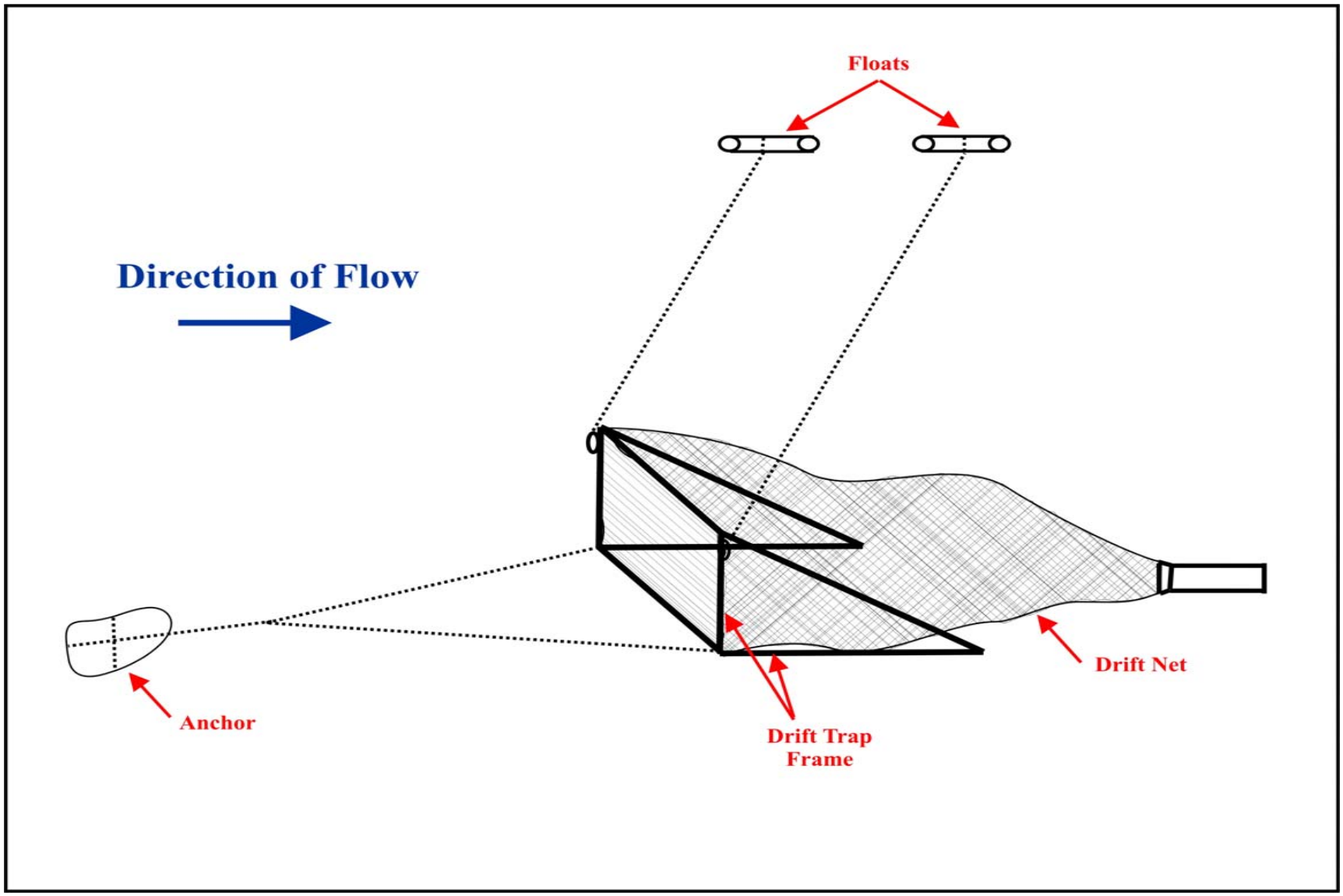

Figure 12. Diagram of bottom set larval drift net assembly used during lake sturgeon investigations in the Keeyask Study Area, 2003.