SASKATCHEWAN RIVER
LAKE STURGEON HABITAT INVESTIGATION
CUMBERLAND HOUSE, SASKATCHEWAN
TO
THE PAS, MANITOBA
JUNE, 2000

A Report Prepared
for

Manitoba Hydro

and

Saskatchewan River Lake Sturgeon
Co-management Board

by

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Capture of a 145 lb lake sturgeon near the community of Cumberland House, Saskatchewan, 1961. From left to right: Franklin Carriere, Ben Fiddler, Paul Doussion, and Pierre Carriere Sr.

EXECUTIVE SUMMARY

A baseline assessment of lake sturgeon (*Acipenser fulvescens*) habitat and habitat utilization in the lower Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, was conducted from 6-14 June, 2000. Habitat parameters (depth, water velocity, and substrate composition) were determined at quarter points on 157 transects spaced at one kilometre intervals and at 97 selected sites. Riparian characteristics were documented at, and between, each transect and at specific locations within the study area. Selected habitats were sampled with gill nets, hoop nets, and drift nets to determine lake sturgeon utilization.

Based on the substrate composition data collected, the 157 km study area was divided into four reaches. The upper reach of the Saskatchewan River, from Bigstone Rapids to approximately 10 km downstream (Cumberland House area), was characterized by relatively fast velocities (up to 1.15 m/sec), shallow depths (mean= 2.92 m), and a variety of substrates, including a relatively higher proportion of rock and boulder deposits than elsewhere in the study area. The reach encompassing transects 11-95, including the Tearing River mouths (1st and 2nd discharge outlets), Saskatchewan/Manitoba border, and Big Bend, was characterized by deeper water (mean= 4.73 m; maximum 18.00 m), lower water velocities (mean= 0.61 m/sec), and predominately sand-based substrates. From Transect 96 (downstream of Big Bend) to Transect 120 (upstream of The Pas), substrates were almost exclusively mud and silt, while water velocities decreased further (mean= 0.50 m/sec). From Transect 121 upstream of The Pas, downstream to the Summerberry River, substrate types and velocities became more diverse (similar to Cumberland House reach), but depths essentially remained greater than 3 m.

Bigstone Rapids was the only location within the study area that was determined to provide suitable spawning habitat for lake sturgeon during the investigation period. However, as a result of low spring flows and a relatively slow increase in water temperatures, it was suspected that majority of lake sturgeon may have been dissuaded from spawning during spring, 2000. In the 10 km downstream of Bigstone Rapids, substrates were suitable for sturgeon spawning (e.g. a high proportion of boulder, cobble, and gravel substrate), but depths were generally greater than 2 m. An absence of turbulent water (which by most accounts, seems to be a pre-requisite for successful lake sturgeon spawning), suggests that there are no other suitable spawning locations downstream of Bigstone Rapids.

The Tearing River, located approximately 25 km downstream of Bigstone Rapids, has been identified as a possible lake sturgeon spawning location because it offers a diverse expanse of rocks and cobble substrates. However, Tearing River flows were insufficient during spring, 2000, to provide suitable spawning habitat. Traditionally, the mouth of the Tearing River has been a common domestic fishing location for lake sturgeon. On June 8, two immature lake sturgeon (mean fork length 780 mm; 10 and 12 years-old, respectively) were captured in gill nets set off the island adjacent to the Tearing River mouth, in approximately 2.5 m of water.

The reach of the Saskatchewan River, extending from Transect 10 (Cumberland House) to downstream of Big Bend (approximately Transect 95), provides uniform deepwater run habitat with substrates composed primarily of sand. A single 123 mm, 2 year-old lake sturgeon was captured in this reach, which may provide ideal habitat for rearing juvenile sturgeon. Studies conducted in Wisconsin, USA, have shown that juvenile sturgeon display a strong preference for flat substrates of coarse sand and pea-sized gravel where there is a detectible current. Such substrates offer protection by allowing juvenile sturgeon to blend into the background, and are also desirable for the dipteran larvae and Baetidae nymphs that immature sturgeon consume. Given the restricted substrate and dietary item preferences of young sturgeon, the availability of this type of habitat for rearing may be just as critical to the sustainability of sturgeon populations as the availability of suitable spawning areas.

The study area downstream of Big Bend (Transect 96) to The Pas (Transect 120) was characterized primarily by mud and silt substrates, and may be less suitable for juvenile sturgeon than upstream reaches. Studies have suggested that feeding conditions for juvenile sturgeon are inferior on silt substrates. While this reach of the Saskatchewan River may be not be optimal for young sturgeon, it may provide important foraging habitat for adult sturgeon. Habitat from The Pas downstream to the Summerberry River (transects 121-157), is relatively diverse and likely provides foraging opportunities for all life stages of lake sturgeon.

Growth rates exhibited by three lake sturgeon captured during the survey were similar to other Manitoba populations, but relatively low compared to more southern sturgeon populations. The slower growth rates of Saskatchewan River fish (e.g. lake sturgeon) are attributable to cool water temperatures and a short growing season (July through September or approximately 92 days per year).

Studies in Wisconsin, USA, have shown that the most effective way to sample YOY (young-of-the-year) lake sturgeon is with an electrofishing boat, but that water level and clarity are major factors affecting the catch. After being electroshocked, YOY sturgeon characteristically roll with the current along the bottom. Given the high turbidity, electrofishing would not be a viable option for sampling YOY sturgeon from the Saskatchewan River. Depending on flow conditions, seining may be an effective method for catching YOY sturgeon in shallow, less turbulent, margins of the Saskatchewan River mainstem.

The level of domestic harvest of lake sturgeon on the Saskatchewan River remains unknown. During the spring, 2000, investigation period, a high proportion of locations determined to be suitable for setting gill nets were already occupied by what was believed to be net markers. Survey nets were not set in these locations, and consequently, it was often difficult to find suitable locations to set nets in some reaches of the study area. The majority of markers were concentrated in the following locations: Bigstone Rapids, Tearing River, Big Bend, and in the vicinity of The Pas. If markers observed are indicative of domestic fishing nets, the potential harvest of sturgeon from this fishery would be of concern to the sustainability of the Saskatchewan River lake sturgeon population.

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1.0 INTRODUCTION

Lake sturgeon (*Acipenser fulvescens*) is the largest of Canada's freshwater fishes, reaching lengths of over 2 m and weights in excess of 140 kg (Scott and Crossman 1998). In addition to its size, lake sturgeon possess a number of unique life history characteristics that distinguish this species from most other freshwater fish in North America, including: longevity (>100 years); old age at maturity (up to 20 years); and, extended spawning periodicity (may only reproduce once every three to six years).

The geographical range of lake sturgeon in Canada extends from the Great Lakes, west to the upper reaches of the North and South Saskatchewan rivers, and north to the Churchill River. Once abundant in several of Manitoba's larger lakes and rivers, lake sturgeon have been extirpated or are on the verge of becoming extirpated in over half of the waterbodies that historically sustained self-reproducing populations (Manitoba Department of Natural Resources [MNR] 1994). The decline of sturgeon in Manitoba, like elsewhere in North America, is attributable to reasons summarized by Houston (1987) as a "synergistic product of life history factors, exploitation, and environmental change". Despite a decline in numbers, the species has not been given any special status by the Manitoba Endangered Species Act (MBESA)("not listed") or the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)("not at risk"). However, Manitoba Conservation has designated the lake sturgeon as a "heritage species" due to its "unique life history characteristics, limited distribution, and economic, social, and historical significance"(MNR 1991). Management objectives for "heritage species" include: documenting distribution and habitat requirements; assuring stocks are conserved and enhanced; managing and conserving habitat and assuring perpetuation of the stocks; assuring implications to heritage stocks are considered prior to approval of species introductions; and increasing public information on heritage stocks.

The Saskatchewan River is one of the few locations in Manitoba that continues to support a limited lake sturgeon population. Historically, lake sturgeon in the Saskatchewan River watershed ranged from Edmonton, Alberta on the North Saskatchewan River, and from the convergence of the Bow and Oldman rivers on the South Saskatchewan River, downstream to Grand Rapids, Manitoba.

Like most other North American sturgeon populations, lake sturgeon in the Saskatchewan River have been subjected to a history of unsustainable harvests and habitat alteration. Commercial fishing for

lake sturgeon in the Manitoba portion of the Saskatchewan River commenced in 1898 and continued intermittently until 1991. Lake sturgeon harvests exceeded 16,000 kg annually in the early in 1900s, but declined rapidly thereafter (Harkness 1980). Annual harvests in the Cumberland Lake area of Saskatchewan ranged from 2,700-3,600 kg from 1940 through 1991 (Wallace 1991). A moratorium was placed on commercial fishing for sturgeon in Saskatchewan in 1996 and the angling catch limit was reduced to zero in 1999 (J. Durbin, SERM, pers. comm.). Similar restrictions are in place in Manitoba. The only legal sturgeon harvests are by First Nations (Treaty) people.

Construction of Manitoba Hydro's Grand Rapids Hydroelectric Generating Station and Saskatchewan Power Corporation (Sask Power's) E.B. Campbell Hydroelectric Generating Station at Squaw Rapids during the early 1960s resulted in significant alterations to habitat in the lower Saskatchewan River (Figure 1). Impacts pertinent to lake sturgeon included flooding of Cedar Lake in Manitoba, loss of potential spawning areas at Tobin and Squaw Rapids in Saskatchewan, fragmentation of habitat, and regulation and reversal of seasonal flows in the Saskatchewan River. Wallace (1991) concluded that recovery of the stock was limited by two factors: habitat and harvest rate.

During the early 1990s, an Interprovincial Lake Sturgeon Steering Committee was developed to address the concerns with regard to impacts on Saskatchewan River lake sturgeon populations. The group has now evolved into the Saskatchewan River Sturgeon Management Board (SRSMB) and includes the following stakeholders: Cumberland House First Nation, Opaskwayak Cree Nation (The Pas), Saskatchewan River Fishermen's Association (The Pas), Cumberland House Fishermen's Cooperative, Saskatchewan Environment and Resource Management (SERM), Manitoba Conservation (MC), Saskatchewan Northern Affairs, SaskPower, and Manitoba Hydro.

Initial consultation of the Lake Sturgeon Steering Committee identified five components that were necessary for restoration and protection of Saskatchewan River lake sturgeon populations (M. Chen in Wallace 1999).

- Habitat inventory and evaluation;
- Population assessment;
- Habitat protection, improvement, or creation;
- Population restoration and/or enhancement; and,
- Co-management with local stakeholders, and assessment of program effectiveness.

A number of studies to address these components were initiated in 1994 and remain ongoing (Wallace 1999, Wallace and Leroux 1999).

Habitat inventory and evaluation is a critical first step in understanding the productive capability of a fish stock, and in protecting and improving that production. To characterize fish habitat it is important to have an understanding of: a) the physical parameters of the habitat; and b) how the habitat is utilized by fish. Physical attributes can be characterized by measuring water depth, water velocity, and evaluation of substrates. Fish utilization is characterized by determining the fish species and life stages that are using the habitat, and the purposes for which it is being used (e.g. spawning, rearing, foraging, and overwintering).

To date, the majority of habitat studies for the Interprovincial Lake Sturgeon Committee have been conducted at, or upstream of, Bigstone Rapids. Consequently, little is known about the type, or utilization, of lake sturgeon habitat downstream of Bigstone Rapids to The Pas, Manitoba. Determining how and when this habitat is used by sturgeon would provide the SRSMB with a better understanding of the factors that may be limiting sturgeon production in the lower Saskatchewan River. With this goal in mind, a study was conducted during spring, 2000, with the following objectives:

i) to document fish habitat in the Saskatchewan River between Bigstone Rapids and the Summerberry River (downstream of The Pas) in terms of depths, water velocities, and substrates; and,

ii) to determine lake sturgeon utilization of characteristic habitats identified during the investigation.

North/South Consultants Inc. conducted the study under contract to Manitoba Hydro. This report provides results of both study components.

1.1 STUDY AREA

The Saskatchewan River watershed originates in the Rocky Mountains near the British Columbia border. In Alberta, the headwater streams converge into the North and South Saskatchewan rivers

which merge into the Saskatchewan River at Prince Albert, Saskatchewan. The Saskatchewan River enters Manitoba near the 54th parallel, in close proximity to The Pas, and then flows through Cedar Lake, entering Lake Winnipeg at Grand Rapids (Figure 1). Elevation decreases from approximately 270 metres above sea level at the Manitoba border to 218 metres above sea level at Lake Winnipeg (Smith et al. 1998). Based on its drainage area of 364,000 km^2, the Saskatchewan River is the largest river draining into Lake Winnipeg. Historical mean monthly discharge of the Saskatchewan River at The Pas has varied from 139.0 m^3/s (*December 1966*) to 1860.0 m^3/s (*June 1965*)(Environment Canada 1991). Mean annual discharge was 648.0 m^3/s from 1913-1990. Saskatchewan River discharges within the study area are regulated by the E.B. Campbell Generating Station at Squaw Rapids.

The study area for the habitat investigation was located between Bigstone Rapids near Cumberland House, Saskatchewan and the mouth of the Summerberry River, located approximately 29 km downstream of The Pas, Manitoba. Within the study area, the Saskatchewan River is underlain by sedimentary bedrock overlain with glacio-lacustrine and till deposits consisting mainly of stratified sands, silts, and clays including alluvial and aeolian deposits (Smith et al. 1998).

2.0 METHODS

The study was comprised of two components: i) measurement of habitat parameters; and ii) a fishing program to determine lake sturgeon utilization of habitats. To maximize the possibilities of encountering a number of different life history stages of lake sturgeon (e.g. spawning adults, non-spawning adults, juveniles, larvae, and eggs), field investigations were scheduled to begin approximately 10 days after peak lake sturgeon spawning activity was estimated to have occurred. The field study was conducted over a nine day period, from 6-14 June 2000, by a three person crew using two 16 ft aluminum boats powered by 25 hp outboard motors. The field crew worked in a downstream direction, from Cumberland House, Saskatchewan (Bigstone Rapids) to The Pas, Manitoba (Summerberry River).

2.1 MEASUREMENT AND CLASSIFICATION OF HABITAT PARAMETERS

The habitat survey was conducted within a 157 km segment of the lower Saskatchewan River between Bigstone Rapids and Summerberry River (Figure 1). Sampling was conducted on transects established at one kilometre intervals (on 1:50,000 topographic maps), or at locations where obvious changes in river morphology occurred. Transect locations were documented by recording the left and right bank (facing upstream) Universal Transverse Meridian (UTM) co-ordinates using a hand-held navigational grade global positioning system unit. Quarter points were geo-referenced, and designated as right bank side (RB), mid-channel (MID) or left bank side (LB).

At each transect quarter point, depth (± 1 cm) was measured with a surveyors rod. Water velocity (m/sec) was measured at 60% of depth where total depth was less than 1 m, or at 20% and 80% of depth where total depth was greater than 1 m. Where more than one water velocity was measured in a fixed position, velocities were averaged to provide a single site velocity. Velocities were measured with a Price Model 622A current meter, which was supported by a 13.6 kg weight and suspended from a manual winch.

Substrate at each transect quarter point was determined by probing the river bottom with a surveyors rod or by collecting a representative grab sample with an Ekman dredge. Substrates were classified qualitatively based on type and compaction. Substrate classification included one or a combination of the following: clay, mud, sand, gravel, cobble, boulder, and/or bedrock. Substrate compaction

was classified as hard, medium or soft. Qualitative information on riparian features were documented for left and right side banks within the study area.

In addition to the data collected on each transect profile, similar site-specific measurements were collected between transects at locations of unique habitat (e.g. tributary confluences, side channels, islands, exposed boulder outcrops). Unique site-specific shoreline features were also noted and photographed.

Provisional real-time discharge data for the Saskatchewan River during the June, 2000, investigation period were obtained from Manitoba Hydro (Power Planning and Operations Division), Winnipeg, Manitoba.

2.2 FISH UTILIZATION ASSESSMENT

Habitats identified in the Saskatchewan River during the nine day study period were sampled to determine whether lake sturgeon were present. In an effort to sample all life stages, a variety of sampling gears were employed including: gill nets, hoop nets, and larval drift nets.

2.2.1 Sampling Gear

2.2.1.1 Gill Nets

Fifty yard (45.7 m) large mesh gill net gangs, consisting of 25 yard (22.9 m), 8 feet (2.46 m) deep panels of 9 inch (228 mm) and 12 inch (305 mm) twisted nylon mesh, were set at a total of four sites daily. Set locations were generally chosen to represent the variety of habitats encountered within a 15-20 km segment of the river each day. However, set locations were also dependent on finding suitable water velocities and depths, where nets would not become fouled with debris. Gill nets were set at each site for a maximum of 24 hours. Generally, the nets were set in the late morning or early afternoon and retrieved the following morning.

Concurrent with the large mesh gang sets, an experimental gill net gang was also set each day in a selected habitat type. The gang consisted of the following: three 25 yard (22.9 m), 6 feet (1.8 m) deep panels of 1.5 inch (38 mm), 2 inch (51 mm), and 3 inch (76 mm) twisted nylon mesh; one 25

yard (22.9 m) panel of 5 inch (127 mm) three strand twisted monofilament mesh; and two 25 yard (22.9 m) panels of 9 inch (228 mm) and 12 inch (305 mm) mesh (one at each end of the gang). This experimental gang was set for no longer than five hours daily to minimize mortalities.

2.2.1.2 Hoop Nets

A single 1.5 m diameter, 6.45 cm^2 mesh, hoop net with 10-15 m wings was set daily during each afternoon and retrieved the following morning. Set locations were based on the presence of suitable conditions (e.g. limited debris, adequate depth). The net was generally set off shore and oriented to capture fish moving in an upstream direction.

2.2.1.3 Drift Nets

Wisconsin-style nets were set opportunistically at several locations in the Saskatchewan River to capture lake sturgeon larvae that may be drifting downstream. Due to the quantity of drift material in the river, drift nets were set at each site for a maximum of three hours. Each drift net consisted of a 3 m long, 950 *um* Nitex screen bag, with a 34 cm x 85 cm inside opening at the mouth, tapering to a 9 cm diameter ABS pipe collecting bottle cod-end. Traps were oriented directly into the current and held in place on the bottom of the river by a 39 mm channel-iron frame attached to two 9.1 kg anchors. Marker floats with sampling permit identification were attached to each anchor.

Drift nets were checked and relocated daily. Sample material was sorted in the field subsequent to net retrieval. All fish captured were preserved in 5% formalin for subsequent identification in the laboratory.

2.2.2 Fish Sampling

All fish captured in gill nets and hoop nets were identified to species, enumerated, measured for fork length and/or total length (lake sturgeon) (± 1 mm), and weighed (± 25 g). Where possible, sexual maturity was determined by examination of external morphological features or by gamete extrusion. A portion of the left pectoral fin for all captured sturgeon was removed for subsequent age determination in the laboratory.

Lake sturgeon captured that exceeded 250 mm in length were marked with individually numbered Floy FD-94 T-bar anchor tags inserted between the basal pterygiophores of the dorsal fin with a Dennison Mark II tagging gun. Individually coded 125 kHz electronic microchip PIT tags were also inserted into the dorsal side at the base of the leading edge of the left pectoral fin using a Syndvex® implant gun.

All captured lake sturgeon were examined for previously implanted microchips using an electronic Pocket Reader EX scanner. Before scanning each fish, the unit was tested (test chip) to verify an accurate scan was achieved before continuing. To locate an implanted PIT tag, the underside of the scanner was held flush against the body of the fish, over the left pectoral injection site region. Juvenile sturgeon were scanned with a metal detector wand to determine whether they were previously marked with wire snout tags prior to stocking by SERM and/or Manitoba Conservation.

Prior to release, all fish were examined externally for the following DELTS (deformities, erosion, lesions or tumours):

- deformed fins or fin rays, head, vertebrae (spinal column), barbel or other associated body part;
- erosion, including corroded fins, operculum, tail, and barbel, including fin rot;
- lesions, such as open sores, exposed tissue, ulcerations, cysts, and eye anomalies (e.g. cataracts); and
- tumours, where the tissue was a solid mass (e.g. not fluid-filled).

Physical injuries, such as damage from predators or sampling gear, were not considered in DELT classifications.

Lake sturgeon pectoral fin rays selected for age determination were dried, dipped in a polymer coating hardener (EnviroTex Lite), and sectioned with a low speed, precision jewellers saw (Struers Minitom). The sections were fixed on glass slides with Cytoseal 60 mounting medium and examined under a (Wild M2) dissecting microscope. Ages were assigned by counting visible annuli.

2.3 DATA ANALYSIS

Daily water temperature and discharge estimates (obtained from Saskatchewan Water Corporation [Moose Jaw, Saskatchewan]) for the Saskatchewan River during June 2000, were graphed. Substrates were classified based on the percentage of substrate components in each river segment. Velocities measured at 20% and 80% of the depth were averaged to compute mean velocity for a particular location. Cross-sectional mean depth and velocity were calculated for each transect.

3.0 RESULTS

Ice break-up on the Saskatchewan River occurred relatively early in 2000. Water temperature reached approximately 10°C by mid-May, where it remained for the following two weeks. Given that lake sturgeon generally spawn when water temperatures rise to above 10°C (Scott and Crossman 1998), and sturgeon have been observed to spawn close to 06 June in the Saskatchewan River near Cumberland House in previous years (Wallace 1999), it was decided to proceed with the habitat survey during the first week of June. The survey was conducted from 6 -14, June, 2000.

3.1 RIVER CONDITIONS

3.1.1 Discharge

Mean estimated daily discharge of the Saskatchewan River at E.B. Campbell Generating Station for June, 2000, was 371.0 m^3/s. Estimated daily discharge during the study period ranged from 292.6 to 571.8 m^3/s (Figure 2). Based on historical June discharge data (mean June discharge for 1970-1990 for the Saskatchewan River at The Pas [Station No. 05KJ001] was 809.0 m^3/s [*Environment Canada 1991*]), discharges during the 2000 study period were below average. Mean June discharges during previous Saskatchewan River lake sturgeon studies (1996, 1997, and 1998) ranged from 202-380 m^3/s (Wallace 1999).

3.1.2 Water Temperatures

Water temperatures in the Saskatchewan River during the study period ranged from10-12.5°C, with a maximum temperature occurring on 06 June (first day of sampling) (Figure 2). However, immediately after sampling was initiated, water temperatures stabilized at 10°C and showed only minor daily fluctuations until completion of the sampling program on 14 June. Previous studies by Wallace (1999 [study years 1996 and 1997]) documented similar temperature variations (10-13°C) during the first two weeks of June.

3.2 SAMPLING LOCATIONS

Figure 3 illustrates the location of study area maps that show specific sampling sites. Habitat parameters (depth, velocity, and substrate) were measured on 158 transects established between

Bigstone Rapids, Saskatchewan and the Summerberry River downstream of The Pas, Manitoba (Figures 4-14). Habitat parameters were also assessed at 97 selected sites and shoreline features were documented at 35 locations in the study area. Gill nets were set at 48 different locations, hoop nets were set at five locations, and drift nets were set at 12 locations (Figures 15-25). The following is a list of sampling sites within each river segment:

Map 1: (Saskatchewan) 0-10km

- Transects (0-10); Habitat Sites (S1-S13); Shoreline Sites (0.0-1.5)
- Gill Net Sets (1,2,5); Hoop Net Sets (N/A); Drift Net Sets (1-4)

Map 2: (Saskatchewan) 11-24km

- Transects (11-24); Habitat Sites (S14-S29); Shoreline Sites (1.6-1.9)
- Gill Net Sets (3-4); Hoop Net Sets (N/A); Drift Net Sets (1-4)

Map 3: (Saskatchewan) 25-38km

- Transects (25-38); Habitat Sites (S30-S40); Shoreline Sites (2.0-2.7)
- Gill Net Sets (6-11); Hoop Net Sets (N/A); Drift Net Sets (1-4)

Map 4: (Saskatchewan/Manitoba) 39-55km

- Transects (39-55); Habitat Sites (S41-S53); Shoreline Sites (2.8-3.0)
- Gill Net Sets (12-20); Hoop Net Sets (1); Drift Net Sets (5-6)

Map 5: (Manitoba) 56-74km

- Transects (56-74); Habitat Sites (S54-S69); Shoreline Sites (3.1-3.4)
- Gill Net Sets (21-23); Hoop Net Sets (2); Drift Net Sets (N/A)

Map 6: (Manitoba) 75-88km

- Transects (75-88); Habitat Sites (S70-S75); Shoreline Sites (3.5)
- Gill Net Sets (24); Hoop Net Sets (N/A); Drift Net Sets (N/A)

Map 7: (Manitoba) 89-103km

- Transects (89-103); Habitat Sites (S76-S84); Shoreline Sites (3.6)
- Gill Net Sets (25-29); Hoop Net Sets (3); Drift Net Sets (7-8)

Map 8: (Manitoba) 104-119km

- Transects (104-119); Habitat Sites (S85-S87); Shoreline Sites (3.7)
- Gill Net Sets (30-32 and 34-35); Hoop Net Sets (4); Drift Net Sets (9-10)

Map 9: (Manitoba) 120-132km

- Transects (120-132); Habitat Sites (S88-S92); Shoreline Sites (3.8-4.0)
- Gill Net Sets (33,37-39); Hoop Net Sets (N/A); Drift Net Sets (N/A)

Map 10: (Manitoba) 133-149km

- Transects (133-149); Habitat Sites (S93-S97); Shoreline Sites (4.1)
- Gill Net Sets (40-42); Hoop Net Sets (5); Drift Net Sets (11-12)

Map 11: (Manitoba) 150-157km

- Transects (150-157); Habitat Sites (N/A); Shoreline Sites (4.2-4.4)
- Gill Net Sets (43-48); Hoop Net Sets (N/A); Drift Net Sets (13-14)

3.3 HABITAT

Habitat data were collected at 177 sites in Saskatchewan (130 quarter points on 46 transects, and 47 selected sites) and from 379 sites in Manitoba (329 quarter points on 112 transects, and 50 selected sites). Habitat site locations (UTM co-ordinates) and habitat data are provided in Appendix 1. Riparian characteristics at 35 shoreline sites are provided in Appendix 2.

3.3.1 Substrate Composition and Compaction

Substrates were generally composed of a mixture of particle sizes. To facilitate analyses, substrate data were summarized into five categories of substrate composition as follows:

Category	*Substrate Composition*
1	mud/silt as dominant substrate
2	sand as dominant substrate with silt and gravel (low) as secondary
3	sand as dominant substrate with cobble and gravel (high) as secondary
4	boulder as dominant substrate with cobble as secondary
5	bedrock

Distribution of the above substrate categories within the study area is illustrated in Figures 26-36.

Overall, 73% of Saskatchewan River substrates identified were primarily sand based, with silt, gravel, and/or cobble as a secondary component. Mud and silt substrates were identified in approximately 24% of the sample locations. Boulder mixed with cobble substrates and bedrock were located in less than 3% of sampling locations.

Eighty percent of the substrate classified was categorized as hard compaction and only 4% was categorized as soft compaction. Moderate to softly compacted substrates were much more prevalent in Manitoba (approximately 28%) than in Saskatchewan (<4%).

The study area was divided into four reaches based on the above substrate categories (Table 1). The area encompassing transects 0-10 was characterized by all five substrate categories and had a much higher proportion of boulder, cobble, and bedrock substrate types (approximately 60%) than other reaches further downstream. In the area encompassing transects 11-95, sand (approximately 85%) was the dominant substrate type with relatively low proportions of silt, gravel, and cobble deposits. Between transects 96 and 120, substrates identified were almost exclusively mud and silt (approximately 97%). Substrates were more diverse downstream of Transect 121 (The Pas region), but were still predominantly sand based.

3.3.2 Water Velocity

Site-specific water velocities (mean velocity at quarter points > 1m deep) within the study area ranged from 0.25-1.15 m/s. In general, water velocities decreased as sampling progressed downstream (Table 2). The highest velocities were detected in the Cumberland House region where boulders and cobble were prevalent. The lowest velocities were located downstream of Big Bend where mud and silt substrates were dominant.

As expected, substrate types within each reach of the Saskatchewan River were related to water velocity. The highest water velocities were associated with Type 4 substrates (e.g. dominated by boulder and cobble), while the lowest water velocities were associated with Type 1 substrates (e.g. mud and silt as dominant substrate). Velocity measurements for each transect measured between Bigstone Rapids and Summerberry River are summarized in Appendix 3.

3.3.3 Depth

Cross-sectional profiles of the Saskatchewan River were generally deeper in the Manitoba portion of the survey area than in Saskatchewan. Maximum transect depths in Manitoba ranged from 0.90-18.00 m (mean= 5.55 m) compared to 0.90-7.55 m (mean= 3.18 m) in Saskatchewan. Site-specific depths and maximum transect depths measured between Bigstone Rapids and the Summerberry River are illustrated in Figures 37-47. Mean transect depths are summarized in Appendix 3.

Depths generally decreased as substrate particle size increased (Table 3). Substrates with mud/silt as the dominant component had a mean depth of 6.16 m compared to a mean depth of 3.56 m for substrates with boulders as the dominant component.

3.3.4 Riparian Features

A summary of riparian features documented between Bigstone Rapids and the Summerberry River during June, 2000, is presented in Appendices 1 and 2.

In general, riparian features were homogeneous throughout the study area. Gently sloping shorelines, moderate flood plain expanses, and depositional sand flats were common on the majority of inside

bends surveyed (Figure 48). Bank instability (cut banks, slumping, and erosion) was common on most outside river bends and on many of the straight (non-meandering) segments of the Saskatchewan River (Figure 49). Exposed, flat expanses of sand and pea-sized gravel were identified in the upper reaches of the study area (Figure 50). Boulder and cobble shorelines were evident in several locations near The Pas (Figure 51).

Crown foliage along Saskatchewan River shorelines was composed primarily of balsam poplar (*Populus balsamifera*) (primary) mixed with balsam fir (*Abies balsamea*), white spruce (*Picea glauca*), white birch (*Betula papyrifera*), and american elm (*Ulmus americana*)(secondary). The vigorous understory bordering the river banks was composed primarily of willows (*Saliw spp.*), alders (*Alnus spp.*), and reedgrass (*Phragmites communis*). No submergent or emergent instream vegetation was identified in the study area.

3.4 HABITAT UTILIZATION

A total of 81 fish, representing nine species, were captured in the Saskatchewan River during the study period (6-14 June). Gill net set locations (Figures 15-25) were limited by high debris, increased flows, and domestic utilization of suitable fishing locations. Details on habitat types in which gill nets were set are provided in Appendix 4.

Twenty-five fish were captured in 48 gill net sets. The catch included: seven northern pike (*Esox lucius*), six walleye (*Stizostedion vitreum*), four white sucker (*Catostomus commersoni*), three lake sturgeon, two longnose sucker (*Catostomus catostomus*), one goldeye (*Hiodon alosoides*), one burbot (*Lota lota*), and one carp (*Cyprinus carpio*) (Appendix 4). Four white sucker were captured in five hoop net sets (Appendix 5). The drift net catch was comprised of 42 sucker larvae, 5 cyprinid larvae, 3 walleye larvae, and 2 yellow perch (*Perca flavescens*) larvae (Appendix 6). Sucker larvae were captured from 9-13 June. Walleye larvae were captured only on 13 June. It is probable that drift of lake sturgeon larvae in 2000 would have occurred after the survey was completed.

Two lake sturgeon were captured in Saskatchewan and one was captured in Manitoba (Table 4). The two larger sturgeon (total lengths 775 mm and 786 mm) were captured in a 12" (305 mm) mesh net at GN-06 Site located on the downstream end of an island near the most upstream outlet of the Tearing River (Figure 17). Physical habitat parameters measured at Transect 26, immediately

downstream of GN-06 site, had a mean depth of 3.59 m and a mean water velocity of 1.04 m/s, which was the highest water velocity of any transect in the study area. Substrate composition in this area (GN-06 Site) was hard packed sand, mixed with cobble, gravel, and boulders. The two sturgeon captured weighed 3400 and 3700 g, and were 10 and 12 years old, respectively. Neither sturgeon captured at GN-06 Site showed signs of current year reproductive activity.

A single 123 mm juvenile sturgeon (Figure 52) was captured in 3" (76 mm) mesh at GN-29 Site downstream of "Big Bend" (Figure 21). The site had a mean depth of 6.15 m and a mean water velocity of 0.50 m/s. Substrate was primarily sand, with a small amount of silt and gravel. The juvenile lake sturgeon weighed approximately 50 g and was determined to be two years of age (Table 4).

Lake sturgeon catch-per-unit-effort was 3 fish per 50 yards of net set over 703.76 hours or 0.002 sturgeon per yard per day. All fish captured, including the three lake sturgeon, were free of deformities, erosion, lesions, and tumours.

4.0 DISCUSSION

4.1 HABITAT

Habitat parameters (e.g. depth, velocity, and substrate) within a stream are generally related to the surrounding geology and geomorphology. Upstream of Cumberland House, the Saskatchewan River flows over a relatively steep gradient, decreasing approximately 138 m in elevation from the "Forks" (convergence of the North and South Saskatchewan rivers) near Prince Albert to Squaw Rapids. Historically, there were a number of rapids within this reach of the river which provided potential for hydroelectric generation. The EB Campbell Generating Station was constructed at Squaw Rapids during the 1960s to take advantage of this potential.

The lower Saskatchewan River, downstream of Squaw Rapids, has a much lower stream gradient than upstream reaches and ultimately flows through a relatively thick layer of glacio-lacustrine till with deposits of sands, silts, and clays overlying sedimentary bedrock. With the exception of Bigstone Rapids (Figure 53), no other locations within the study area were identified as having bedrock substrate.

Although much less distinct than the gradient differences above and immediately downstream of Squaw Rapids, river gradient gradually changes within the 158 km study area. A slightly higher gradient in Saskatchewan generally results in shallower water depths and higher velocities compared to the reaches downstream into Manitoba. While the differences in depth and velocity are barely detectable on a reach by reach basis, differences in substrates are more obvious. Classification of substrates allows habitat in the lower Saskatchewan River to be delineated into the following four reaches: Transects 0-10; Transects 11-95; Transects 96-120; and Transect 121-157 (Summerberry River).

The upper reach of the study area, from Bigstone Rapids to 10 km downstream (Transect 10), was characterized by relatively fast velocities (mean= 0.70 m/s; maximum 1.15 m/s), shallow depths (mean= 2.92 m; maximum 6.40 m), and a variety of substrates (composed of boulder, sand, mud, and silt). This reach of the Saskatchewan River had the highest proportion of rock and boulder substrate of all reaches in the study area.

The reach encompassing transects 11-95, including the Tearing River mouths (1st and 2nd outlets), Saskatchewan/Manitoba border, and Big Bend, was characterized by relatively deeper water (mean= 4.73 m; maximum 18.00 m), lower water velocities (mean= 0.61 m/s; maximum 0.66 m/s) , and more uniform substrates. Substrates within this reach were almost exclusively sand based, with some gravel and silt.

From Transect 96 (downstream of Big Bend) to Transect 120 (upstream of The Pas) substrates were almost exclusively mud and silt. Although river depths did not change substantially, on average, this segment was the deepest portion of the study area (mean= 6.2 m). In addition, mean transect water velocities decreased further in this reach (mean= 0.50 m/s) and showed little variation (0.48-0.60 m/s).

Habitat within the most downstream reach of the study area, from Transect 121 (near The Pas) to Transect 157 (Summerberry River), was considerably more diverse than the preceding two upstream reaches. Although water velocities changed little, mean depths decreased and a greater variety of substrate types occurred. The proportion of boulder, cobble, and gravel substrates increased to over 30%.

4.2 HABITAT UTILIZATION

Lake sturgeon utilization of Saskatchewan River habitat from EB Campbell Generating Station at Squaw Rapids downstream to the Manitoba border was investigated by Wallace (1999) during the 1990s. By soliciting local knowledge, Wallace identified at least six potential lake sturgeon spawning areas, including: Torch River, Tobin and Squaw Rapids, EB Campbell Generating Station Tailrace, Bigstone Rapids, Mossy River, and the Tearing River. The capture of ripe fish and/or larvae by Wallace (1999) at EB Campbell Station Tailrace, the Torch River, and Bigstone Rapids, provided further evidence that lake sturgeon spawned in these locations. According to Wallace (1999), the large broken rock in the moderately large Bigstone Rapids (Figure 53) provides excellent spawning conditions for lake sturgeon. Water velocities measured immediately downstream of the rapids in June, 2000, averaged 0.51 m/s and depths ranged from 1.6-2.1 m. It is expected that water velocities would be higher and depths would be shallower within the rapids. The conditions in Bigstone Rapids appear appropriate for lake sturgeon spawning, given that sturgeon are known to

spawn in water depths between 0.6 m and 4.5 m (Scott and Crossman 1998) and in water velocities in excess of 0.15 m/s (Kempinger 1988).

Few lake sturgeon were captured in the vicinity of Bigstone Rapids during spring, 2000, compared to previous years (J. Durbin, SERM, Prince Albert, pers. comm). As part of this study, three 9" (228 mm) and 12" (305 mm) gill nets set near the rapids for a combined total of 45 hours on 06 June 2000 did not capture any sturgeon. A spawn taking program conducted by SERM captured only eight lake sturgeon at Bigstone Rapids during May/June 2000 (J. Durbin, SERM, pers. comm.). Similar netting programs conducted within the vicinity of the rapids during spring, 1999, yielded a total of 92 lake sturgeon (Wallace 1999).

The apparent absence of sturgeon at Bigstone Rapids (a known spawning area) during spring, 2000, may have been related to a combination of factors. Water temperature remained at 10°C for an extended period of time during the usual spawning period in early June, and did not reach the optimum lake sturgeon spawning temperature of between 13°C and 18°C (Scott and Crossman 1998) until at least the third week of June. In addition, Saskatchewan River flows were less than half historical average flow volumes for this period (371.0 m^3/s for June 2000; compared to a mean of 809.0 m^3/s for June 1970-1990).

During six years of study on the Sturgeon River, Wisconsin, USA, Auer (1996) found that sexually mature lake sturgeon often did not achieve spawning condition even though optimum spawning temperatures were reached. Auer linked these occurrences to the years when an upstream hydroelectric facility was operated as a peaking station (i.e. water was stored for power generation during periods of high demand). Only in run-of-the-river (ROR) flow operation years were numerous ripe-and-running sturgeon observed. Auer (1996) hypothesized that adequate water flows, during periods when water temperatures are optimum, may be an important trigger for spawning for some lake sturgeon populations. Because many fish, such as sturgeon, migrate to optimize reproductive success, it may be to their advantage to minimize the amount of time they spend on the spawning grounds if food and protective cover are not available (McKeown 1984, in Auer 1996). If physical conditions were not adequate for spawning in the vicinity of Bigstone Rapids during spring, 2000, sexually mature sturgeon may have moved elsewhere to maximize spawning and foraging opportunities.

Wallace (1999) concluded that there were few, if any, other potential lake sturgeon spawning locations between Bigstone Rapids and the Manitoba/Saskatchewan border. For the first 10 km downstream of the rapids, a high proportion of boulder, cobble, and gravel substrate (approximately 60%) was noted, and water velocities were within the desired range for sturgeon spawning (mean range of 0.62-0.87 m/sec). However, deep water (>2m) within this reach of the Saskatchewan River and further downstream precludes the occurrence of turbulent water habitat, which by most accounts (e.g. Harkness and Dymond 1961, Kempinger 1988, Scott and Crossman 1998), seems to be a pre-requisite for successful sturgeon reproduction. The Tearing River (1st Outlet), immediately upstream of Transect 26, has been identified as a possible spawning location (Bob Fudge and Doug Leroux, pers comm, in Wallace 1999) because it offers widespread rock and cobble substrate. However, flows observed in the Tearing River during the current survey were negligible, and it is unlikely that sturgeon spawned in the river during spring, 2000. Some boulder, gravel, and cobble substrate and relatively high water velocities (>1 m/sec) were noted in the Saskatchewan River near the mouth of the Tearing River (Transect 26), but depths were generally 2-4 m and flows were not turbulent. In addition, this area is known as a popular domestic fishing location, and Wallace (1999) has reported catching mature sturgeon weighing up to 60 lbs [27 kg]) in the region. Whether this location is a staging area for pre-spawning sturgeon, or just a suitable location for setting nets, is not known. Two immature sturgeon (mean= 780 mm) were captured off the island adjacent to the Tearing River mouth in approximately 2.5 m of water on 08 June, 2000.

The reach encompassing transects 11 to 95, including the Tearing River mouths (1st and 2nd outlets), the Manitoba/Saskatchewan border, and Big Bend, provides uniform, deepwater run habitat with substrates composed primarily of sand. Within this reach, near Transect 93, a single 123 mm, two year-old sturgeon was captured (Figure 52). Kempinger (1996) reported that all young-of-the-year (YOY) sturgeon captured during a study in the Wolf River, Wisconsin, were taken on flat substrates composed of coarse sand and pea-sized gravel, where there was a detectable current. Substrates with rooted aquatic plants did not yield any young lake sturgeon. Sibkin and Bibikov (1988 in Kempinger 1996) stated that "young [sturgeon] apparently avoid zones with vegetation because such zones are mechanical factors that hinder their feeding, orientation, and movement". Observations of captive lake sturgeon in aquaria also have shown that young sturgeon clearly prefer a sandy substrate and avoid uneven bottoms and vegetation (Sibkin and Bibikov 1988, in Kempinger 1996; Steve Peake, North/South Consultants Inc. pers. comm.; S. Matkowski, Manitoba Fisheries Branch, Fish Culture, pers. comm.). Kempinger (1996) suggested that the preference of young sturgeon for sand substrates

may be important for avoiding predation because they blend in visually with the sand background. The abundant sand substrate composition between transects 11 and 95 provides ideal rearing habitat for young sturgeon in the Saskatchewan River.

Kempinger (1996) reported that most YOY sturgeon captured from the Wolf River, Wisconsin, were taken in depths of less than 1.5 m. However, this may be more an artifact of his sampling methods (seining and boat electrofishing) than a habitat preference. Kempinger did not investigate deep water habitat areas, which may be just as important for juvenile sturgeon as are shallower areas. The deeper areas may be especially important for young sturgeon in rivers such as the Saskatchewan, where significant daily water level fluctuations occur due to hydroelectric operations.

In contrast to adult lake sturgeon which are opportunistic feeders and consume a wide variety of organisms, juvenile sturgeon have a much more restricted diet. Kempinger (1996) reported that Baetidae (mayfly) nymphs and Diptera larvae (mostly chironomids or midges) were the two principle food items consumed by lake sturgeon during their first summer of growth in the Wolf River, Wisconsin. Kempinger (1996) also stated that the coarse sand substrates that are desirable for YOY sturgeon are also desirable for the dipteran larvae and Baetidae nymphs that they consume. Given the restricted preferences of YOY sturgeon for particular substrates and dietary items, the availability of sand substrates in the Saskatchewan River for rearing may be just as critical to the sustainability of sturgeon populations as the availability of suitable spawning areas.

The area encompassing transects 96-120 (downstream of Big Bend), which was characterized predominately by mud and silt substrates, may be less suitable for juvenile sturgeon than upstream reaches within the study area. Kempinger (1996) did not find young lake sturgeon utilizing fine detritus substrates, and Levin (1988, in Kempinger 1996) concluded that feeding conditions for juvenile sturgeon were inferior on silt. While this reach may not be optimal for young sturgeon, it may provide an important foraging area for adult sturgeon. Wallace (1999) reported that food items available for lake sturgeon in the Saskatchewan River were most abundant downstream of Squaw Rapids, in side channels and in regions where water velocities were lower and substrates were more clay based.

Habitat in the lower Saskatchewan River between transects 121 and 157 is relatively diverse and probably provides foraging habitat for all life stages of lake sturgeon.

4.3 CATCH-PER-UNIT-EFFORT

The low number of lake sturgeon captured within the study area (n=3) was not surprising given that the survey did not target prime fishing areas. Nevertheless, the catch rate (0.0020 sturgeon/yard/day) was similar to the catch rate reported by Wallace and Leroux (1999) for index fishing in Saskatchewan in 1996 (0.0032 sturgeon/yard/day). These rates are significantly lower than catch rates reported for Alberta reaches of the Saskatchewan River (0.0291 sturgeon /yard/day)(RLL 1991 in Wallace and Leroux 1999) and for Ontario Rivers (up to 0.0107) (Seylor 1997, in Wallace and Leroux 1999). It should be noted that comparisons of catch-per-unit-effort data for sturgeon must be viewed with caution because of the tendency for sturgeon to congregate in distinct areas. Fouling of nets with debris may also decrease CPUE in the Saskatchewan River compared to rivers in Ontario and elsewhere.

4.4 GROWTH

The two larger lake sturgeon (10 and 12 years old) captured in the Saskatchewan River during June, 2000, were of comparable size (mean total length =780 mm) to sturgeon of similar age captured by Sunde (1961) from the Nelson River, Manitoba. Thuemler (1985) reported similar size classes for 10-12 year old lake sturgeon from the Menominee River, Wisconsin, but much larger sizes (>1000 mm) for similar age sturgeon from Lake Winnebago, Wisconsin.

Capture of the two year-old, 123 mm, juvenile sturgeon during the study showed relatively slow growth compared to populations further south. Kempinger (1996) found that juvenile lake sturgeon in the Wolf River, Wisconsin, attained a length of 159 mm after 91 days. Ceskleba et al. (1985) reported a mean length of 101 mm after 123 days for hatchery reared lake sturgeon from the Fox River, Wisconsin. The slower growth rate for Saskatchewan River lake sturgeon (i.e. 123 mm in approximately 184 growing days) is attributable to colder water temperatures and a shorter growing season (i.e. July through September or approximately 92 days per year).

4.5 SAMPLING JUVENILE LAKE STURGEON

There have been few studies conducted on the importance of rearing habitat to lake sturgeon primarily because of the difficulty of catching juvenile fish. Kempinger (1996) found that the most effective way to sample YOY sturgeon was with an electrofishing boat. However, he also noted that

water level and clarity were major factors affecting the catch of YOY sturgeon while electrofishing. After being electroshocked, YOY sturgeon rarely surfaced upwards into the water column like other fish, but characteristically wiggled slightly and rolled with the current along the bottom. This behaviour and the species cryptic colouration made successful sampling difficult. Given the high turbidity, boat electrofishing would not be a viable option for sampling YOY sturgeon from the Saskatchewan River. Golder Associates Ltd. (1999) electrofished for lake sturgeon at Bigstone Rapids during spring, 1999, and concluded that it was an ineffective method for capturing sturgeon under the conditions encountered in the Saskatchewan River.

Kempinger (1996) reported that seining was the second most effective method for sampling young sturgeon in the Wolf River. This method yielded few YOY sturgeon at first, but after a tickler chain was added in front of the bottom edge of the seine to scare sturgeon off the bottom and into the water column, catches increased in the final year of the program (Kempinger 1996). This method of sampling may be effective for catching YOY sturgeon in shallow margins of the Saskatchewan River mainstem. An alternative to gill nets for sampling in the deep middle portion of the Saskatchewan River channel has not been identified.

4.6 DOMESTIC FISHING

In large, turbid, fast-flowing rivers such as the Saskatchewan River, gill nets can only be set effectively in backwaters or areas where currents are deflected. During the June, 2000, habitat survey it was noted that a high proportion of backwater or deflected current sites (at least 20) between Bigstone Rapids and Summerberry River were occupied by markers or floats (e.g. plastic 2L bottles). Because survey nets were not set in locations where markers were noted, it was often difficult to find suitable locations to set sampling gear in some river segments. Although markers were noted along most of the river, the majority were concentrated in the following locations: Bigstone Rapids, Tearing River, Big Bend, and in the vicinity of The Pas. In addition, a commercial fishing operation was observed downstream of The Pas in the vicinity of Buck Island, where markers were identified at approximately 17 locations between transects 151 and 152 (Figure 14). It should be noted that none of the markers were checked for identification and the nets that ***may*** have been attached were not lifted to check for mesh size or length. However, if the markers observed are indicative of fishing nets, the potential harvest of sturgeon from this fishery would be of concern to the sustainability of the Saskatchewan River lake sturgeon population.

5.0 CONCLUSIONS

1) Bigstone Rapids in Saskatchewan was the only location within the 157 km study area that provided suitable lake sturgeon spawning habitat during spring, 2000.

2) The Saskatchewan River between Bigstone Rapids and the Summerberry River can be separated into four reaches based on substrate characteristics. The first reach, located between Bigstone Rapids and 10 km downstream, was characterized by a relatively high proportion of boulder, cobble, and gravel substrate, higher water velocities, and shallower depths than other portions of the study area. The second reach, between Transect 10 and downstream of Big Bend (Transect 95), was characterized by predominately sand substrate, deeper water (up to 18.00 m), and slower water velocities compared to the Cumberland House region. The third reach, from downstream of Big Bend (Transect 96) to The Pas (Transect 120), was characterized by mud and silt substrates, relatively deep water, and slower water velocities. The fourth reach, from The Pas (Transect 121) downstream to the Summerberry River (Transect 157), was characterized by more diverse substrates, depths, and water velocities.

3) Sand substrates between transects 11 and 95 may provide important rearing habitat for young-of-the-year and juvenile lake sturgeon.

4) The study reach encompassing transects 96-120 may be less suitable for juvenile lake sturgeon than upstream areas due to the higher percentage of mud and silt substrate. However, this reach may provide an important foraging area for adult sturgeon.

5) Diverse habitat from The Pas downstream to the Summerberry River may provide foraging habitat for a number of lake sturgeon life history stages.

6) Growth of adult lake sturgeon from the Saskatchewan River appears comparable to sturgeon from the Nelson River, in northern Manitoba. Slower growth of juvenile sturgeon from the Saskatchewan River compared to more southerly populations is probably attributable to cooler water temperatures and a shorter growing season.

7) Boat electrofishing is known to be an effective sampling method to capture young sturgeon, but would not be practical for this purpose in the Saskatchewan River because of high turbidity levels. Seining may be an effective alternative method to capture young sturgeon on the shallow margins of the river mainstem.

8) A large number of markers (floats), that were suspected to be attached to nets, were observed between Bigstone Rapids and the Summerberry River during the survey. If indicative of domestic fishing pressure, the presence of these markers are of concern to the sustainability of the Saskatchewan River lake sturgeon population.

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Table 1. Substrate composition (%) by river segment, Saskatchewan River, June, 2000.

Transects	Location	Substrate Composition (%)[1]			
		1	2	3	4
0-10	Cumberland House, SK, including Bigstone Rapids	10.0	30.0	40.0	20.0
11-95	Tearing River, SK/MB Border including Big Bend	3.3	84.4	12.2	-
96-120	Downstream of Big Bend to The Pas, MB	96.5	-	-	3.4
121-157	The Pas, MB downstream to Summerberry River	22.0	43.9	31.7	2.4
0-157	*All*	*24.1*	*57.0*	*16.4*	*2.5*

[1] **Substrate Composition Classifications:**

1 = mud/silt as dominant substrate
2 = sand as dominant substrate with silt and gravel (low) as secondary
3 = sand as dominant substrate with cobble and gravel (high) as secondary
4 = boulder as dominant substrate with cobble as secondary

5 = bedrock

Note: Bedrock was not used for comparison purposes due to limited distribution

Table 2. Mean velocities (m/s) by substrate type and river segment, Saskatchewan River, June, 2000.

		Substrate Type[1]														
		1			2			3			4			All		
Transects	Location	Mean	Mean Range	Max^	Mean	Mean Range	Max^	Mean	Mean Range	Max^	Mean	Mean Range	Max^	Mean	Mean Range	Max^
0-10	Cumberland House, SK, including Bigstone Rapids	0.65	-	1.07	0.62	0.41-1.03	0.66	0.70	0.64-0.76	0.81	0.87	0.76-0.98	1.15	0.70	0.62-0.87	1.15
11-95	Tearing River, SK/MB Border including Big Bend	0.53	0.50-0.55	0.64	0.59	0.39-1.03	1.03	0.75	0.58-1.04	1.05	-	-	-	0.61	0.53-0.75	1.05
96-120	Downstream of Big Bend to The Pas, MB	0.48	0.38-0.59	0.64	-	-	-	-	-	-	0.60	-	0.66	0.50	0.48-0.60	0.66
121-157	The Pas, MB downstream to Summerberry River	0.48	0.47-0.49	0.56	0.50	0.45-0.62	0.62	0.49	0.44-0.61	0.66	0.50	-	0.61	0.49	0.48-0.50	0.66
0-157	*All*	*0.49*	*0.38-0.65*	*1.07*	*0.58*	*0.39-1.03*	*1.03*	*0.63*	*0.44-1.04*	*1.05*	*0.71*	*0.76-0.98*	*1.15*	*0.57*	*0.48-0.87*	*1.15*

[1]Substrate Type Classifications:

1 = mud/silt as dominant substrate
2 = sand as dominant substrate with silt and gravel (low) as secondary
3 = sand as dominant substrate with cobble and gravel (high) as secondary
4 = boulder as dominant substrate with cobble as secondary

5 = bedrock

Note: Bedrock was not used for comparison purposes due to limited distribution

^ = maximum velocity includes transect and site specific measurements

Table 3. Mean transect depths (m) and maximum depth measured by substrate type and river segment, Saskatchewan River, June, 2000.

		Substrate Type[1]														
		1			2			3			4			All		
Transects	Location	Mean	Mean Range	Max^	Mean	Mean Range	Max^	Mean	Mean Range	Max^	Mean	Mean Range	Max^	Mean	Mean Range	Max^
0-10	Cumberland House, SK, including Bigstone Rapids	3.57	-	4.40	5.47	-	6.40	2.80	2.73-2.83	4.10	1.94	1.87-2.00	3.58	2.92	1.87-2.83	6.40
11-95	Tearing River, SK/MB Border including Big Bend	6.74	6.15-7.71	11.77	4.82	0.90-11.86	18.00	3.79	1.69-7.45	9.50	-	-	-	4.73	0.90-11.90	18.00
96-120	Downstream of Big Bend to The Pas, MB	6.69	3.28-13.49	14.82	-	-	-	-	-	-	6.20	-	8.38	6.20	3.28-13.49	14.82
121-157	The Pas, MB downstream to Summerberry River	4.62	2.76-6.58	9.45	4.85	2.58-15.59	15.59	4.62	3.19-6.64	8.28	4.17	-	4.67	4.31	2.76-15.59	15.59
0-157	*All*	*6.16*	*2.76-13.49*	*14.82*	*4.83*	*0.90-15.59*	*18.00*	*4.13*	*1.69-7.45*	*9.50*	*3.56*	*1.87-2.20*	*8.38*	*4.81*	*0.90-15.59*	*18.00*

[1]**Substrate Type Classifications:**

1 = mud/silt as dominant substrate
2 = sand as dominant substrate with silt and gravel (low) as secondary
3 = sand as dominant substrate with cobble and gravel (high) as secondary
4 = boulder as dominant substrate with cobble as secondary

5 = bedrock

Note: Bedrock was not used for comparison purposes due to limited distribution

^ = maximum depth includes transect and site specific measurements

Table 4. Summary of lake sturgeon captured in gill nets from the Saskatchewan River, June, 2000.

Date	Site	Gear Type[1]	Map Location	Water Temperature (°C)	Mesh Size (mm)	Duration (hrs)	Habitat Classification[2]		Total Length (mm)	Fork Length (mm)	Weight (g)	Age (yrs)	Floy Tag No.	PIT Tag No.
							Substrate	Compaction						
8-Jun	GN-06	GN	3	11.0	305	19.62	3	A	786	775	3700	12	NSC43002	127257112A
8-Jun	GN-06	GN	3	11.0	305	19.62	3	A	775	758	3400	10	NSC43003	127261524A
10-Jun	GN-29	EXP	7	10.0	-	2.42	2	A	123	100	50	2	-	-

Codes

[1]Gear Types:

GN = Gill Net
EXP = Experimental Gillnet

[2]Habitat Classification:

1 = mud/silt as dominant substrate
2 = sand as dominant substrate with silt and gravel (low) as secondary
3 = sand as dominant substrate with cobble and gravel (high) as secondary
4 = boulder as dominant substrate with cobble as secondary

A - Hard
B - Medium
C - Soft

Note: Experimental gillnet gang constructed of 6-25 m long, 1.8 m deep, panels of 38, 51, 76, 127, 228, 305 mm mesh.

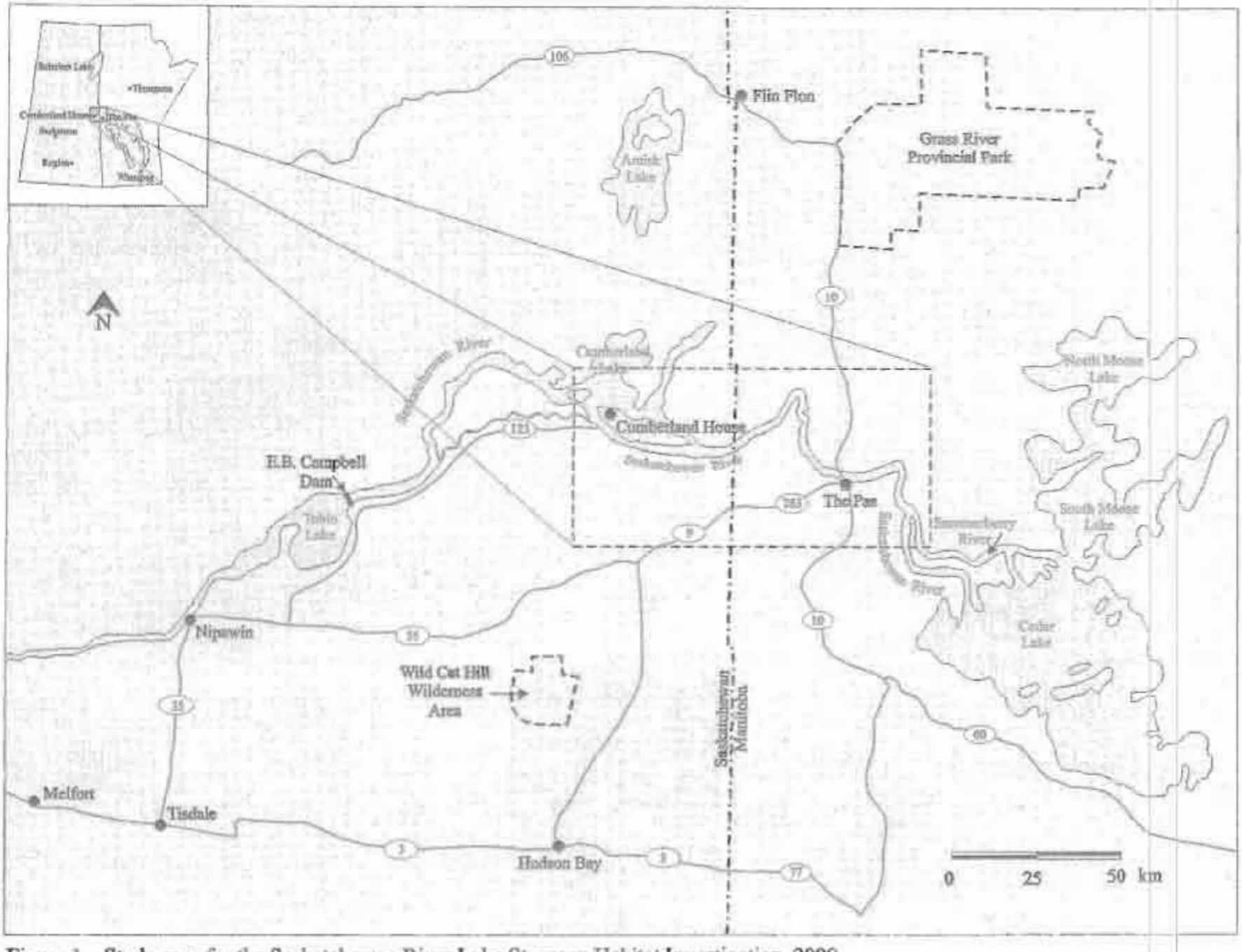

Figure 1. **Study** area for the Saskatchewan River Lake Sturgeon Habitat Investigation, 2000.

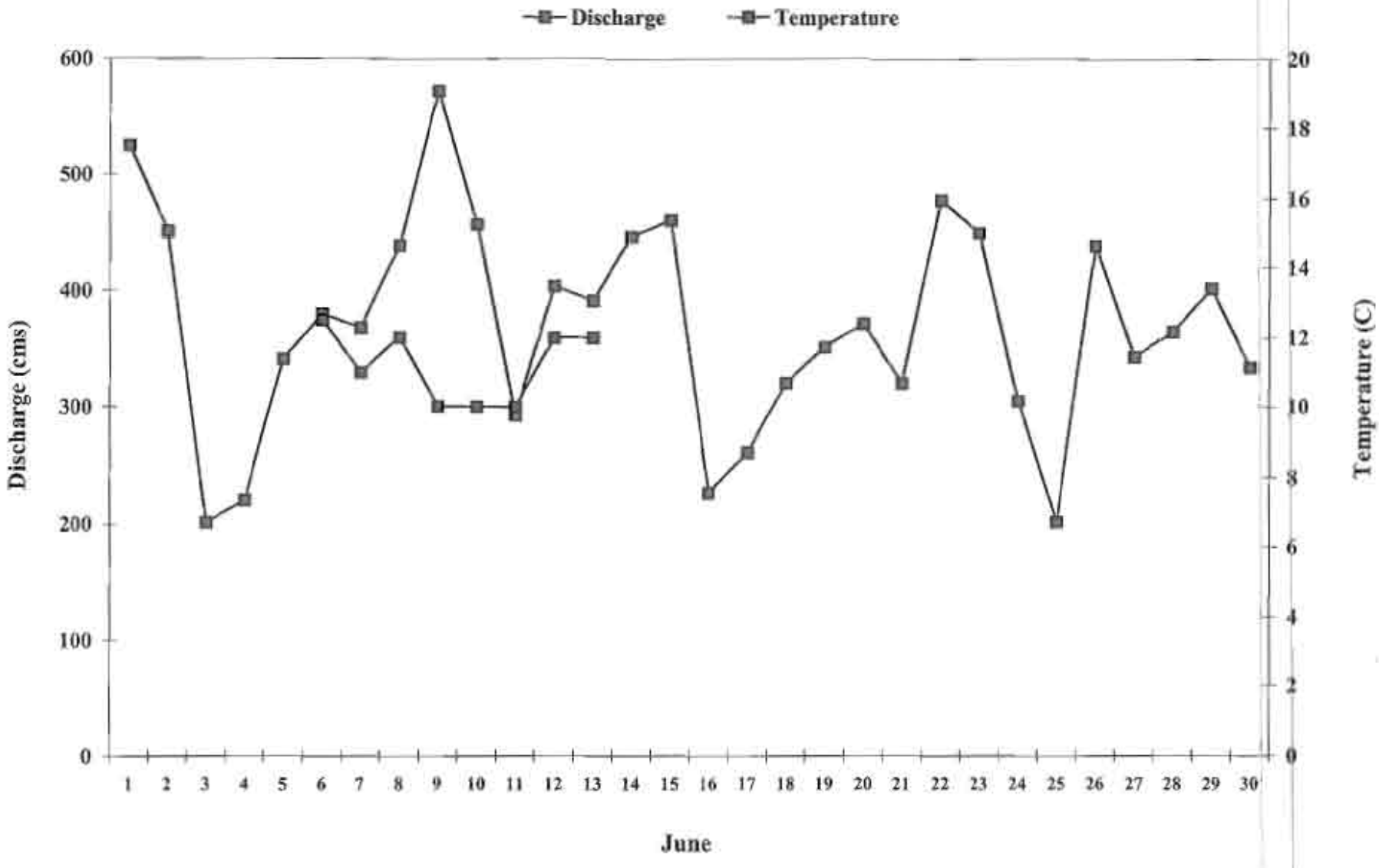

Figure 2. Estimated daily discharge (@ E.B. Campbell Generating Station release) and maximum daily water temperature of the Saskatchewan River, June, 2000.

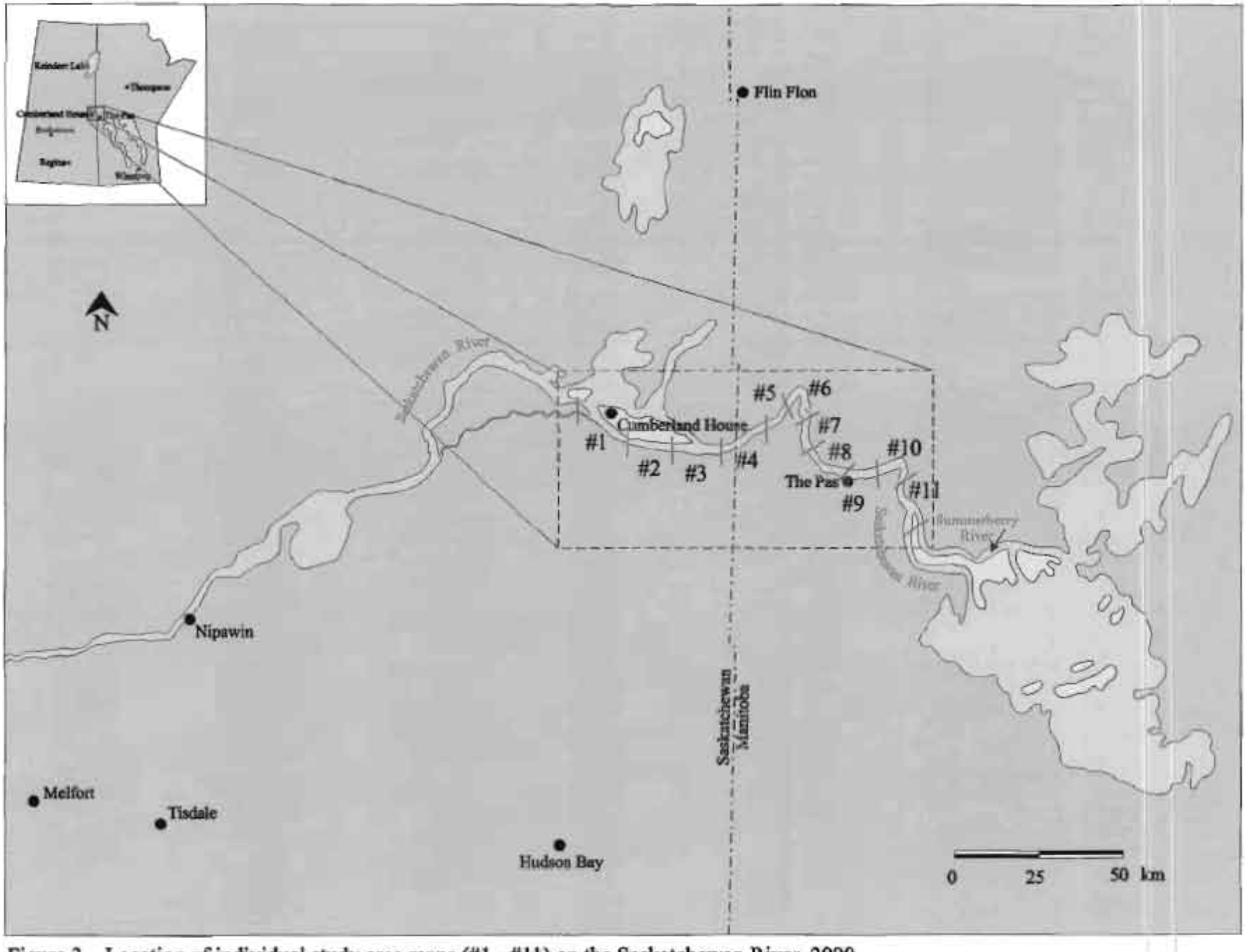

Figure 3. Location of individual study area maps (#1 - #11) on the Saskatchewan River, 2000.

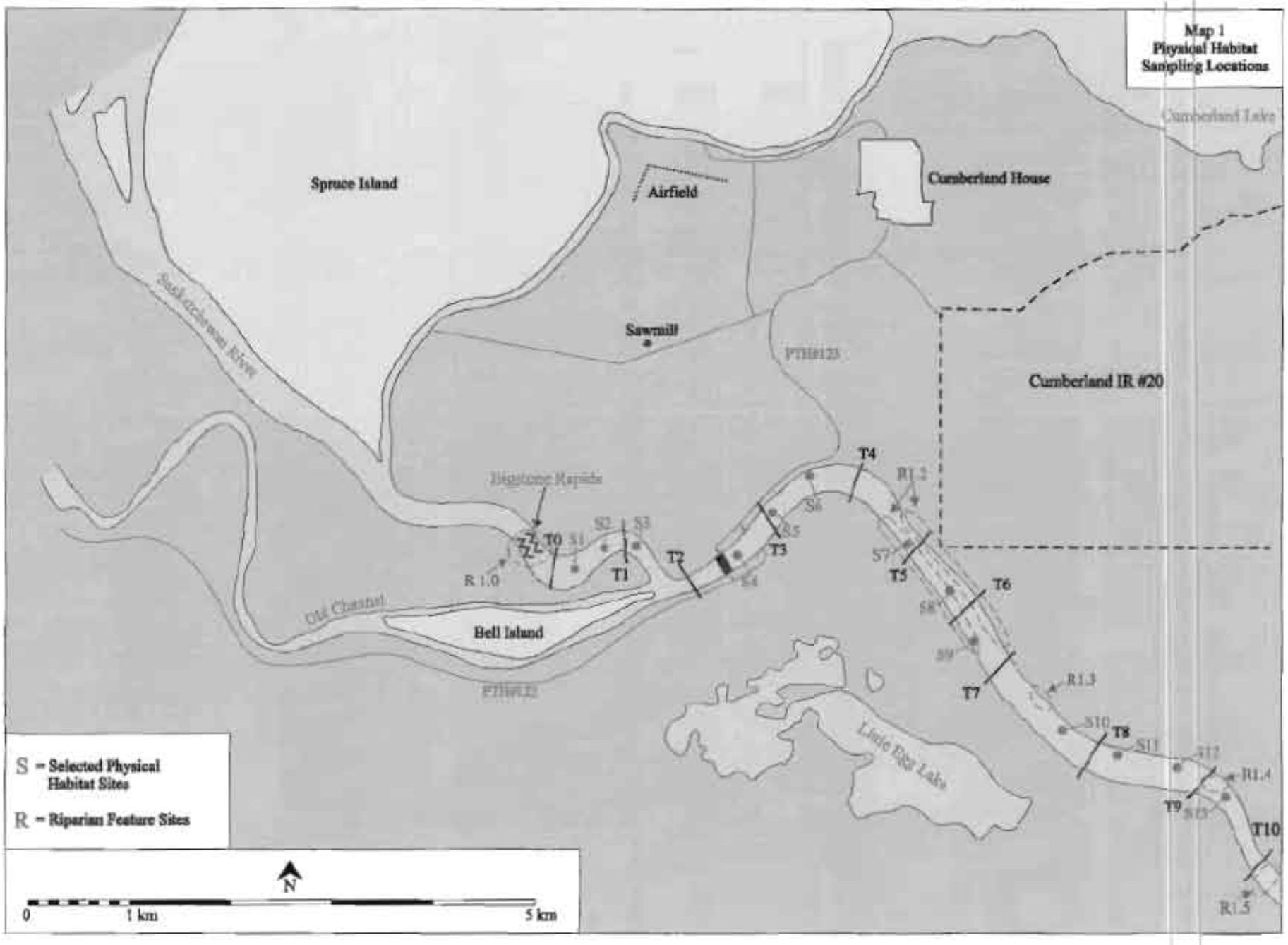

Figure 4. Locations of transects, selected physical habitat sites (S), and riparian feature sites (R) on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 0 - Transect 10)

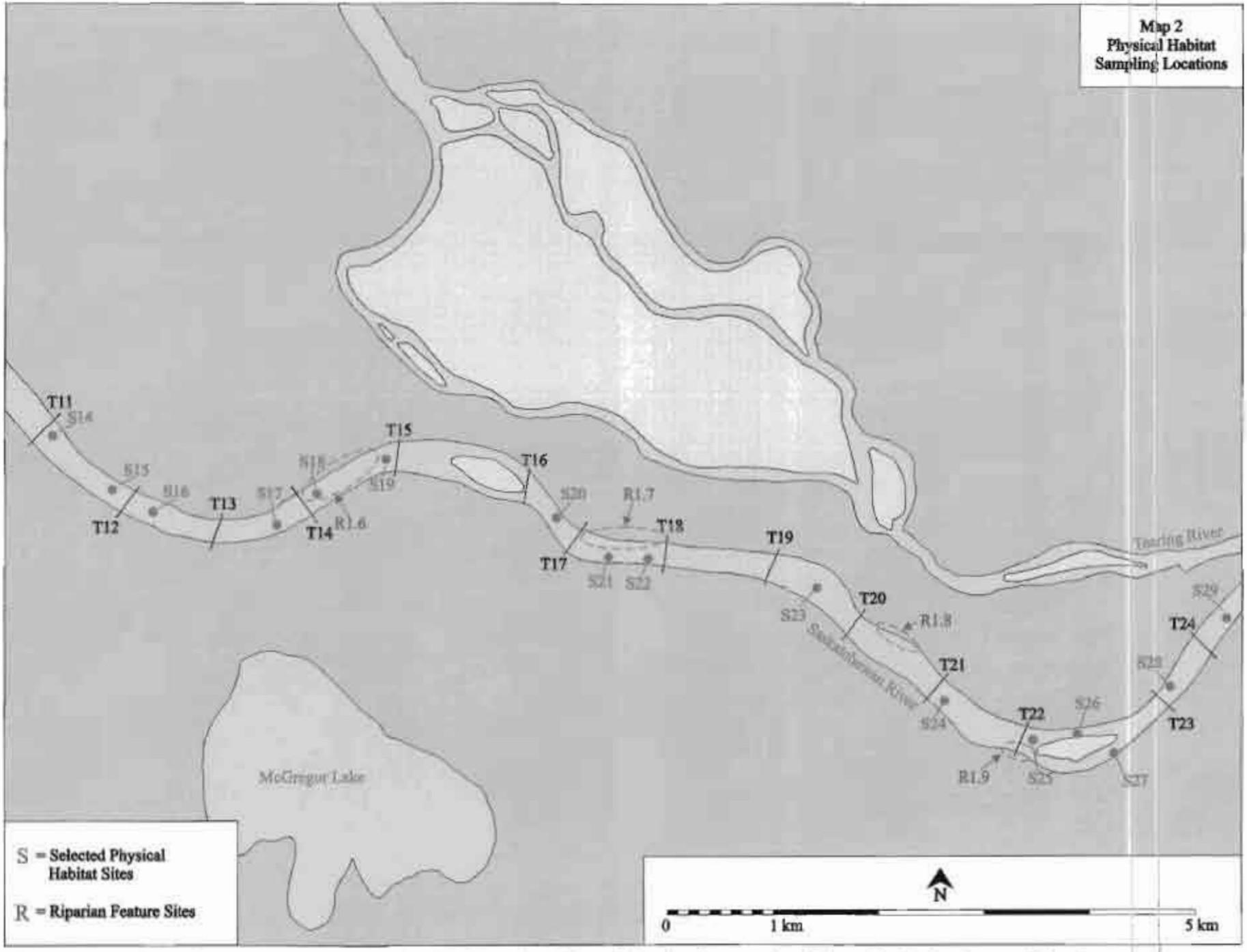

Figure 5. Locations of transects, selected physical habitat sites (S), and riparian feature sites (R) on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 11 - Transect 24)

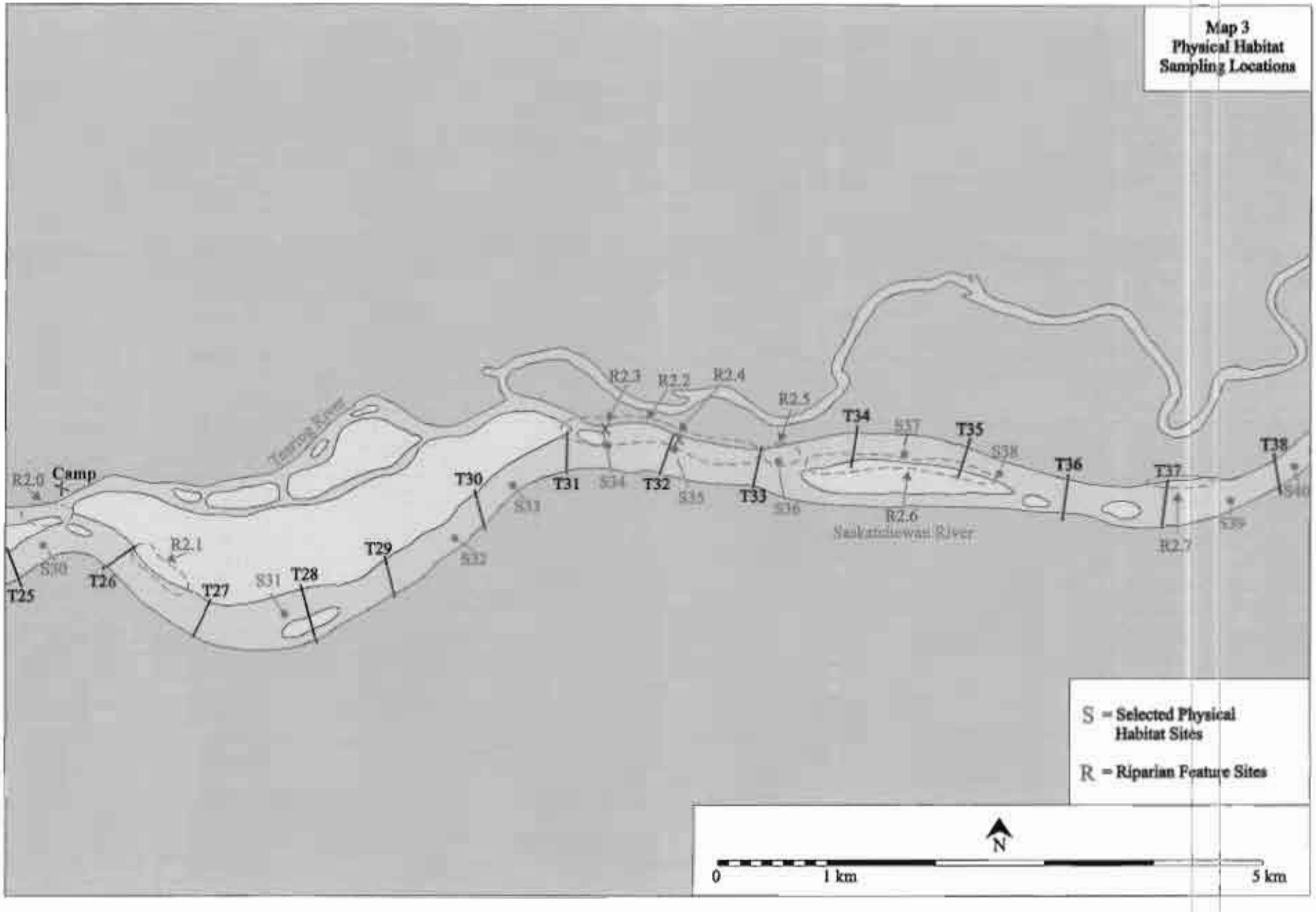

Figure 6. Locations of transects, selected physical habitat sites (S), and riparian feature sites (R) on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 25 - Transect 38)

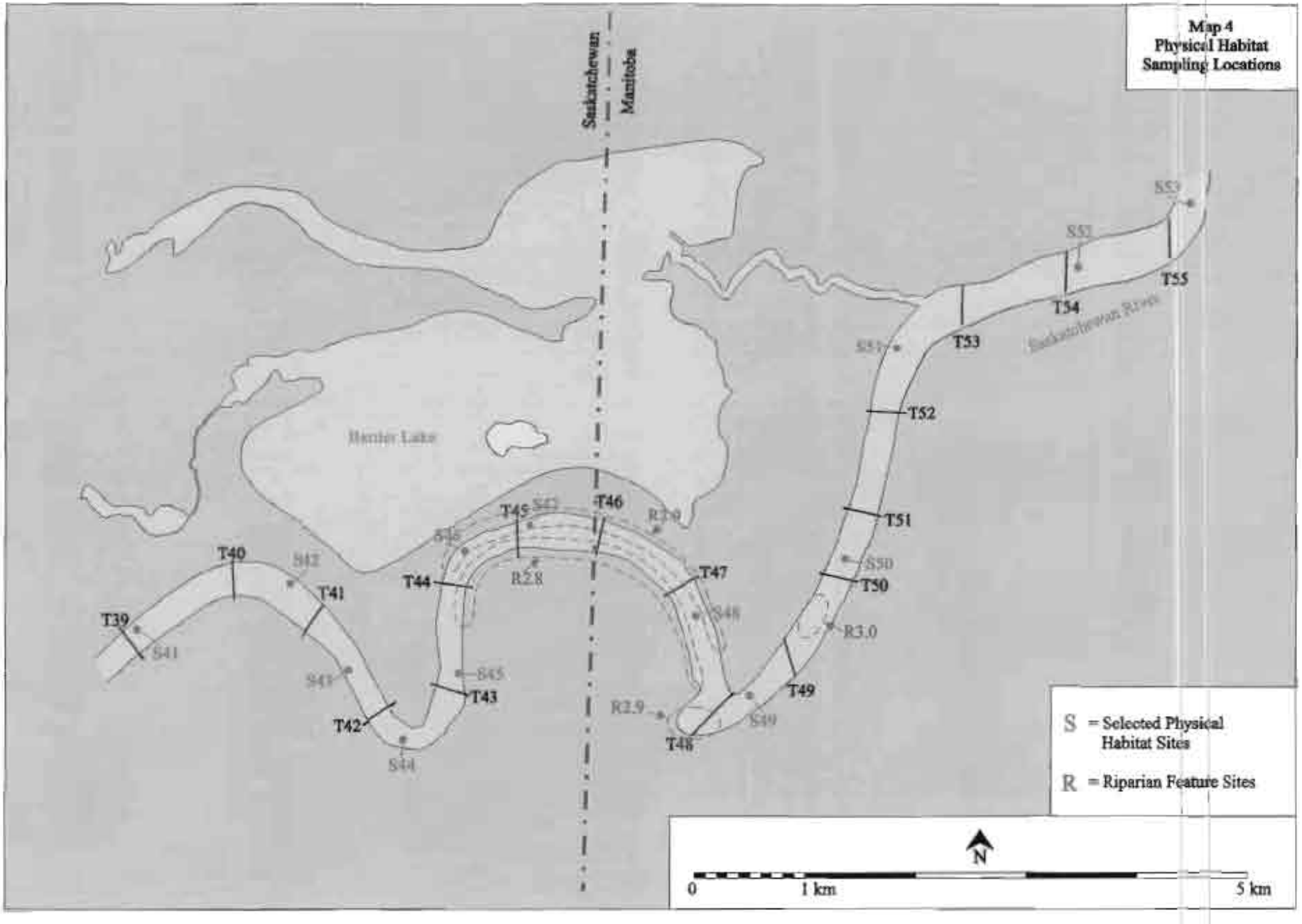

Figure 7. Locations of transects, selected physical habitat sites (S), and riparian feature sites, (R) on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 39 - Transect 55)

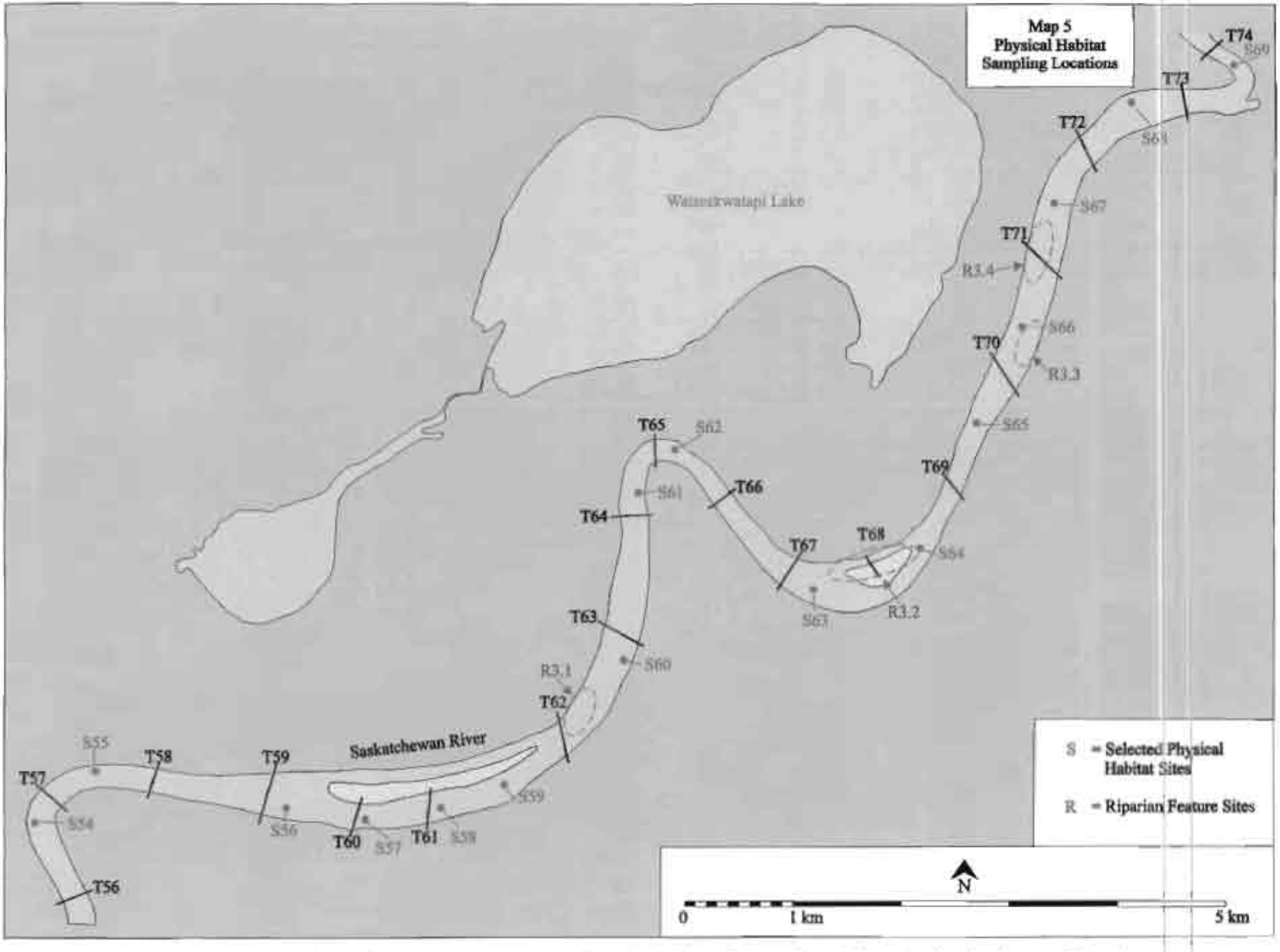

Figure 8. Locations of transects, selected physical habitat sites (S), and riparian feature sites (R) on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 56 - Transect 74)

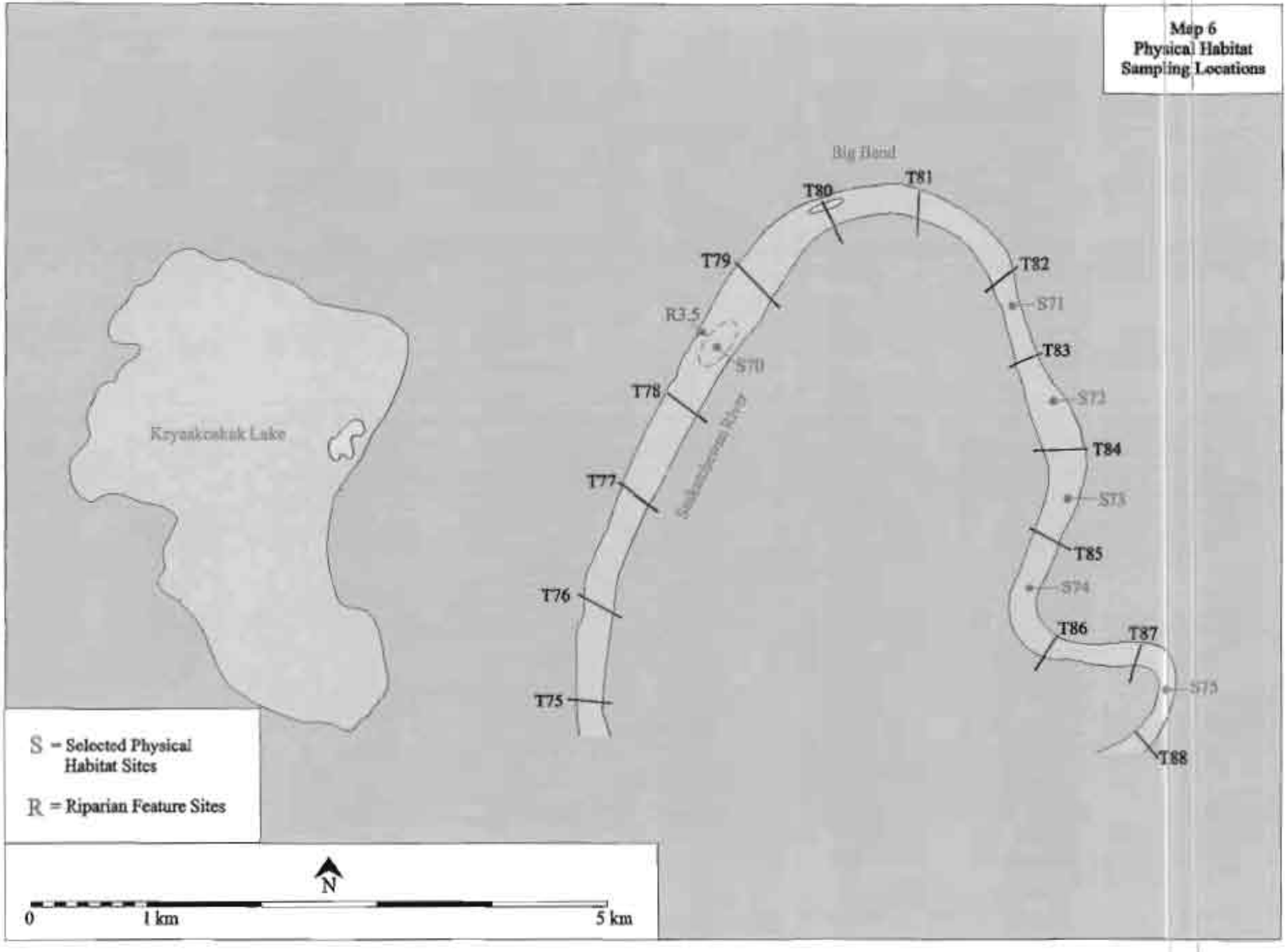

Figure 9. Locations of transects, selected physical habitat sites (S), and riparian feature sites (R) on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 75 - Transect 88)

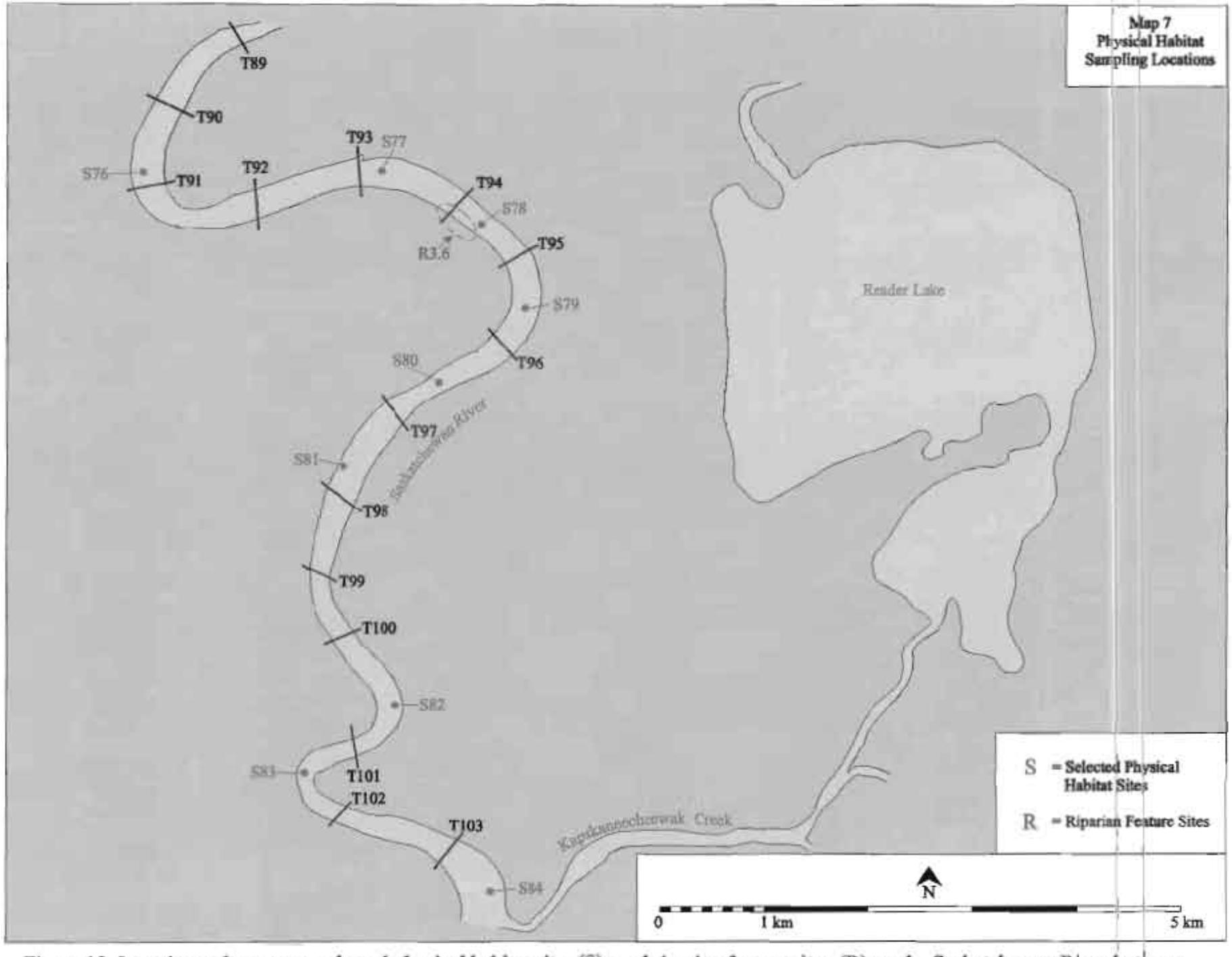

Figure 10. Locations of transects, selected physical habitat sites (S), and riparian feature sites (R) on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 89 - Transect 103)

Figure 11. Locations of transects, selected physical habitat sites (S), and riparian feature sites (R) on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 104 - Transect 119)

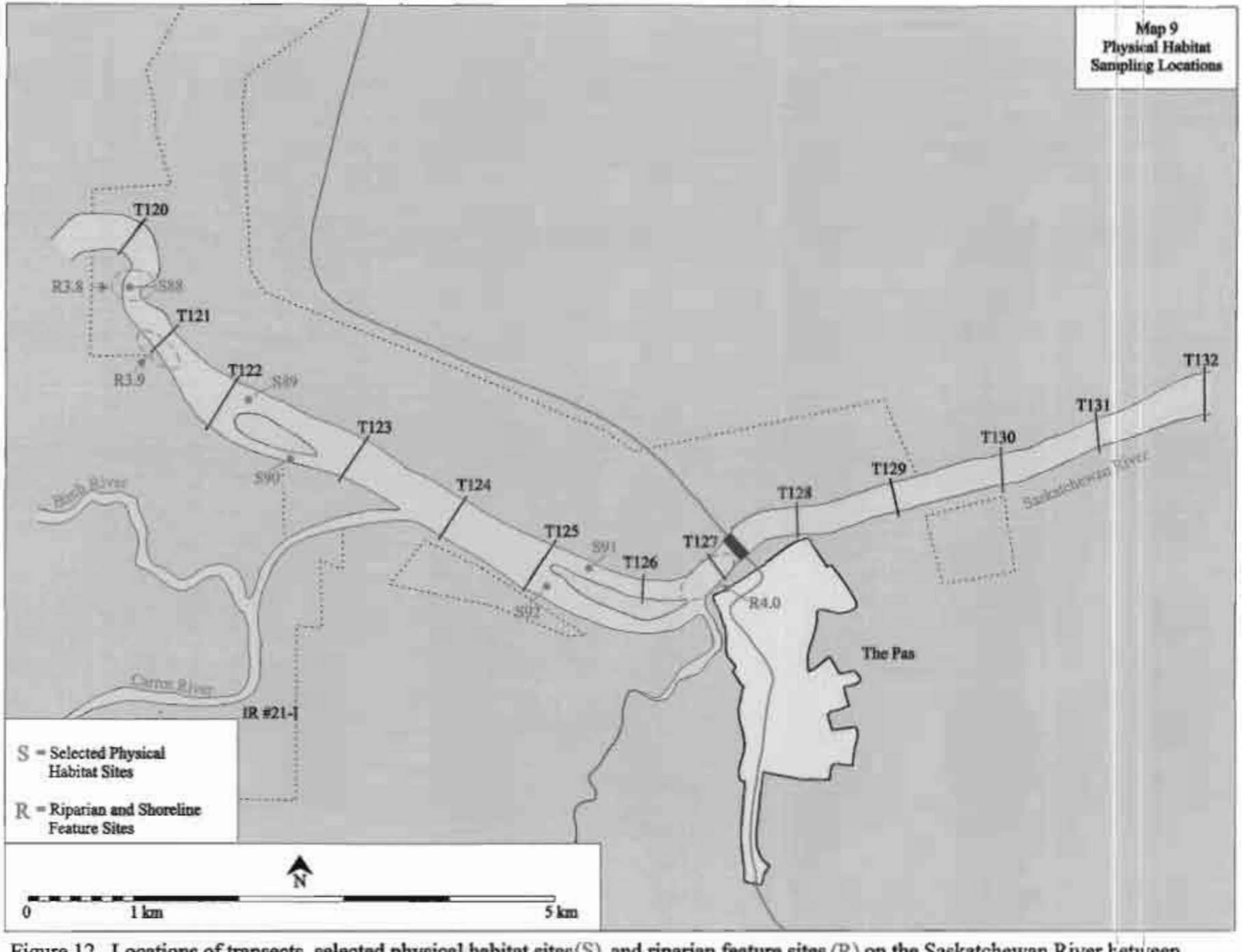

Figure 12. Locations of transects, selected physical habitat sites (S), and riparian feature sites (R) on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 120 - Transect 132)

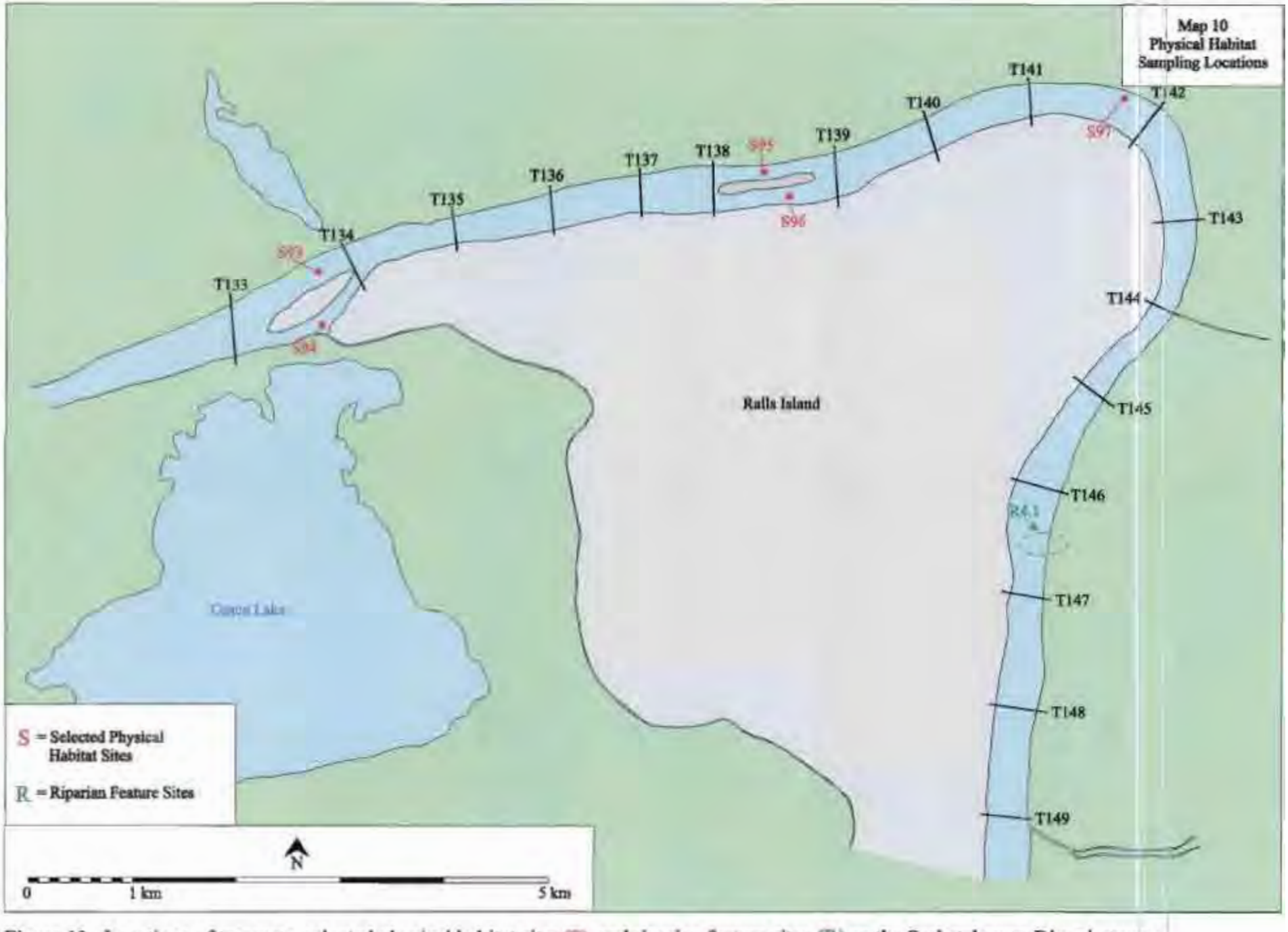

Figure 13. Locations of transects, selected physical habitat sites (S), and riparian feature sites (R) on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 133 - Transect 149)

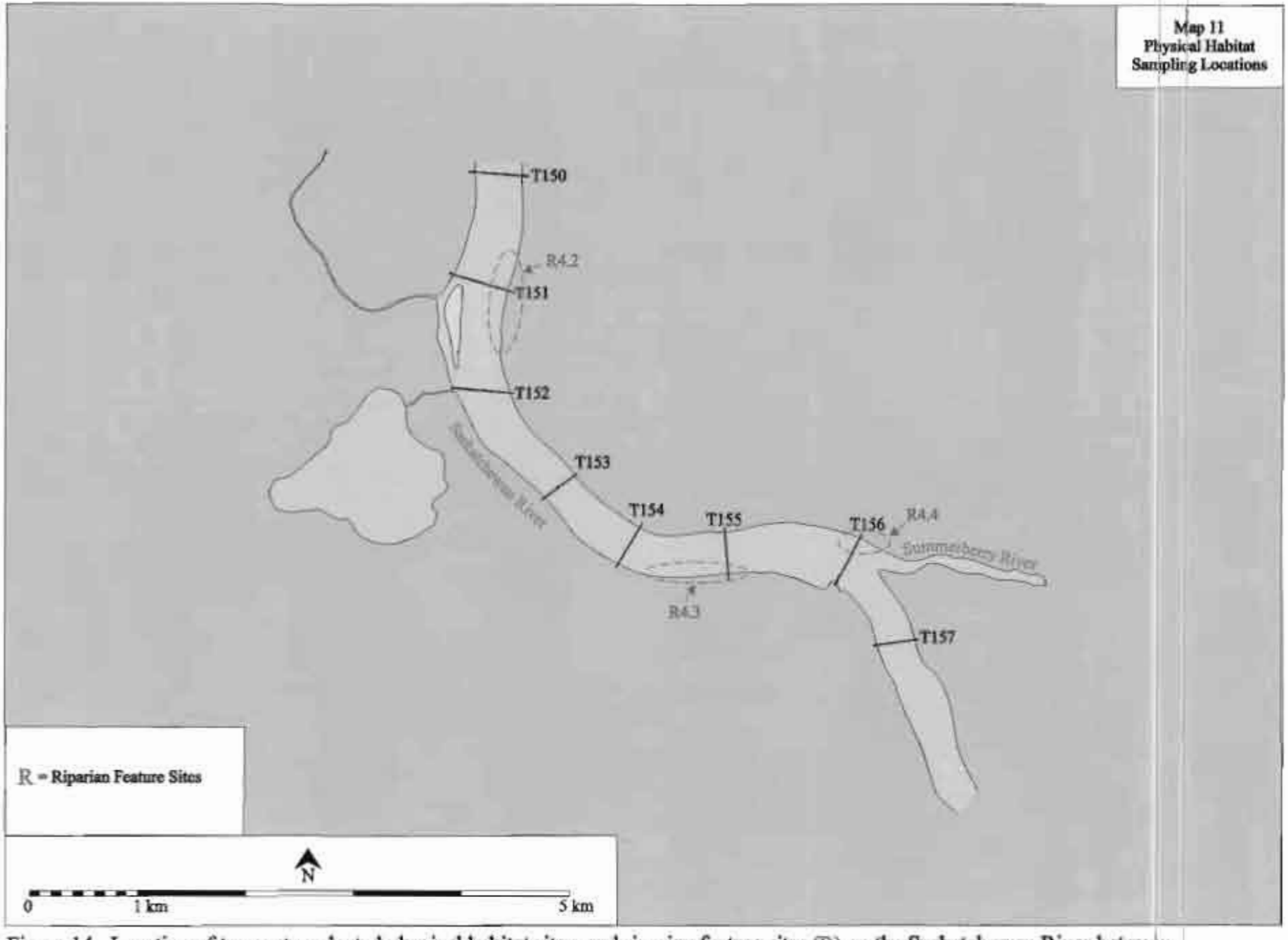

Figure 14. Location of transects, selected physical habitat sites, and riparian feature sites (R) on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 150 - Transect157)

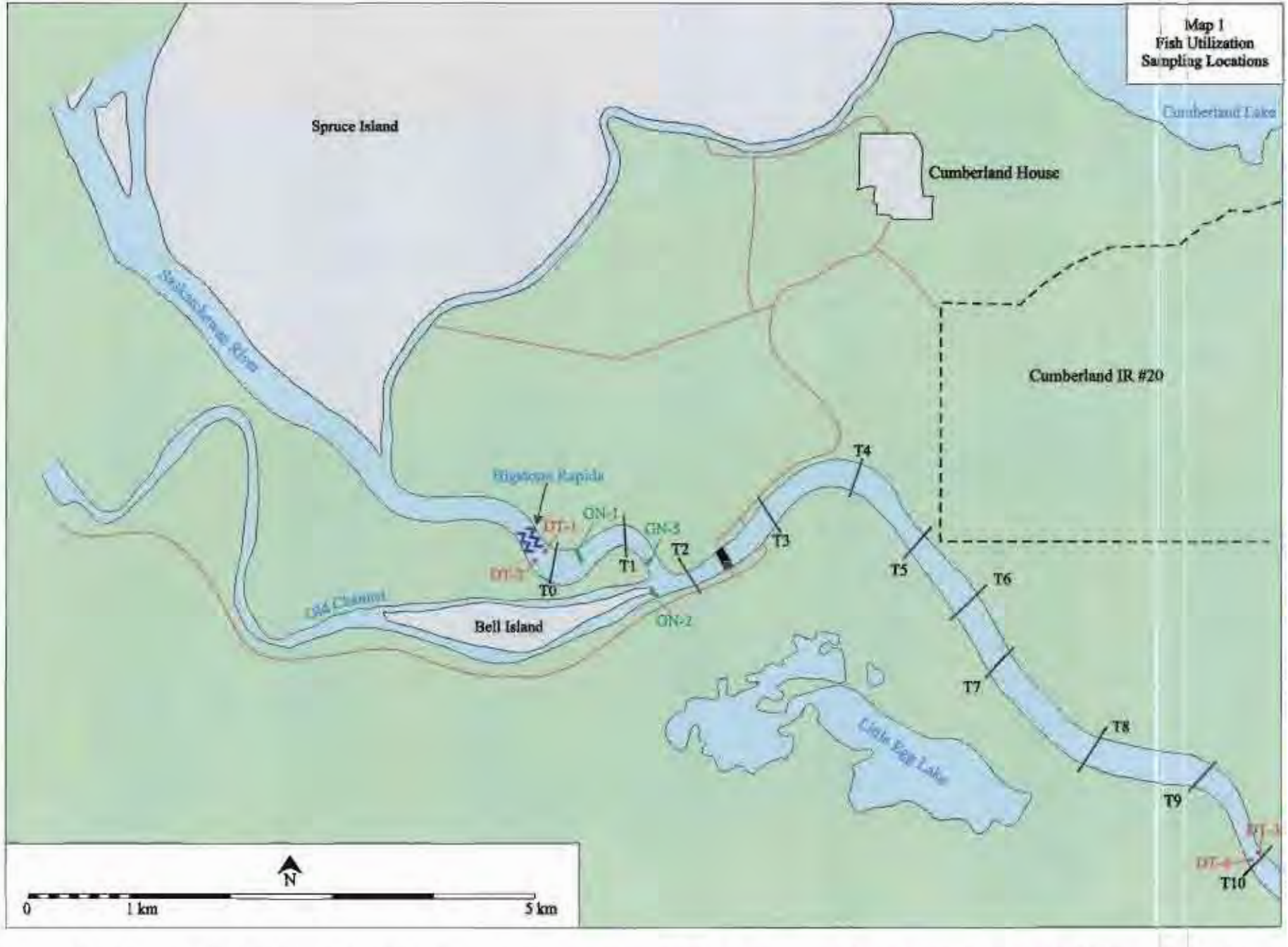

Figure 15. Location of gill net (GN) , drift net (DT), and hoop net sets on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 0 - Transect 10)

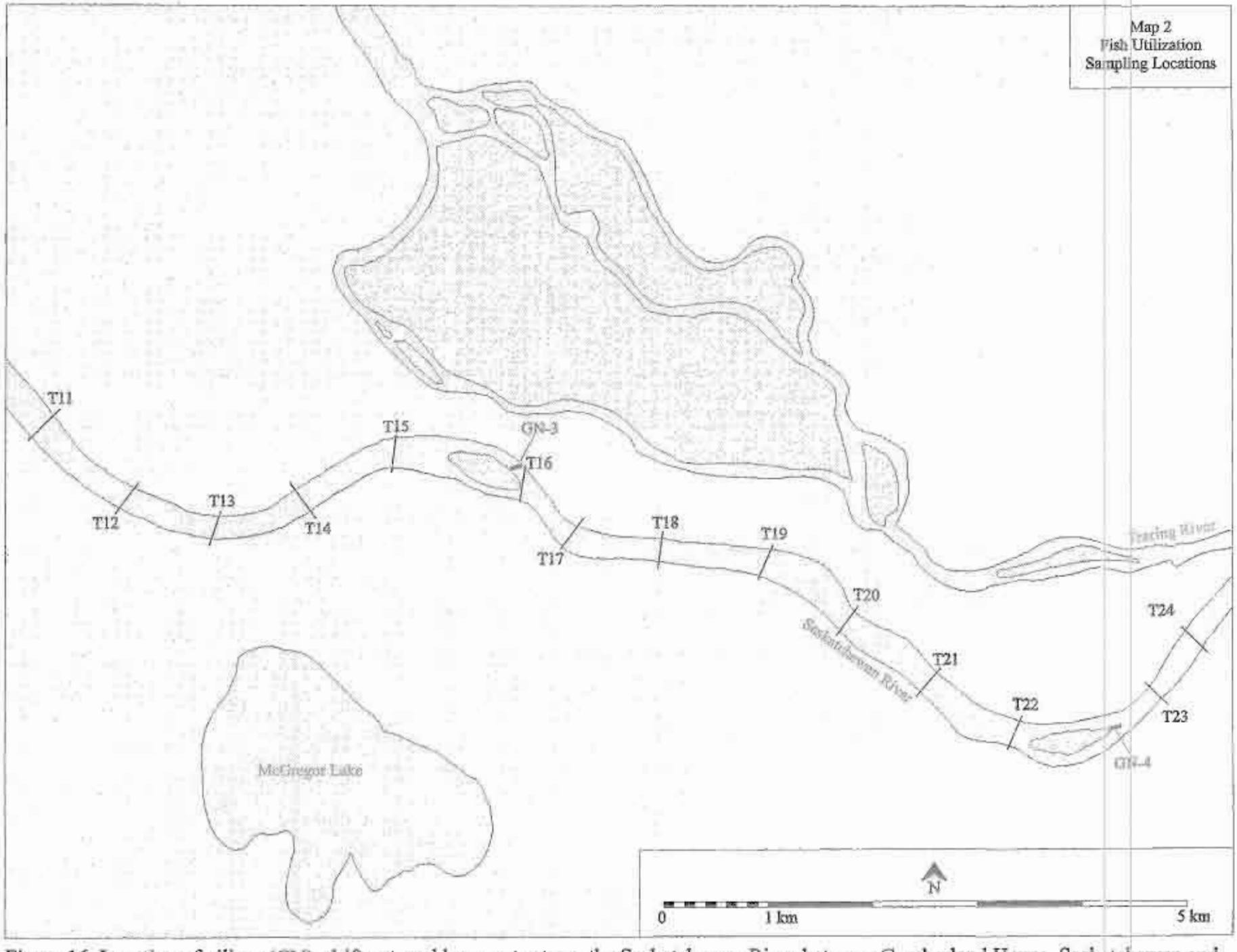

Figure 16. Location of gill net(GN), drift net, and hoop net sets on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 11 - Transect 24)

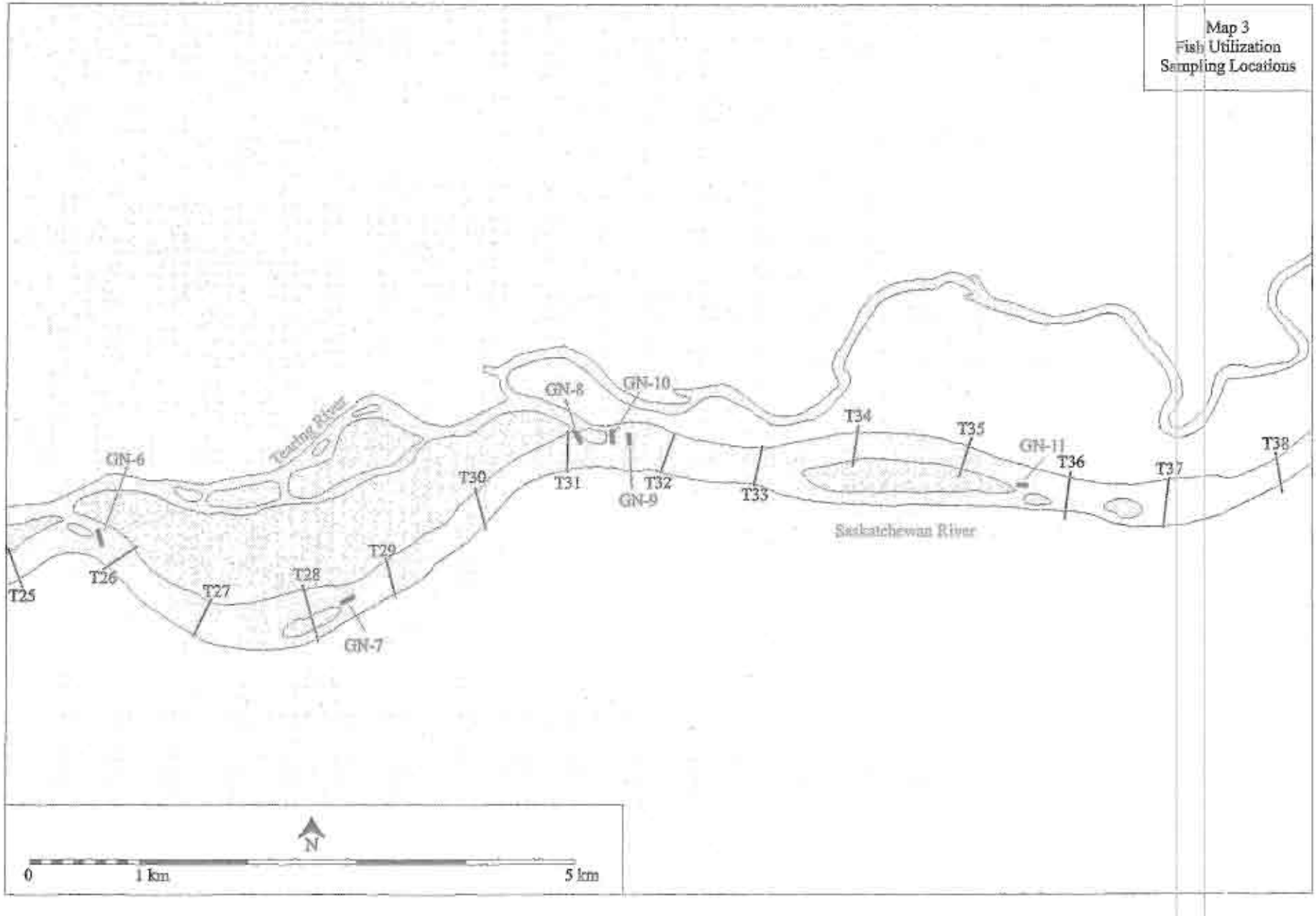

Figure 17. Location of gill net (GN), drift net, and hoop net sets on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 25 - Transect 38)

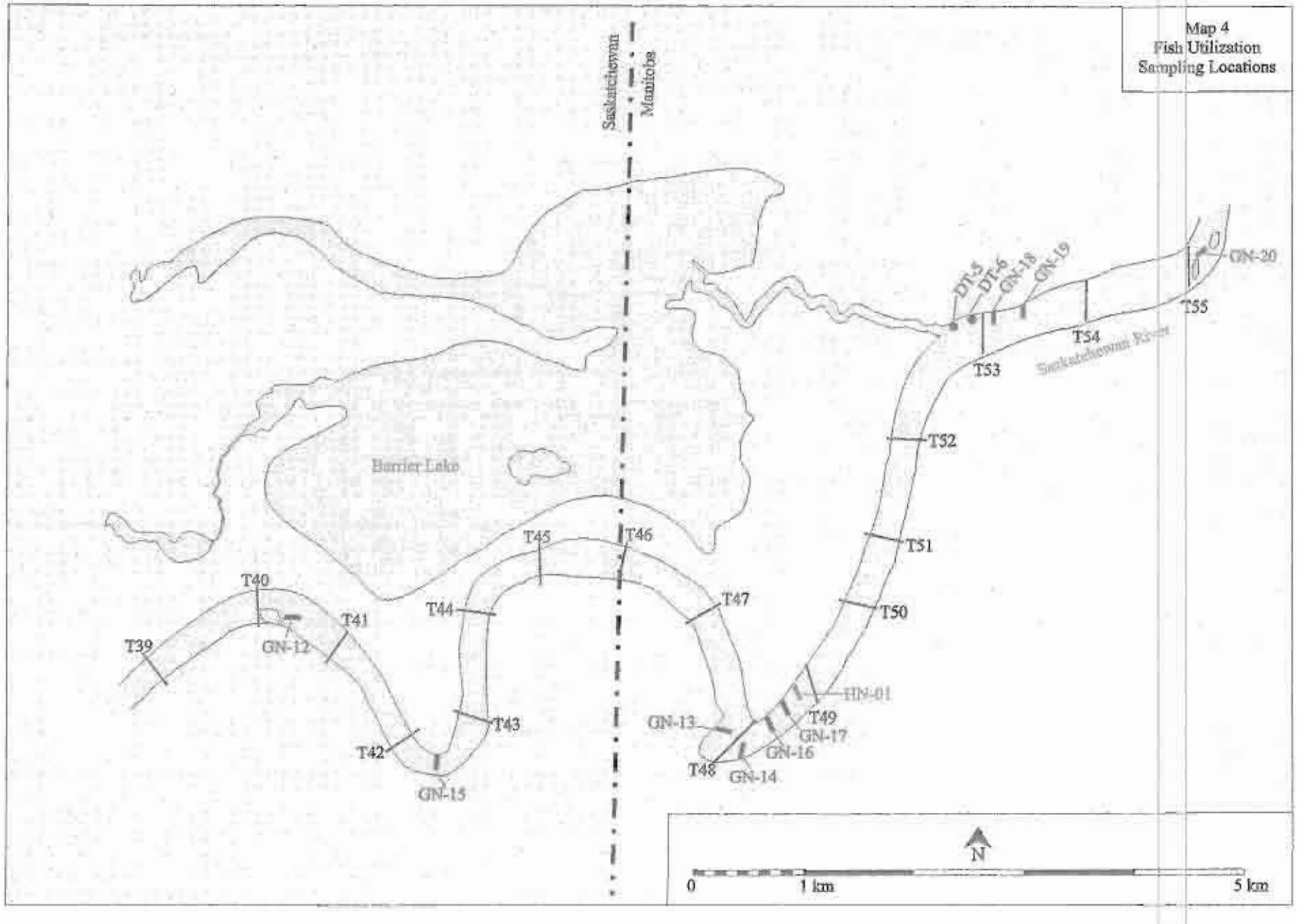

Figure 18. Location of gill net (GN), drift net (DT), and hoop net (HN) sets on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 39 - Transect 55)

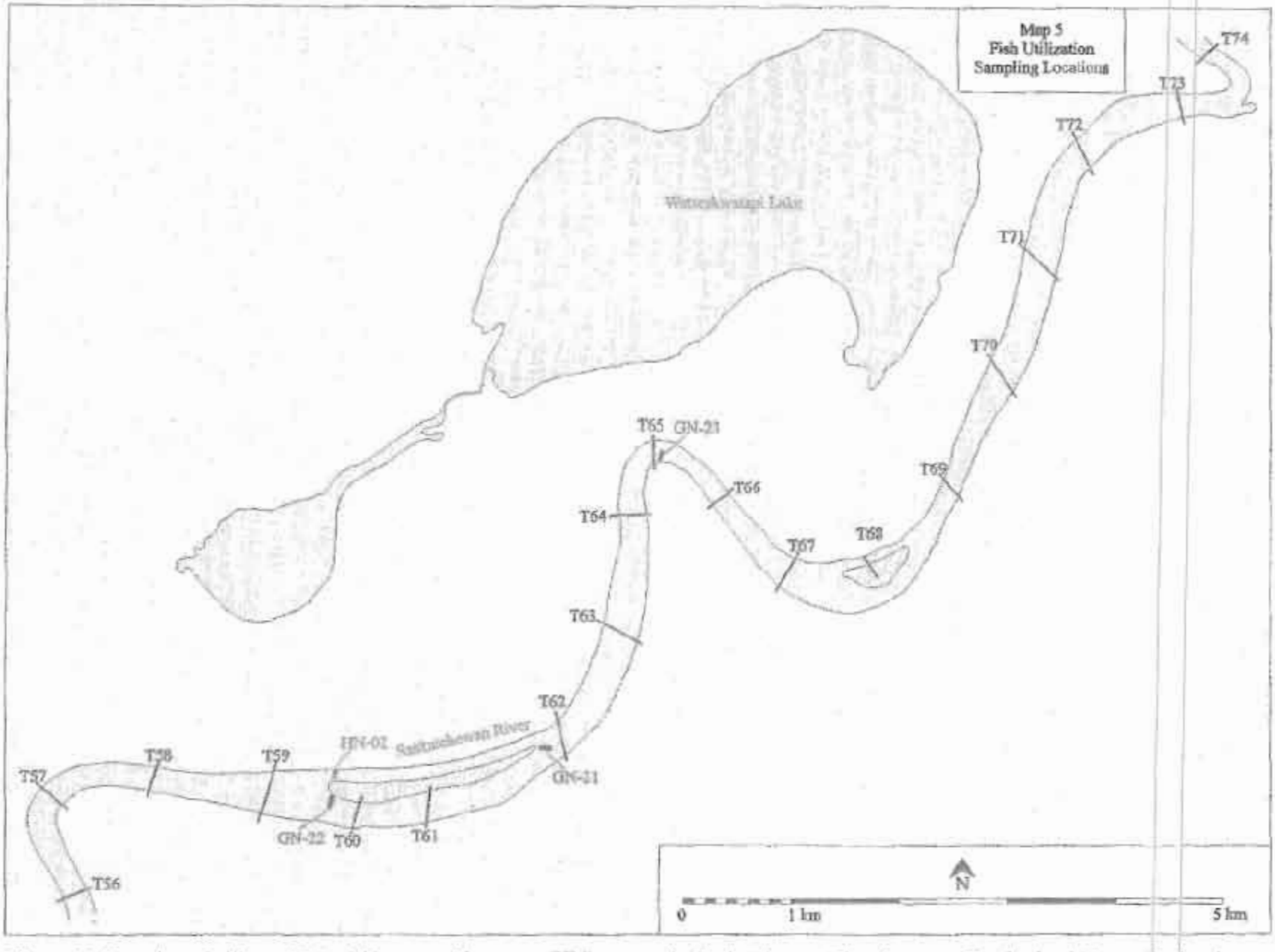

Figure 19. Location of gill net (GN), drift net, and hoop net (HN) sets on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 56 - Transect 74)

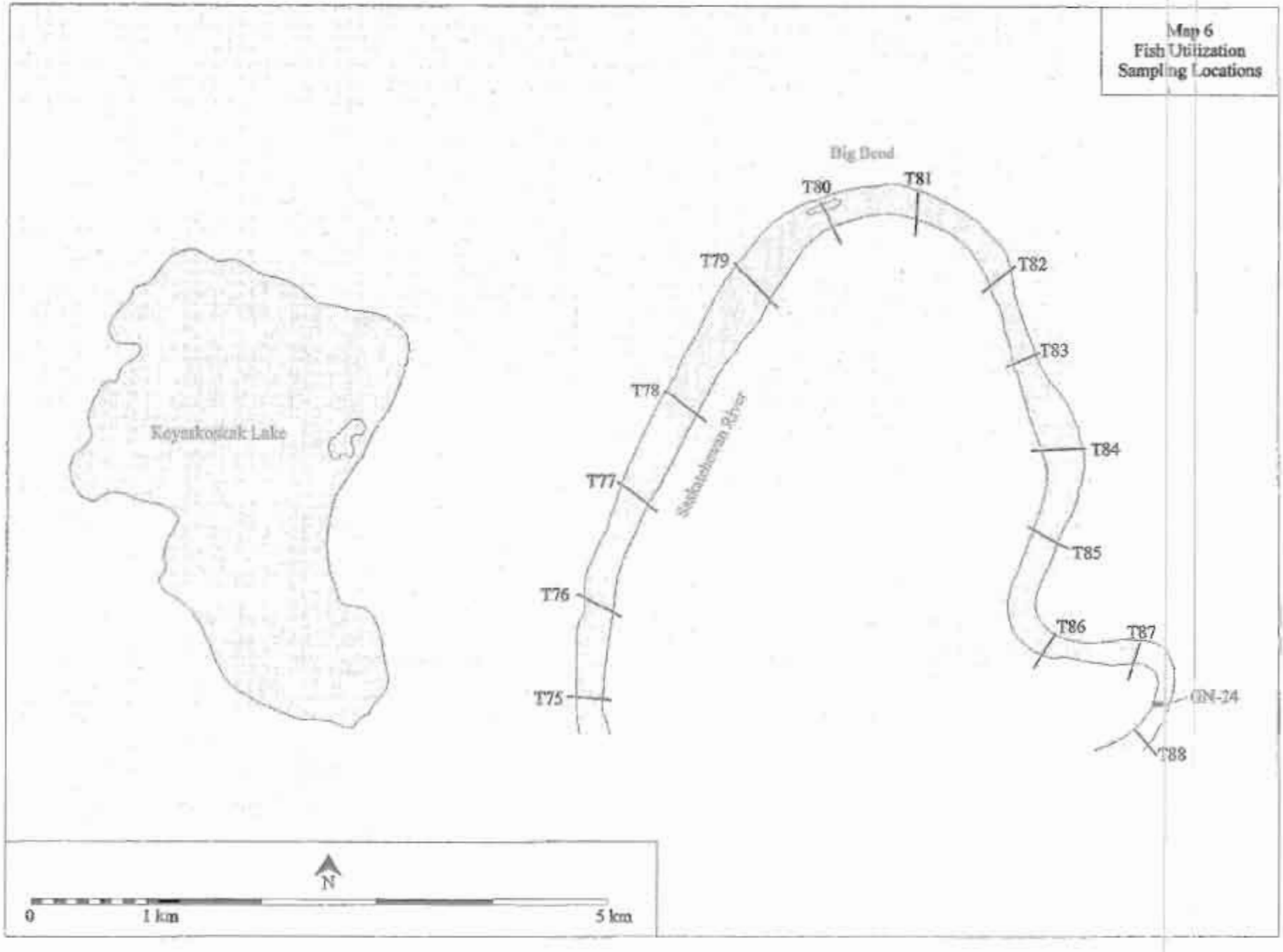

Figure 20. Location of gill net (GN), drift net, and hoop net sets on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 75 - Transect 88)

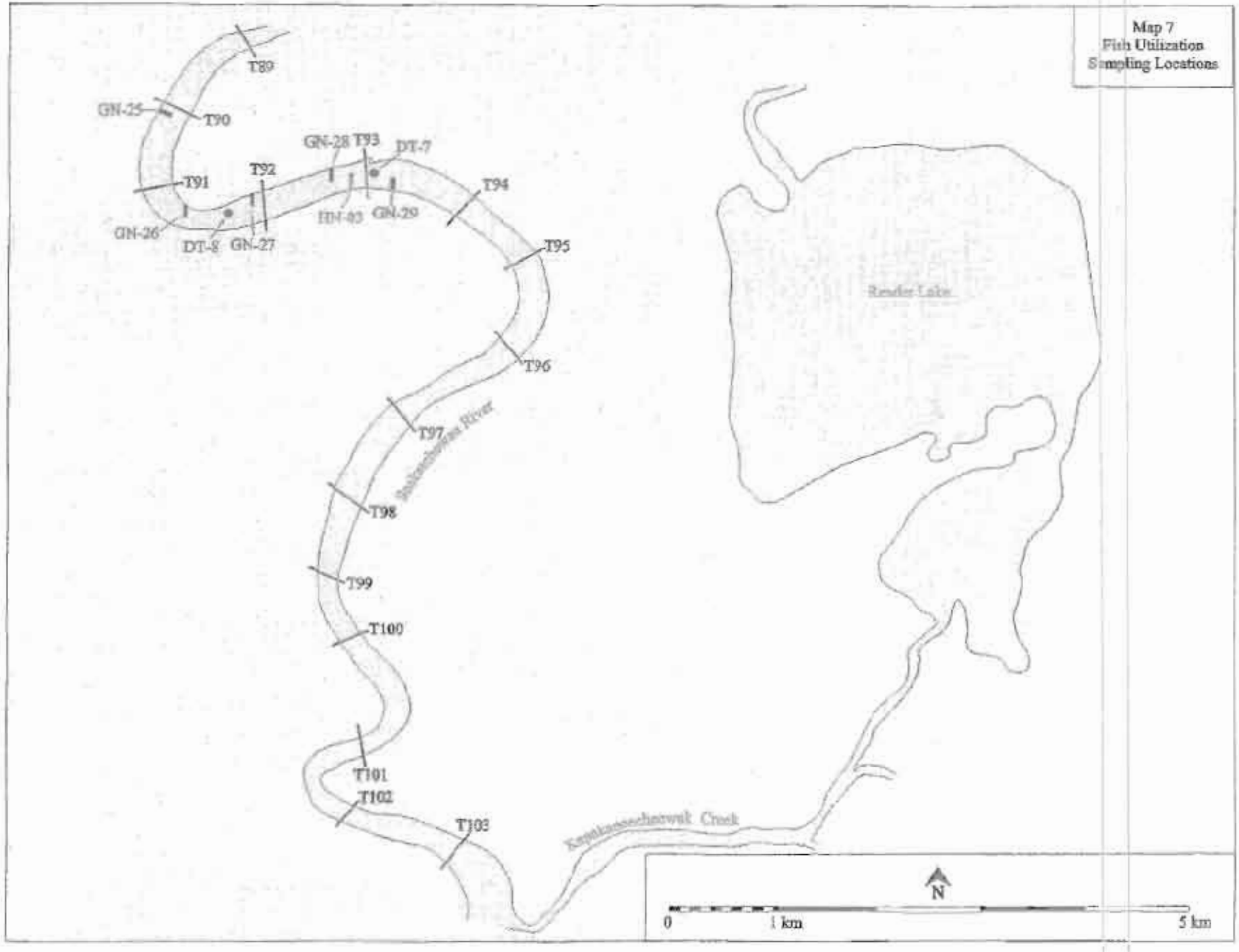

Figure 21. Location of gill net (GN), drift net (DT), and hoop net (HN) sets on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 89 - Transect 103)

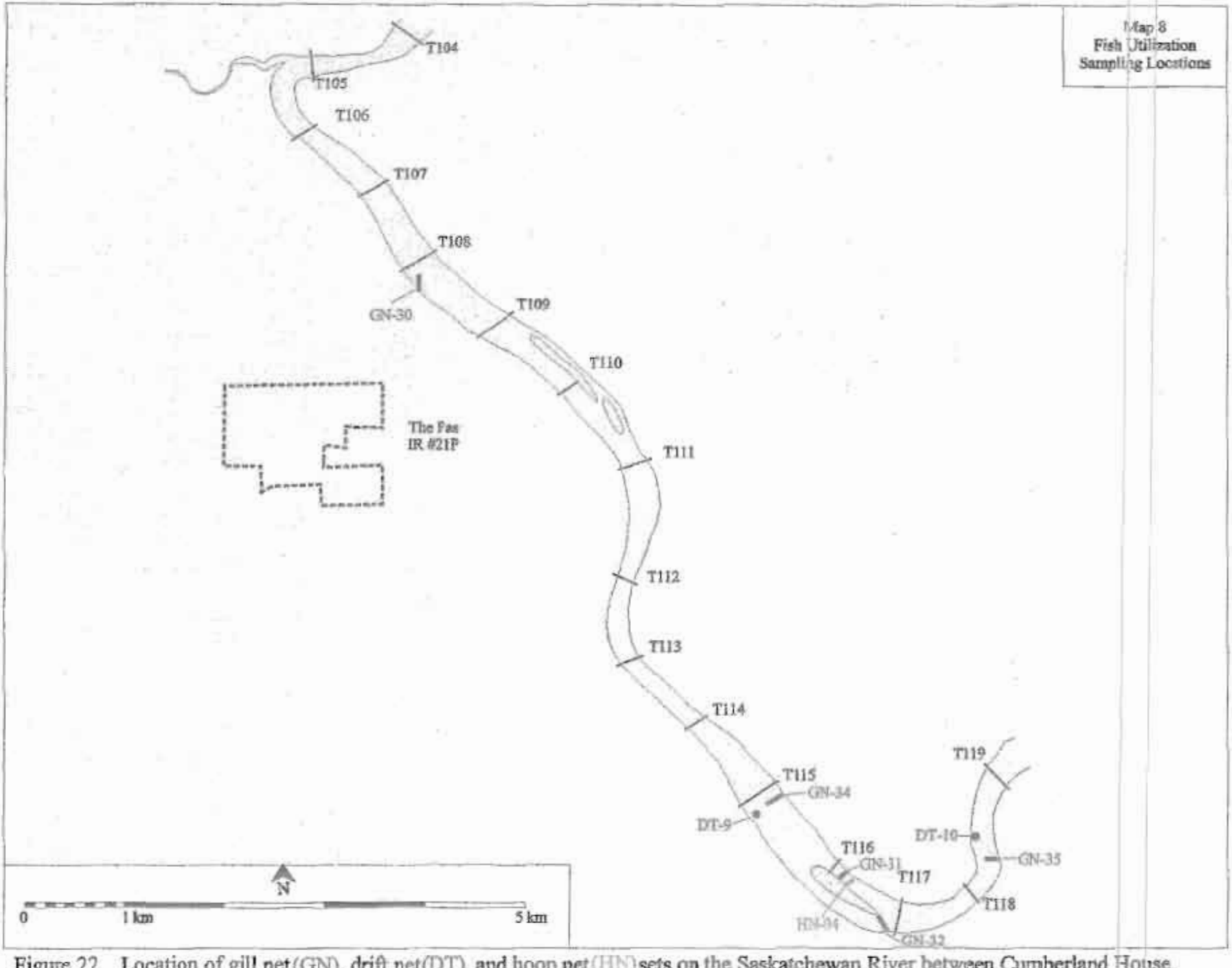

Figure 22. Location of gill net(GN), drift net(DT), and hoop net(HN)sets on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 104 - Transect 119)

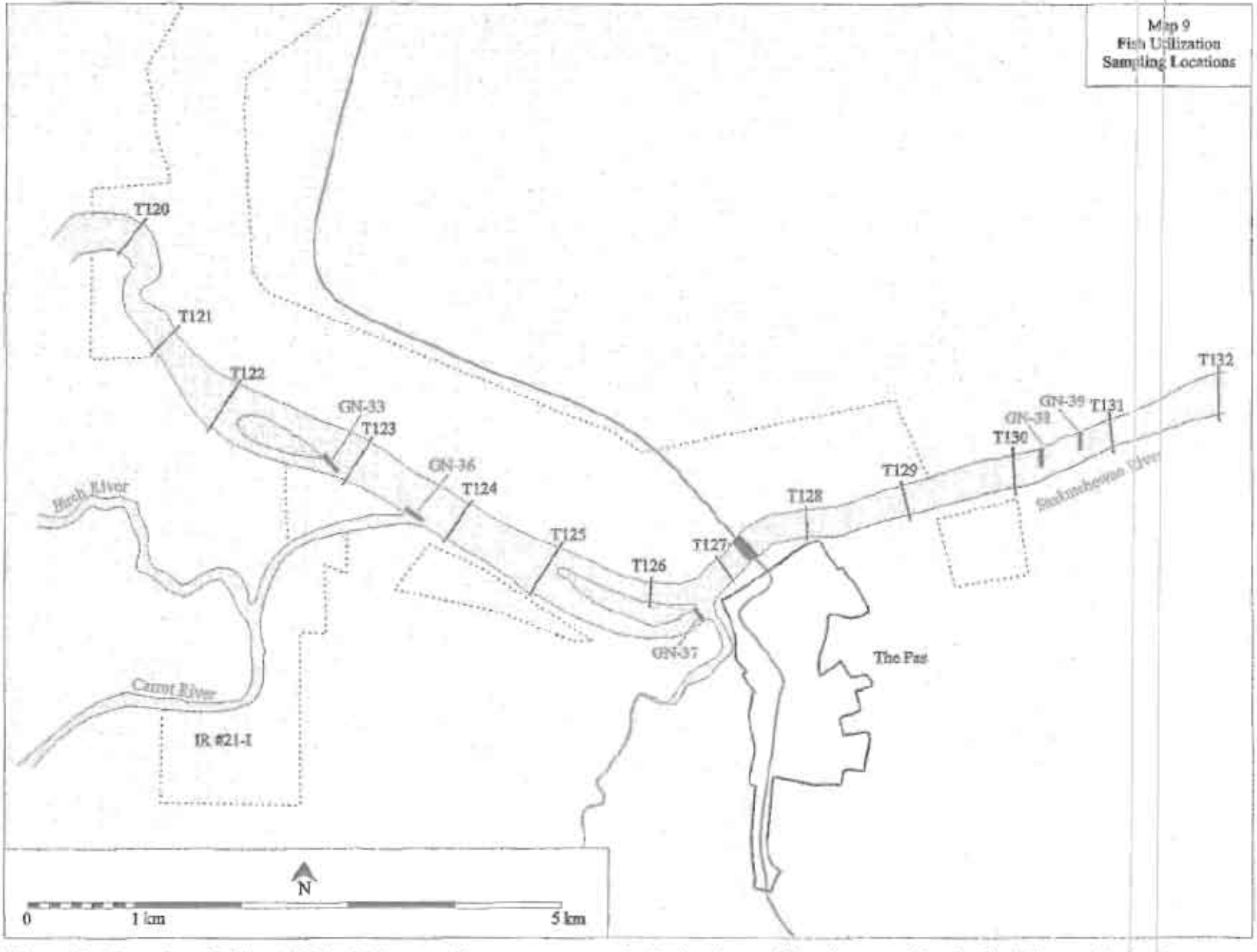

Figure 23. Location of gill net (GN), drift net, and hoop net sets on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 120 - 132)

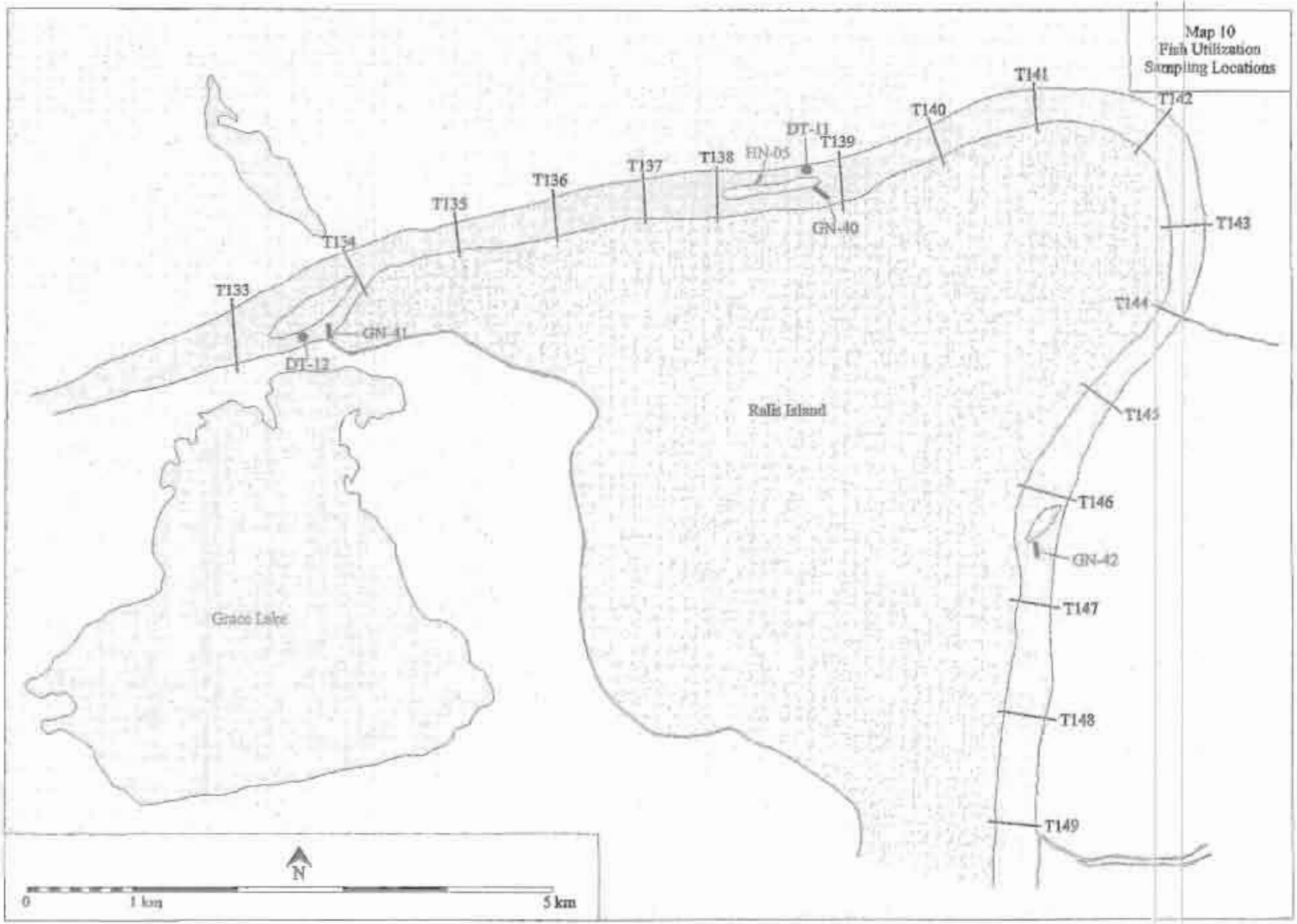

Figure 24. Location of gill net (GN), drift net (DT), and hoop net (HN) sets on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000. (Transect 133 - Transect 149)

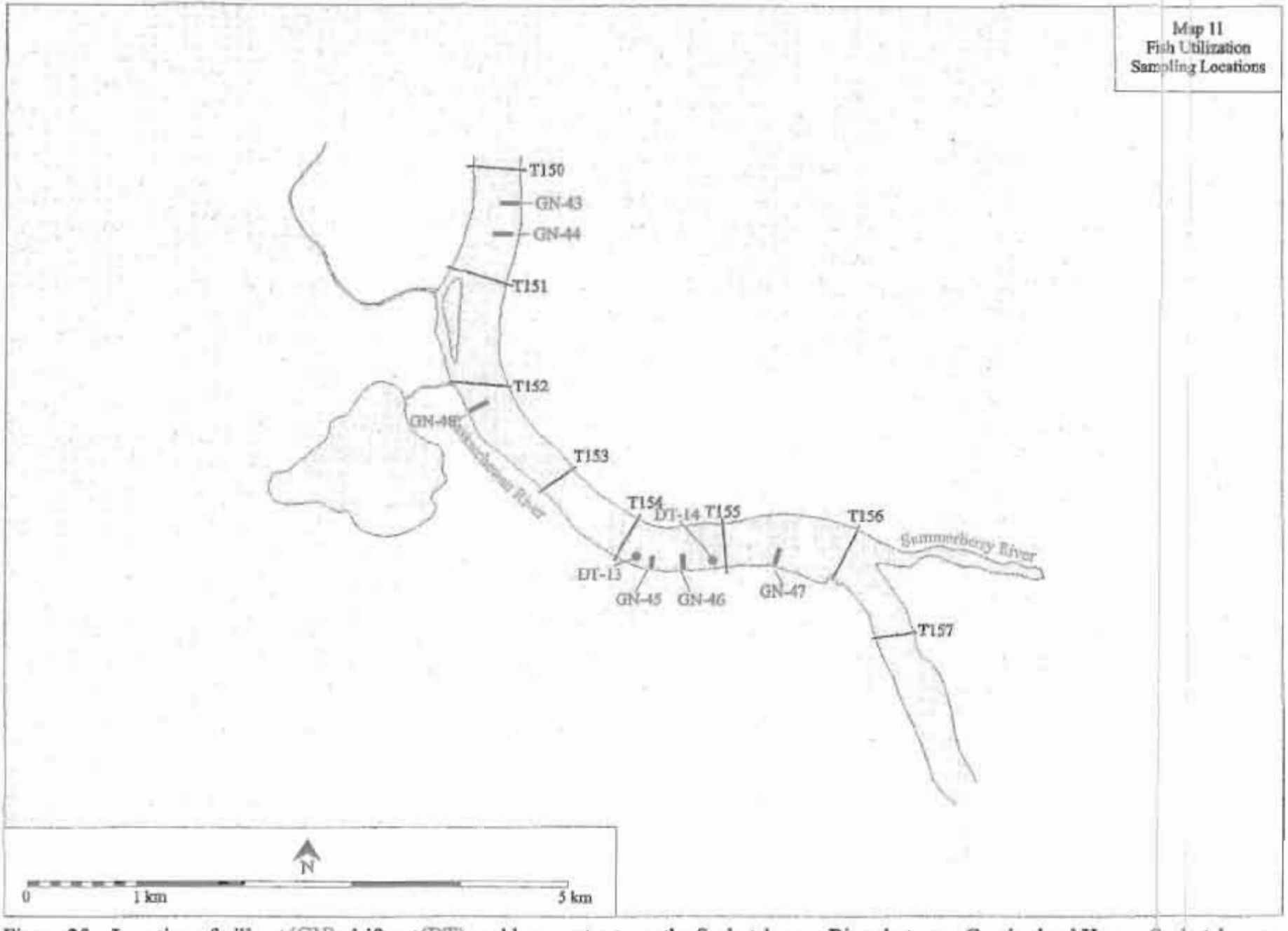

Figure 25. Location of gill net (GN), drift net (DT), and hoop net sets on the Saskatchewan River between Cumberland House, Saskatchewan, and Summerberry River, Manitoba, June, 2000. (Transect 150 - Transect 157)

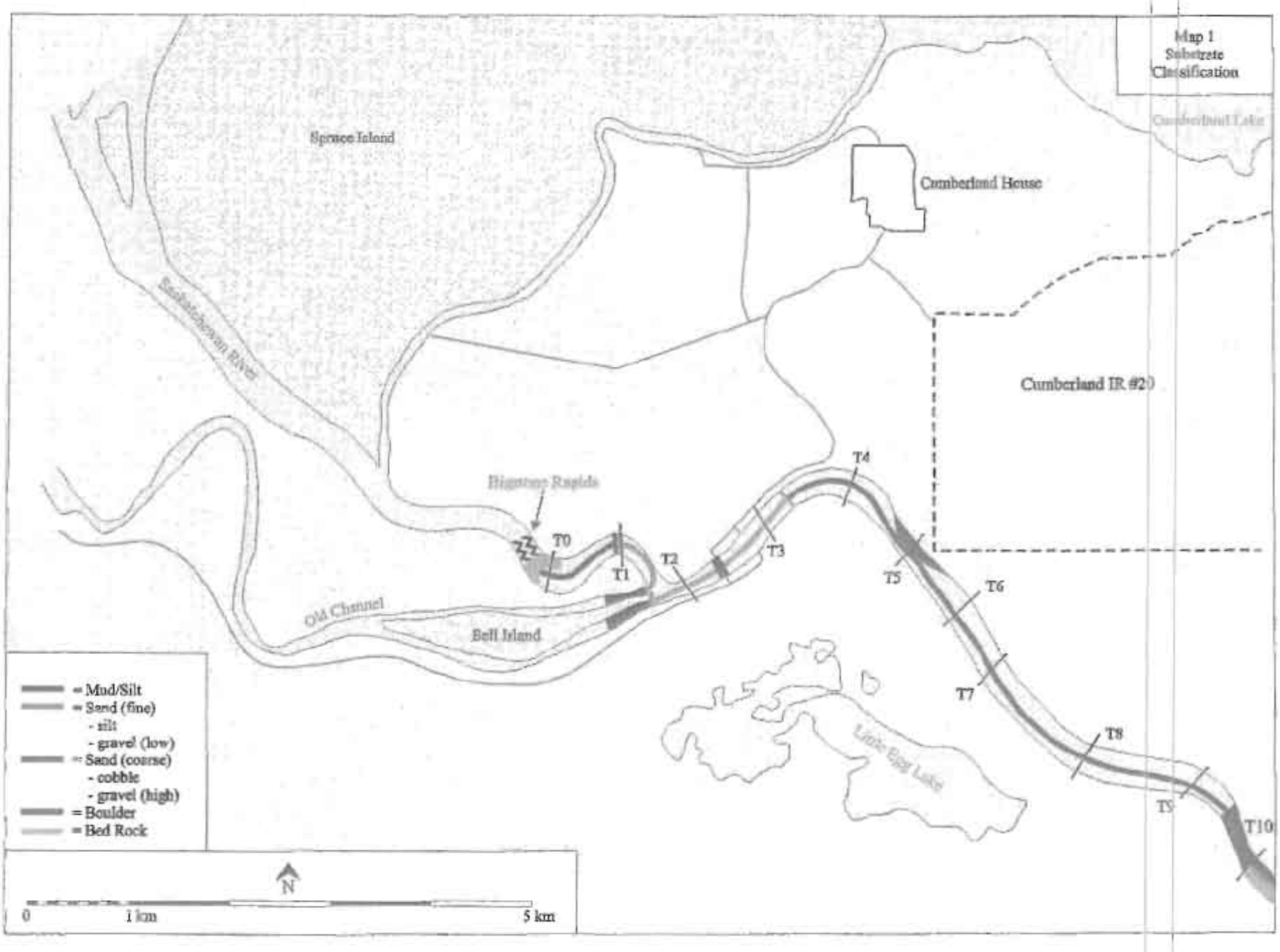

Figure 26. Substrate composition of the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 0 - Transect 10)

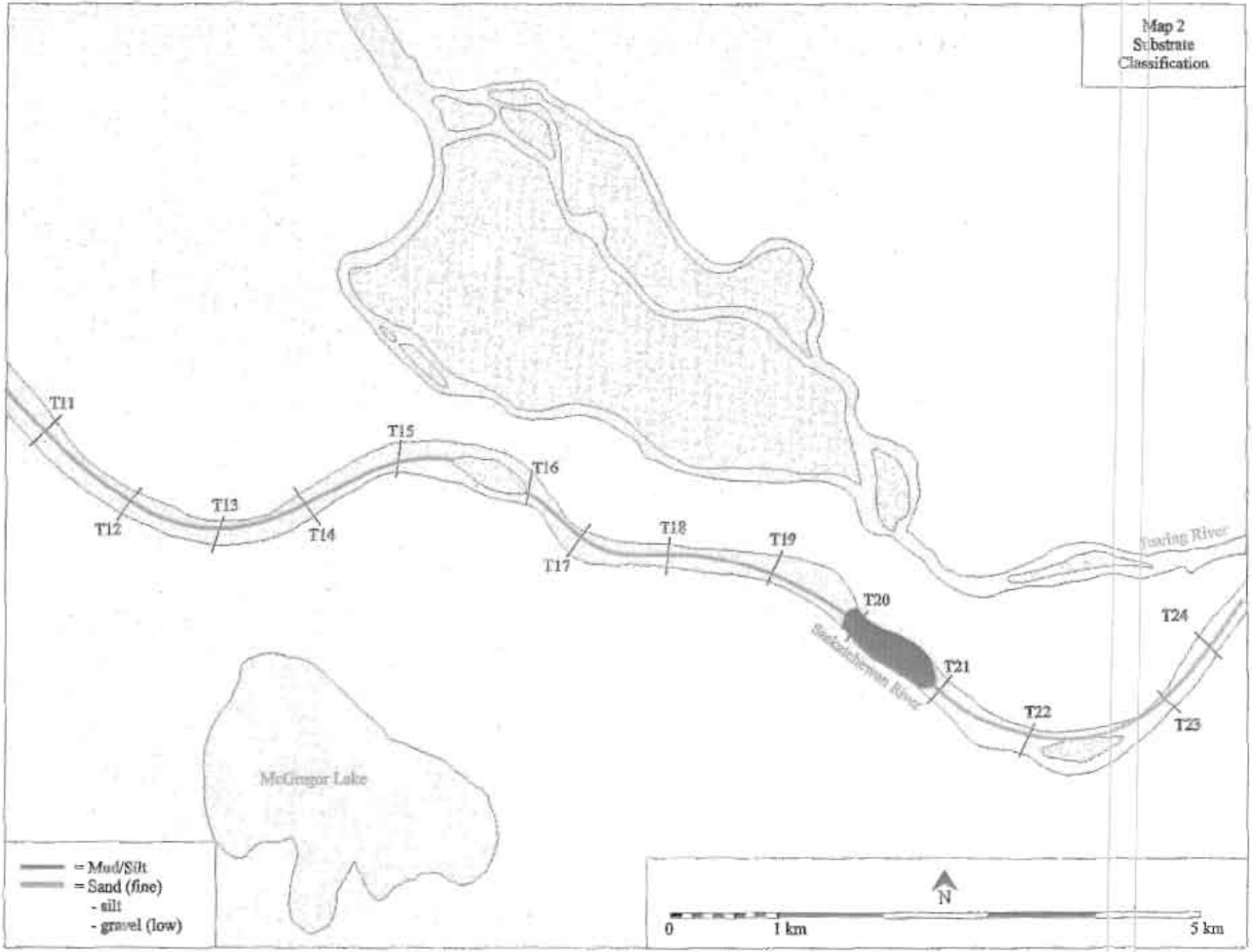

Figure 27. Substrate composition of the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 11 - Transect 24)

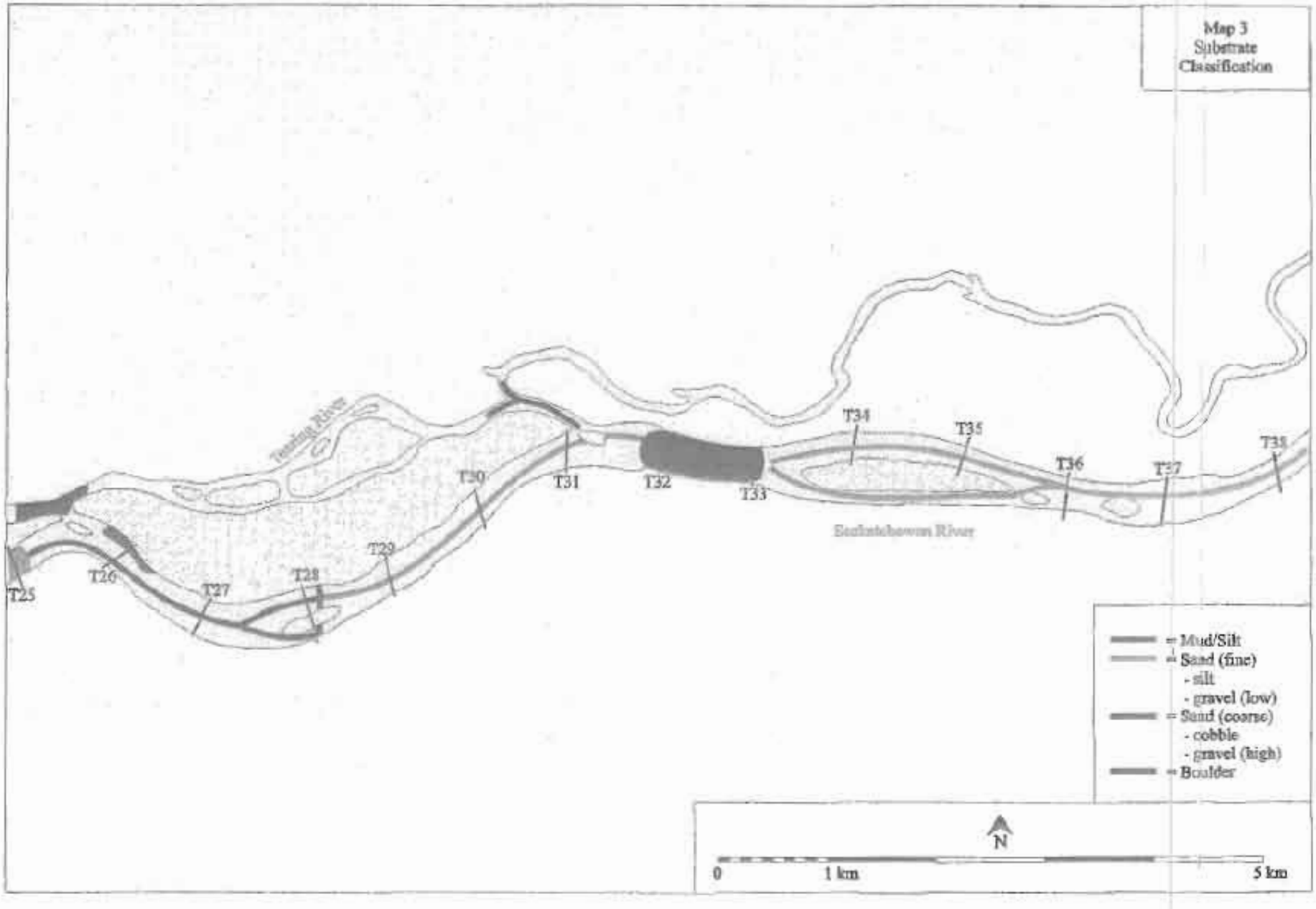

Figure 28. Substrate composition of the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 25 - Transect 38)

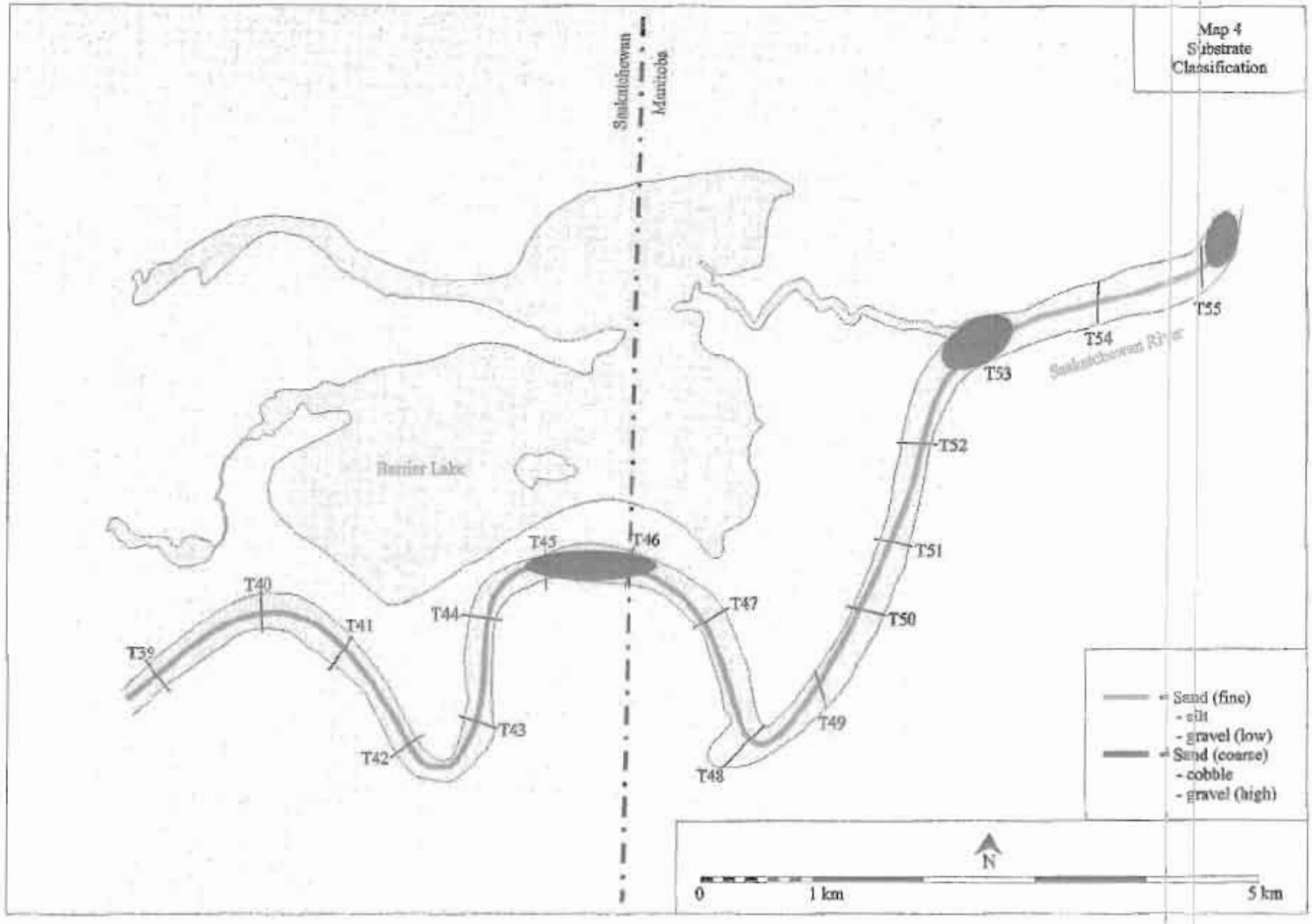

Figure 29. Substrate composition of the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 39 - Transect 55)

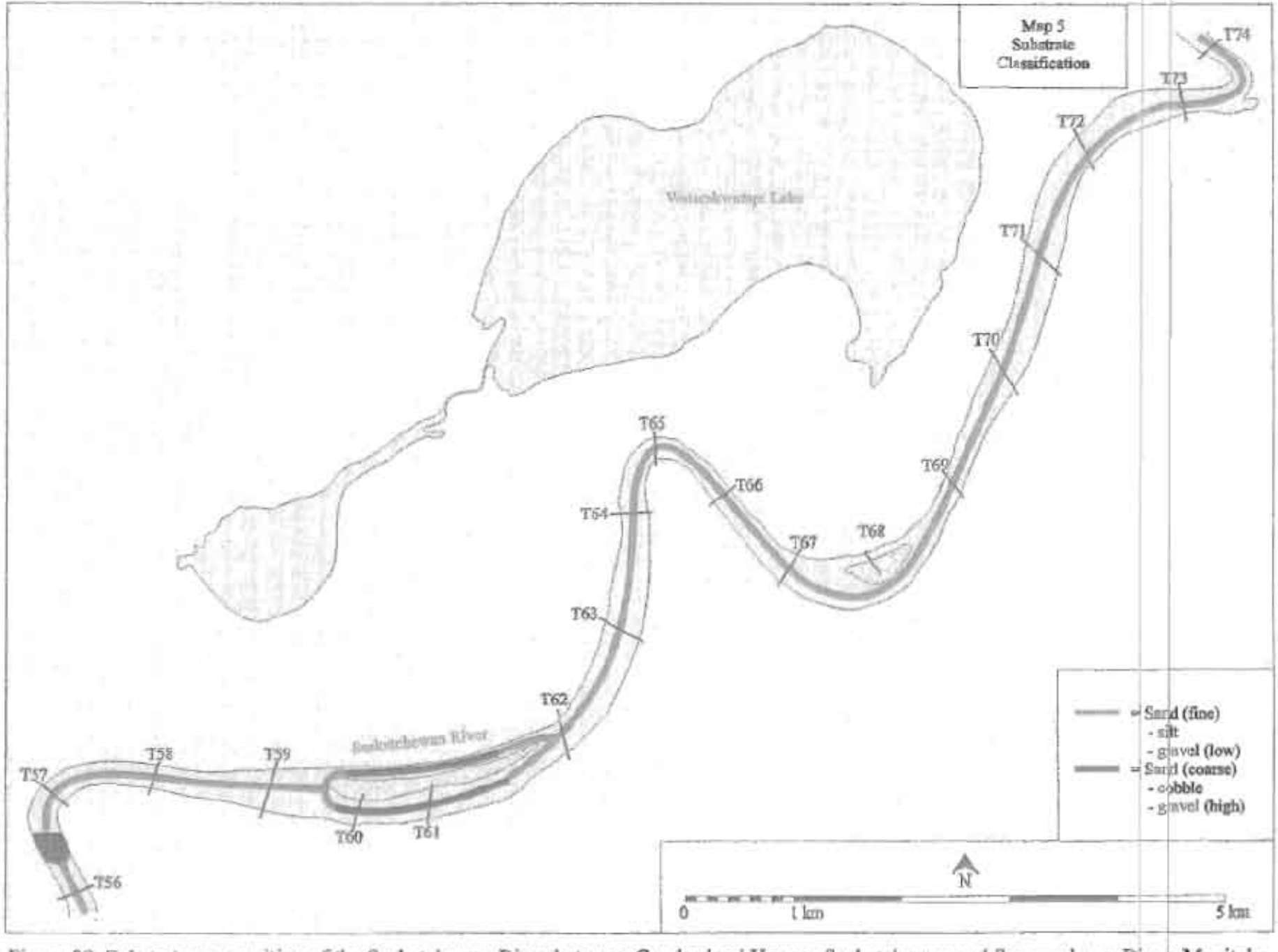

Figure 30. Substrate composition of the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 56 - Transect 74)

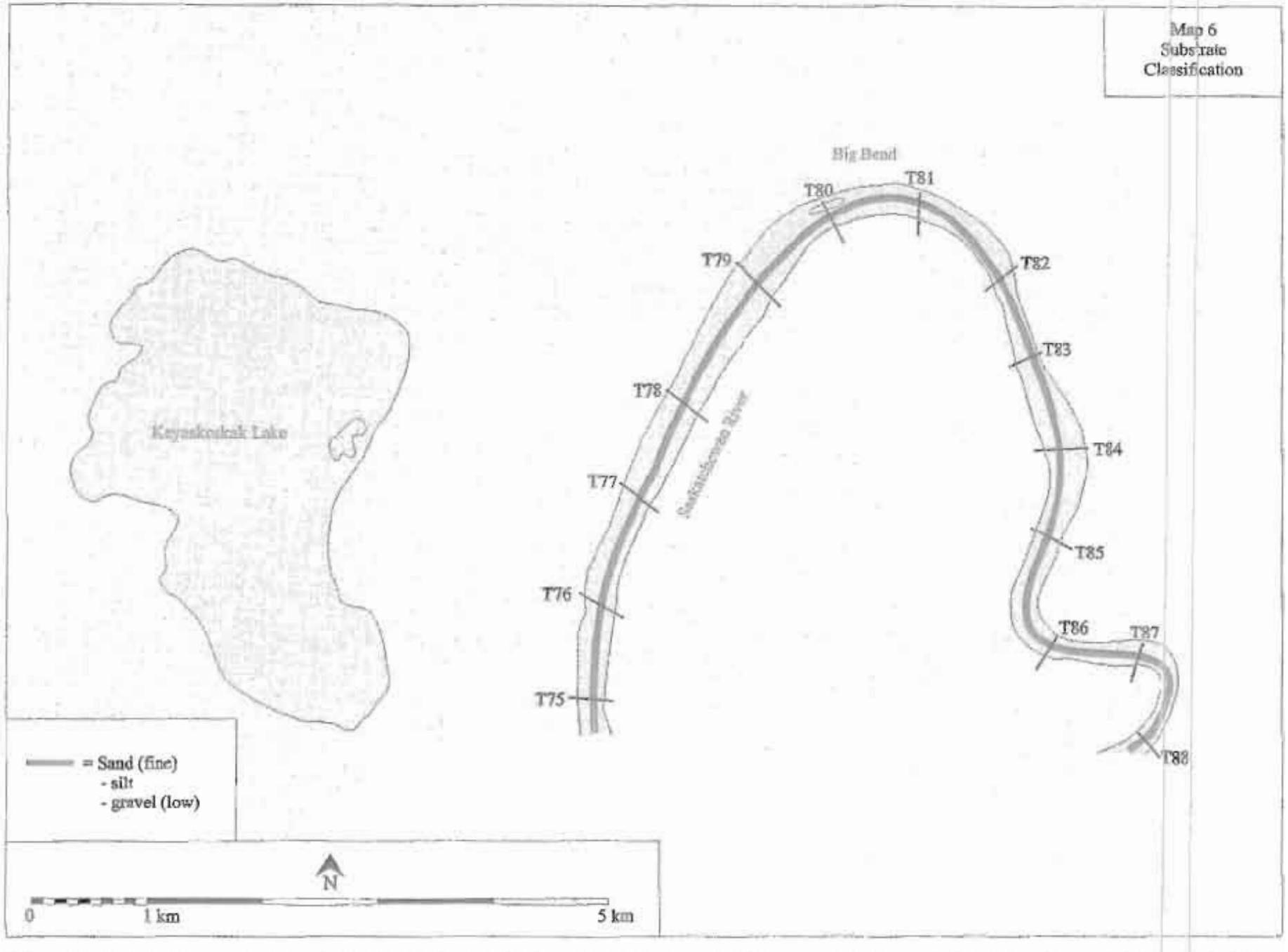

Figure 31. Substrate composition of the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 75 - Transect 88)

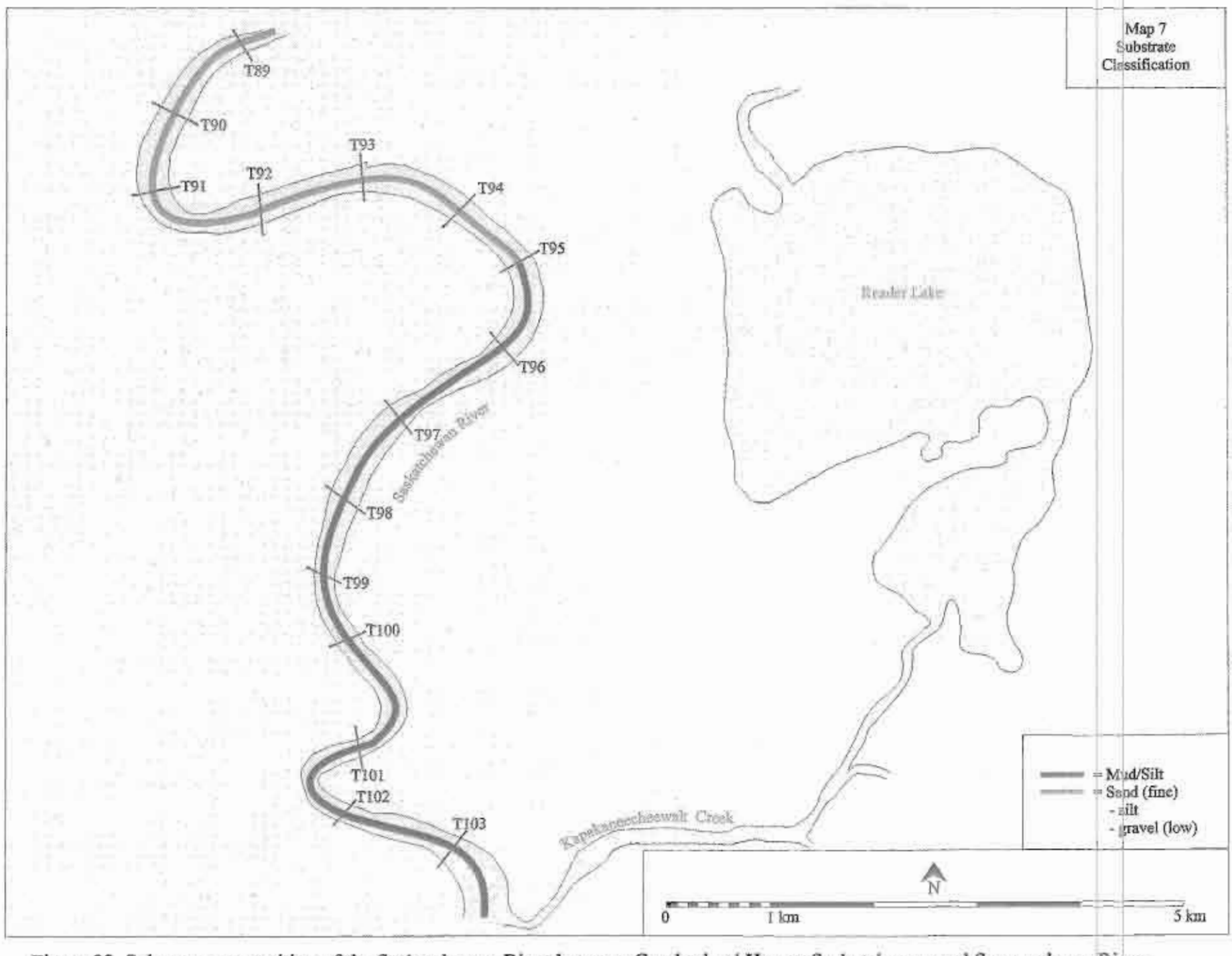

Figure 32. Substrate composition of the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 89 - Transect 103)

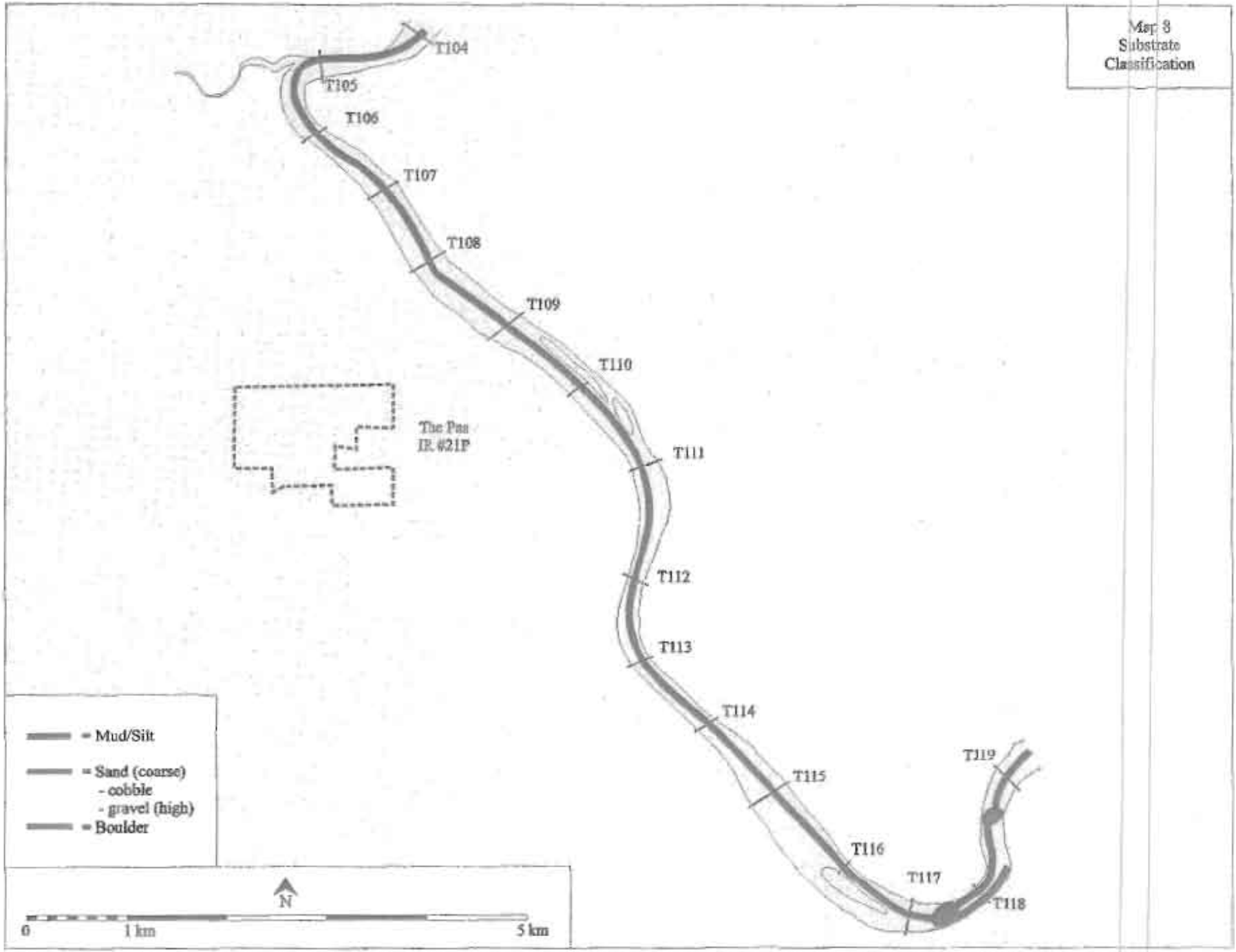

Figure 33. Substrate composition of the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 104 - Transect 119)

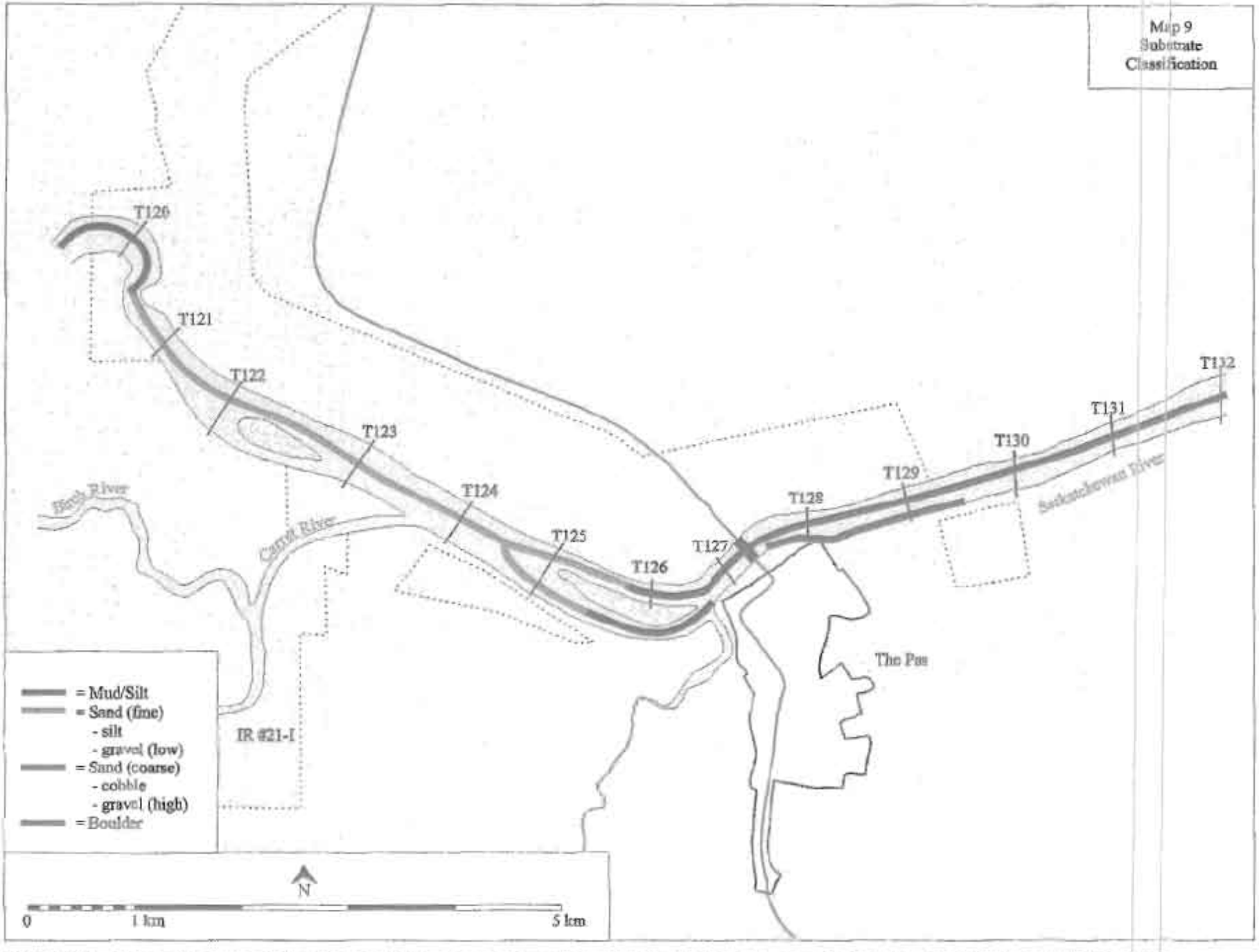

Figure 34. Substrate composition of the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 120 - Transect 132)

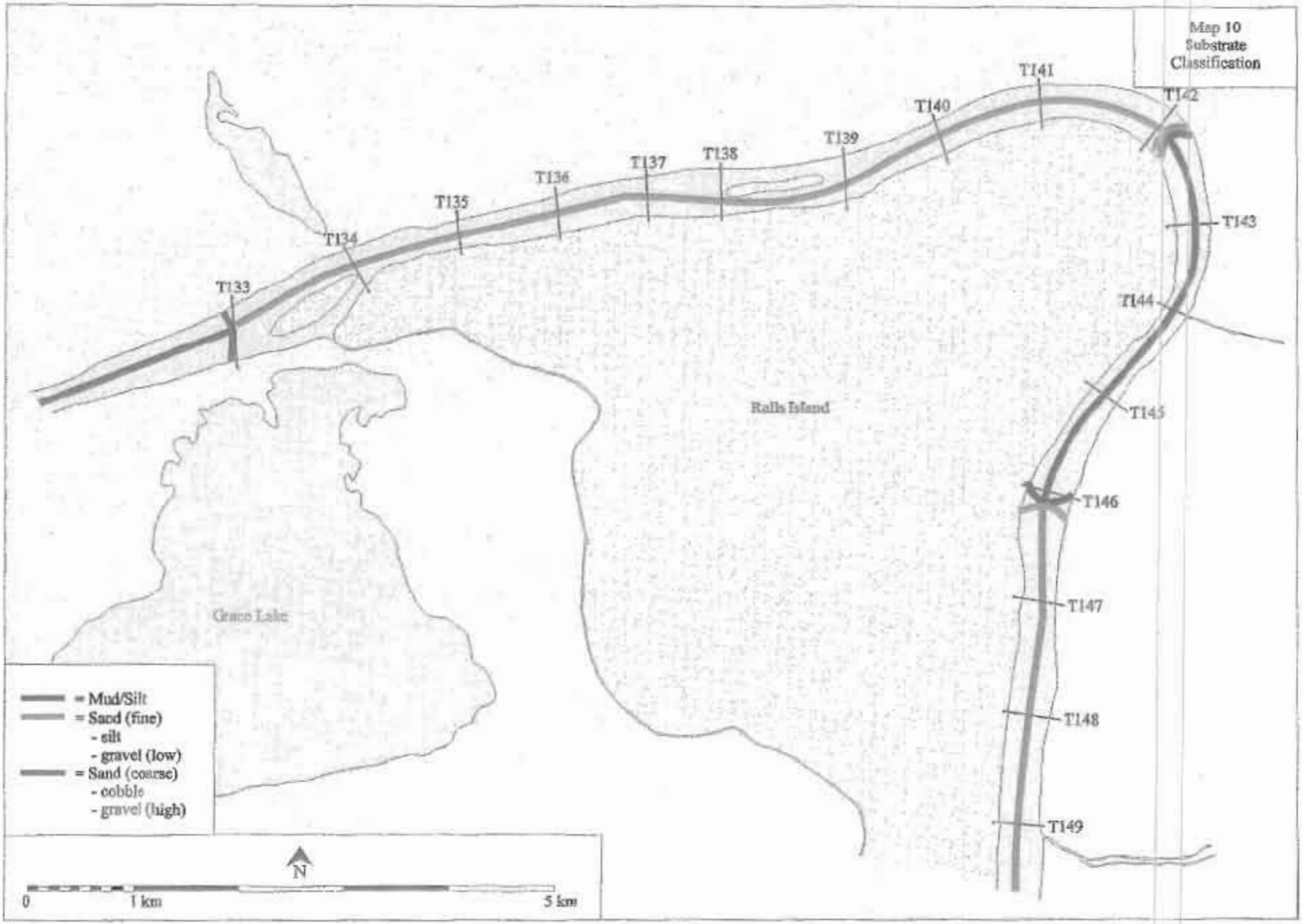

Figure 35. Substrate composition of the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 133 - Transect 149)

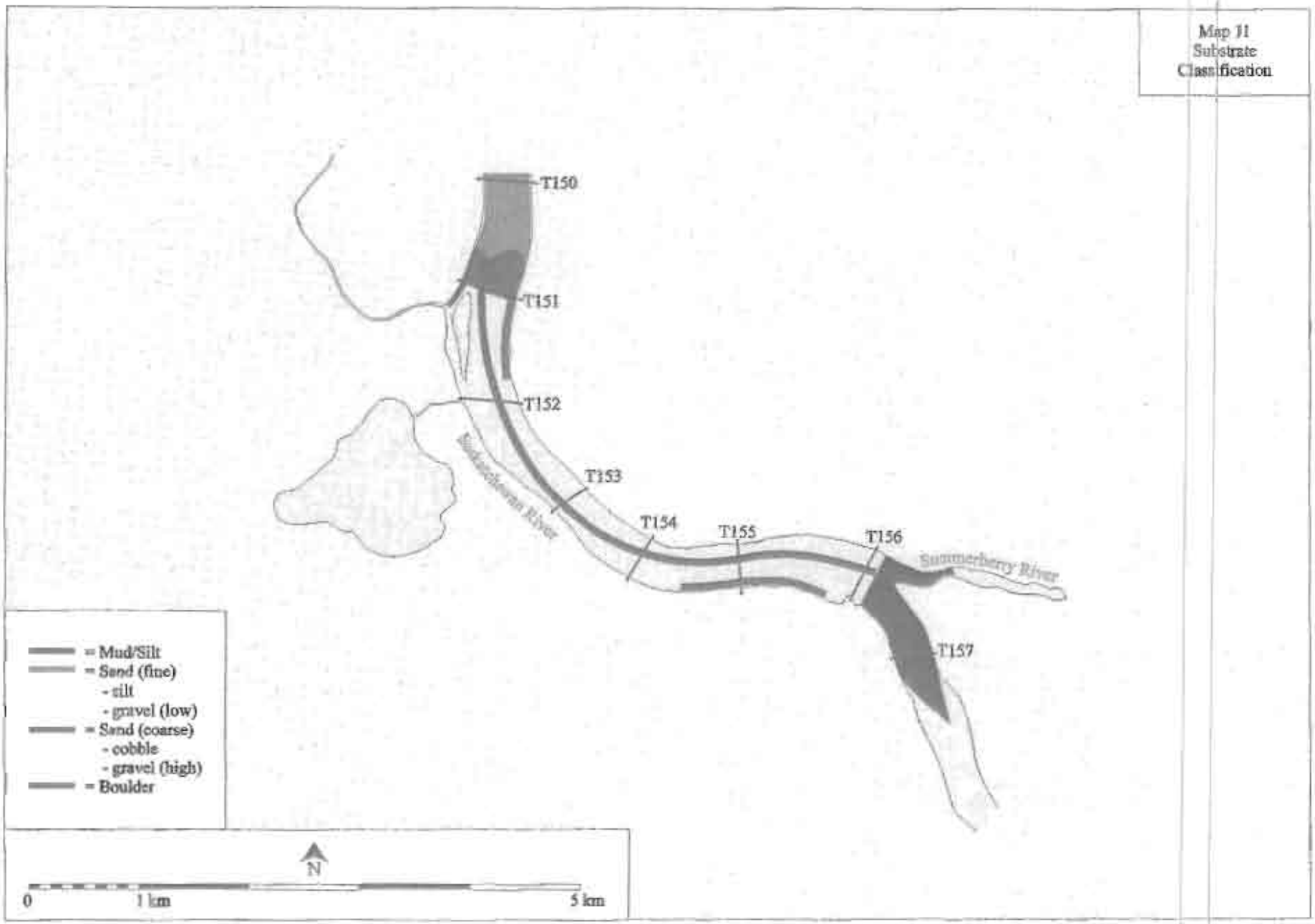

Figure 36. Substrate composition of the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 150 - Transect 157)

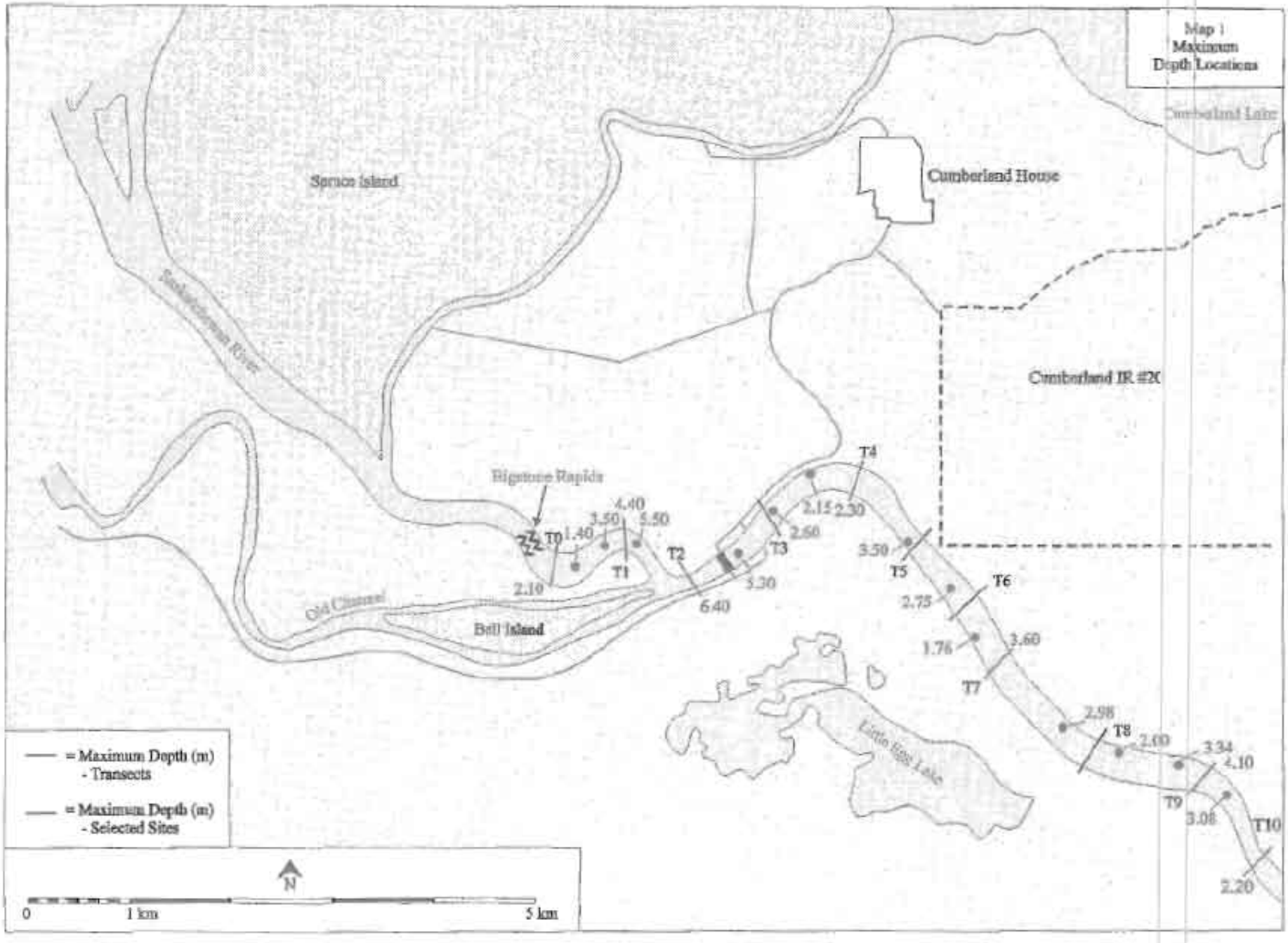

Figure 37. Location of maximum depths on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 0 - Transect 10)

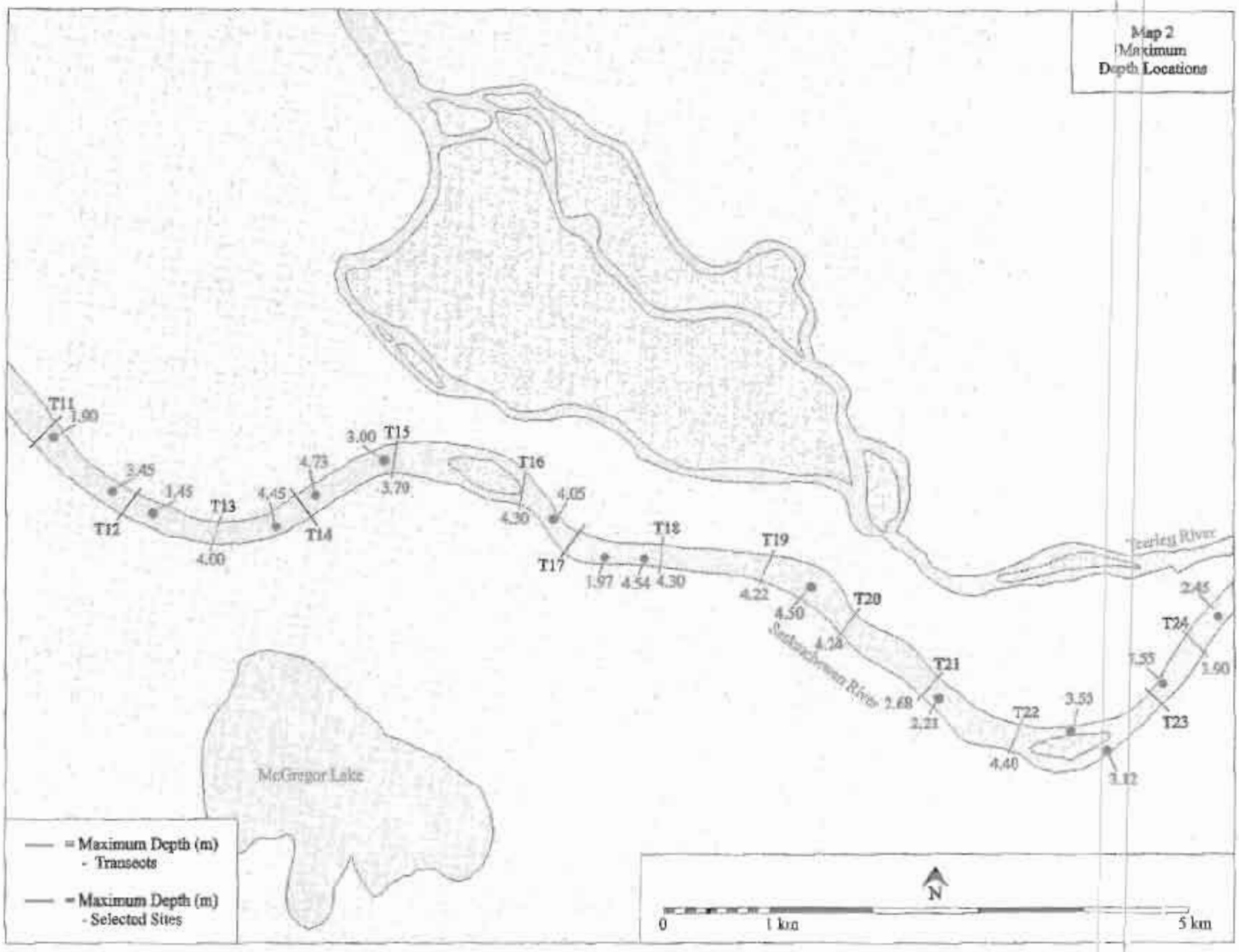

Figure 38. Location of maximum depths on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 11 - Transect 24)

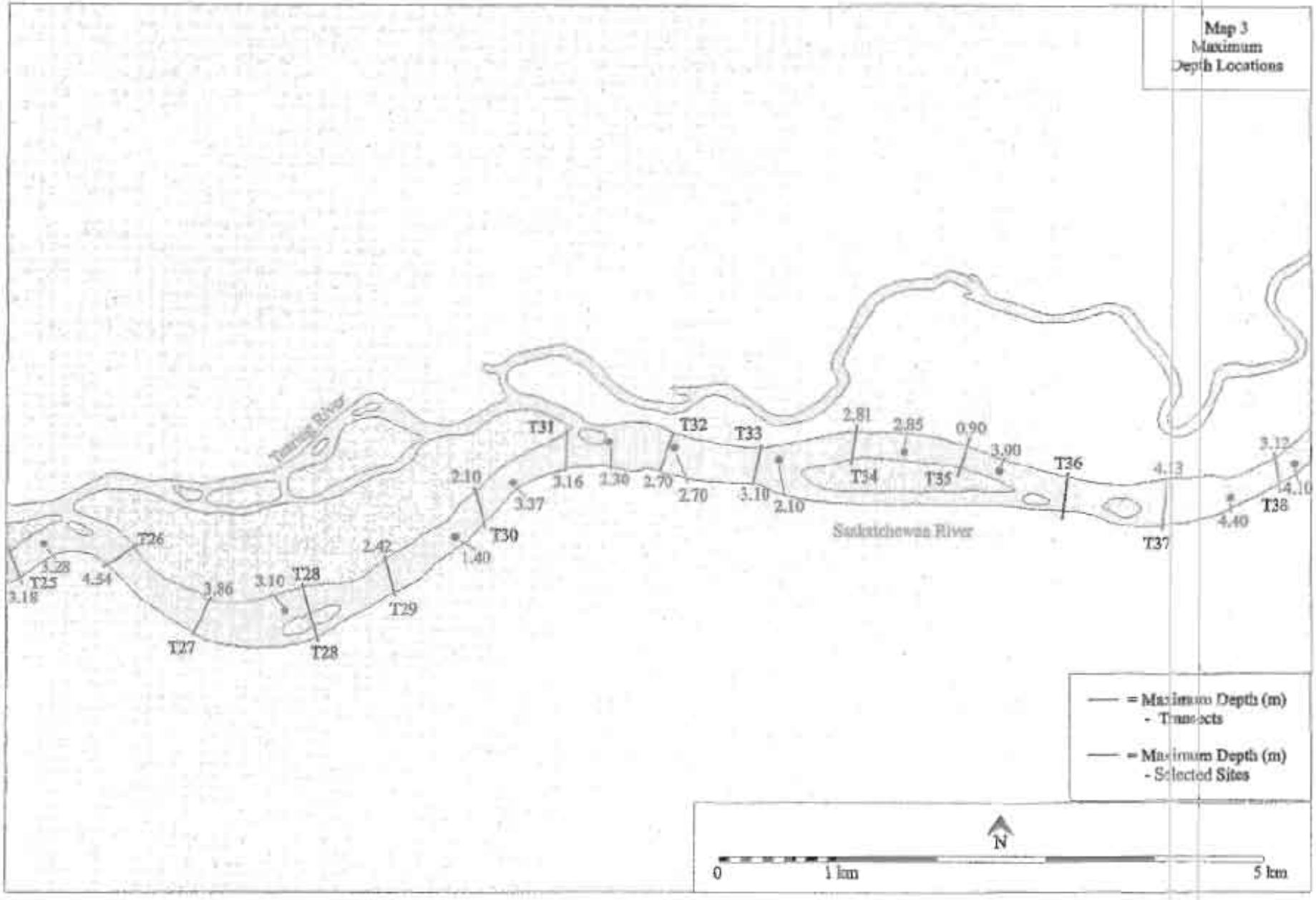

Figure 39. Location of maximum depths on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 25 - Transect 38)

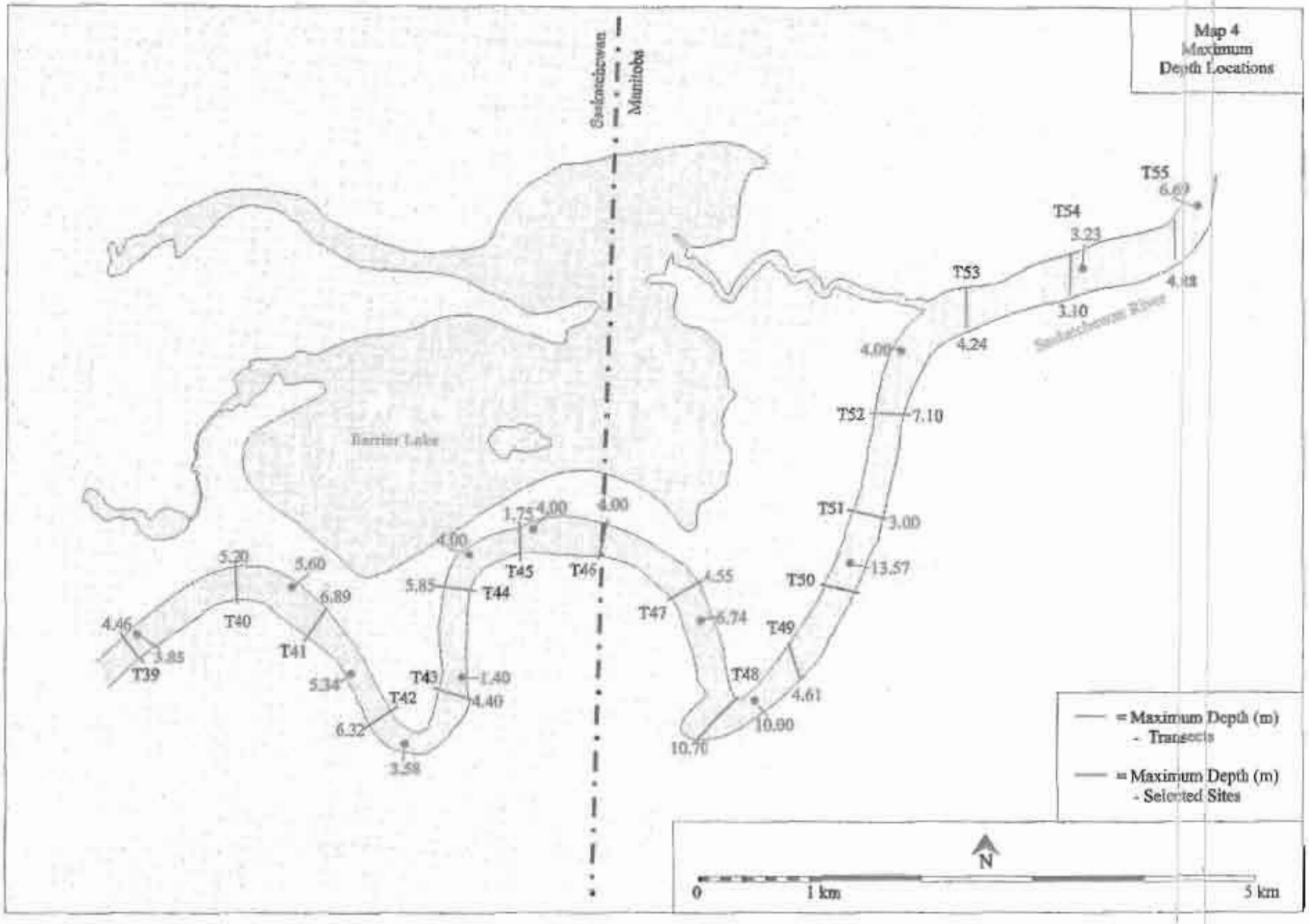

Figure 40. Location of maximum depths on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 39 - Transect 55)

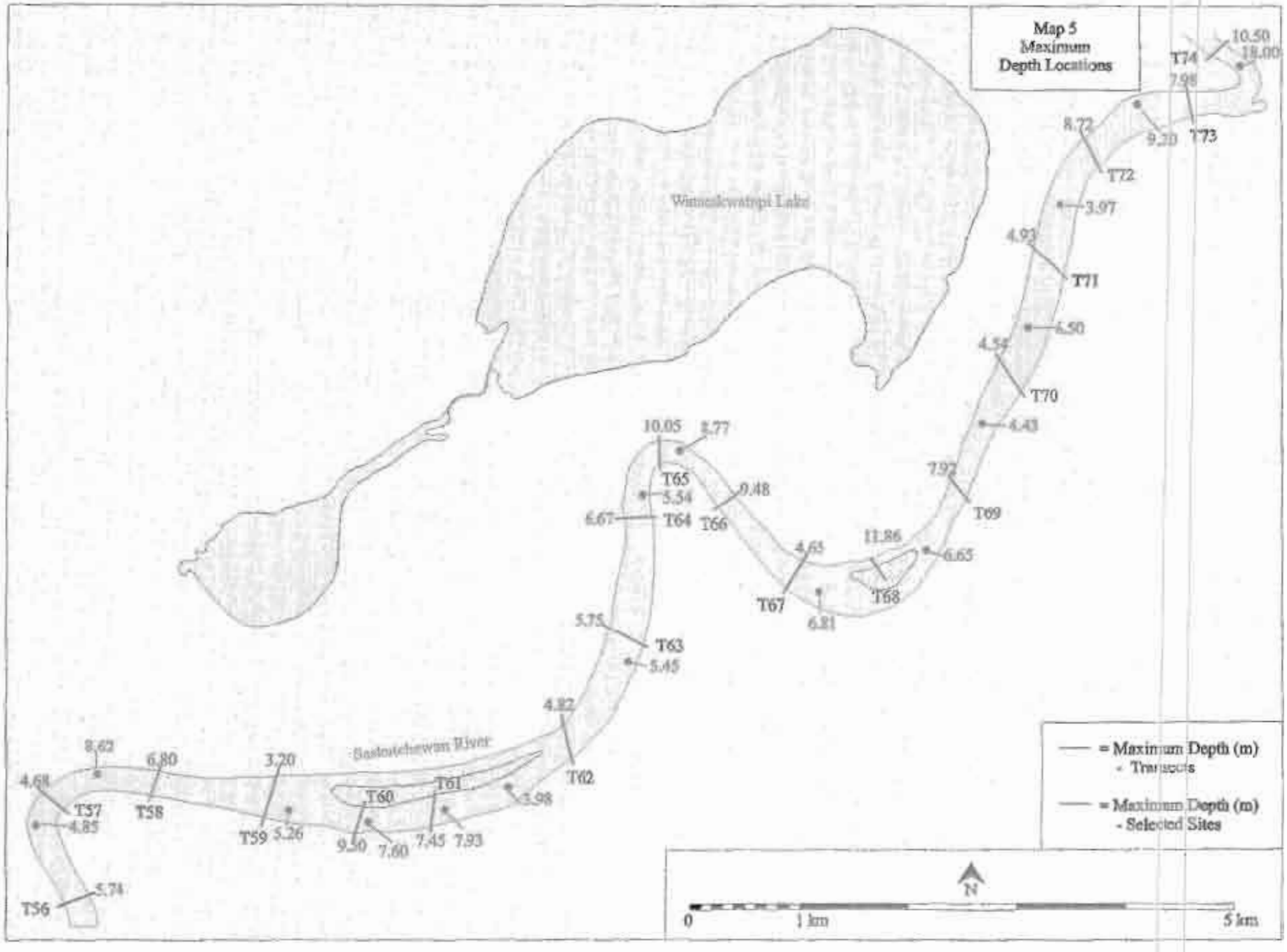

Figure 41. Location of maximum depths on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 56 - Transect 74)

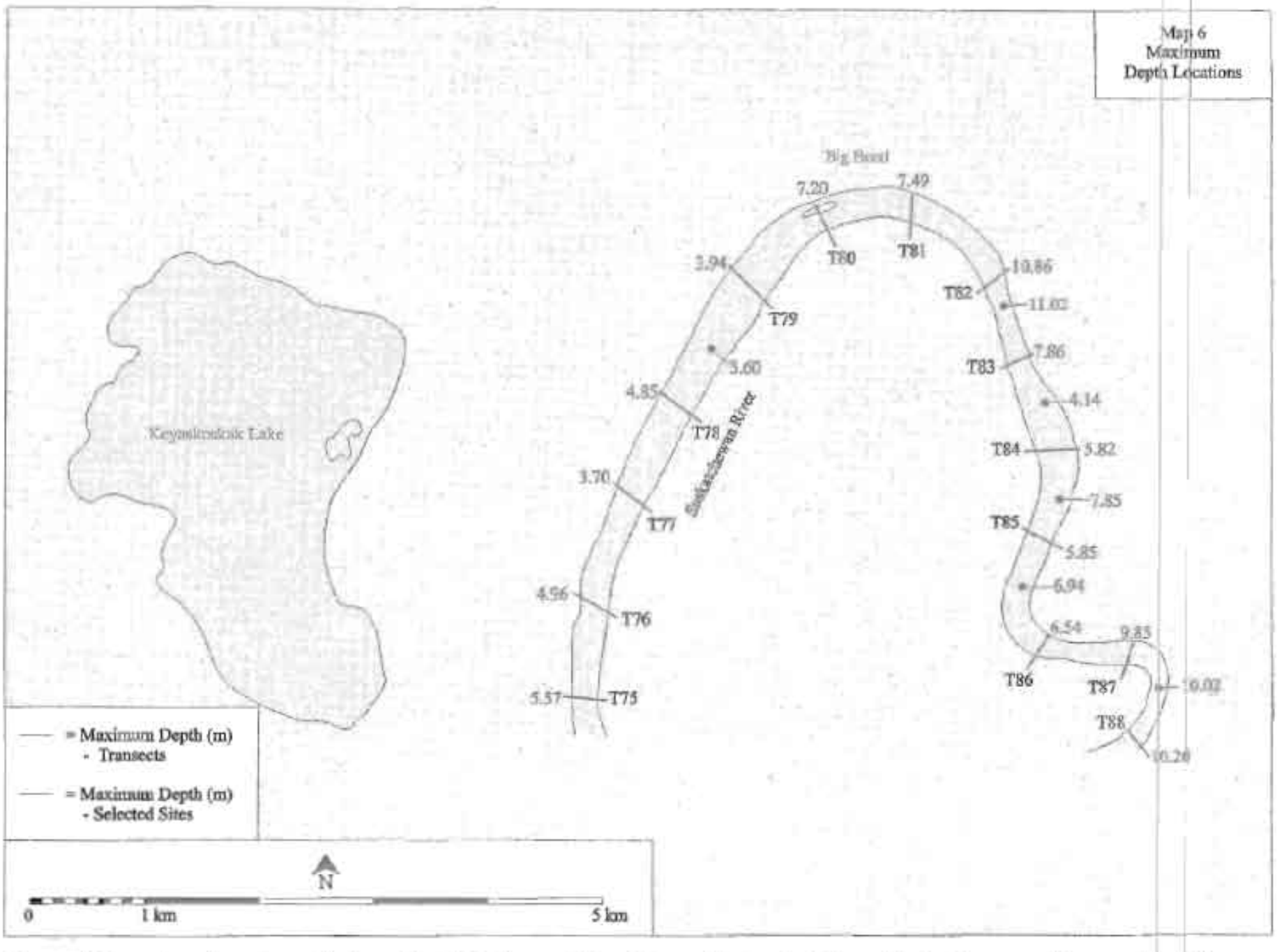

Figure 42. Location of maximum depths on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 75 - Transect 88)

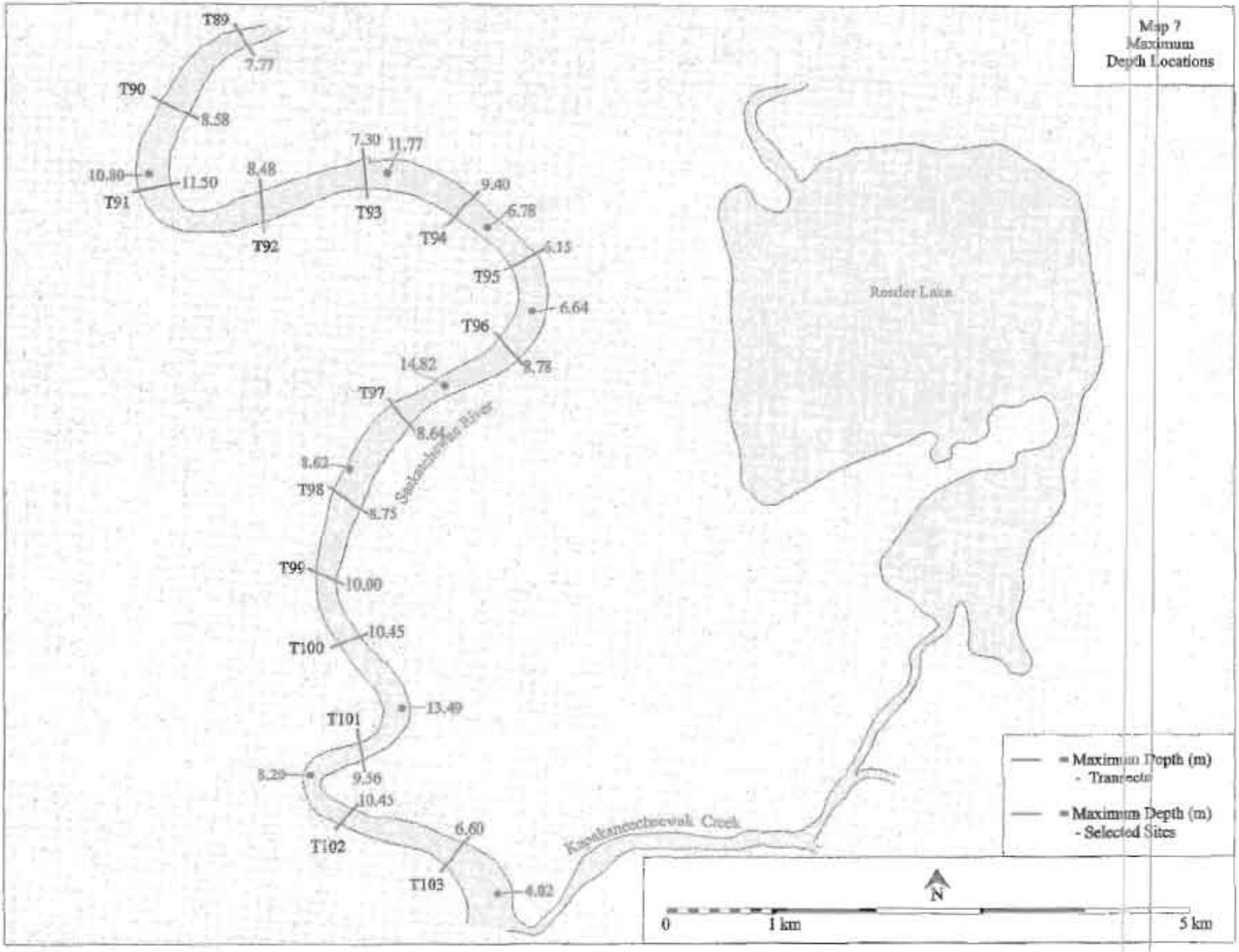

Figure 43. Location of maximum depths on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 89 - Transect 103)

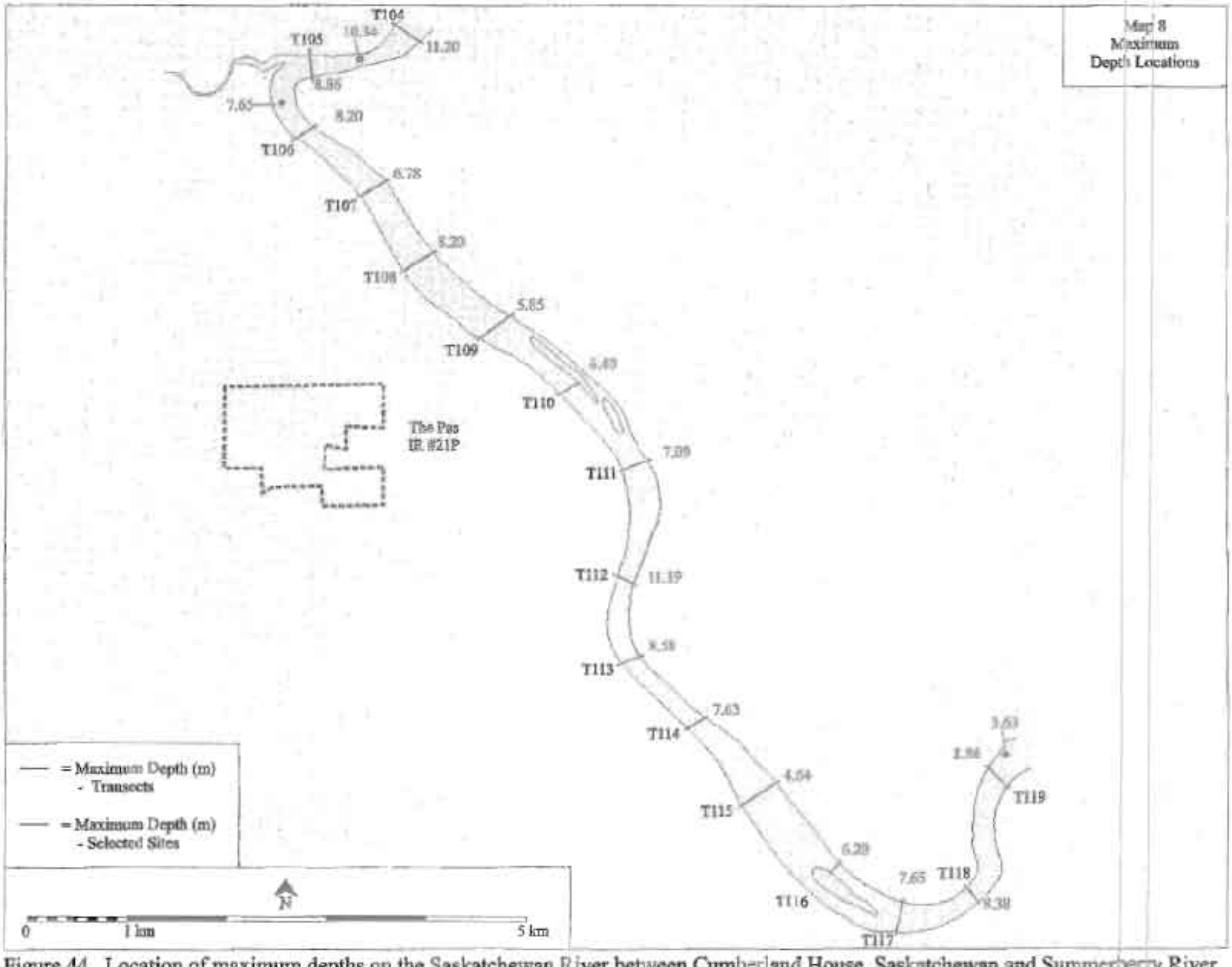

Figure 44. Location of maximum depths on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 104 - Transect 119)

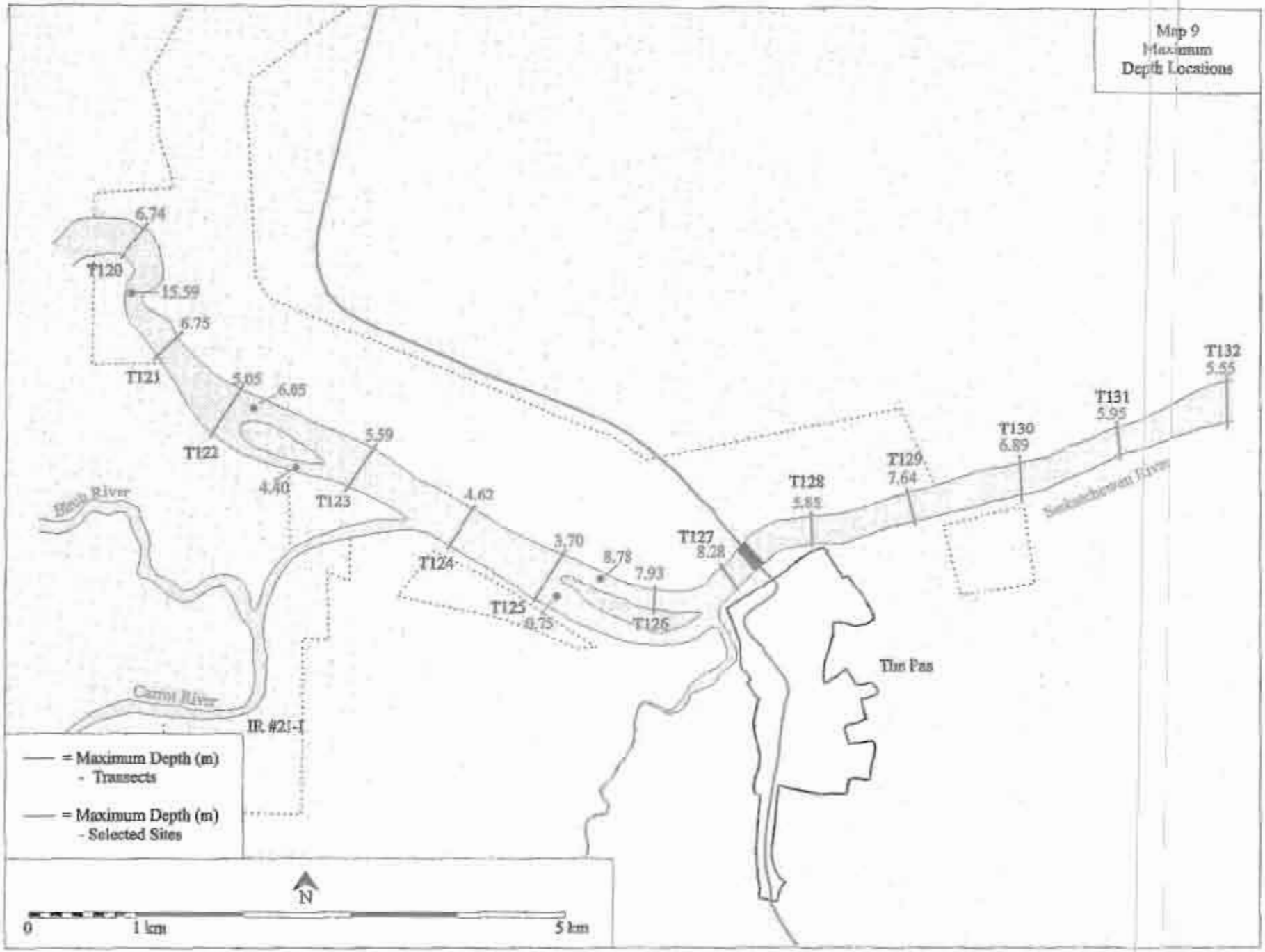

Figure 45. Location of maximum depths on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 120 - Transect 132)

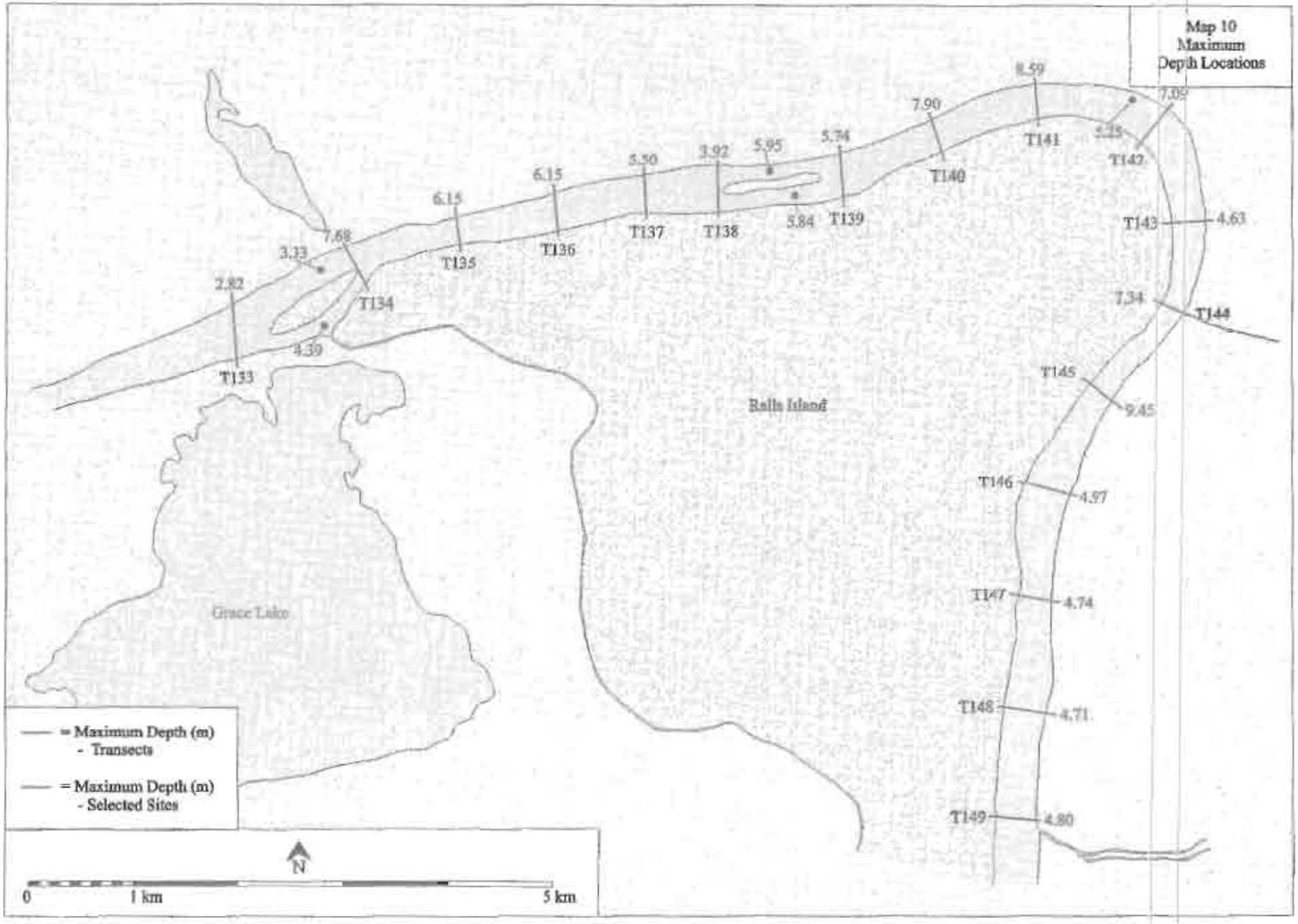

Figure 46. Location of maximum depths on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 133 - Transect 149)

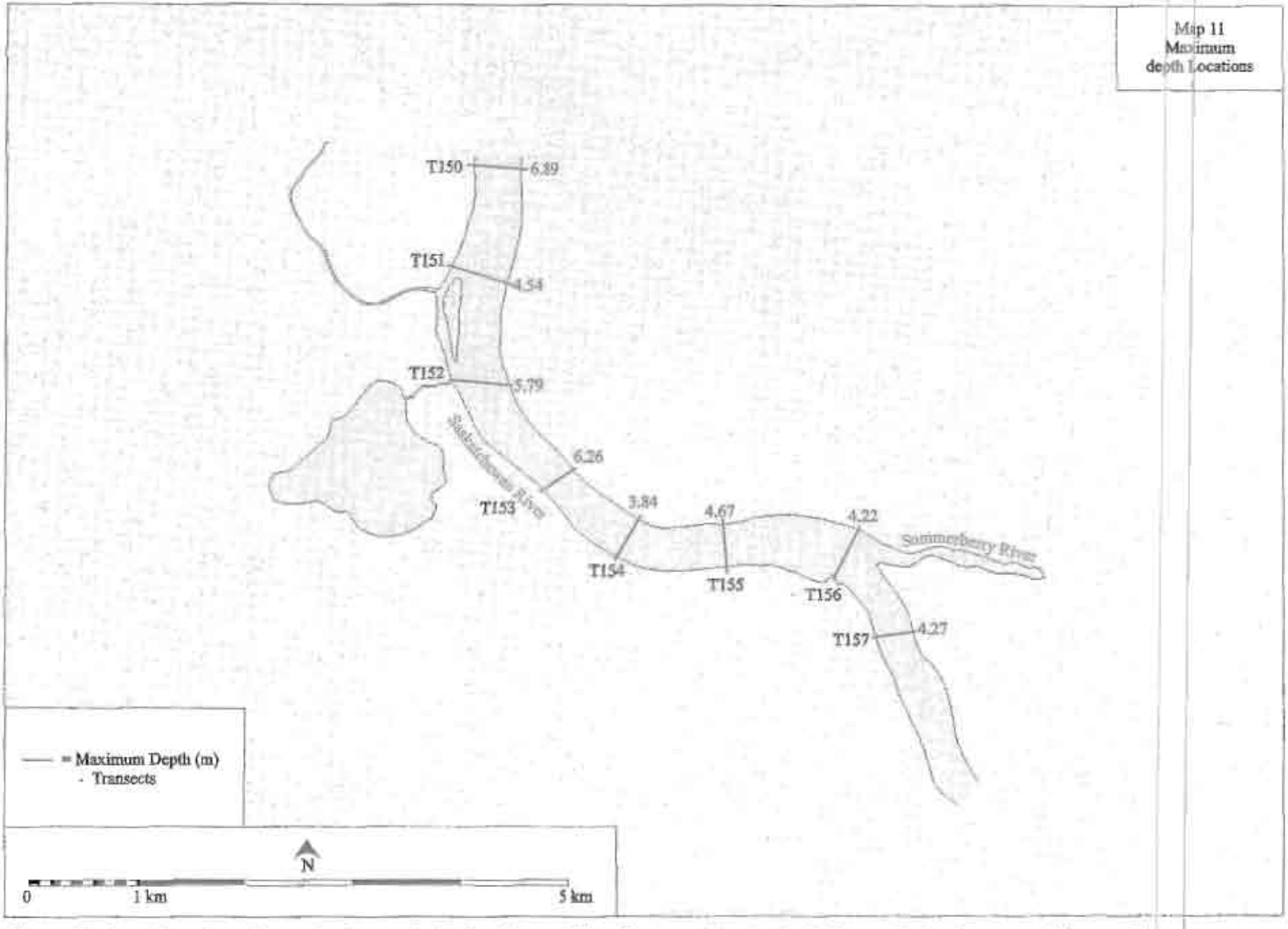

Figure 47. Location of maximum depths on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, based on data collected during, June, 2000. (Transect 150 - Transect 157)

Figure 48. Camp location illustrating typical shorelines. Note deposition on near shore (inside bend) and eroding shoreline on far shore (outside bend).

Figure 49. Bank instability (slumping) on outside river bend, a common shoreline feature throughout the study area.

Figure 50. Area exhibiting exposed, flat expanses of sand and pea-sized gravel in upper reach of study region in Saskatchewan.

Figure 51. Shoreline composed of boulder and cobble in the lower reach of the study area, near The Pas, Manitoba.

Figure 52. Juvenile lake sturgeon captured at GN-29 Site downstream of "Big Bend" in Manitoba.

Figure 53. Bigstone Rapids at Cumberland House, Saskatchewan, June, 2000. Note bedrock shelf (right bank facing upstream) located immediately downstream of rapids.

Appendix 1. Substrate characteristics, total depth, and velocity measurements collected at quarter points on transects and at selected sites on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000.

Location[1]	UTM (13U) NAD 83				Habitat Classification[2]		Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Quarter Point	E	N	Map	Date	Substrate	Compaction			
Transect #0									
RB	676156	5978207	1	6-Jun	1, 6	A	1.80	0.32	bank erosion (moderate/unstable); vegetation (balsam poplar); rock shelf (bedrock)
MID	-	-		-	1, 6	A	1.60	0.62	
LB	-	-		-	1, 6	A	2.10	0.58	bank erosion (moderate/unstable); vegetation (willow, balsam poplar)
Site #1									
MID	676468	5978217	1	6-Jun	1	A	1.40	-	
Site #2									
MID	676767	5978357	1	6-Jun	1	A	3.50	-	
Transect #1									
RB	676770	5978403	1	6-Jun	1	A	2.90	0.40	bank erosion (moderate/unstable); vegetation (balsam poplar)
MID	-	-		-	1	A	3.40	0.49	
LB	-	-		-	1	A	4.40	1.07	bank erosion (moderate/unstable); vegetation (balsam poplar)
Site #3									
MID	677143	5977978	1	6-Jun	1, 2	A	5.50	-	
Transect #2									
RB	677417	5977964	1	6-Jun	2	A	5.60	0.58	bank erosion (low/stable); vegetation (willow, balsam poplar); Cumberland House
MID	-	-		-	1, 2	A	6.40	0.62	
LB	-	-		-	1, 2	A	4.40	0.66	bank erosion (high/unstable/slumping); vegetation (balsam poplar)
Site #4									
LB	677782	5978122	1	6-Jun	1, 2	A	5.30	-	
Transect #3									
RB	-	-	1	6-Jun	2	A	-	-	bank erosion (low/stable); vegetation (willow, balsam poplar); Cumberland House
MID	-	-		-	2	A	-	-	
LB	-	-		-	1, 2	A	-	-	bank erosion (high/unstable/scoured); vegetation (balsam poplar)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Site #5									
MID	678175	5978555	1	6-Jun	1, 2	A	2.60	-	
Site #6									
RB	678584	5979004	1	6-Jun	1, 2, 3	A	2.15	-	
Transect #4									
RB	679167	5978980	1	6-Jun	1	A	2.30	0.57	bank erosion (low/stable); vegetation (willow, balsam poplar); Cumberland House
MID	-	-		-	2, 3	A	1.40	0.84	
LB	-	-		-	2, 3	A	2.30	0.86	bank erosion (high/unstable/scoured); vegetation (balsam poplar);
Site #7									
LB	679955	5978187	1	6-Jun	2, 3, 4	A	3.58	-	
Transect #5									
RB	-	-	1	6-Jun	2, 3, 4, 5	A	-	-	bank erosion (moderate/unstable); vegetation (balsam poplar, white spruce); Site 1.2
MID	-	-		-	2, 3, 4	A	-	-	
LB	-	-		-	2, 3	A	-	-	bank erosion (moderate/unstable/slumping); vegetation (balsam poplar, white spruce)
Site #8									
LB	680129	5977534	1	6-Jun	2, 3, 4	A	2.75	-	
Transect #6									
RB	-	-	1	6-Jun	2, 3, 4	A	-	-	bank erosion (moderate/unstable); vegetation (balsam poplar, white spruce)
MID	-	-		-	2, 3, 4	A	-	-	
LB	-	-		-	2, 3	A	-	-	bank erosion (moderate/unstable/slumping); vegetation (balsam poplar, white spruce)
Site #9									
LB	680752	5976900	1	6-Jun	2, 3, 4	A	1.76	-	
Transect #7									
RB	680627	5972212	1	6-Jun	2, 3	A	3.60	0.56	bank erosion (moderate/unstable); vegetation (balsam poplar, white spruce)
MID	-	-		-	1, 2	A	2.90	0.79	
LB	-	-		-	1, 2	A	1.70	0.56	bank erosion (moderate/unstable/slumping); vegetation (balsam poplar, white spruce)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Site #10									
MID	681218	5976401	1	6-Jun	2, 3	A	2.98	-	
Transect #8									
RB	-	-	1	6-Jun	2, 3	A	-	-	flood plain; exposed shoal (rock, gravel); bank erosion (high/unstable),
MID	-	-		-	2, 3	A	-	-	RB Contd... vegetation (balsam poplar, white spruce);*Site 1.3
LB	-	-		-	2, 3	A	-	-	bank erosion (high/unstable); vegetation (balsam poplar, white spruce)
Site #11									
RB	682024	5976277	1	6-Jun	2, 3	A	2.00	-	
Site #12									
MID	682496	5976282	1	6-Jun	2, 3	A	3.34	-	
Transect #9									
RB	682805	5975997	1	6-Jun	2, 3, 4	A	1.80	0.68	bank vegetation (balsam poplar, white spruce); small instream island
MID	-	-		-	2, 3, 4	A	2.70	0.78	
LB	-	-		-	2, 3, 4	A	4.10	0.81	bank erosion (high/stable); vegetation (balsam poplar, white spruce); small instream island LB Contd... *Site 1.4
Site #13									
MID	682972	5975684	1	6-Jun	2, 3, 4, 5	A	3.08	-	
Transect #10									
RB	683438	5975131	1	6-Jun	2, 3, 4, 5	A	2.20	0.98	rock/boulder shoal (exposed at low flow); vegetation (balsam poplar, white spruce)-*Site 1.5
MID	-	-		-	2, 3, 4, 5	A	1.60	1.15	
LB	-	-		-	2, 3, 4, 5	A	1.80	0.81	bank erosion (high/stable); vegetation (balsam poplar, white spruce); small instream island
Transect #11									
RB	-	-	2	6-Jun	2	A	-	-	bank erosion (moderate/stable); vegetation (balsam poplar, white spruce)
MID	-	-		-	2	A	-	-	
LB	-	-		-	2	A	-	-	bank erosion (moderate/stable); vegetation (balsam poplar, white spruce)
Site #14									
MID	6834812	5974421	2	6-Jun	2	A	1.90	-	

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #12									
RB	-	-	2	6-Jun	2	A	-	-	bank erosion (moderate/stable); vegetation (balsam poplar, white spruce)
MID	-	-		-	2	A	-	-	
LB	-	-		-	2	A	-	-	bank erosion (moderate/stable); vegetation (balsam poplar, white spruce)
Site #15									
MID	684504	5973842	2	6-Jun	2	A	3.45	-	
Site #16									
MID	685010	5973599	2	6-Jun	2	A	1.45	-	
Transect #13									
RB	6855267	5673576	2	6-Jun	2	A, B	2.30	0.60	bank erosion (moderate/stable); vegetation (balsam poplar, white spruce)
MID	-	-		-	2	A	2.10	0.52	
LB	-	-		-	2, 4	A, B	4.00	0.70	bank erosion (moderate/stable); vegetation (balsam poplar, white spruce)
Site #17									
LB	686131	5973404	2	6-Jun	1, 2	A, B	4.45	-	
Transect #14									
RB	-	-	2	6-Jun	1, 2	A, B	-	-	bank erosion (low/stable); vegetation (willow, balsam poplar, white spruce); *Site 1.6
MID	-	-		-	1, 2	A	-	-	
LB	-	-		-	1, 2	A, B	-	-	bank erosion (moderate/stable); vegetation (balsam poplar, white spruce)
Site #18									
LB	686563	5973675	2	6-Jun	1, 2	A, B	4.73	-	
Site #19									
MID	687351	5973988	2	6-Jun	1, 2	A	3.00	-	
Transect #15									
RB	686796	5974021	2	6-Jun	1, 2	A, B	2.80	0.61	bank erosion (low/stable); vegetation (willow, balsam poplar, white spruce)
MID	-	-		-	1, 2	A	3.70	0.65	
LB	-	-		-	1, 2	A, B	3.70	0.38	bank erosion (moderate/stable); vegetation (balsam poplar, white spruce)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #16									
RB	688111	5974288	2	6-Jun	1, 2	A, B	-	-	bank erosion (moderate/stable); vegetation (willow, balsam poplar)
MID	-	-		-	-	-	2.60	0.51	instream island (mid-channel); vegetation (reedgrass, willow)
LB	-	-		-	1, 2	A, B	4.30	0.67	bank erosion (high/stable); vegetation (willow, balsam poplar)
Site #20									
MID	688870	5973680	2	6-Jun	1, 2	A	1.50	-	
Transect #17									
RB	-	-	2	6-Jun	1, 2	A, B	-	-	bank erosion (moderate/stable); vegetation (willow, balsam poplar); *Site 1/7
MID	-	-		-	1, 2	A	-	-	
LB	-	-		-	1, 2	A, B	-	-	bank erosion (moderate/stable); vegetation (willow, balsam poplar)
Site #21									
LB	689221	5973265	2	6-Jun	1	A	-	-	
Site #22									
LB	689636	5973183	2	6-Jun	2	A	4.54	-	
Transect #18									
RB	689909	5973307	2	6-Jun	1, 2	A	4.30	0.61	bank erosion (moderate/stable); vegetation (willow, balsam poplar)
MID	-	-		-	1	A	3.90	0.80	
LB	-	-		-	1	A	3.90	0.56	bank erosion (high/stable); vegetation (balsam poplar, white spruce)
Transect #19									
RB	690823	5973289	2	7-Jun	2	A	3.95	0.45	bank erosion (moderate/stable); vegetation (balsam poplar)
MID	-	-		-	2	A	2.72	0.48	
LB	-	-		-	2	A	4.22	0.77	bank erosion (moderate/stable); vegetation (balsam poplar)
Site #23									
LB	-	-	2	7-Jun	2	A	4.50	1.03	instream island (exposed); no vegetation

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #20									
RB	671949	5972541	2	7-Jun	1	C	1.50	0.36	gentle sloping shoreline (stable); vegetation (willow, balsam poplar)
MID	-	-		-	1	A	4.24	0.59	
LB	-	-		-	1	A	4.20	0.64	bank erosion (high/unstable), vegetation (balsam poplar)
Transect #21									
RB	692256	5971994	2	7-Jun	-	-	-	-	bank erosion (high/unstable); vegetation (balsam poplar)
MID	-	-		-	2	A	2.68	-	
LB	-	-		-	-	-	-	-	flood plain; moderate sloping shoreline (unstable); vegetation (willow, balsam poplar)
Site #24									
MID	692776	5971841	2	7-Jun	2	A, B	2.21	-	
Transect #22									
RB	693248	5971675	2	7-Jun	2	A	4.40	0.50	bank erosion (low/stable); vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	2	A	3.55	0.52	
LB	-	-		-	2	A, B	1.51	0.49	flood plain; gentle sloping shoreline (stable); vegetation (reedgrass, willow, balsam poplar) LB contd.. * Site 1.9
Site #25									
LB	-	-	2	7-Jun	1, 2	A, B	-	-	bank erosion (low/stable); vegetation (balsam poplar)
Site #26									
RB	693940	5971621	2	7-Jun	2	A, B	3.53	0.71	
Site #27									
LB	694381	5971470	2	7-Jun	2	A, B	3.12	0.41	bank erosion (low/stable); vegetation (balsam poplar)
Transect #23									
RB	-	-	2	7-Jun	2	A, B	-	-	bank erosion (low/stable); vegetation (balsam poplar)
MID	-	-		-	2	A, B	-	-	
LB	-	-		-	2	A, B	-	-	bank erosion (low/stable); vegetation (balsam poplar)
Site #28									
MID	694858	5972124	2	7-Jun	2	A, B	7.55	0.55	

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #24									
RB	695201	5972623	2	7-Jun	2	A, B	3.90	0.58	bank erosion (low/stable); vegetation (balsam poplar)
MID	-	-		-	2	A, B	3.63	0.67	
LB	-	-		-	1	A, B	1.45	0.52	bank erosion (low/stable); vegetation (balsam poplar)
Site #29									
MID	695414	5972872	2	7-Jun	2	B	2.45	-	
Transect #25									
RB	695479	5973075	3	7-Jun	2	A, B	2.80	0.65	bank erosion (low-moderate/stable); vegetation (balsam poplar)
MID	-	-		-	2	A	2.33	0.66	
LB	-	-		-	1, 2, 4	A	5.18	0.85	bank erosion (moderate-high/stable); vegetation (balsam poplar)
Site #30									
MID	695931	5972904	3	7-Jun	-	-	3.28	-	Tearing River (1st outlet); instream island (reedgrass, willow); *Site 2.2
Transect #26									
RB	696528	5973085	3	7-Jun	2, 3, 4, 5	A	-	-	Tearing River (1st outlet); rock/boulder shoreline (exposed); *Site 2.1
MID	-	-		-	1, 2, 3, 4	A	2.64	1.05	
LB	-	-		-	1, 2, 3, 4	A	4.54	1.02	bank erosion (high/stable); vegetation (balsam poplar)
Transect #27									
RB	697014	5972696	3	8-Jun	2	A, B	-	-	continuation of rock/boulder shoreline (exposed); vegetation (balsam poplar)
MID	-	-		-	2	A	-	-	
LB	-	-		-	2	A	3.86	-	bank erosion (high/stable); vegetation (balsam poplar)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #28									
RB	303176	5972679	3	8-Jun	1, 2, 3, 4	A	2.49	0.72	bank erosion (moderate-high/stable); vegetation (balsam poplar)
MID	-	-		-	2	A, B	1.58	0.70	
LB	-	-		-	2	A, B	1.00	0.65	bank erosion (moderate-high/stable); vegetation (balsam poplar)
Site #31									
MID	303740	5972798	3	8-Jun	2	A	3.10	-	instream island; vegetation (reedgrass, willow, balsam poplar, white spruce)
Transect #29									
RB	304842	5973224	3	8-Jun	2	A, B	2.42	0.66	
MID	-	-		-	2	A, B	1.74	0.75	
LB	-	-		-	2	A, B	2.02	0.69	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Site #32									
MID	305107	5973343	3	8-Jun	2	A	1.40	-	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Transect #30									
RB	305434	5973591	3	8-Jun	2	A	2.10	-	bank erosion (high/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	-	-	-	-	
LB	-	-		-	-	-	-	-	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Site #33									
LB	305811	5973779	3	8-Jun	2	A	3.37	-	
Transect #31									
RB	306181	5973981	3	8-Jun	2	A, B	3.00	0.74	Tearing River (2nd outlet); instream island (reedgrass, willow); *Site 2.2
MID	-	-		-	2	A, B	3.16	0.87	
LB	-	-		-	2	A, B	-	-	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Site #34									
MID	306706	5974030	3	8-Jun	2, 3, 4	A	2.30	-	

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #32									
RB	307183	5973940	3	8-Jun	-	-	-	-	bank erosion (moderate/stable); vegetation (balsam poplar)
MID	-	-		-	2, 3, 4	A	2.70	-	
LB	-	-		-	-	-	-	-	bank erosion (moderate/stable); vegetation (willow, balsam poplar)
Site #35									
MID	307183	5973940	3	8-Jun	2, 3, 4	A	2.70	-	
Transect #33									
RB	307851	5973941	3	8-Jun	2	A, B	1.10	0.25	continuation of submerged sand/gravel shoal from Tearing River (2nd outlet); *Site 2.5
MID	-	-		-	2	A, B	3.10	0.67	RB contd., gentle sloping shoreline; vegetation (balsam poplar, american elm)
LB	-	-		-	2	A, B	2.65	0.75	gentle sloping shoreline; vegetation (willow, balsam poplar)
Site #36									
MID	308284	5973880	3	8-Jun	2	A	2.10	-	
Transect #34									
RB	308799	5973880	3	8-Jun	2	A	-	-	bank erosion (moderate-high/stable); vegetation (willow, balsam poplar, american elm)
MID	-	-		-	2	A	2.81	0.68	instream island; bank erosion (high/unstable); vegetation (willow, balsam poplar)
LB	-	-		-	2	A	-	-	bank erosion (moderate/stable); vegetation (willow, balsam poplar, american elm)
Site #37									
MID	309774	5973796	3	8-Jun	2	A	0.90	-	
Transect #35									
RB	309774	5973796	3	8-Jun	2	A	-	-	bank erosion (moderate-high/stable); *Site 2.6
MID	-	-		-	2	A	-	-	
LB	-	-		-	2	A	0.90	0.63	bank erosion (high/stable)
Site #38									
RB	310352	5973791	3	8-Jun	2	A	3.00	0.69	

Appendix 1. (Continued)

Location[1]	UTM (13U) NAD 83				Habitat Classification[2]		Total Depth	Mean Velocity	
Quarter Point	E	N	Map	Date	Substrate	Compaction	(m)	(m/s)	Riparian and Shoreline Features
Transect #36									
RB	-	-	3	8-Jun	2	A	-	-	bank erosion (moderate-high/stable); vegetation (willow, balsam poplar, american elm)
MID	-	-		-	2	A	-	-	
LB	-	-		-	2	A	-	-	bank erosion (moderate-high/stable); vegetation (willow, balsam poplar)
Transect #37									
RB	311924	5973470	3	8-Jun	2	A	1.58	0.66	floodplain; gentle sloping bank, some slumping; vegetation (willow, balsam poplar); *Site 2.7
MID	-	-		-	2	A	1.53	0.51	
LB	-	-		-	1, 2	A	4.13	0.17	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Site #39									
LB	312677	5973461	3	8-Jun	1	A	4.40	-	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Transect #38									
RB	313041	5973686	3	8-Jun	-	-	-	-	gentle sloping shoreline, some slumping; vegetation (willow, balsam poplar)
MID	-	-		-	1, 2	A	3.12	0.86	
LB	-	-		-	-	-	-	-	bank erosion (high/stable); vegetation (balsam poplar)
Site #40			3						
MID	313274	5973872		8-Jun	2	A	4.10	-	
Transect #39									
RB	313496	5974179	4	8-Jun	1, 2	B	3.17	0.54	gentle sloping shoreline, some slumping; vegetation (willow, balsam poplar)
MID	-	-		-	1, 2	B	4.46	0.72	
LB	-	-		-	1, 2	A	3.79	0.78	bank erosion (high/stable); vegetation (balsam poplar)
Site #41									
RB	313862	5974513	4	8-Jun	2	A	3.85	-	bank erosion (moderate/stable); vegetation (balsam poplar); instream island
Transect #40									
RB	314710	5974882	4	8-Jun	1	A	5.20	0.64	bank erosion (moderate-high/stable)
MID	-	-		-	1, 2	A	-	-	
LB	-	-		-	2	A, B	-	-	floodplain; gentle sloping shoreline; vegetation (willow, balsam poplar)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13E) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Site #42									
RB	315105	5974719	4	8-Jun	1	A	5.60	-	
Transect #41									
RB	315355	5974486	4	8-Jun	1	A	6.89	0.55	bank erosion (high/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	2	A, B	3.10	0.85	
LB	-	-		-	2	B	2.59	0.60	gentle sloping shoreline; vegetation (willow, balsam poplar)
Site #43									
MID	315513	5974363	4	8-Jun	1, 2	B	5.34	-	
Transect #42									
RB	315816	5974363	4	8-Jun	1	A, B	6.32	0.67	bank erosion (high/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	2	A, B	5.00	0.67	
LB	-	-		-	1, 2	A, B	1.97	0.52	gentle sloping shoreline; vegetation (willow, balsam poplar)
Site #44									
MID	316073	5973321	4	8-Jun	2	A, B	3.58	0.56	
Transect #43									
RB	316523	5973488	4	8-Jun	1	A, B	-	-	flood plain; gentle sloping shoreline; vegetation (willow)
MID	-	-		-	2	A, B	-	-	
LB	-	-		-	1, 2	A, B	4.40	0.61	bank erosion (high/stable); vegetation (balsam poplar)
Site #45									
LB	316615	5974048	4	8-Jun	2	A	1.40	-	
Transect #44									
RB	316492	5974561	4	8-Jun	2	A, B	3.60	0.53	flood plain; gentle sloping shoreline; vegetation (willow)
MID	-	-		-	2	A, B	5.20	0.67	
LB	-	-		-	2	A, B	5.85	0.56	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Site #46									
RB	316564	5974872	4	8-Jun	2	A, B	4.00	-	

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #45									
RB	316876	597150	4	8-Jun	1, 2, 4	A	1.75	0.94	bank erosion (high/stable); vegetation (willow, balsam poplar)
MID	-	-		-	2	A	-	-	
LB	-	-		-	2	A, B	-	-	flood plain; gentle sloping shoreline; vegetation (willow, balsam poplar); *Site 2.8
Site #47									
RB	317250	5975255	4	8-Jun	1, 2, 3	A	4.00	-	
Transect #46									
RB	317703	5975172	4	8-Jun	1, 2, 4	A	-	-	bank erosion (high/stable); vegetation (willow, balsam poplar)
MID	-	-		-	1, 2	A	4.00	0.66	
LB	-	-		-	1, 2	A, B	-	-	flood plain; gentle sloping shoreline; vegetation (willow, balsam poplar)
Transect #47									
RB	318583	5974646	4	8-Jun	1, 2	A	3.67	0.77	bank erosion (high/stable); vegetation (willow, balsam poplar)
MID	-	-		-	2	A, B	4.55	0.66	
LB	-	-		-	2	A, B	3.11	0.53	flood plain; gentle sloping shoreline; vegetation (willow, balsam poplar)
Site #48									
RB	318349	5974328	4	8-Jun	1, 2	A	6.74	-	
Transect #48									
RB	319116	5973615	4	8-Jun	2	A	5.35	0.62	bank erosion (high/stable); vegetation (willow, balsam poplar)
MID	-	-		-	2	A, B	10.70	0.43	
LB	-	-		-	1, 2	B, C	6.07	0.46	flood plain; gentle sloping bank; vegetation (willow, balsam poplar); *Site 2.9 (back eddy)
Site #49									
MID	319413	5973670	4	8-Jun	1	B, C	10.00	-	
Transect #49									
RB	319772	5974271	4	9-Jun	2	A	2.36	0.63	bank erosion (moderate-high/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	2	A	4.61	0.75	
LB	-	-		-	1	A	2.89	0.65	bank erosion (moderate-high/stable); vegetation (willow, balsam poplar, american elm)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Site #50									
MID	320162	5974694	4	9-Jun	1, 2	A	13.57	-	
Transect #50									
RB	-	-	4	9-Jun	1, 2	A	-	-	floodplain; exposed shoal (sand/silt); vegetation (balsam poplar, american elm)
MID	-	-		-	1, 2	A	-	-	
LB	-	-		-	1	A	-	-	bank erosion (moderate-high/stable); vegetation (balsam poplar, american elm)
Transect #51									
RB	320276	5974968	4	9-Jun	1, 2	A	-	-	floodplain; shoal (sand/silt); vegetation (balsam poplar, american elm)
MID	-	-		-	1, 2	A	-	-	
LB	-	-		-	1	A	3.00	-	bank erosion (moderate-high/stable); vegetation (balsam poplar, american elm)
Transect #52									
RB	320384	5975842	4	9-Jun	2	A, B	1.20	0.34	floodplain; shoal (sand/silt); vegetation (balsam poplar, american elm)
MID	-	-		-	1, 2	A, B	4.48	0.65	
LB	-	-		-	1	A	7.10	0.63	bank erosion (moderate-high/stable); vegetation (balsam poplar, american elm)
Site #51									
MID	320688	5976555	4	9-Jun	2	A	4.00	-	
Transect #53									
RB	321355	5977016	4	9-Jun	2	A, B	-	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1, 2, 4	A, B	4.24	0.90	
LB	-	-		-	1, 2, 4	A, B	1.68	0.61	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #54									
RB	321851	5977183	4	9-Jun	2	A, B	-	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	2	A, B	3.10	0.62	
LB	-	-		-	2	A, B	-	-	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Site #52									
MID	322354	5977525	4	9-Jun	2	A, B	3.23	-	

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #55									
RB	322952	5977706	4	9-Jun	1	A, B	4.88	0.74	bank erosion (high/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	1, 2	A, B	-	-	instream island; vegetation (willow)
LB	-	-		-	1, 2	A, B	-	-	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Site #53									
MID	323486	5978136	4	9-Jun	1	A	6.69	-	
Transect #56									
RB	323155	5978711	5	9-Jun	2	A, B	3.39	0.63	floodplain; gentle sloping shoreline; vegetation (willow, balsam poplar, american elm)
MID	-	-		-	2	A, B	5.74	0.09	
LB	-	-		-	1	A	5.51	0.85	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Site #54									
RB	323294	5979113	5	9-Jun	2, 3, 4	A	4.85	-	
Transect #57									
RB	323153	5979517	5	9-Jun	1, 2	A	4.68	0.83	bank erosion (high/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	1, 2	A	-	-	
LB	-	-		-	2	A	-	-	floodplain; gentle sloping shoreline; vegetation (willow)
Site #55									
RB	323631	5979620	5	9-Jun	1	A	8.62	-	
Transect #58									
RB	342260	5979571	5	9-Jun	2	A	6.60	0.66	bank erosion (high/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	2	A	6.80	0.66	
LB	-	-		-	2	A	2.71	0.43	floodplain; gentle sloping shoreline; vegetation (willow)
Transect #59									
RB	324941	597315	5	9-Jun	2	A	-	-	gentle sloping shoreline; vegetation (willow, balsam poplar)
MID	-	-		-	2	A	3.10	-	
LB	-	-		-	2	A	3.20	-	bank erosion (high/stable); vegetation (balsam poplar, american elm)

Appendix 1. (Continued)

Location[1]	UTM (13U) NAD 83				Habitat Classification[2]		Total Depth	Mean Velocity	
Quarter Point	E	N	Map	Date	Substrate	Compaction	(m)	(m/s)	Riparian and Shoreline Features
Site #56									
LB	325194	5979184	5	9-Jun	2	A	5.26	-	
Transect #60									
RB	325604	5979220	5	9-Jun	2	A	2.06	0.48	gentle sloping shoreline; vegetation (willow, balsam poplar)
MID	-	-		-	1, 2	A	2.64	0.62	
LB	-	-		-	1, 2, 3, 4	A	9.50	0.63	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Site #57									
LB	325944	5979074	5	9-Jun	2, 3,4	A	7.60	-	
Transect #61									
RB	326303	5979062	5	9-Jun	2	A	-	-	gentle sloping shoreline; vegetation (willow, balsam poplar)
MID	-	-		-	1, 2	A	-	-	
LB	-	-		-	1, 2, 3, 4	A	7.45	0.67	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Site #58									
LB	326656	5979180	5	9-Jun	1, 2	A	7.93	-	
Site #59								-	
RB	327101	5979385	5	9-Jun	2	A, B	3.98	0.65	
Transect #62									
RB	327814	5979975	5	9-Jun	2	B	0.90	0.39	gentle sloping shoreline; vegetation (willow, balsam poplar)
MID	-	-		-	2	A, B	3.58	0.67	
LB	-	-		-	1, 2	A	4.82	0.65	bank erosion (high/stable); vegetation (balsam poplar, american elm)
Site #60									
LB	328413	5980607	5	9-Jun	1	A	5.45	-	
Transect #63									
RB	328307	5980971	5	9-Jun	1, 2	B	-	-	gentle sloping shoreline; vegetation (willow); instream island (willow)
MID	-	-		-	1, 2	A, B	-	-	
LB	-	-		-	1	A	5.75	0.51	bank erosion (high/stable); vegetation (balsam poplar, american elm)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #64									
RB	328500	5981783	5	9-Jun	1, 2	B	-	-	floodplain; gentle sloping shoreline; vegetation (willow)
MID	-	-		-	1, 2	A, B	-	-	
LB	-	-		-	1	A, B	6.67	0.49	bank erosion (high/unstable); high instream and shoreline debris
Site #61									
LB	328316	5982265	5	9-Jun	1	A, B	5.54	-	
Transect #65									
RB	328660	5982612	5	9-Jun	1	A, B	9.25	0.52	bank erosion (high/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	1	A, B	10.05	0.57	
LB	-	-		-	1	C	3.09	0.45	gentle sloping shoreline; vegetation (willow)
Site #62									
RB	328931	5982486	5	9-Jun	1	A, B	8.77	-	
Transect #66									
RB	329126	5982486	5	9-Jun	1	A	9.48	0.56	bank erosion (high/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	1	A, B	-	-	
LB	-	-		-	1	A, B	-	-	gentle sloping shoreline; vegetation (willow)
Transect #67									
RB	329776	5981430	5	9-Jun	1	B, C	4.34	0.59	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
MID	-	-		-	1	C	4.65	0.63	
LB	-	-		-	1	B, C	4.54	0.52	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Site #63									
LB	330114	5981200	5	9-Jun	1	B, C	6.81	-	old island; surrounding extinct channel; vegetation (willow, balsam poplar)
Transect #68									
RB	330627	5981085	5	9-Jun	1, 2	A, B	-	-	old island, surrounding extinct channel; vegetation (willow, balsam poplar)
MID	-	-		-	1, 2	A, B	-	-	
LB	-	-		-	1	A	11.86	0.39	bank erosion (high/unstable); vegetation (balsam poplar, american elm)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (I30) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Site #64									
LB	331143	5981465	5	9-Jun	1	A, B	6.65	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Transect #69									
RB	331392	5982289	5	9-Jun	1, 2	B	4.55	0.54	old island, surrounding extinct channel; vegetation (willow, balsam poplar)
MID	-	-		-	1, 2	B	7.00	0.62	
LB	-	-		-	1, 2	A	7.92	0.54	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Site #65									
MID	331628	5982774	5	9-Jun	2	A	4.43	-	
Transect #70									
RB	331703	5983109	5	9-Jun	2	A	4.54	0.62	bank erosion (moderate/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	2	A	2.61	0.49	
LB	-	-		-	2	A	1.89	0.47	gentle sloping shoreline; vegetation (reedgrass, balsam poplar, american elm)
Site #66									
RB	331357	5983495	5	9-Jun	2	A	6.50	0.79	
Transect #71									
RB	332004	5984127	5	10-Jun	2	A, B	4.93	-	bank erosion (moderate/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	-	-	-	-	
LB	-	-		-	2	A, B	3.00	0.49	bank erosion (moderate/stable); vegetation (balsam poplar, american elm)
Site #67									
MID	332332	5984496	5	10-Jun	2	A	3.97	0.63	
Transect #72									
RB	332672	5985285	5	10-Jun	2	A, B	-	-	gentle sloping shoreline; vegetation (reedgrass, balsam poplar); end of extinct island
MID	-	-		-	-	-	8.72	0.42	
LB	332326	5984133		-	2	A,B	-	-	gentle sloping shoreline; vegetation (willow, balsam poplar)
Site #68									
RB	333105	5985785	5	10-Jun	2	A	9.20	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #73									
RB	333635	5985837	5	10-Jun	2	A	7.98	0.75	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
MID	-	-		-	2	A, B	5.74	0.62	
LB	-	-		-	1, 2	B, C	2.05	0.34	gentle sloping shoreline; vegetation (willow, balsam poplar)
Site #69									
MID	334211	5985911	5	10-Jun	1, 2	B	18.00	-	
Transect #74									
RB	333956	5986213	5	10-Jun	1, 2	A, B	3.95	0.40	bank erosion (high/stable); vegetation (willow, balsam poplar, american elm)
MID	-	-		-	1, 2	A	10.50	0.44	
LB	-	-		-	1	A	5.80	0.54	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #75									
RB	333497	5986923	6	10-Jun	1	A	5.57	0.69	bank erosion (high/stable); vegetation (willow, balsam poplar, american elm)
MID	-	-		-	1, 2	A	-	-	
LB	-	-		-	1, 2	A	-	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #76									
RB	333605	5987985	6	10-Jun	2	A	4.96	0.56	bank erosion (high/stable); vegetation (willow, balsam poplar, american elm)
MID	-	-		-	2	A	-	-	
LB	-	-		-	2	A	-	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #77									
RB	333992	5988794	6	10-Jun	2	A	-	-	bank erosion (high/stable); vegetation (willow, balsam poplar, american elm)
MID	-	-		-	2	A	3.70	0.60	
LB	-	-		-	2	A	-	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #78									
RB	334333	5989550	6	10-Jun	2	A	4.85	0.66	bank erosion (high/stable); vegetation (willow, balsam poplar, american elm)
MID	-	-		-	2	A	1.52	0.55	
LB	-	-		-	2	A	-	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Site #70									
MID	334663	5899970	6	10-Jun	2	A	3.60	-	

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #79									
RB	335167	5990603	6	10-Jun	2	A	-	-	gentle sloping shoreline; vegetation (willow); old channel
MID	-	-		-	2	A	3.94	0.56	
LB	-	-		-	2	A	-	-	bank erosion (high/unstable); vegetation (balsam poplar)
Transect #80									
RB	335959	5991275	6	10-Jun	2	A	7.20	0.52	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
MID	-	-		-	2	A, B	4.55	0.58	
LB	-	-		-	2	A, B	2.95	0.49	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #81									
RB	336664	5991179	6	10-Jun	1	A	7.49	0.57	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
MID	-	-		-	2	A	-	-	
LB	-	-		-	2	B, C	-	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #82									
RB	337140	5990707	6	10-Jun	1	A	10.86	0.50	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
MID	-	-		-	2	A	6.05	0.53	
LB	-	-		-	2	B, C	2.27	0.45	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Site #71									
RB	337251	5990326	6	10-Jun	1	A	11.02	-	
Transect #83									
RB	337346	5989887	6	10-Jun	2	A	7.86	0.56	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	2	A	7.38	0.51	
LB	-	-		-	2	A	4.11	0.49	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Site #72									
MID	337472	5989401	6	10-Jun	2	A	4.14	-	
Transect #84									
RB	337665	5988821	6	10-Jun	2	A	4.61	-	bank erosion (high/unstable); vegetation (balsam poplar); turning to gradual sloped shoreline
MID	-	-		-	2	A	5.82	-	
LB	-	-		-	1, 2	A	5.79	-	bank erosion (high/unstable); vegetation (balsam poplar)

Appendix 1. (Continued)

Location[1]	UTM (13U) NAD 83				Habitat Classification[2]		Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Quarter Point	E	N	Map	Date	Substrate	Compaction			
Site #73									
RB	337678	5988207	6	10-Jun	1	A	7.85	-	
Transect #85									
RB	337471	5988018	6	10-Jun	1	A	5.85	0.55	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
MID	-	-		-	1, 2	A	4.89	0.38	
LB	-	-		-	1, 2	B	1.57	0.38	floodplain; gentle sloping shoreline; vegetation (willow)
Site #74									
MID	327291	5987593	6	10-Jun	2	A, B	6.94	-	
Transect #86									
RB	337539	5987318	6	10-Jun	1, 2	A	-	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
MID	-	-		-	1, 2	A	-	-	
LB	-	-		-	1	A	6.54	0.52	floodplain; gentle sloping shoreline; vegetation (willow)
Transect #87									
RB	338363	5987313	6	10-Jun	2	A	4.44	0.50	floodplain; gentle sloping shoreline; vegetation (willow)
MID	-	-		-	2	A	7.18	0.57	
LB	-	-		-	1, 2	A	9.85	-	bank erosion (moderate-high/stable); vegetation (reedgrass, balsam poplar, american elm)
Site #75									
RB	338598	5986944	6	10-Jun	1	A	10.02	-	
Transect #88									
RB	338095	5986317	6	10-Jun	1	A	10.00	-	floodplain; gentle sloping shoreline; vegetation (willow)
MID	-	-		-	2	A	10.20	-	
LB	-	-		-	2	A	3.00	-	bank erosion (moderate-high/stable); vegetation (reedgrass, balsam poplar, american elm)
Transect #89									
RB	337253	5986101	7	10-Jun	2	A, B	7.77	0.45	gentle sloping shoreline; vegetation (willow, balsam poplar)
MID	-	-		-	2	A, B	6.57	0.59	
LB	-	-		-	2	B	4.95	0.57	floodplain; gentle sloping shoreline; vegetation (balsam poplar, american elm)

Appendix 1. (Continued)

Location[1]	UTM (13U) NAD 83				Habitat Classification[2]		Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Quarter Point	E	N	Map	Date	Substrate	Compaction			
Transect #90									
RB	336473	5985187	7	10-Jun	2	A, B	4.80	-	gentle sloping shoreline; vegetation (willow, balsam poplar)
MID	-	-		-	1, 2	A	7.80	-	
LB	-	-		-	1	A	8.58	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Site #76									
LB	336415	5984567	7	10-Jun	1	A	10.80	-	
Transect #91									
RB	337015	5984430	7	10-Jun	2	A, B	6.10	0.50	floodplain; gentle sloping shoreline; vegetation (willow)
MID	-	-		-	1, 2	A, B	10.93	0.59	
LB	-	-		-	1	A, B	11.50	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Transect #92									
RB	337710	5984500	7	10-Jun	2	A, B	-	-	floodplain; gentle sloping shoreline; vegetation (willow)
MID	-	-		-	1, 2	A, B	-	-	
LB	-	-		-	1	A	8.48	0.50	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Transect #93									
RB	338510	5984877	7	10-Jun	2	A	5.75	-	gentle sloping shoreline; vegetation (willow, balsam poplar)
MID	-	-		-	2	A, B	7.30	-	
LB	-	-		-	2	A, B	6.05	-	gentle sloping shoreline; vegetation (willow, balsam poplar)
Site #77									
MID	338952	5984941	7	10-Jun	1	A	11.77	-	
Transect #94									
RB	339496	5984541	7	10-Jun	1	A	8.09	0.59	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
MID	-	-		-	1, 2	B	9.40	0.64	
LB	-	-		-	1, 2	B	5.63	0.41	gentle sloping shoreline; vegetation (willow, balsam poplar)
Site #78									
MID	339741	5984656	7	10-Jun	2	A, B	6.78	-	

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #95									
RB	340197	5983904	7	11-Jun	1	C	6.15	0.50	bank erosion (moderate/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	1	B	-	-	
LB	-	-		-	1	B	-	-	gentle sloping shoreline; vegetation (willow, balsam poplar)
Site #79									
MID	340230	5983420	7	11-Jun	1	A	6.54	-	
Transect #96									
RB	339954	5983024	7	11-Jun	1	A	7.92	0.56	bank erosion (moderate-high/unstable); vegetation (balsam poplar, american elm)
MID	-	-		-	1	A	8.78	0.51	
LB	-	-		-	1	B, C	3.32	0.50	gentle sloping shoreline; vegetation (willow, balsam poplar)
Site #80									
RB	339334	5982781	7	11-Jun	1	A, B	14.82	-	
Transect #97									
RB	338862	5982375	7	11-Jun	1	B, C	3.10	-	floodplain; gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	B, C	6.24	-	
LB	-	-		-	1	A	8.64	-	bank erosion (moderate-high/unstable); vegetation (balsam poplar, american elm)
Site #81									
LB	338267	5981986	7	11-Jun	1	A	8.62	-	
Transect #98									
RB	338100	5981244	7	11-Jun	1	C	4.00	0.55	floodplain; gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	B, C	8.78	0.44	
LB	-	-		-	1	A	8.75	0.53	bank erosion (moderate-high/unstable); vegetation (balsam poplar, american elm)
Transect #99									
RB	338088	5980829	7	11-Jun	1	C	3.00	-	floodplain; gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	B, C	10.00	-	
LB	-	-		-	1	A	9.28	-	bank erosion (moderate-high/unstable); vegetation (balsam poplar, american elm)

Appendix 1. (Continued)

Location[1]	UTM (13U) NAD 83				Habitat Classification[2]		Total Depth (m)	Mean Velocity (m/s)	
Quarter Point	E	N	Map	Date	Substrate	Compaction			Riparian and Shoreline Features
Transect #100									
RB	338334	5980320	7	11-Jun	1	C	6.51	0.61	floodplain; gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	B, C	10.45	0.56	
LB	-	-		-	1	A, B	7.48	0.38	bank erosion (high/unstable); vegetation (balsam poplar)
Site #82									
RB	338732	5979769	7	11-Jun	1	A, B	13.49	0.40	
Transect #101									
RB	338440	5979332	7	11-Jun	1	A	7.65	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
MID	-	-		-	1	B	9.56	-	
LB	-	-		-	1	B	2.80	-	gentle sloping shoreline; vegetation (reedgrass, willow)
Site #83									
MID	337856	5979037	7	11-Jun	1	A, B	8.20	0.28	
Transect #102									
RB	338232	5978753	7	11-Jun	1	C	4.54	0.51	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	B	10.45	-	
LB	-	-		-	1	B	7.35	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Transect #103									
RB	339175	5978474	7	11-Jun	1	B	3.95	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	B, C	6.60	-	
LB	-	-		-	1	B, C	6.50	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm); @ transect turns into LB Cond... a gentle sloping bank; vegetation (reedgrass, willow)
Site #84									
MID	339640	5977964	7	11-Jun	1	B, C	4.02	0.54	
Transect #104									
RB	339465	5977406	8	11-Jun	1	A	10.00	0.43	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
MID	-	-		-	1	A	11.20	0.41	
LB	-	-		-	1	C	3.35	0.37	floodplain; gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Site #85									
MID	338856	5977158	8	11-Jun	1	A	10.34	0.59	
Transect #105									
RB	338392	5977155	8	11-Jun	1	A	-	-	bank erosion (low/stable); vegetation (balsam poplar, american elm)
MID	-	-		-	1	A	8.86	-	
LB	-	-		-	1	B	-	-	floodplain, gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Site #86									
LB	337991	5976966	8	11-Jun	1	B, C	7.65	0.47	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Transect #106									
RB	338220	5976473	8	11-Jun	1	A	-	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	A	-	-	
LB	-	-		-	1	B	8.20	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Transect #107									
RB	338936	5975791	8	11-Jun	1	B, C	5.14	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	A, B	6.78	-	
LB	-	-		-	1	B, C	5.65	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #108									
RB	339512	5975197	8	11-Jun	1	B, C	8.20	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	B, C	5.65	-	
LB	-	-		-	1	C	2.89	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #109									
RB	340191	5974570	8	11-Jun	1	C	2.62	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	A, B	4.97	-	
LB	-	-		-	1	A, B	5.85	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Transect #110									
RB	340988	5973946	8	11-Jun	1	B, C	4.30	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	A, B	5.17	-	
LB	-	-		-	1	A, B	6.40	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #111									
RB	341702	5973026	8	11-Jun	1	A	7.09	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	A, B	5.04	-	
LB	-	-		-	1	B	3.00	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Transect #112									
RB	341547	5972024	8	11-Jun	1	A	11.19	0.64	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	B, C	8.58	0.51	
LB	-	-		-	1	C	2.20	0.26	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Transect #113									
RB	341482	5971110	8	11-Jun	1	C	5.25	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	A, B	9.45	-	
LB	-	-		-	1	A	8.58	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Transect #114									
RB	342095	5970519	8	11-Jun	1	C	4.65	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	A, B	6.77	-	
LB	-	-		-	1	A, B	7.63	-	bank erosion (high/unstable); vegetation (balsam poplar, american elm)
Transect #115									
RB	342753	5969915	8	11-Jun	1	A, B	4.64	-	gentle sloping shoreline; vegetation (reedgrass, willow, dogwood, balsam poplar)
MID	-	-		-	1	A, B	3.65	-	
LB	-	-		-	1	A, B	3.49	-	gentle sloping shoreline; vegetation (willow, balsam poplar)
Transect #116									
RB	342946	5969121	8	11-Jun	1	C	6.28	-	gentle sloping shoreline; vegetation (reedgrass, dogwood, balsam poplar)
MID	-	-		-	-	-	-	-	
LB	-	-		-	1	B, C	2.62	-	gentle sloping shoreline; vegetation (balsam poplar)
Transect #117									
RB	344221	5968519	8	11-Jun	1	B, C	3.02	-	gentle sloping shoreline; vegetation (reedgrass, willow, dogwood, balsam poplar)
MID	-	-		-	1	A, B	7.63	-	
LB	-	-		-	1	A, B	3.33	-	bank erosion (high/unstable); vegetation (balsam poplar); open burn area

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #118									
RB	344895	5969058	8	11-Jun	1	B, C	4.47	0.56	bank erosion (high/unstable); vegetation (willow, dogwood, balsam poplar); open burn area
MID	-	-		-	2, 3, 4	A	8.38	0.66	
LB	-	-		-	2, 3, 4	A	5.74	0.59	gentle sloping shoreline (rock, boulder); vegetation (reedgrass, willow, balsam poplar) LB Contd... *Site 3.7
Transect #119									
RB	344944	5969696	8	12-Jun	1	C	4.33	0.53	bank erosion (high/unstable); vegetation (willow, dogwood, balsam poplar)
MID	-	-		-	1	B, C	8.86	0.45	
LB	-	-		-	1	B, C	7.29	0.35	gentle sloping shoreline; vegetation (reedgrass, willow)
Site #87									
RB	345332	5970079	8	12-Jun	1	C	3.63	-	
Transect #120									
RB	345738	5970170	9	12-Jun	1	A, B	6.74	-	bank erosion (high/unstable); vegetation (willow, dogwood, balsam poplar)
MID	-	-		-	2	A, B	1.20	-	
LB	-	-		-	2	A, B	1.90	-	gentle sloping shoreline; vegetation (reedgrass, willow)
Site #88									
MID	345842	5969647	9	12-Jun	2	A, B	15.59	0.60	
Transect #121									
RB	346078	5969258	9	12-Jun	2	A, B	4.64	-	gentle sloping shoreline (rock, gravel); vegetation (willow, balsam poplar); recreation area
MID	-	-		-	2	A, B	4.84	-	
LB	-	-		-	2	A, B	6.75	-	gentle sloping shoreline (rock, boulder); vegetation (reedgrass, willow, dogwood); *Site 3.9
Transect #122									
RB	346622	5968668	9	12-Jun	2	A, B	5.05	-	gentle sloping shoreline (rock, gravel); vegetation (willow, balsam poplar); recreation area
MID	-	-		-	2	A, B	2.20	-	
LB	-	-		-	2	A, B	2.82	-	gentle sloping shoreline (rock, boulder); vegetation (reedgrass, willow, dogwood)
Site #89									
MID	346824	5968126	9	12-Jun	1	A, B	6.05	-	

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Site #90									
MID	347461	5968205	9	12-Jun	2	A, B	4.40	-	
Transect #123									
RB	347999	5967943	9	12-Jun	2	A, B	2.79	0.37	gentle sloping shoreline (rock, gravel); vegetation (willow, balsam poplar)
MID	-	-		-	2	A, B	5.59	0.48	
LB	-	-		-	2	A, B	4.09	0.54	bank erosion (high/unstable); vegetation (willow, dogwood, balsam poplar)
Transect #124									
RB	349026	5967421	9	12-Jun	2	A, B	1.40	0.39	gentle sloping shoreline (rock, gravel); vegetation (willow, balsam poplar)
MID	-	-		-	2	A, B	4.62	0.49	
LB	-	-		-	2	A, B	4.32	0.54	gentle sloping shoreline (rock, gravel); vegetation (willow, dogwood, balsam poplar)
Transect #125									
RB	349647	5966936	9	12-Jun	2	A, B	3.70	-	gentle sloping shoreline; vegetation (balsam poplar)
MID	-	-		-	2	A, B	3.33	-	
LB	-	-		-	2	A, B	0.70	-	gentle sloping shoreline; vegetation (willow, dogwood, balsam poplar)
Site #91									
MID	350327	5966804	9	12-Jun	1	B, C	8.78	-	island; gentle sloping shoreline; vegetation (willow, dogwood, balsam poplar)
Site #92									
MID	337710	5984500	9	12-Jun	2	A, B	< 1.0	-	island; gentle sloping shoreline; vegetation (willow, dogwood, balsam poplar)
Transect #126									
RB	350752	5966654	9	12-Jun	1, 2	B	7.93	0.66	open area (community-The Pas, MB); vegetation (willow, balsam poplar)
MID	-	-		-	-	-	-	-	
LB	-	-		-	1, 2	B, C	2.82	0.33	gentle sloping shoreline; vegetation (willow, dogwood, balsam poplar)
Transect #127									
RB	351492	5967011	9	12-Jun	2, 3, 4	A, B	6.74	0.55	The Pas, MB
MID	-	-		-	2, 3, 4	A, B	8.28	0.63	
LB	-	-		-	2, 3, 4, 5	A, B	4.89	0.65	The Pas, MB; *Site 4.0

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #128									
RB	352187	5967415	9	12-Jun	2, 3, 4	A, B	3.93	-	gentle sloping shoreline (rock, boulder outcroppings); vegetation (willow, balsam poplar)
MID	-	-		-	2, 3, 4	A, B	5.85	-	
LB	-	-		-	2, 3, 4, 5	A, B	3.74	-	gentle sloping shoreline (gravel, rock, boulder); vegetation (willow, dogwood, balsam poplar)
Transect #129									
RB	353025	5967584	9	12-Jun	2, 3, 4	A, B	4.01	-	gentle sloping shoreline (rock, boulder outcroppings); vegetation (willow, balsam poplar)
MID	-	-		-	2, 3, 4	A, B	7.64	-	
LB	-	-		-	2, 3, 4, 5	A, B	6.09	-	gentle sloping shoreline (gravel, rock, boulder); vegetation (willow, dogwood, balsam poplar)
Transect #130									
RB	354107	5967863	9	12-Jun	2	A, B	3.07	0.44	gentle sloping shoreline (rock, boulder outcroppings); vegetation (willow, balsam poplar)
MID	-	-		-	2, 3, 4	A, B	5.39	0.54	
LB	-	-		-	2, 3, 4	A, B	6.89	0.49	gentle sloping shoreline (rock, boulder);vegetation (willow, balsam poplar)
Transect #131									
RB	355030	5968156	9	12-Jun	2	B	3.29	-	gentle sloping shoreline (rock, boulder outcroppings); vegetation (willow, balsam poplar)
MID	-	-		-	2	B	5.95	-	
LB	-	-		-	2, 3, 4	A, B	5.95	-	gentle sloping shoreline (rock, boulder); vegetation (willow, balsam poplar)
Transect #132									
RB	355900	5968494	9	12-Jun	2	B	3.00	0.43	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	2	A, B	3.74	0.57	
LB	-	-		-	2, 3, 4	A, B	5.55	0.53	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar); local highway
Transect #133									
RB	356626	5968796	10	12-Jun	2	A, B	2.62	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	2	A, B	2.72	-	
LB	-	-		-	2	A, B	2.82	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar); local highway
Site #93									
MID	357741	5968789	10	12-Jun	1, 2	B	3.33	-	
Site #94									
MID	357878	5969355	10	12-Jun	1, 2	B	4.39	-	

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13O) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #134									
RB	358248	5969566	10	12-Jun	2	A, B	2.46	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	2	A, B	4.83	-	
LB	-	-		-	2	A, B	7.68	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #135									
RB	359172	5969802	10	12-Jun	1, 2	A, B	5.35	0.55	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1, 2	A, B	6.15	0.47	
LB	-	-		-	1, 2	A, B	4.60	0.44	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #136									
RB	360266	5970095	10	12-Jun	1, 2	A, B	6.15	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1, 2	A, B	4.60	-	
LB	-	-		-	1	B, C	0.70	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #137									
RB	360740	5970182	10	12-Jun	1, 2	B	5.50	0.42	gentle sloping shoreline; vegetation (willow, balsam poplar)
MID	-	-		-	1, 2	B	3.68	0.51	
LB	-	-		-	1, 2	B	3.02	0.41	gentle sloping shoreline; vegetation (willow, balsam poplar)
Transect #138									
RB	361461	5970262	10	12-Jun	2	B	3.20	-	bank erosion (moderate/stable); vegetation (willow, balsam poplar)
MID	-	-		-	2	B	1.60	-	
LB	-	-		-	2	B	3.92	-	bank erosion (moderate/stable); vegetation (willow, balsam poplar); open area (farmland)
Site #95									
MID	362170	5970046	10	12-Jun	2	B, C	5.95	0.57	
Site #96									
MID	362220	5970298	10	12-Jun	1, 2	A, B	5.84	0.56	
Transect #139									
RB	362974	5970398	10	12-Jun	2	B	3.23	-	gentle sloping shoreline; vegetation (willow, balsam poplar)
MID	-	-		-	2	B	5.74	-	
LB	-	-		-	1, 2	B, C	2.76	-	bank erosion (moderate/stable); vegetation (willow, balsam poplar); open area (farmland)

Appendix 1. (Continued)

Location[1]	UTM (13S) NAD 83				Habitat Classification[2]		Total Depth	Mean Velocity	
Quarter Point	E	N	Map	Date	Substrate	Compaction	(m)	(m/s)	Riparian and Shoreline Features
Transect #140									
RB	363609	5970648	10	12-Jun	1	C	4.65	0.53	gentle sloping shoreline; vegetation (willow, balsam poplar)
MID	-	-		-	1	A	7.90	0.48	
LB	-	-		-	1	C	2.96	0.54	gentle sloping shoreline; vegetation (balsam poplar)
Transect #141									
RB	364594	5971078	10	13-Jun	1	C	3.49	0.46	gentle sloping shoreline; vegetation (willow, balsam poplar)
MID	-	-		-	1, 2	B, C	5.25	0.55	
LB	-	-		-	1, 2	B, C	8.59	0.45	gentle sloping shoreline; vegetation (willow, balsam poplar); open area (pasture land)
Site #97									
MID	365224	5971037	10	13-Jun	2	A, B	5.25	-	
Transect #142									
RB	365934	5970835	10	13-Jun	1	B, C	7.09	-	bank erosion (moderate-high/stable); vegetation (willow, balsam poplar)
MID	-	-		-	2	A, B	2.74	-	
LB	-	-		-	2	A, B	1.80	-	bank erosion (low/stable); vegetation (willow, balsam poplar)
Transect #143									
RB	366277	5969611	10	13-Jun	1	A, B	4.60	-	bank erosion (moderate-high/stable); vegetation (willow, balsam poplar)
MID	-	-		-	1	A, B	4.63	-	
LB	-	-		-	1	C	1.00	-	bank erosion (low/stable); vegetation (willow, balsam poplar)
Transect #144									
RB	365847	5968799	10	13-Jun	1	B	5.03	0.47	bank erosion (moderate-high/stable); vegetation (willow, balsam poplar)
MID	-	-		-	1	A	5.65	0.43	
LB	-	-		-	1	A	7.34	0.56	bank erosion (low/stable); vegetation (willow, balsam poplar)
Transect #145									
RB	365211	5967915	10	13-Jun	1	B, C	3.75	-	bank erosion (moderate-high/stable); vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	A, B	9.45	-	RB Contd... changing to a gentle sloping shoreline; vegetation (reedgrass, willow)
LB	-	-		-	1	A, B	6.54	-	bank erosion (low/stable); vegetation (willow, balsam poplar)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #146									
RB	364859	5966955	10	13-Jun	1	B, C	1.90	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	B	1.40	-	
LB	-	-		-	1	A	4.97	-	bank erosion (high/unstable); vegetation (reedgrass, willow, balsam poplar); open pasture land
Transect #147									
RB	364799	5965795	10	13-Jun	1, 2	B, C	2.82	0.45	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	2	A, B	4.65	0.50	
LB	-	-		-	2	A, B	4.74	0.45	bank erosion (high/unstable); vegetation (reedgrass, willow, balsam poplar); open pasture land
Transect #148									
RB	364687	5964547	10	13-Jun	2	A, B	3.23	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	2	A, B	4.71	-	
LB	-	-		-	2	A, B	3.02	-	bank erosion (high/unstable); vegetation (reedgrass, willow, balsam poplar); open pasture land LB Contd... changing to low/stable gentle sloping shoreline
Transect #149									
RB	364689	5963716	10	13-Jun	1	B, C	2.09	0.42	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	2	A, B	2.72	0.47	
LB	-	-		-	2	A, B	4.80	0.53	bank erosion (low/stable); vegetation (balsam poplar)
Transect #150									
RB	364369	5962954	11	13-Jun	-	-	-	-	gentle sloping shoreline (rock, boulder area); vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	-	-	-	-	RB Contd... with series of small islands near Buck Island (Commercially Fished)
LB	-	-		-	2	A, B	6.89	0.62	bank erosion (low/stable); vegetation (balsam poplar); Bucks Island (old channel extinct) LB Contd... Ralls Creek flowing in from inbehind island (low discharge)
Transect #151									
RB	364199	5961877	11	13-Jun	-	-	-	-	gentle sloping shoreline (rock, boulder region); vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	-	-	-	-	
LB	-	-		-	2, 3, 4	A	4.54	0.53	erosion (low/stable); vegetation (balsam poplar); Bucks Island (old channel extinct)
Transect #152									
RB	364672	5961029	11	13-Jun	2, 3, 4	A	5.79	0.53	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	1	B, C	2.32	0.43	
LB	-	-		-	1	C	2.03	0.25	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)

Appendix 1. (Continued)

Location[1] Quarter Point	UTM (13U) NAD 83 E	N	Map	Date	Habitat Classification[2] Substrate	Compaction	Total Depth (m)	Mean Velocity (m/s)	Riparian and Shoreline Features
Transect #153									
RB	365199	5960191	11	13-Jun	1	C	3.37	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	2	A, B	6.26	-	
LB	-	-		-	2, 3, 4	A	5.98	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
Transect #154									
RB	365853	5960074	11	13-Jun	2	A, B	3.78	-	gentle sloping shoreline; vegetation (reedgrass, willow, balsam poplar)
MID	-	-		-	2, 3, 4	A, B	3.84	0.41	
LB	-	-		-	2, 3, 4	A, B	3.13	0.47	gentle sloping shoreline; vegetation (willow, balsam poplar)
Transect #155									
RB	366669	5960005	11	13-Jun	2	A	4.67	0.61	gentle sloping shoreline (gravel, rock, boulder area); vegetation (willow, balsam poplar)
MID	-	-		-	2, 3, 4	A, B	3.90	0.51	
LB	-	-		-	2, 3, 4	A, B	3.93	0.39	gentle sloping shoreline; vegetation (willow, balsam poplar)
Transect #156									
RB	367527	5959798	11	13-Jun	2	A, B	4.22	0.62	bank erosion (moderate-high/stable); vegetation (willow, balsam poplar); *Site 4.4
MID	-	-		-	2, 3, 4	A, B	3.22	0.44	
LB	-	-		-	2, 3, 4	A, B	2.13	0.33	gentle sloping shoreline; vegetation (willow, balsam poplar)
Transect #157									
RB	368242	5958949	11	13-Jun	1	B, C	2.20	0.42	bank erosion (moderate-high/stable); vegetation (balsam poplar)
MID	-	-		-	1	B, C	4.00	0.51	
LB	-	-		-	1	B, C	4.27	0.49	bank erosion (moderate-high/stable); vegetation (balsam poplar)

[1]**Location:**

RB = Right Bank
MID = Mid-Channel
LB = Left Bank

[2]**Habitat Classification:**

Substrate:
1 - Mud/Silt
2 - Sand
3 - Gravel
4 - Cobble
5 - Boulder
6 - Bed Rock

Compaction:
A - Hard
B - Medium
C - Soft

Appendix 2. Summary of riparian and shoreline features documented for selected sites on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000.

Bank Location	Map Location	Date	Riparian and Shoreline Feature(s)
Site #1.0			
LB	1	6-Jun	Bigstone Rapids; erosion (high); vegetation (balsam poplar)
RB			Bigstone Rapids; erosion (high); vegetation (balsam poplar)
Site #1.1			
LB	1	6-Jun	braided channel (old channel); vegetation (willow, balsam poplar)
Site #1.2			
RB	1	6-Jun	bank erosion (moderate); vegetation (balsam poplar, white spruce)
Site #1.3			
RB	1	6-Jun	floodplain; gentle sloping bank (exposed rock, boulders, gravel)
Site #1.4			
LB	1	6-Jun	bank erosion (high/stable); vegetation (balsam poplar, white spruce); small instream island
Site #1.5			
RB	1	6-Jun	rock/boulder shoal (exposed at low flow); vegetation (balsam poplar, white spruce)
Site #1.6			
LB	2	6-Jun	bank erosion (low/stable); vegetation (willow, balsam poplar, white spruce)
Site #1.7			
RB	2	6-Jun	bank erosion (low/stable); vegetation (willow, balsam poplar)
Site #1.8			
LB	2	6-Jun	gentle sloping shoreline (silt bar); vegetation (willow, reedgrass)
RB			bank erosion (high/stable); vegetation (balsam poplar)
Site #1.9			
LB	2	7-Jun	flood plain; gentle sloping bank, stable; vegetation (reedgrass, willow, balsam poplar)
Site #2.0			
RB	3	7-Jun	Tearing River (1st outlet); instream island (reedgrass, willow)
Site #2.1			
RB	3	7-Jun	Tearing River (1st outlet); rock/boulder shoreline (exposed)
Site #2.2			
RB	3	8-Jun	Tearing River (2nd outlet); instream island (reedgrass, willow); *Site 2.2
Site #2.3			
RB	3	8-Jun	instream island (armashed); vegetation (willow)

Appendix 2. (Continued)

Bank Location	Map Location	Date	Riparian and Shoreline Features
Site #2.4			
RB	3	8-Jun	gentle sloping bank (rock deposits); vegetation (willow); turning to eroded bank (moderate/unstable); vegetation (balsam poplar, american elm)
Site #2.5			
RB	3	8-Jun	Tauring River (2nd outlet); submerged sand/gravel shoal; gentle sloping bank; vegetation (balsam poplar, american elm)
Site #2.6			
LB	3	8-Jun	bank erosion (moderate-high/stable)
Site #2.7			
LB RB	3	8-Jun	bank erosion (high/stable); vegetation (balsam poplar, american elm) floodplain; gentle sloping bank, some slumping; vegetation (willow, balsam poplar)
Site #2.8			
LB	4	8-Jun	flood plain; gentle sloping bank; vegetation (willow, balsam poplar)
Site #2.9			
LB	4	8-Jun	flood plain; gentle sloping bank; vegetation (willow, balsam poplar); large back eddy
Site #3.0			
RB	4	9-Jun	gentle sloping shoreline; vegetation (willow, balsam poplar)
Site #3.1			
MID	5	9-Jun	instream island (unmarked); vegetation (willow)
Site #3.2			
RB	5	9-Jun	gentle sloping shoreline; vegetation (willow, balsam poplar)
Site #3.3			
MID	5	9-Jun	instream island (mid-channel)
Site #3.4			
LB	5	10-Jun	instream island (mid-channel)
Site #3.5			
LB RB	6	10-Jun	instream island (mid-channel)
Site #3.6			
LB RB	7	10-Jun	instream island (mid-channel)
Site #3.7			
LB	8	11-Jun	gentle sloping shoreline (rock/boulder deposits); vegetation (willow, balsam poplar)

Appendix 2. (Continued)

Bank Location[1]	Map Location	Date	Riparian and Shoreline Features
Site #3.8			
LB	9	12-Jun	floodplain; gentle sloping shoreline (rock, boulder); vegetation (reedgrass, willow, balsam poplar); *local domestic fishing site
Site #3.9			
LB	9	12-Jun	gentle sloping shoreline (rock, boulder); vegetation (reedgrass, willow, dogwood)
Site #4.0			
LB RB	9	12-Jun	The Pas, Manitoba
Site #4.1			
MID	10	13-Jun	instream island (unmarked); vegetation (willow)
Site #4.2			
RB	11	13-Jun	gentle sloping shoreline (rock, boulder); vegetation (reedgrass, willow, balsam poplar)
Site #4.3			
LB	11	13-Jun	gentle sloping shoreline (rock, boulder); vegetation (reedgrass, willow, balsam poplar)
Site #4.4			
LB RB	11	13-Jun	bank erosion (moderate-high/stable); vegetation (willow, balsam poplar) gentle sloping shoreline; vegetation (willow, balsam poplar)

LOCATION:

RB = Right Bank
MID = Mid-Channel
LB = Left Bank

Appendix 3. Mean depth and velocity collected at each transect on the Saskatchewan River between Cumberland House, Saskatchewan and Summerberry River, Manitoba, June, 2000.

Location[1]	Map Location	Date	Mean Depth (m)	Mean Velocity (m/s)
Transect #0	1	6-Jun	1.83	0.51
Transect #1	1	6-Jun	3.57	0.65
Transect #2	1	6-Jun	5.47	0.62
Transect #3	1	6-Jun	-	-
Transect #4	1	6-Jun	2.00	0.76
Transect #5	1	6-Jun	-	-
Transect #6	1	6-Jun	-	-
Transect #7	1	6-Jun	2.73	0.64
Transect #8	1	6-Jun	-	-
Transect #9	1	6-Jun	2.87	0.76
Transect #10	1	6-Jun	1.87	0.98
Transect #11	2	6-Jun	-	-
Transect #12	2	6-Jun	-	-
Transect #13	2	6-Jun	2.80	0.61
Transect #14	2	6-Jun	-	-
Transect #15	2	6-Jun	3.40	0.55
Transect #16	2	6-Jun	3.45	0.59
Transect #17	2	6-Jun	-	-
Transect #18	2	6-Jun	4.03	0.66
Transect #19	2	7-Jun	3.63	0.57
Transect #20	2	7-Jun	3.31	0.53
Transect #21	2	7-Jun	2.68	-
Transect #22	2	7-Jun	3.15	0.50
Transect #23	2	7-Jun	-	-
Transect #24	2	7-Jun	2.99	0.59
Transect #25	3	7-Jun	2.77	0.72
Transect #26	3	7-Jun	3.59	1.04
Transect #27	3	8-Jun	3.86	-
Transect #28	3	8-Jun	1.69	0.69
Transect #29	3	8-Jun	2.06	0.70
Transect #30	3	8-Jun	2.10	-
Transect #31	3	8-Jun	3.08	0.81
Transect #32	3	8-Jun	2.70	-
Transect #33	3	8-Jun	2.28	0.56
Transect #34	3	8-Jun	2.81	0.68
Transect #35	3	8-Jun	0.90	0.63
Transect #36	3	8-Jun	-	-
Transect #37	3	8-Jun	2.41	0.65
Transect #38	3	8-Jun	3.12	0.86
Transect #39	4	8-Jun	3.81	0.54
Transect #40	4	8-Jun	5.20	0.64
Transect #41	4	8-Jun	4.19	0.67
Transect #42	4	8-Jun	4.43	0.62
Transect #43	4	8-Jun	4.40	0.61
Transect #44	4	8-Jun	4.88	0.59
Transect #45	4	8-Jun	1.75	0.94
Transect #46	4	8-Jun	4.00	0.66
Transect #47	4	8-Jun	3.78	0.65
Transect #48	4	8-Jun	7.37	0.50

Appendix 3. (Continued)

Location	Map Location	Date	Mean Depth (ft)	Mean Velocity (ft/s)
Transect #49	4	9-Jun	3.29	0.68
Transect #50	4	9-Jun	-	-
Transect #51	4	9-Jun	3.00	-
Transect #52	4	9-Jun	4.26	0.54
Transect #53	4	9-Jun	2.96	0.76
Transect #54	4	9-Jun	3.10	0.62
Transect #55	4	9-Jun	4.88	0.74
Transect #56	5	9-Jun	4.88	0.72
Transect #57	5	9-Jun	4.68	0.83
Transect #58	5	9-Jun	5.37	0.58
Transect #59	5	9-Jun	3.05	-
Transect #60	5	9-Jun	4.73	0.58
Transect #61	5	9-Jun	7.45	0.67
Transect #62	5	9-Jun	3.10	0.57
Transect #63	5	9-Jun	5.75	0.51
Transect #64	5	9-Jun	6.67	0.49
Transect #65	5	9-Jun	7.46	0.51
Transect #66	5	9-Jun	9.48	0.56
Transect #67	5	9-Jun	4.51	0.59
Transect #68	5	9-Jun	11.86	0.39
Transect #69	5	9-Jun	6.49	0.57
Transect #70	5	9-Jun	3.01	0.53
Transect #71	5	10-Jun	3.97	0.49
Transect #72	5	10-Jun	8.72	0.42
Transect #73	5	10-Jun	5.26	0.57
Transect #74	5	10-Jun	6.75	0.46
Transect #75	6	10-Jun	5.57	0.69
Transect #76	6	10-Jun	4.96	0.56
Transect #77	6	10-Jun	3.70	0.60
Transect #78	6	10-Jun	3.19	0.61
Transect #79	6	10-Jun	3.94	0.56
Transect #80	6	10-Jun	4.90	0.53
Transect #81	6	10-Jun	7.49	0.57
Transect #82	6	10-Jun	6.39	0.49
Transect #83	6	10-Jun	6.45	0.52
Transect #84	6	10-Jun	5.41	-
Transect #85	6	10-Jun	4.10	0.44
Transect #86	6	10-Jun	6.54	0.52
Transect #87	6	10-Jun	7.16	0.54
Transect #88	6	10-Jun	7.73	-
Transect #89	7	10-Jun	6.43	0.54
Transect #90	7	10-Jun	7.06	-
Transect #91	7	10-Jun	9.51	0.55
Transect #92	7	10-Jun	8.48	0.50
Transect #93	7	10-Jun	6.37	-
Transect #94	7	10-Jun	7.71	0.55
Transect #95	7	11-Jun	6.15	0.50
Transect #96	7	11-Jun	6.67	0.52
Transect #97	7	11-Jun	5.99	-
Transect #98	7	11-Jun	7.18	0.51

Appendix 3. (Continued)

Location[1]	Map Location	Date	Mean Depth (m)	Mean Velocity (m/s)
Transect #99	7	11-Jun	7.43	-
Transect #100	7	11-Jun	8.15	0.52
Transect #101	7	11-Jun	6.67	-
Transect #102	7	11-Jun	7.45	0.51
Transect #103	7	11-Jun	5.68	-
Transect #104	8	11-Jun	8.18	0.40
Transect #105	8	11-Jun	8.86	-
Transect #106	8	11-Jun	8.20	-
Transect #107	8	11-Jun	5.86	-
Transect #108	8	11-Jun	5.58	-
Transect #109	8	11-Jun	4.48	-
Transect #110	8	11-Jun	5.29	-
Transect #111	8	11-Jun	5.04	-
Transect #112	8	11-Jun	7.32	0.47
Transect #113	8	11-Jun	7.76	-
Transect #114	8	11-Jun	6.35	-
Transect #115	8	11-Jun	3.93	-
Transect #116	8	11-Jun	4.45	-
Transect #117	8	11-Jun	4.67	-
Transect #118	8	11-Jun	6.20	0.60
Transect #119	8	12-Jun	6.83	0.44
Transect #120	9	12-Jun	3.28	-
Transect #121	9	12-Jun	5.41	-
Transect #122	9	12-Jun	3.36	-
Transect #123	9	12-Jun	4.16	0.46
Transect #124	9	12-Jun	3.45	0.47
Transect #125	9	12-Jun	2.58	-
Transect #126	9	12-Jun	5.38	0.50
Transect #127	9	12-Jun	6.64	0.61
Transect #128	9	12-Jun	4.51	-
Transect #129	9	12-Jun	5.91	-
Transect #130	9	12-Jun	5.12	0.49
Transect #131	9	12-Jun	5.06	-
Transect #132	9	12-Jun	4.10	0.51
Transect #133	10	12-Jun	2.72	-
Transect #134	10	12-Jun	4.99	-
Transect #135	10	12-Jun	5.37	0.49
Transect #136	10	12-Jun	3.82	-
Transect #137	10	12-Jun	4.07	0.45
Transect #138	10	12-Jun	2.71	-
Transect #139	10	12-Jun	3.91	-
Transect #140	10	12-Jun	5.17	0.52
Transect #141	10	13-Jun	5.78	0.49
Transect #142	10	13-Jun	3.88	-
Transect #143	10	13-Jun	3.41	-
Transect #144	10	13-Jun	6.01	0.47
Transect #145	10	13-Jun	6.58	-
Transect #146	10	13-Jun	2.76	-
Transect #147	10	13-Jun	4.07	0.47
Transect #148	10	13-Jun	3.65	-

Appendix 3. (Continued)

Location[1]	Map Location	Date	Mean Depth (m)	Mean Velocity (m/s)
Transect #149	10	13-Jun	3.20	0.47
Transect #150	11	13-Jun	6.89	0.62
Transect #151	11	13-Jun	4.54	0.53
Transect #152	11	13-Jun	3.38	0.44
Transect #153	11	13-Jun	5.20	-
Transect #154	11	13-Jun	3.58	0.44
Transect #155	11	13-Jun	4.17	0.50
Transect #156	11	13-Jun	3.19	0.46
Transect #157	11	13-Jun	3.49	0.47

[1] = Transect cross sectional profiles include mean depth and velocity for up to three measurements (Right Bank, Mid-Channel, Left Bank)

Appendix 4. Biological data for fish captured in gill nets from the Saskatchewan River, June, 2000.

Site	Map Location	Date Set	Time Set	Date Pulled	Time Pulled	Duration (hrs)	Gang Length (yds)	Mesh Size (mm)[1]	Fish Number	Species	Total Length (mm)	Fork Length (mm)	Weight (g)	Water Temperature (°C)	Habitat Classification[2]	
															Substrate	Composition
GN-01	1	6-Jun	1300	6-Jun	1500	2.00	50	305	-	-	-	-	-	12.5	1	A
GN-02	1	6-Jun	1310	7-Jun	1135	22.42	50	305	-	-	-	-	-	-	1,2	A
GN-03	2	6-Jun	1410	7-Jun	1200	21.83	50	228	-	-	-	-	-	-	1,2	A,B
GN-04	2	6-Jun	1355	7-Jun	1305	23.83	50	228	-	-	-	-	-	-	2	A,B
GN-05	1	6-Jun	1503	7-Jun	1123	20.33	50	305	-	-	-	-	-	-	1,2	A
GN-06	1	7-Jun	1333	8-Jun	910	19.62	50	305	1	LKST	786	775	3700	11.0	1,2,3,4,5	A
-	-	-	-	-	-	-	-	-	2	LKST	775	758	3400	-	1,2,3,4,5	A
GN-07	3	7-Jun	1345	8-Jun	950	20.08	50	228	-	-	-	-	-	-	2	A
GN-08	3	7-Jun	1400	8-Jun	1000	20.00	50	228	-	-	-	-	-	-	2	A,B
GN-09	3	7-Jun	1405	8-Jun	1015	20.16	50	305	-	-	-	-	-	-	2,3,4	A
GN-10	3	7-Jun	1715	7-Jun	1845	1.50	150	EXP	-	-	-	-	-	-	2,3,4	A
GN-11	3	7-Jun	1730	7-Jun	1900	1.50	150	EXP	-	-	-	-	-	-	2	A
GN-12	4	8-Jun	1030	9-Jun	840	22.16	50	305	-	-	-	-	-	-	1,2	A,B
GN-13	4	8-Jun	1045	9-Jun	855	22.16	50	228	-	-	-	-	-	-	1,2	B,C
GN-14	4	8-Jun	1050	9-Jun	910	22.33	50	228	-	-	-	-	-	-	1,2	B,C
GN-15	4	8-Jun	1140	9-Jun	915	21.58	50	305	-	-	-	-	-	-	1	A,B
GN-16	4	8-Jun	1440	8-Jun	1600	1.33	150	EXP	3	LNSC	-	365	650	-	1	B,C
-	-	-	-	-	-	-	-	-	4	LNSC	-	338	450	-	1	B,C
GN-17	4	8-Jun	1447	8-Jun	1630	1.72	150	EXP	5	WHSC	-	329	450	-	1	B,C
-	-	-	-	-	-	-	-	-	6	GOLD	-	301	250	-	1	B,C
GN-18	4	9-Jun	940	10-Jun	830	23.17	50	305	-	-	-	-	-	10.0	1,2,3	A,B
GN-19	4	9-Jun	945	10-Jun	900	23.25	50	228	-	-	-	-	-	-	1,2,3	A,B
GN-20	4	9-Jun	1040	10-Jun	920	22.66	50	305	-	-	-	-	-	-	1,2	A
GN-21	5	9-Jun	1045	10-Jun	925	22.66	50	228	-	-	-	-	-	-	1,2	A,B
GN-22	5	9-Jun	1520	9-Jun	1700	1.66	100	EXP	-	-	-	-	-	-	1,2,3,4	A
GN-23	5	9-Jun	1535	9-Jun	1715	1.66	150	EXP	7	WALL	-	333	400	-	1	C
GN-24	6	10-Jun	1110	11-Jun	830	21.33	50	305	-	-	-	-	-	-	1	A
GN-25	7	10-Jun	1112	11-Jun	840	21.47	50	228	-	-	-	-	-	-	1	A
GN-26	7	10-Jun	1120	11-Jun	855	21.58	50	228	-	-	-	-	-	-	2	A,B
GN-27	7	10-Jun	1125	11-Jun	905	21.66	50	305	-	-	-	-	-	-	2	A,B
GN-28	7	10-Jun	1455	10-Jun	1700	2.08	150	EXP	-	-	-	-	-	-	2	A,B
GN-29	7	10-Jun	1505	10-Jun	1730	2.42	150	EXP	8	LKST	123	100	50	-	1	A
GN-30	8	11-Jun	945	12-Jun	820	22.58	50	228	10	NRPK	-	306	300	-	1	C
GN-31	8	11-Jun	1015	12-Jun	840	22.42	50	305	-	-	-	-	-	-	1	C
GN-32	8	11-Jun	1020	12-Jun	910	22.83	50	305	-	-	-	-	-	-	1	A,B
GN-33	9	11-Jun	1030	12-Jun	1045	24.25	50	228	-	-	-	-	-	-	2	A,B
GN-34	8	11-Jun	1350	11-Jun	1550	2.00	150	EXP	9	BURB	-	300	325	-	2	A,B
GN-35	8	11-Jun	1410	11-Jun	1620	2.17	150	EXP	-	-	-	-	-	-	2,3,4	A
GN-36	9	12-Jun	910	13-Jun	810	23.00	50	305	-	-	-	-	-	12.0	2	A,B
GN-37	9	12-Jun	920	13-Jun	825	23.08	50	228	-	-	-	-	-	-	1,2	B,C
GN-38	9	12-Jun	1215	13-Jun	900	20.75	50	305	-	-	-	-	-	-	2	A,B
GN-39	9	12-Jun	1220	13-Jun	910	20.83	50	228	12	CARP	-	662	6300	-	2	A,B
-	-	-	-	-	-	-	-	-	13	NRPK	-	431	450	-	2	A,B
-	-	-	-	-	-	-	-	-	14	NRPK	-	491	800	-	2	A,B
GN-40	10	12-Jun	1445	12-Jun	1655	2.08	150	EXP	-	-	-	-	-	-	1,2	B
GN-41	10	12-Jun	1510	12-Jun	1725	2.25	150	EXP	11	WALL	-	180	200	-	1,2	A,B

Appendix 4. (Continued)

Site	Map Location	Date Set	Time Set	Date Pulled	Time Pulled	Duration (hrs)	Gang Length (yds)	Mesh Size (mm)	Fish Number	Species	Total Length (mm)	Fork Length (mm)	Weight (g)	Water Temperature (°C)	Habitat Classification[2] Substrate	Compaction
GN-42	10	13-Jun	1000	13-Jun	1315	3.25	50	228	-	-	-	-	-	12.0	2	A,B
GN-43	11	13-Jun	1005	14-Jun	820	22.25	50	305	-	-	-	-	-	-	1,3,4	A
GN-44	11	13-Jun	1010	14-Jun	830	22.33	50	228	-	-	-	-	-	-	1,3,4	A
GN-45	11	13-Jun	1045	14-Jun	800	21.25	50	305	25	WALL	-	330	350	-	1,3,4	A
GN-46	11	13-Jun	1055	13-Jun	1410	3.25	150	EXP	21	NRPK	-	511	800	-	1,3,4	A
"	"	"	"	"	"	"	"	"	22	NRPK	"	420	500	"	1,3,4	A
"	"	"	"	"	"	"	"	"	23	WALL	"	325	200	"	1,3,4	A
"	"	"	"	"	"	"	"	"	24	WHSC	"	455	1350	"	1,3,4	A
GN-47	11	13-Jun	1105	13-Jun	1350	2.75	150	EXP	15	WALL	"	380	500	"	1,3,4	A,B
"	"	"	"	"	"	"	"	"	16	WALL	"	334	350	"	1,3,4	A,B
"	"	"	"	"	"	"	"	"	17	WHSC	"	447	1325	"	1,3,5	A,B
"	"	"	"	"	"	"	"	"	18	NRPK	"	865	5300	"	1,3,6	A,B
"	"	"	"	"	"	"	"	"	19	NRPK	"	853	4850	"	1,3,7	A,B
"	"	"	"	"	"	"	"	"	20	WHSC	"	343	600	"	1,3,8	A,B
GN-48	11	13-Jun	1330	14-Jun	810	18.66	50	228	-	-	-	-	-	-	1	C

Codes

[1]Gear Types:

GN = Gill Net Set Number
EXP = Experimental Gill Net

Species:

BURB = Burbot
CARP = Carp
GOLD = Goldeye
LKST = Lake sturgeon
LNSC = Longnose sucker
NRPK = Northern pike
WALL = Walleye
WHSC = White sucker

[2]Classification:

Substrate:
1 - Mud/Silt
2 - Sand
3 - Gravel
4 - Cobble
5 - Boulder
6 - Bed Rock

Compaction:
A - Hard
B - Medium
C - Soft

Note: All experimental gillnet gangs constructed of 6 - 25 yard long, 6 ft deep, panels of 38, 51, 76, 127, 228, and 305 mm mesh.

Appendix 5. Biological data for fish captured in hoop nets from the Saskatchewan River, June, 2000.

Site[1]	Map Location	Date Set	Time Set	Date Pulled	Time Pulled	Duration (hrs)	Fish Number	Species	Fork Length (mm)	Weight (g)	Water Temperature (°C)	Habitat Classification[2]	
												Substrate	Compaction
HN-01	4	8-Jun	1515	9-Jun	1110	19.92	1	WHSC	340	550	12.0	1	B,C
HN-02	5	9-Jun	1515	9-Jun	1725	2.17	2	WHSC	345	550	10.0	1,2,3,4	A
HN-03	7	10-Jun	1600	10-Jun	1745	1.75	-	-	-	-	10.0	2	A,B
HN-04	8	11-Jun	1430	11-Jun	1645	2.25	-	-	-	-	10.0	1	C
HN-05	10	12-Jun	1530	12-Jun	1745	2.25	3	WHSC	152	175	12.0	2	B,C
-	-	-	-	-	-	-	4	WHSC	212	250	-	2	B,C

Codes

[1]Gear Types:

HN = Hoop Net Set Number

Species:

WHSC = White sucker

[2]Classification:

Substrate: 1 - Mud/Silt
2 - Sand
3 - Gravel
4 - Cobble
5 - Boulder
6 - Bed Rock

Compaction: A - Hard
B - Medium
C - Soft

Note: Single hoop net was constructed of 1.50 m diameter, 6.45 cm^2 mesh, with 15 m long wing attachments.

Appendix 6. Summary of larval drift data from the Saskatchewan River, June, 2000.

Site[1]	Map Location	Date Set	Time Set	Date Pulled	Time Pulled	Duration (hrs)	Water Temperature (°C)	Habitat Classification[2]		Species				
								Substrate	Compaction	Suckers	Cyprinids	YLPR	WALL	Unidentified Eggs
DT-01	1	6-Jun	1245	6-Jun	1450	2.08	12.5	1,6	A	-	-	-	-	4
DT-02	1	6-Jun	1250	6-Jun	1455	2.08	-	1,6	A	-	-	-	-	-
DT-03	1	6-Jun	1535	6-Jun	1710	1.58	-	2,3,4,5	A	-	-	-	-	-
DT-04	1	6-Jun	1540	6-Jun	1715	1.58	-	2,3,4,5	A	-	-	-	-	1
DT-05	4	9-Jun	1135	9-Jun	1235	1.00	10.0	1,2,4	A,B	1	-	1	-	-
DT-06	4	9-Jun	1140	9-Jun	1240	1.00	-	1,2,4	A,B	25	-	-	-	-
DT-07	7	10-Jun	1535	10-Jun	1735	2.00	10.0	2	A,B	-	-	-	-	1
DT-08	7	10-Jun	1545	10-Jun	1715	1.50	-	1,2	A,B	-	-	-	-	-
DT-09	8	11-Jun	1345	11-Jun	1600	2.25	10.0	1	A,B	2	-	-	-	-
DT-10	8	11-Jun	1405	11-Jun	1630	2.42	-	1	B,C	1	-	-	-	-
DT-11	10	12-Jun	1440	12-Jun	1705	2.42	12.0	2	B,C	-	-	-	-	-
DT-12	10	12-Jun	1515	12-Jun	1720	2.08	-	1,2	A,B	-	-	-	-	-
DT-13	11	13-Jun	1020	13-Jun	1415	3.92	12.0	2,3,4	A	7	5	-	2	-
DT-14	11	13-Jun	1025	13-Jun	1425	4.00	-	2,3,4	A	6	-	1	1	-

Codes

[1]Gear Types:

DT = Wisconsin Larval Drift Trap

Species

YLPR = Yellow perch
WALL = Walleye

[2]Classification:

Substrate:
1 - Mud/Silt
2 - Sand
3 - Gravel
4 - Cobble
5 - Boulder
6 - Bed Rock

Compaction:
A - Hard
B - Medium
C - Soft

Note: Each Wisconsin-style larval drift net consisted of a 3 m long, 950 um Nitex screen bag, with a 43 cm x 85 cm inside trap mouth opening, tapering to a 9 cm diameter cod end.