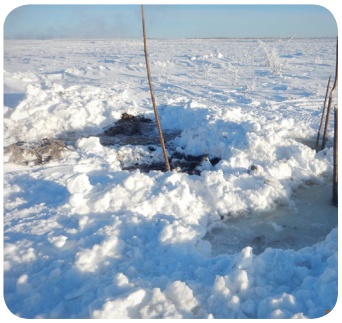
Keeyask Generation Project

Aquatic Effects Monitoring Plan

Beaver Habitat Effects and Mortality Monitoring Report

TEMP-2018-19



KEEYASK

Manitoba Sustainable Development Client File 5550.00
Manitoba Environment Act Licence No. 3107

2017 -2018

KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2018-19

BEAVER HABITAT EFFECTS AND MORTALITY 2016 TO 2018

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Services MB Inc.

June 2018

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SUMMARY

Background

Construction of the Keeyask Generation Project (the Project) at Gull Rapids began in July 2014. The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the generating station on the terrestrial environment. Monitoring results will help the KHLP, government regulators, members of local First Nation communities, and the general public understand how construction and operation of the generating station will affect the environment, and whether or not more needs to be done to reduce harmful effects.

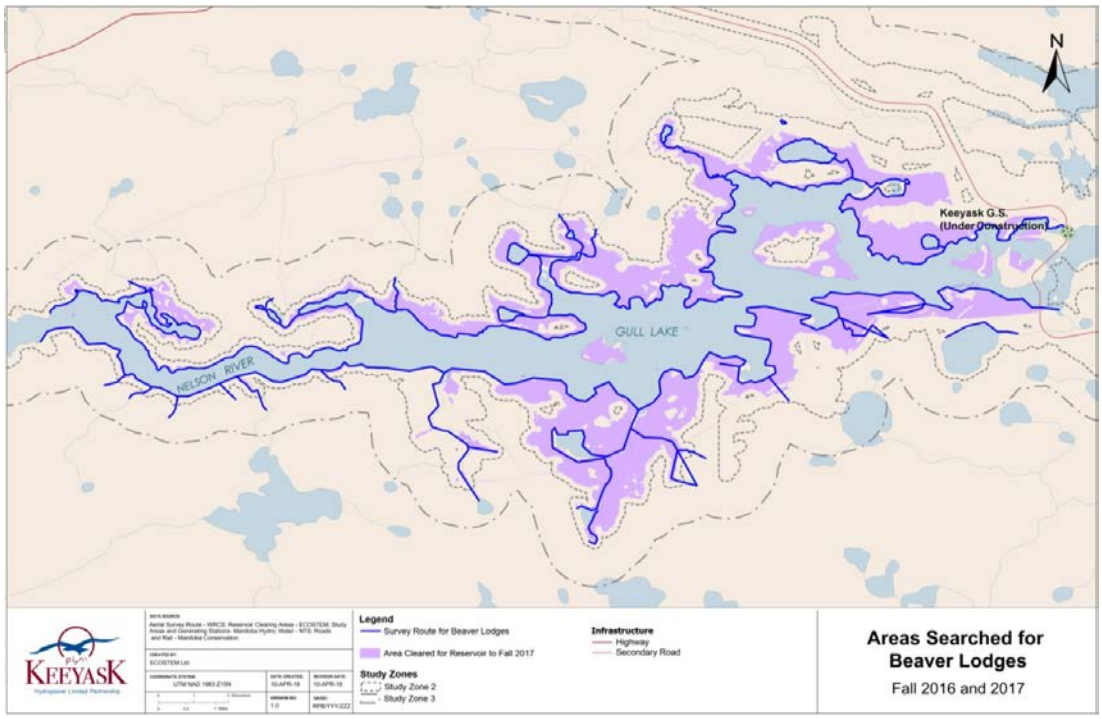
This report describes the results of beaver lodge monitoring conducted during the fall of 2016 and fall 2017, the third and fourth years of Project construction. Monitoring occurred along the shorelines of the Nelson River and adjoining tributaries and ponds within the future Keeyask reservoir.

Why is the study being done?

The Project has the potential to affect beaver populations through alteration and loss of habitat, as well as sensory disturbance. As reservoir impoundment will flood beaver lodges, beaver will be humanely trapped out of affected areas by a local licensed trapper to prevent starving or drowning deaths of these animals after flooding.

What was done?

Helicopter surveys of the study area were conducted to determine the abundance and distribution of active and inactive beaver lodges in the future reservoir area. The results of fall aerial surveys, conducted in 2016 and 2017, guided efforts to humanely remove beaver from lodges in the future reservoir area and monitor the beaver population. Trapping was conducted in the winters of 2016/17 and 2017/18. To estimate the age of all removed beaver, body measurements (including weight, body length, and skull size) were recorded to categorize removed beaver as adults or juveniles. Lodges were considered successfully trapped out if two adults (*i.e.*, a breeding pair) were removed from a lodge. Beaver meat was distributed by the trapper to Split Lake community members and some muscle tissue and internal organs were removed and stored for the Keeyask mercury in wildlife monitoring study.



Beaver lodge aerial survey routes in fall 2016 and 2017

A trapper and his helpers setting beaver traps in the future reservoir area. Burning brush piles from reservoir clearing are visible in the background

What was found?

In the future reservoir area, 34 active beaver lodges were observed in fall 2016. During the winter of 2016/2017, 19 beaver were removed from eight lodges in the future reservoir area. Breeding pairs of adult beaver were removed from two lodges and single adults or juveniles were removed from five lodges.

The number of active beaver lodges in the future reservoir area decreased to 15 in fall 2017. During the winter of 2017/2018, 18 beaver were removed from eight lodges. Pairs of adult beaver were removed from three lodges and single adults or juveniles were removed from four lodges.

What does it mean?

To date, 37 beaver have been removed from 16 lodges (between January 2017 and March 2018). Efforts to remove adult beaver from lodges were successful in contributing to a decrease in the number of active beaver lodges in the future reservoir area. Tree clearing prior to flooding in the future reservoir area, which reduced the local availability of beaver food and lodge building materials, as well as high water levels in spring 2017, likely contributed to a decrease in the number of active beaver lodges.

What will be done next?

Aerial surveys will be carried out again in fall 2018, that will provide information on the total number of active beaver lodges remaining prior to reservoir impoundment. The need for additional trapping efforts will be evaluated following the fall 2018 survey.

STUDY TEAM

We would like to thank Sherrie Mason, Rachel Boone, Brian Crockett, Brian Fournier, and Michelle Ewacha of Manitoba Hydro and Ron Bretecher of North/South Consultants Inc. for logistical assistance in the field. We would also like to thank Dr. James Ehnes of ECOSTEM Ltd. for GIS cartographic services. Biologists and other personnel who designed, participated in, and drafted the survey results included:

- Robert Berger (M.N.R.M) – Design and reporting
- Nicholas LaPorte (M.N.R.M.) – Aerial survey personnel and reporting
- Kate McCormick (B.Sc., Honours) – Aerial survey personnel
- Jonathan Saunders – Licensed trapper
- Mark Saunders – Trapping assistant
- Anthony Jacobs – Trapping assistant

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1.0 INTRODUCTION

Construction of the Keeyask Generation Project (the Project), a 695-megawatt hydroelectric generating station (GS) and associated facilities, began in July 2014. The Project is located at Gull Rapids on the lower Nelson River in northern Manitoba where Gull Lake flows into Stephens Lake, 35 km upstream of the existing Kettle GS.

The Keeyask Generation Project Response to EIS Guidelines (the EIS), completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. Technical supporting information for the terrestrial environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs is provided in the *Keeyask Generation Project Environmental Impact Statement Terrestrial Supporting Volume* (TE SV) (KHLP 2012). The *Keeyask Generation Project Terrestrial Effects Monitoring Plan* (TEMP) (KHLP 2015) was developed as part of the licensing process for the Project. Monitoring activities for various components of the terrestrial environment were described, including the focus of this report, beaver (*Castor canadensis*), during the construction phase.

Beaver are medium-sized aquatic furbearers that inhabit waterbodies in forested areas. Beaver are common in the Keeyask region and are an important furbearer species in the Keeyask region, having cultural, economic, and ecological value (KHLP 2012). As a keystone species (Baker and Hill 1982), by building dams and through their feeding activities, beaver alter aquatic ecosystems, increase the diversity of species and habitat on a landscape, and create habitat for other species that use wetlands. On the Nelson River, beaver habitat is not commonly found along the main channel due to strong currents. However, the creeks, tributaries and ponds adjacent to the Nelson River provide habitat for beaver.

The main drivers of change and stressors of beaver in the Keeyask region include food availability and physiographic and hydrologic factors. Changes to any of these factors have the potential to affect the local and regional beaver populations, primarily through habitat change. Other drivers and stressors that could influence habitat quality or individuals to a lesser degree include mortality due to harvest and predation, accidents, and parasites and disease. The availability of suitable habitat is expected to have the greatest influence on beaver distribution and abundance in the Keeyask region.

In 2011, the number of beaver lodges in the future Project reservoir area was 23 active lodges and seven inactive lodges (KHLP 2012). Density of lodges was greatest in streams and ponds, and only one active lodge was located in the Nelson River (KHLP 2012). Predicted Project effects on beaver include habitat loss or alteration, sensory disturbance, and increased mortality. The loss or alteration of approximately 5% of the beaver habitat in Study Zone 4 is anticipated as a result of reservoir creation (KHLP 2012). Reservoir impoundment will result in a permanent loss of beaver habitat as creeks, tributaries, and small ponds and lakes are flooded. Long-term habitat losses are associated with reservoir impoundment, erosion, and peatland disintegration. Fluctuations in water levels in the future reservoir will make any potential habitat

unsuitable. However, the formation of floating peatlands in the reservoir could attract beaver to these habitats, and temporarily increase the abundance of beaver in the reservoir. Once these peatlands break down, beaver will most likely abandon the reservoir and seek alternate habitat.

As reservoir impoundment will flood beaver lodges, beaver were humanely trapped out of affected areas (*i.e.*, killed) by a local licensed trapper to prevent the prolonged exposure and displacement deaths of these animals. The results of fall aerial surveys, conducted in 2016 and 2017, guided efforts to remove beaver from lodges in the future reservoir area and to monitor the beaver population in portions of Study Zone 2 (see Map 1 in Section 2.1) during the winters of 2016/17 and 2017/18.

2.0 METHODS

2.1 AERIAL SURVEYS

Aerial surveys for beaver lodges were conducted over two years in portions of the Keeyask Study Zone 2 (Map 1). A Bell 206 JetRanger helicopter was used for the surveys on September 17, and October 19, 2016 and October 3, 2017. A helicopter was used rather than a fixed-wing aircraft as it has been found to be more efficient to detect beaver lodges and food caches while using a helicopter (Payne 1981). Detection probabilities of 0.89 from helicopters were reported for boreal forests in Newfoundland (Payne 1981), on rivers in central Wyoming (Swenson et al. 1983), and in Montana (Osmundson and Bursick 1993). Surveys were conducted during clear weather conditions, after leaf fall, and before freeze-up to maximize detections of beaver lodges.

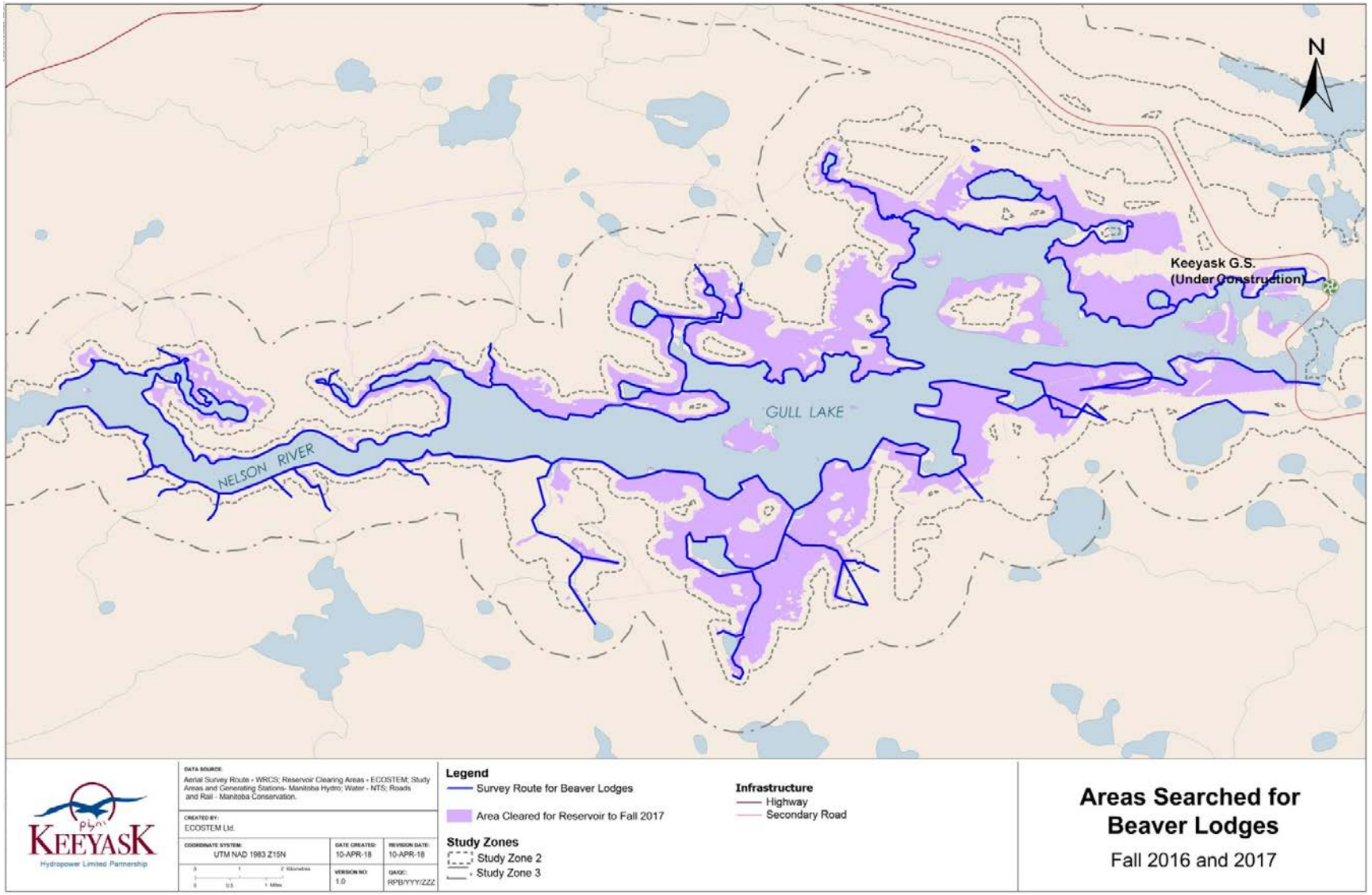
The same area was surveyed in 2016 and 2017. The aerial survey focused on the shorelines of the Nelson River from Gull Rapids to 6 km east of Birthday Rapids and on adjacent waterbodies and waterways in the future Project reservoir area (Map 1).

Survey routes were flown following a predetermined pathway of water bodies and watercourses, at a speed of approximately 100 km/hr at approximately 50 m above ground level (AGL). Observers were stationed on both sides of the helicopter. Beaver lodge locations were recorded with a handheld GPS unit and photographed. The presence of food caches and whether lodges were active or inactive was recorded. Typically, active beaver lodges in fall are characterized by signs of lodge maintenance (*i.e.*, fresh mud and timber), nearby recent foraging, and the presence and condition of a food cache (Photo 1). Inactive lodges typically lack these characteristics (Photo 2).

2.2 BEAVER REMOVALS AND BODY MEASUREMENTS

The licensed trapper's efforts were guided by the results of the aerial surveys. Trapping activities occurred from January 8 to March 15, 2017 and January 8 to March 9, 2018 (Photo 3). All traps were set in accordance with provincial humane trapping standards (Manitoba 2015). Although all beaver were intended to be removed from lodges, if two adults (*i.e.*, a breeding pair) are removed from a lodge, the lodge will likely be abandoned after the dispersal of sub-adults. The family can also disband if the female is removed (Beer 1955, Miller 1960). Lodges were considered successfully trapped out if two adults were removed from a lodge.

For each removed beaver, weight (kg) was measured using a spring scale, while body length, skull width and skull length (cm) were measured using a fabric measuring tape. To separate



Map 1: Survey route for beaver lodges in the future Project reservoir area in fall 2016 and 2017

Photo 1: Active beaver lodge with food cache (lodge # 4) in fall 2017

Photo 2: Inactive beaver lodge (lodge # 13) in fall 2017

Photo 3: Installation of underwater traps at a beaver lodge in January 2018

beaver into subadults and adults, beaver that weighed 14 kg or greater were considered as potential adults (Flemming 1977). Although skull width and length have both been shown to be reliable predictors of beaver age, skull length is superior at estimating beaver age (Rosell et al. 2010). Beaver with skull length greater than 13 cm (Rosell et al. 2010) were considered as potential adults. Used in conjunction, beaver were assessed as adults only when both body length and skull width measurements met the criteria of Flemming (1977) and Rosell *et al.* (2010). All other beaver were assessed as subadults.

3.0 RESULTS

3.1 AERIAL SURVEYS

During the fall 2016 aerial survey, a total of 44 beaver lodges were observed. Of these 44 lodges, 34 were active and ten were inactive (Appendix 1). North of the Nelson River, five active lodges and one inactive lodge were observed, while south of the Nelson River 29 active lodges and nine inactive lodges were observed (Map 2). In fall 2016, four active lodges north of the Nelson River and 23 south of the Nelson River were in the future Project reservoir area (Appendix 1).

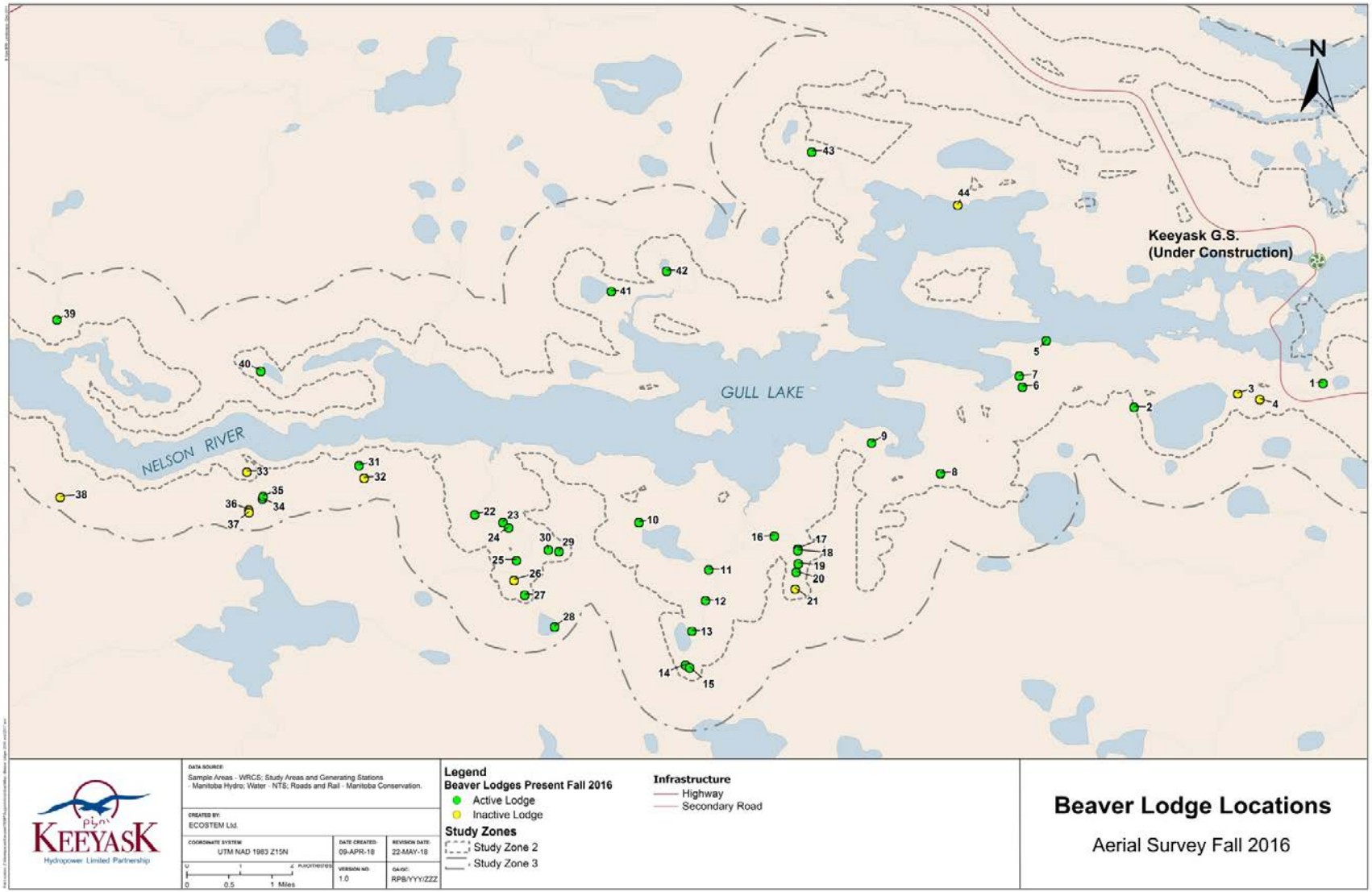
Sites where lodges were identified in 2016 were revisited in fall 2017 and new lodges were located. A total of 47 lodges were observed in 2017, of which 15 were active and 32 were inactive (Appendix 1). North of the Nelson River, six active lodges and five inactive lodges were observed, while south of the Nelson River nine active lodges and 27 inactive lodges were observed (Map 3). In fall 2017, four active lodges north of the Nelson River and five south of the Nelson River were in the future Project reservoir area (Appendix 1).

Ten new lodges were identified in fall 2017, seven of which were active (Appendix 1). Furthermore one inactive and six active lodges, recorded in 2016, were not observed in 2017 (Appendix 1). All of these seven lodges were located in areas that were cleared in winter 2016/2017 as part of Project reservoir clearing. One of these lodges was located in the Nelson River proper (Photo 4).

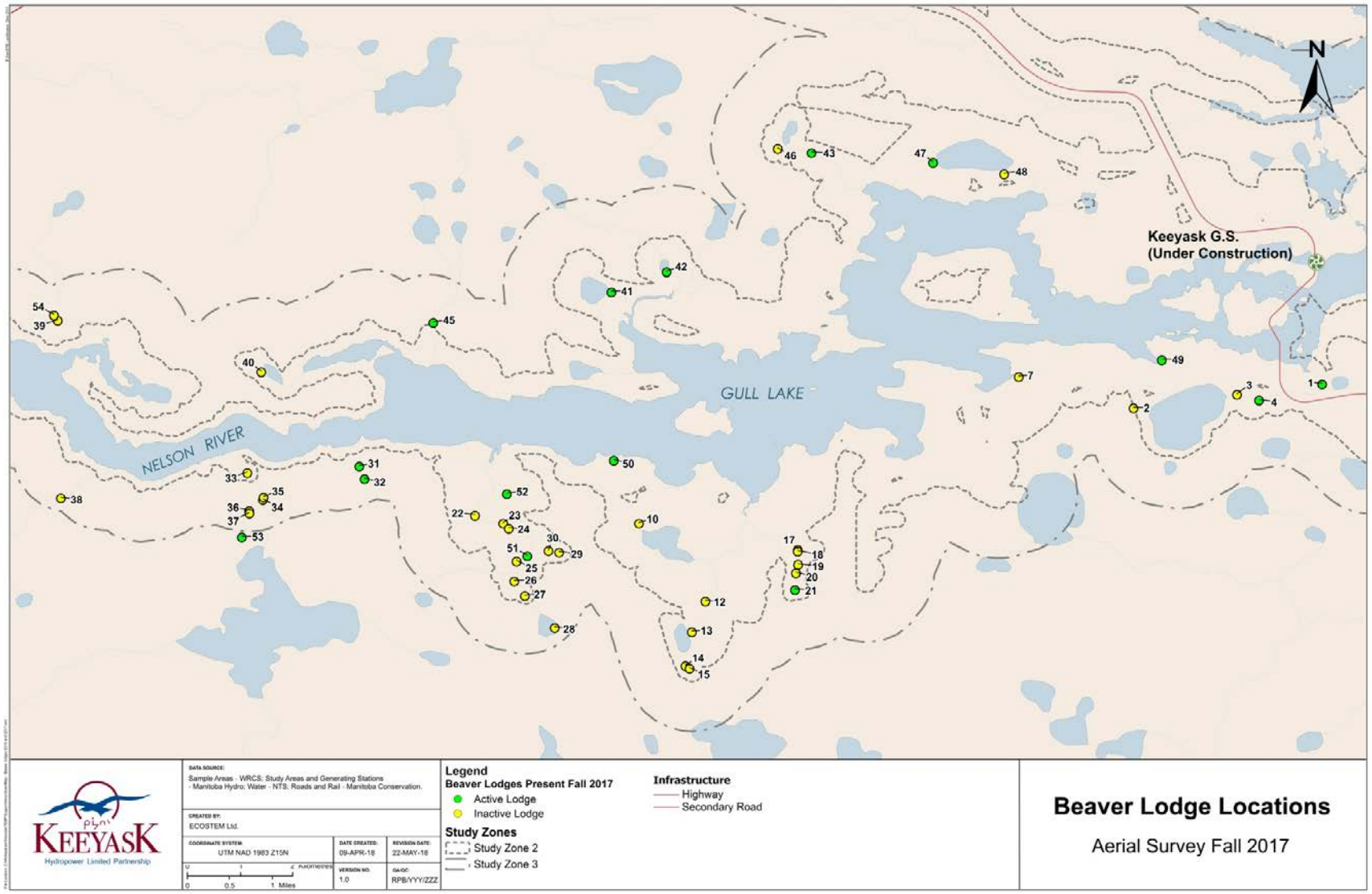
3.2 BEAVER REMOVALS

Trapping efforts in winter 2016/2017 were focussed on 13 of the 23 active beaver lodges south of the Nelson River (Appendix 2; Map 2). In fall 2017, four active lodges north of the Nelson River and five south of the Nelson River were in the future Project reservoir (Appendix 1; Map 3). Trapping efforts in winter 2017/2018 focussed on eight of these nine active beaver lodges (Appendix 3).

During the winter of 2016/2017, 19 beaver and two river otter (*Lontra canadensis*) were removed from eight lodges in the future Project reservoir (Table 1). At five other lodges where traps were set, no animals were removed (Table 1). Seven beaver had weights ≥14 kg and 14 had skull lengths ≥13 cm Figure 1). Seven beaver were assessed as adults and the remaining 12 were assessed as juveniles (Table 1). Pairs of adult beaver were removed from two lodges and single adults or juveniles were removed from five lodges (Table 1). Consequently, two lodges were successfully trapped out.



Map 2: Beaver lodges in the future Project reservoir area in fall 2016



Map 3: Beaver lodges in the future Project reservoir area in fall 2017

Photo 4: Active beaver lodge (lodge # 5) in the Nelson River in September 2016. The Keeyask construction site can be seen to the east in the background

During the winter of 2017/2018, 18 beaver and one muskrat (*Ondatra zibethicus*) were removed from eight lodges in the future Project reservoir area (Table 2). Of these 18 beaver, 10 had weights ≥14 kg and 10 had skull lengths ≥13 cm (Figure 2). Consequently, nine beaver were assessed as adults and the remaining nine were assessed as juveniles (Table 2). Pairs of adult beaver, or three in one case, were removed from three lodges and single adults or juveniles were removed from four lodges (Table 2). Consequently, three lodges were successfully trapped out.

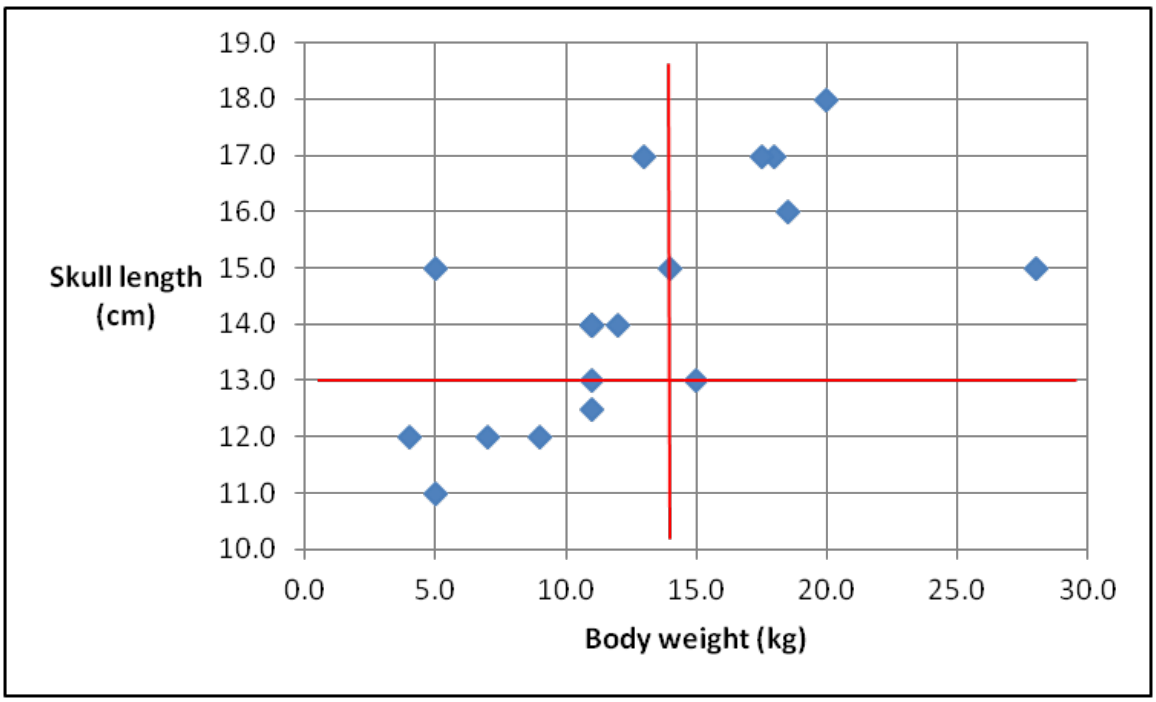
In 2017, a total of seven adult beaver were removed from five lodges in 2017 (Table 1). Pairs of adult beaver were removed from two of these lodges (*i.e.*, lodges 14 & 23) in 2017 (Table 1). In 2018, nine adult beaver were removed from five lodges (Table 2). Pairs of adult beaver were removed from two of these lodges *(i.e.*, lodges 21 & 51) and three adult beaver were removed from one other lodge (*i.e.*, lodge 41) in 2018 (Table 2).

Table 1: Trapping effort, body measurements and estimated age of animals removed in 2017

ID	Lodge	Date Trap Set	Species Harvested	Date Harvested	Date Trap Removed	Weight (Kg)	Body Length (cm)	Skull Width (cm)	Skull Length (cm)	Estimated Age
B-1-2017	14	February-18-17	Beaver	February-23-17	March-14-17	18.0	110.0	15.0	17.0	Adult
B-2-2017	19	January-08-17	Beaver	January-14-17	March-15-17	9.0	94.0	11.0	12.0	Juvenile
B-3-2017	10	January-17-17	Beaver	January-21-17	February-08-17	28.0	97.0	15.0	15.0	Adult
B-4-2017	7	January-07-17	Beaver	January-23-17	February-08-17	11.0	97.0	12.0	14.0	Juvenile
B-5-2017	10	January-17-17	Beaver	January-23-17	February-08-17	13.0	101.0	15.0	17.0	Juvenile
B-6-2017	12	January-21-17	Beaver	January-23-17	February-08-17	11.0	95.0	12.0	14.0	Juvenile
B-7-2017	12	January-21-17	Beaver	January-25-17	February-08-17	11.0	97.0	12.0	12.5	Juvenile
B-8-2017	19	January-08-17	Beaver	January-25-17	March-15-17	15.0	105.0	12.5	13.0	Adult
B-9-2017	14	February-18-17	Beaver	February-20-17	March-14-17	5.0	79.0	10.0	11.0	Juvenile
B-10-2017	14	February-18-17	Beaver	February-21-17	March-14-17	4.0	71.0	11.0	12.0	Juvenile
B-11-2017	24	February-21-17	Beaver	February-23-17	March-02-17	17.5	116.0	15.0	17.0	Adult
B-12-2017	14	February-18-17	Beaver	February-24-17	March-14-17	7.0	74.0	10.0	12.0	Juvenile
B-13-2017	14	February-18-17	Beaver	February-24-17	March-14-17	5.0	74.0	12.0	15.0	Juvenile
B-14-2017	14	February-18-17	Beaver	February-27-17	March-14-17	18.5	111.0	14.0	16.0	Adult
B-15-2017	14	February-18-17	Beaver	February-27-17	March-14-17	11.0	95.0	12.0	13.0	Juvenile
B-16-2017	23	February-28-17	Beaver	March-06-17	March-14-17	12.0	97.5	12.0	14.0	Juvenile
B-17-2017	14	February-18-17	Beaver	March-13-17	March-14-17	11.0	98.0	12.0	14.0	Juvenile
B-18-2017	23	February-28-17	Beaver	March-14-17	March-14-17	20.0	116.0	14.0	18.0	Adult
B-19-2017	23	February-28-17	Beaver	March-14-17	March-14-17	14.0	103.0	13.0	15.0	Adult
OT-1-2017	14	February-18-17	Otter	March-13-17	March-14-17	8.0	111.0	10.0	11.5	Adult
OT-2-2017	20	January 14, 2017	Otter	January-21-17	February-10-17	22.0	119.0	9.0	14.0	Adult
NA	13	January-23-17	NA	NA	February-03-17	NA	NA	NA	NA	NA
NA	11	January-23-17	NA	NA	February -24-17	NA	NA	NA	NA	NA
NA	27	February-13-17	NA	NA	February-15-17	NA	NA	NA	NA	NA
NA	25	February-20-17	NA	NA	March-03-17	NA	NA	NA	NA	NA
NA	15	January-21-17	NA	NA	March-13-17	NA	NA	NA	NA	NA

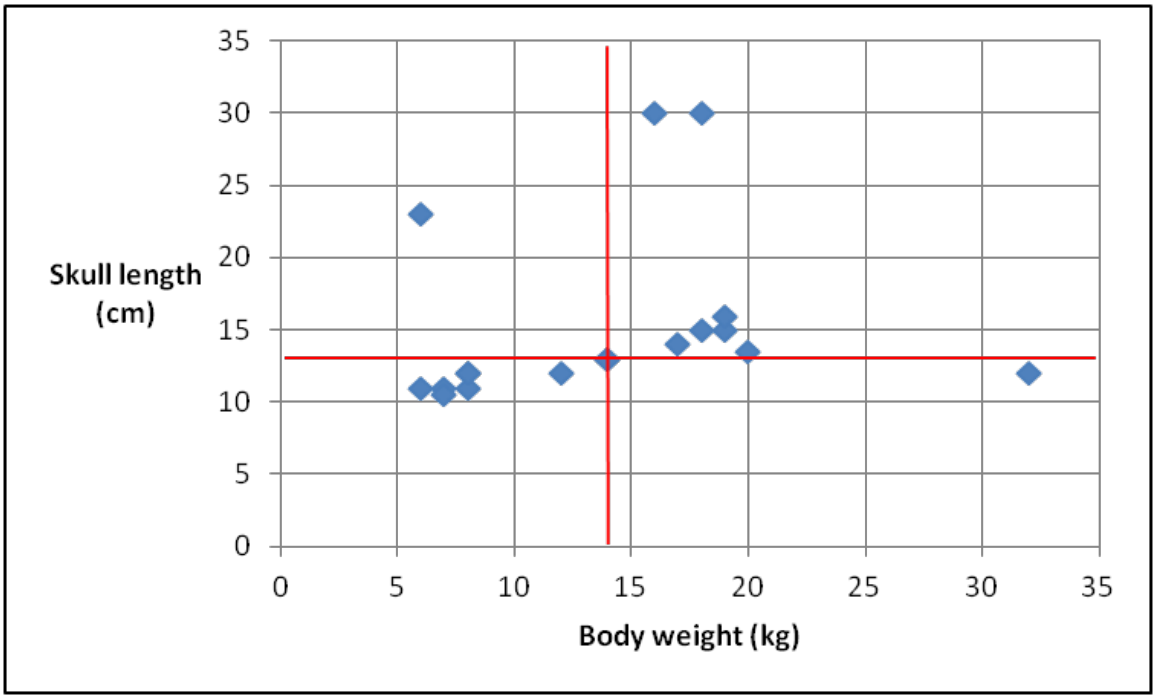
Table 2: Trapping effort, body measurements and estimated age of animals removed in 2018

ID	Lodge	Date Trap Set	Species Harvested	Date Harvested	Date Trap Removed	Weight (Kg)	Body Length (cm)	Skull Width (cm)	Skull Length (cm)	Estimated Age
B-1-2018	41	January-08-18	Beaver	January-11-18	March-08-18	18.0	103.0	36.0	30.0	Adult
B-2-2018	47	January-08-18	Beaver	January-13-18	March-08-18	6.0	76.0	28.0	23.0	Juvenile
B-3-2018	42	January-09-18	Beaver	January-13-18	March-08-18	16.0	111.0	36.0	30.0	Adult
B-4-2018	41	January-08-18	Beaver	January-16-18	March-08-18	19.0	109.0	12.0	15.0	Adult
B-5-2018	52	January-14-18	Beaver	January-18-18	March-09-18	32.0	116.0	14.0	12.0	Juvenile
B-6-2018	21	January-14-18	Beaver	January-18-18	March-09-18	17.0	106.0	12.0	14.0	Adult
B-7-2018	52	January-14-18	Beaver	January-18-18	March-09-18	19.0	115.0	14.0	16.0	Adult
B-8-2018	51	January-14-18	Beaver	January-18-18	March-09-18	14.0	100.0	11.0	13.0	Adult
B-9-2018	41	January-08-18	Beaver	January-20-18	March-08-18	12.0	95.0	10.0	12.0	Juvenile
B-10-2018	41	January-08-18	Beaver	January-23-18	March-08-18	8.0	83.0	9.0	11.0	Juvenile
B-11-2018	52	January-14-18	Beaver	January-24-18	March-09-18	8.0	82.0	9.0	12.0	Juvenile
B-12-2018	51	January-14-18	Beaver	January-24-18	March-09-18	18.0	112.0	13.0	15.0	Adult
B-13-2018	21	January-14-18	Beaver	January-24-18	March-09-18	14.0	100.0	10.5	13.0	Adult
B-14-2018	52	January-14-18	Beaver	January-29-18	March-09-18	7.0	81.0	9.0	11.0	Juvenile
B-15-2018	41	January-08-18	Beaver	February-06-18	March-08-18	8.0	82.0	10.0	12.0	Juvenile
B-16-2018	50	January-14-18	Beaver	February-10-18	March-09-18	7.0	77.0	8.0	10.5	Juvenile
B-17-2018	50	January-14-18	Beaver	February-10-18	March-09-18	6.0	78.0	9.0	11.0	Juvenile
B-18-2018	41	January-08-18	Beaver	February-16-18	March-08-18	20.0	108.0	11.0	13.5	Adult
M-1-2018	43	January-08-18	Muskrat	February -22-17	March-08-18	2.0	58.0	5.0	6.0	Adult



Adult thresholds are indicated as red lines.

Figure 1: Body weight (kg) vs. skull length (cm) for beaver removed in winter 2016/2017



Adult thresholds are indicated as red lines.

Figure 2: Body weight (kg) vs. skull length (cm) for beaver removed in winter 2017/2018

3.3 NELSON RIVER WATER LEVELS

Water levels in the spring and summer of 2017 in the Nelson River at Split Lake were higher than average and peaked in late May (Photo 5) (Appendix 2). From October 2016 to October 2017, Split Lake outflows ranged from about 3,200-6,600 m^3/s. Flows exceeded the historical annual median flow of approximately 3,300 m^3/s each month except for October 2017 when it dropped to about 3,200 m^3/s (Government of Canada 2018). From about October 2016 through mid-September 2017, the flows exceeded the historical 75th percentile flow of about 3,780 m^3/s, and from about May to mid-August 2017 the flows exceeded the 95th percentile flow of approximately 5,230 m^3/s (Government of Canada 2018). During the spring melt in May 2017, the flows rose to about 6,590 m^3/s, which was close to the historical maximum flow observed in August 2005 (Government of Canada 2018). Water levels varied in conjunction with the flows, ranging in May 2017 from approximately 168.4 m to 169.1 m Above Sea Level (ASL) on Split Lake, with the highest level observed during the near historical maximum flow in May (Appendix 2) (Government of Canada 2018).

Photo 5: Spring flooding at Split Lake in May 2017

During an aerial survey for bald eagle nests in May 2017, visibly high water levels were observed to be impacting beaver in the Nelson River system. On May 18, 2017, two beaver and

a bald eagle were seen on the edge of melting ice, watching each other closely (Photo 6). Much of the rapidly melting Nelson River system was frozen at this time with open-water only in the near shore zone (Photo 5). The nearby beaver lodge barely extended beyond the water surface and was certainly flooded, apparently forcing the beaver out of their lodge. One beaver appeared to be watching this eagle, which was standing 50 m away on the ice-pan, while the other beaver kept watch of a second bald eagle that was circling from above.

Photo 6: Two beaver on the edge of an ice-pan in Split Lake on May 18, 2017

4.0 DISCUSSION

Trapping efforts to remove adult beaver from lodges in the winters of 2016/2017 and 2017/2018 were successful in contributing to a decrease in the number of active beaver lodges in the future Project reservoir area since fall 2016. Overall, a total of 37 beaver were removed from 16 lodges between January 2017 and March 2018. Beaver meat was distributed by the trapper to Split Lake community members. Some muscle tissue and internal organs were removed and stored for the Keeyask TEMP mercury in wildlife monitoring study.

Reservoir clearing in winter 2016/2017 and high water levels in spring 2017 also likely contributed to the observed decrease in active beaver lodges. Alternately, some of these lodges may have been abandoned for reasons unrelated to trapping or clearing. Mortality (harvest, predation, disease), habitat quality (food availability, water levels), and behaviour (territorial activities and intrafamily aggression) can all contribute to slight variation in active lodge counts from year to year (Novak 1999).

No effort was made to remove beaver from an active lodge (lodge 5) located approximately 50 m from the south shoreline of the Nelson River in fall 2016. Efforts to do so would have posed a safety risk to the trapper due to fast flowing water under the ice surface and uncertain ice conditions. Furthermore, the licensed trapper thought it was likely this lodge would be washed away by large sections of river ice flowing downstream in the spring freshet. It is assumed with a high degree of certainty that this was the fate of this particular lodge and why it was not subsequently observed in fall 2017.

Two lodges (*i.e.,* lodges 13 & 23) where pairs of adults were removed from each lodge in February and March 2017, were inactive in fall 2017. These lodges likely became inactive in the spring after the pair were removed. Any juveniles remaining in the lodge likely dispersed in the spring, resulting in the lodge becoming inactive. Furthermore, reservoir clearing in the vicinity of these lodges in winter 2016/2017 removed nearby beaver food sources. Without food in close proximity to the lodge, any beaver exiting the lodge in spring would likely move out of the future Project reservoir area, to surrounding areas where food continues to be abundant.

Five other lodges in the future reservoir area where one adult or juvenile beaver were removed in winter 2016/2017, were also probably abandoned due to a lack of nearby food following reservoir clearing. However, even though whole beaver families may relocate if food sources are depleted (Buckley 1950, Rutherford 1964, Gunson 1970, Hall 1971), lodges may be abandoned when food is present (Retzer *et al*. 1956, Shelton 1966). New groups may also reoccupy old sites (Warren 1932, Lawrence 1952, Patric and Webb 1953, Fowle *et al*. 1954, Neff 1959).

An additional six lodges in the future Project reservoir area that were active in fall 2016 were not observed during aerial surveys in fall 2017. The trees around these lodges were cleared as part of reservoir clearing in the winter of 2016/2017. Reasons for why these lodges were absent in fall 2017 are not readily apparent. Similar to other lodges, they may have been abandoned due

to a lack of nearby food caused by clearing, with high spring and summer water levels removing evidence of inactive lodges.

High water levels in spring 2017 likely flooded many lodges in the Nelson River system including within the future Project reservoir area. Evidence of this was apparent in Split Lake in May 2017, where two beaver were observed on an ice-pan near their flooded lodge. Beaver become vulnerable to predation when forced out of lodges during the spring melt. As grey wolves are common in the Keeyask region, they may have been a significant predator of beaver in spring 2017. Furthermore, beaver exiting their lodges and finding little to no food nearby, would have had to travel great distances to sources of food, thus increasing their vulnerability to predation.

The combination of a lack of nearby food/lodge materials, high water levels increasing vulnerability to predation, and high water levels washing away lodges, may explain why six active lodges identified in fall 2016 were not observed during the fall 2017 aerial survey.

Trapping efforts and other factors may also have caused some beaver to relocate within the future Project reservoir area. In fall 2017, five new lodges constructed since the previous aerial survey were found in the future Project reservoir area. Including these newly constructed lodges, the number of active lodges in the future Project reservoir area decreased from 30 to nine in fall 2017.

Trapping efforts in winter 2017/2018 focused on eight of nine active beaver lodges. Three of these lodges are likely to become inactive in spring 2018 as a result of trapping efforts. The total number of active lodges within the future Project reservoir area are likely to continue to decrease. Regardless of trapping effort, some lodges may be abandoned due to a lack of nearby food/lodge materials, and some new lodges may be established. The lack of abundant food or lodge building/maintaining materials makes the reoccupation of waterbodies and watercourses in the future Project reservoir area unlikely.

Aerial surveys planned for fall 2018 will provide updated information on the total number of active beaver lodges remaining prior to reservoir impoundment.

5.0 SUMMARY AND CONCLUSIONS

In the future Project reservoir area, 34 active beaver lodges were observed during the fall 2016 aerial survey. During the winter of 2016/2017, 19 beaver were removed from eight lodges in the future reservoir area. Breeding pairs of adult beaver were removed from two lodges and single adults or juveniles were removed from five lodges in winter 2016/2017.

Trapping efforts in the winters of 2016/2017 were successful in contributing to a decrease in the number of active beaver lodges in the future reservoir area to 15 in fall 2017. During the winter of 2017/2018, 18 beaver were removed from eight lodges. Breeding pairs of adult beaver were removed from three lodges and single adults or juveniles were removed from four lodges.

Reservoir clearing in winter 2016/2017 and very high water levels in spring 2017 also likely contributed to the observed decrease in active beaver lodges. Alternatively, some of these lodges may have been abandoned for reasons unrelated to the Project or to high water levels.

Aerial surveys planned for fall 2018 will determine the total number of active beaver lodges remaining prior to reservoir impoundment.

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APPENDIX 1:
STATUS OF BEAVER LODGES IN 2016 AND 2017

Wpt.	UTM Coordinates	Status 2016	Status 2017	In Future Project Reservoir	North or South of Nelson River
1	15 V 364034 6244769	Active	Active	No	South
2	15 V 360254 6244290	Active	Inactive	No	South
3	15 V 362329 6244561	Inactive	Inactive	No	South
4	15 V 362771 6244448	Inactive	Active	No	South
5	15 V 358494 6245626	Active	Not observed	Yes	South
6	15 V 358018 6244698	Active	Not observed	Yes	South
7	15 V 357954 6244917	Active	Inactive	Yes	South
8	15 V 356377 6242966	Active	Not observed	Yes	South
9	15 V 354998 6243575	Active	Not observed	Yes	South
10	15 V 350341 6241984	Active	Inactive	Yes	South
11	15 V 351738 6241039	Active	Not observed	Yes	South
12	15 V 351673 6240424	Active	Inactive	Yes	South
13	15 V 351401 6239811	Active	Inactive	Yes	South
14	15 V 351273 6239131	Active	Inactive	Yes	South
15	15 V 351355 6239079	Active	Inactive	Yes	South
16	15 V 353050 6241710	Active	Not observed	Yes	South
17	15 V 353523 6241456	Active	Inactive	Yes	South
18	15 V 353521 6241424	Active	Inactive	Yes	South
19	15 V 353530 6241160	Active	Inactive	Yes	South
20	15 V 353487 6240990	Active	Inactive	Yes	South
21	15 V 353469 6240652	Inactive	Active	Yes	South
22	15 V 347054 6242141	Active	Inactive	Yes	South
23	15 V 347619 6241984	Active	Inactive	Yes	South
24	15 V 347732 6241879	Active	Inactive	Yes	South
25	15 V 347887 6241223	Active	Inactive	Yes	South
26	15 V 347841 6240827	Inactive	Inactive	Yes	South
27	15 V 348054 6240533	Active	Inactive	Yes	South
28	15 V 348652 6239894	Active	Inactive	No	South
29	15 V 348739 6241404	Active	Inactive	Yes	South
30	15 V 348526 6241437	Active	Inactive	Yes	South
31	15 V 344734 6243126	Active	Active	No	South
32	15 V 344840 6242872	Inactive	Active	No	South
33	15 V 342490 6242995	Inactive	Inactive	Yes	South
34	15 V 342802 6242456	Active	Inactive	No	South
35	15 V 342816 6242505	Active	Inactive	No	South
36	15 V 342528 6242237	Inactive	Inactive	No	South
37	15 V 342532 6242184	Inactive	Inactive	No	South
38	15 V 338753 6242489	Inactive	Inactive	No	South
39	15 V 338689 6246044	Active	Inactive	No	North

Wpt.	UTM Coordinates	Status 2016	Status 2017	In Future Project Reservoir	North or South of Nelson River
40	15 V 342770 6245015	Active	Inactive	Yes	North
41	15 V 349789 6246611	Active	Active	Yes	North
42	15 V 350894 6247016	Active	Active	Yes	North
43	15 V 353800 6249400	Active	Active	Yes	North
44	15 V 356722 6248336	Inactive	Not observed	Yes	North
45	15 V 346216 6246001	NA	Active	No	North
46	15 V 353123 6249483	NA	Inactive	Yes	North
47	15 V 356236 6249204	NA	Active	Yes	North
48	15 V 357660 6248976	NA	Inactive	Yes	North
49	15 V 360821 6245253	NA	Active	Yes	South
50	15 V 349836 6243243	NA	Active	Yes	South
51	15 V 348103 6241329	NA	Active	Yes	South
52	15 V 347692 6242573	NA	Active	Yes	South
53	15 V 342380 6241707	NA	Active	No	North
54	15 V 338613 6246150	NA	Inactive	No	North

APPENDIX 2:
NELSON RIVER WATER LEVELS - SPRING/SUMMER 2017

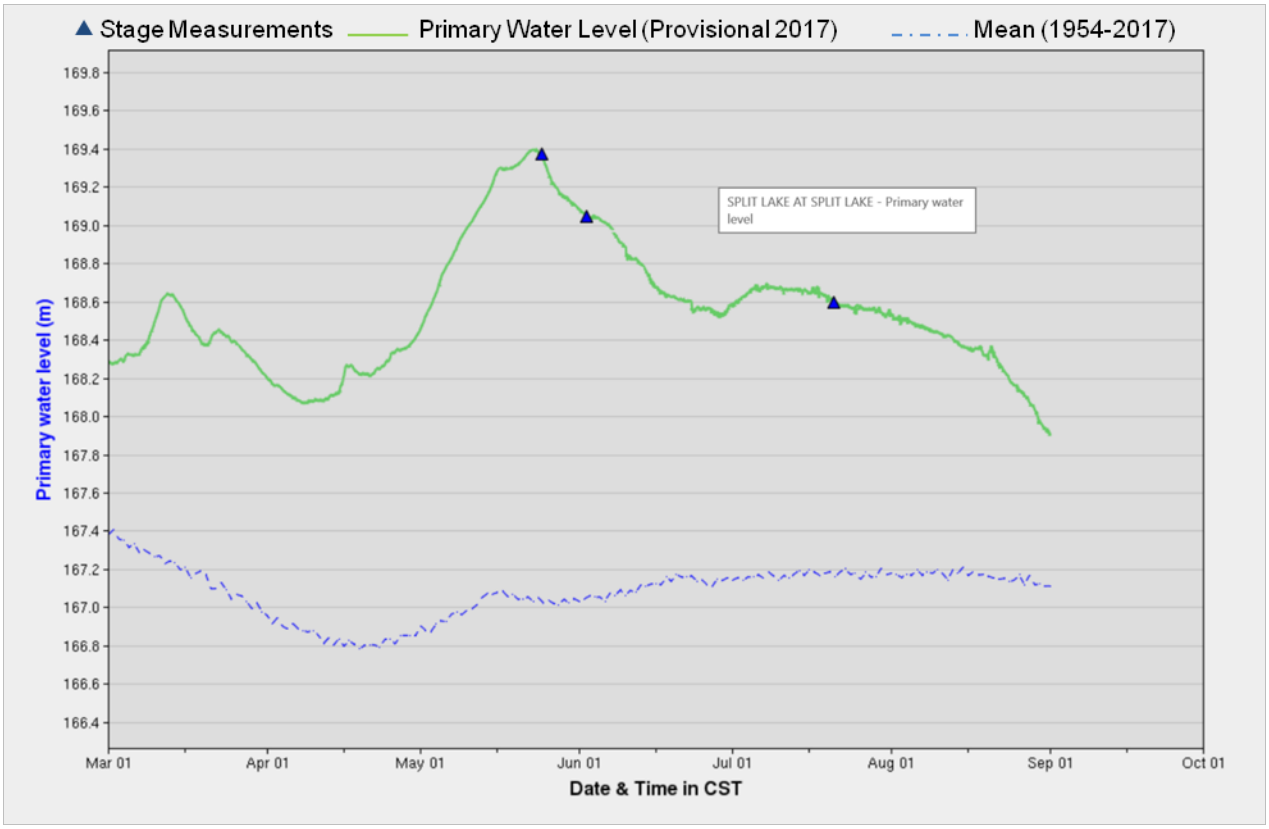

Figure 3: Comparison of Mean (March-September 1954-2017) and 2017 (March-September) Water Levels (magl) in the Nelson River System Measured at Split Lake, Manitoba (Government of Canada 2018)