



# Keeyask Generation Project Terrestrial Effects Monitoring Plan

## Beaver Habitat Effects Monitoring Report

TEMP-2022-09



# **KEEYASK GENERATION PROJECT**

## **TERRESTRIAL EFFECTS MONITORING PLAN**

REPORT #TEMP-2022-09

## **BEAVER HABITAT EFFECTS MONITORING 2021**

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Services MB, Inc.

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# SUMMARY

## Background

Construction of the Keeyask Generation Project (the Project) at Gull Rapids began in July 2014 and the reservoir was impounded in early September 2020. 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 more needs to be done to reduce harmful effects.

This report describes the results of beaver habitat effects monitoring conducted during the fall of 2021, the eighth year of Project construction.

## Why is the study being done?

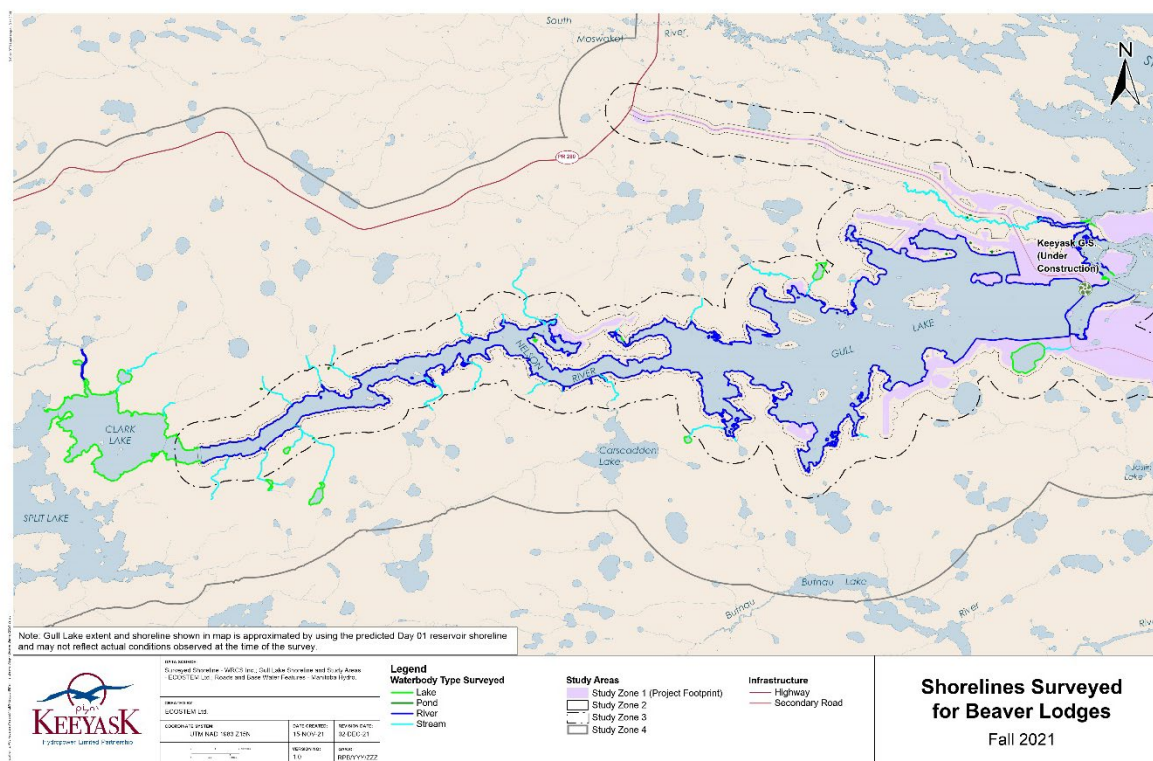
Predicted Project effects on beavers included habitat loss or alteration, sensory disturbance, and increased mortality. Reservoir impoundment has resulted in a permanent loss of local beaver habitat as creeks, tributaries, and small ponds and lakes were flooded. The objective of the study is to monitor the regional beaver population to verify predicted Project effects.



**Active Beaver Lodge in the Keeyask Region**

## What was done?

An aerial survey focused on the Keeyask reservoir and upstream Nelson River and Clark Lake shorelines was conducted on September 20, 2021 to determine the number and location of active and inactive beaver lodges in the surveyed area.



## What was found?

A total of 44 beaver lodges were observed along the survey route in Study Zone 3, the Local Study Area (see map above). Nine active lodges were counted in the Project footprint, three of which were in the Keeyask reservoir and had not been observed during monitoring surveys in previous years. There was a small increase in the density of active lodges from the previous year, when density was reduced following reservoir impoundment. No significant difference in the density of active lodges was found between the pre-construction and construction periods, but active lodge density was significantly lower after impoundment than before.

## What does it mean?

The density of active beaver lodges in the Local Study Area was significantly lower after the reservoir was impounded in 2020 than before. However, there was a small increase in active lodge density in 2021, with three new lodges observed in the reservoir, suggesting that suitable habitat was at least temporarily available along the new shoreline and that beavers had begun to re-colonize the area surrounding the reservoir. As predicted in the EIS, Project effects included a small reduction in the local beaver population.

In the Regional Study Area (Study Zone 4, see map above), the density of active lodges declined somewhat over the pre-construction and construction periods but there was little variation after 2001 (WRCS 2021). No substantial decline in lodge density was observed, suggesting that reservoir impoundment had a minimal effect on the regional beaver population, as predicted in the EIS.

**What will be done next?**

Construction monitoring for beaver habitat effects has now concluded. A multi-year monitoring report will provide an evaluation of Project construction effects on beavers and their habitat using all results from this monitoring study. Monitoring of beavers will continue during Project operation.

# STUDY TEAM

We would like to thank Sherrie Mason and Rachel Boone 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 contributed to the study included:

- Robert Berger, Wildlife Resource Consulting Services MB Inc. (WRCS) – Design and reporting
- Andrea Ambrose, WRCS – Data analysis and reporting
- Kevin McRae, WRCS –Data collection, field study lead
- Levi Warkentine, WRCS – Data collection

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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. Reservoir impoundment began August 31, 2020 and was completed on September 5, 2020.

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). The *Terrestrial Effects Monitoring Plan* (TEMP) 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.

The beaver is a medium-sized aquatic furbearer that inhabits waterbodies in forested areas. Beavers are common in the Keeyask region and are an important furbearer species, having cultural, economic, and ecological value (Keeyask Hydropower Limited Partnership [KHLP] 2012). By building dams and through their feeding activities, beavers alter aquatic ecosystems, increase the diversity of species and habitat on a landscape, and create habitat for other species that use wetlands (e.g., Naiman et al. 1988; Wright et al. 2002). Beavers do not typically inhabit the main channel of the Nelson River due to strong currents (KHLP 2012). However, the nearby creeks, ponds, and lakes provide suitable habitat.

Predicted Project effects on beavers included habitat loss or alteration, sensory disturbance, and increased mortality. Reservoir impoundment has resulted in a permanent loss of local beaver habitat as creeks, tributaries, and small ponds and lakes were flooded. Additional, long-term habitat loss due to shoreline erosion and peatland disintegration is anticipated. Water level fluctuations in the future reservoir will make any potential habitat along the shorelines unsuitable. However, the expected formation of floating peatlands in the reservoir could attract beavers to these habitats and temporarily increase their abundance in the reservoir. Once these peatlands break down, beavers will most likely abandon the reservoir and seek habitat in the surrounding area.

## 2.0 METHODS

Aerial surveys for construction-phase beaver monitoring began in 2016 and continued in 2017. The survey was expanded in 2018 and repeated in 2019 and 2020 along shorelines in waterbodies and waterways in the Regional Study Area (Study Zones 1–4; Map 1). In 2020, the survey was conducted shortly after reservoir impoundment was complete and included the newly expanded Gull Lake shoreline. The density of beaver lodges along the survey route (lodges/km) was compared among study zones to explore potential Project effects in the reservoir area. Direct Project effects (habitat loss and alteration) were anticipated in Study Zone 1 (the Project footprint), while direct and indirect (e.g., sensory disturbance) Project effects were expected in Study Zones 2 and 3 which, along with Study Zone 1, comprised the Local Study Area. Study Zones 1–4 were the regional reference area for the beaver population.

On September 20, 2021 a survey focused mainly on the Keeyask reservoir and the Nelson River upstream to Clark Lake was flown in a Bell 206 Jet Ranger helicopter, at a speed of approximately 100 km/hr and approximately 50 m above ground level. Observers were stationed on the left side of the helicopter. Beaver lodge locations were recorded with a handheld Global Positioning System (GPS) unit and photographed. The presence of food caches and whether lodges were active or inactive was recorded. Beaver lodges were classified as either standard lodges or bank burrows. Standard lodges (Photo 1, Photo 2) are commonly freestanding conical mounds of branches and logs plastered with mud with one or more underwater openings to tunnels that meet at a cavity in the center of the mound (Novak 1999). Bank burrows (Photo 3) are dug into shoreline banks where the water is deep or fast, are often covered in sticks and mud, and are occasionally connected to an extensive underground network of tunnels (Novak 1999). Active beaver lodges were characterized by signs of lodge maintenance (fresh mud and timber), nearby recent foraging, and the presence and condition of a food cache (see Photo 1). Lodges lacking these characteristics were considered inactive (see Photo 2).



**Photo 1: Active Standard Beaver Lodge with Food Cache**



**Photo 2: Inactive Standard Beaver Lodge**





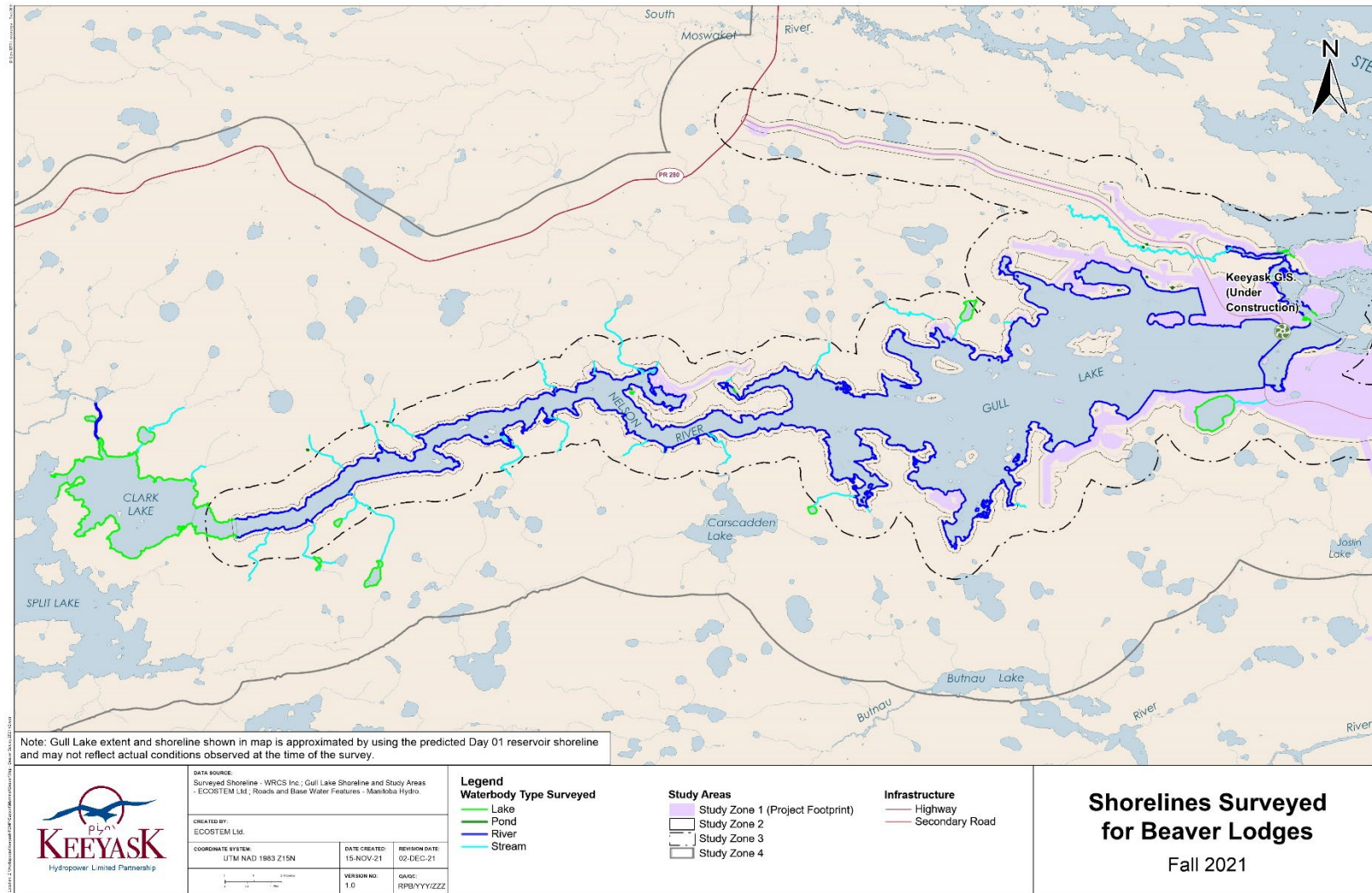
**Photo 3: Active Beaver Bank Burrow**

A census of beaver lodges was conducted along the Nelson River shoreline from the Keeyask GS upstream to Clark Lake, inclusive (Map 1). Some ponds and portions of streams were also surveyed within Study Zone 3. Because the reservoir had been impounded in 2020, the shoreline length surveyed in Study Zone 1 had changed from 235 km in 2018 and 2019 to 273 km in 2021 (Table 1). A total of 338 km was surveyed in Study Zone 3, the Local Study Area.

**Table 1: Length of Shorelines Surveyed for Beaver Lodges, 2021**

Study Zone	Length (km)
1 (Project footprint)	273
2	13
3	52
1–3 (Local Study Area)	338

A two-sample *t* test was used to compare the density of active beaver lodges in the Local Study Area before and after Project construction, and before and after reservoir impoundment. Significance was determined at the  $\alpha = 0.05$  level.



**Map 1: Shorelines Surveyed for Beaver Lodges, Fall 2021**

### 3.0 RESULTS

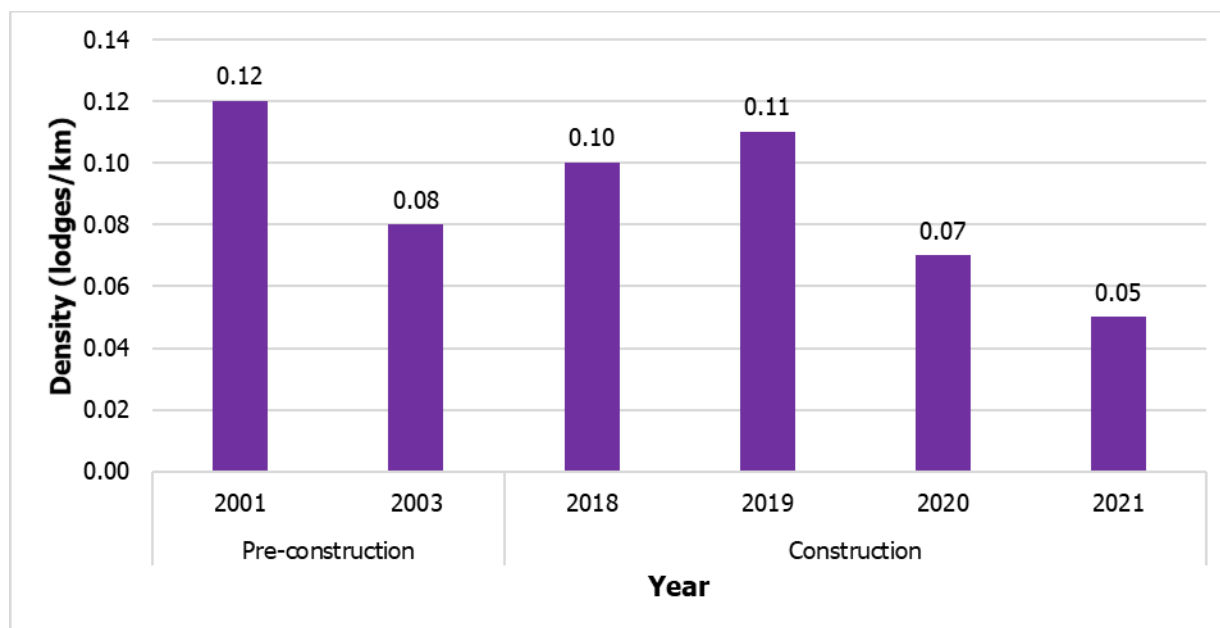
A total of 44 beaver lodges, including 41 standard lodges and three bank burrows, were observed along the survey route in Study Zone 3 (the Local Study Area) during the fall 2021 aerial survey. Seventeen lodges were active and 27 were inactive. Other lodges ( $n = 16$ ) were observed off the survey route or beyond Study Zone 3 and were recorded as incidental; all beaver lodges observed during the fall aerial survey are depicted in Map 2 and listed in Appendix 1, Table 1-1. Three of the active lodges observed in Study Zone 1 were in the Keeyask reservoir and had not been observed during previous surveys.

In 2021, the density of active lodges in Study Zones 1–3 was 0.05 lodges/km and the density of inactive lodges was 0.08 lodges/km. In Study Zone 3 the density of active beaver lodges was lower in 2021 than in previous study years (Table 2). A decline in active lodge density in Study Zone 1 (the Project footprint) had been observed from 2019 to 2020 due mainly to the submergence of four lodges as a result of flooding during reservoir impoundment. There were two additional active lodges in the Project footprint that were beyond the reservoir area in 2020. The density of inactive lodges in Study Zone 1 also declined in 2020 because of lodge submergence during impoundment. However, the density of active lodges increased in Study Zone 1 from 2020 to 2021. Of the nine active lodges observed in Study Zone 1 in 2021, three were identified as inactive the previous year, three were observed in 2018 and 2019 but not in 2020, and three were new (see Map 2). One of the active lodges observed in 2020 was inactive in 2021 and the other was not observed during the 2021 survey.

**Table 2: Number and Density (lodges/km) of Beaver Lodges in Study Zones 1–3, 2018 to 2021**

Study Zone	Lodge Status	2018		2019		2020		2021	
		Number	Density	Number	Density	Number	Density	Number	Density
1	Active	4	0.02	7	0.03	2	0.01	9	0.03
	Inactive	28	0.12	37	0.16	15	0.07	3	0.01
2	Active	4	0.05	7	0.10	2	0.03	1	0.08
	Inactive	6	0.08	10	0.14	11	0.15	1	0.08
3	Active	47	0.21	42	0.19	33	0.15	7	0.13
	Inactive	43	0.19	78	0.35	72	0.33	23	0.44
1–3	Active	55	0.10	56	0.11	37	0.07	17	0.05
	Inactive	77	0.15	125	0.24	98	0.19	27	0.08

In Study Zones 1–3 (the Local Study Area), the density of active beaver lodges was lower in 2020 and 2021, after reservoir impoundment, than in previous survey years (Figure 1). There was no significant difference in active lodge density between the pre-construction (2001–2003; mean = 0.10, variance = <0.01) and construction (2018–2021; mean = 0.08, variance = <0.01) periods ( $t = 0.73$ ,  $p = 0.51$ ).



**Figure 1: Density of Active Beaver Lodges in Study Zones 1–3 before and during Project Construction**

There was no significant difference in the mean density of active beaver lodges among the pre-construction (2001, 2003), construction pre-impoundment (2018, 2019), and construction post-impoundment (2020, 2021) phases in Study Zones 1–3 (Table 3). When the combined pre-impoundment phase (2001, 2003, 2018, and 2019) and the post-impoundment phase (2020, 2021) were compared, active lodge density was significantly ( $p = 0.048$ ) lower after the reservoir was impounded.

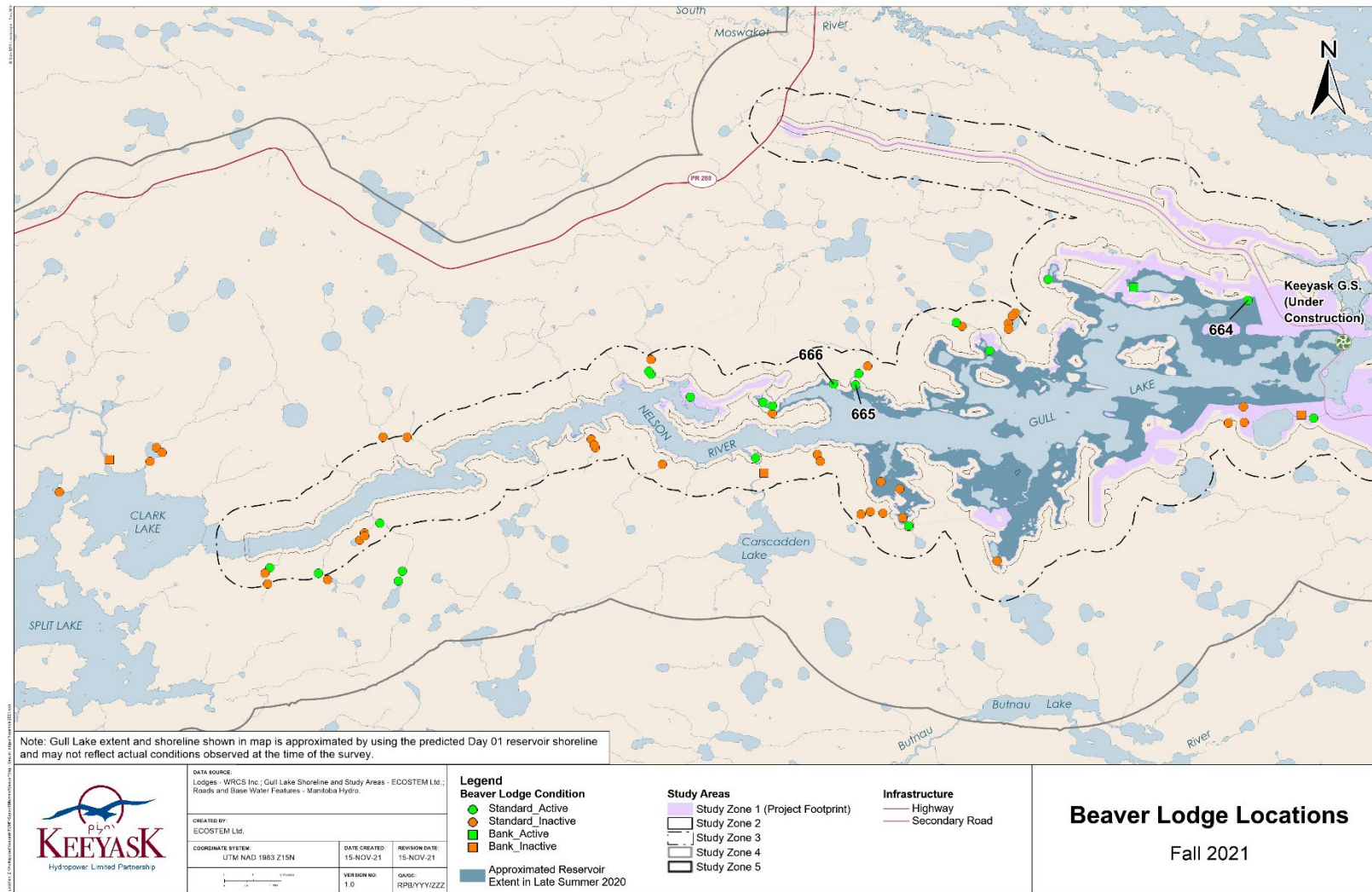
**Table 3: Mean Density (lodges/km) of Beaver Lodges in Study Zones 1–3 before Project Construction, before Reservoir Impoundment, and after Reservoir Impoundment**

Period	Metric	Value
Pre-construction (2001, 2003)	Mean	0.100
	Variance	0.001
Construction pre-impoundment (2018, 2019)	Mean	0.105
	Variance	<0.001
Construction post-impoundment (2020, 2021)	Mean	0.060
	Variance	<0.001
Pre-impoundment (2001, 2003, 2018, 2019)	Mean	0.103
	Variance	<0.01
Pre-construction vs. Construction pre-impoundment	<i>t</i>	-0.243
	<i>p</i>	0.831

Period	Metric	Value
Pre-construction vs. Construction post-impoundment	$t$	1.789
	$p$	0.216
Construction pre-impoundment vs. Construction post-impoundment	$t$	4.025
	$p$	0.057
Pre-impoundment vs. Construction post-impoundment	$t$	3.232
	$p$	0.048

One beaver mortality was reported in May 2020, near the South Dyke. The cause was unknown. Nineteen beavers were trapped out of the future reservoir area in 2017, 18 in 2018, and six in 2019, before the reservoir was impounded.





NOTE: Numbered lodges were first observed in 2021.

**Map 2: Beaver Lodge Locations, Fall 2021**

## 4.0 DISCUSSION

The number of active beaver lodges observed in the Project footprint (Study Zone 1) during fall aerial surveys declined during construction, from 34 in 2016 (WRCS 2018) to 2 in 2020, due to the removal of beavers from lodges in the future reservoir area as part of the Project's pre-impoundment trapping program (WRCS 2018, 2019, 2020, 2021); tree clearing and noise disturbance in the future reservoir area, which likely reduced the quality of habitat nearby; the inundation of four lodges in the reservoir during impoundment; and another two lodges in the reservoir becoming inactive following impoundment.

The density of active beaver lodges fluctuated in the Local Study Area (Study Zones 1–3) during the pre-construction (2001, 2003) and construction (2018–2021) periods, due in part to the aforementioned removal of beavers from the future reservoir area from 2017 to 2019. Following reservoir impoundment in early September 2020, there was a slight decline in the density of active beaver lodges in the Local Study Area, mainly due to the submergence of the few remaining lodges in the reservoir area (WRCS 2021). While active lodge density was lowest after reservoir impoundment, there was no significant difference between the pre-construction and construction periods in the Local Study Area. Active lodge density was significantly lower after impoundment than during the combined pre-impoundment period. However, there was a small increase in active lodge density in 2021, when three new lodges were observed in the reservoir, suggesting that suitable habitat was at least temporarily available along the new shoreline and that beavers had begun to re-colonize the area surrounding the reservoir. As predicted in the EIS, Project effects included a small reduction in the local beaver population.

In the Regional Study Area (Study Zones 1–4), the density of active lodges declined somewhat over the pre-construction and construction periods but there was little variation after 2001 (WRCS 2021). No substantial decline was observed, suggesting that reservoir impoundment had a minimal effect on the regional beaver population, as predicted in the EIS.

## 5.0 SUMMARY AND CONCLUSIONS

Beavers were successfully trapped out of most known active lodges in the future reservoir area prior to impoundment in 2020. The density of active beaver lodges fluctuated in the Local Study Area from 2001 to 2019, then declined after reservoir impoundment in 2020 when remaining lodges were submerged. Three new lodges were observed in the Keeyask reservoir in 2021, suggesting that suitable habitat was available along the new shoreline and that beavers had begun to re-colonize the area surrounding the reservoir.

Construction monitoring for beaver habitat effects has concluded. A multi-year monitoring report will provide an integrated evaluation of Project construction effects on beaver numbers and location and the availability of suitable habitat using all results from this monitoring study. Monitoring of beavers will continue during Project operation.

## 6.0 LITERATURE CITED

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## **APPENDIX 1: AERIAL SURVEY OBSERVATIONS 2021**



**Table 1-1: Location and Status of Beaver Lodges, Fall 2021**

Study Zone	Waterbody Type	Lodge Type	Lodge Status	Lodge	Observed in 2018	Observed in 2019	Observed in 2020	Observed in 2021	UTM
1 (Project footprint)	Lake	Standard	Active	40	✓	✓	✓	✓	15 V 342769 6245016
				46	✓	✓	✓	✓	15 V 353122 6249484
			Inactive	479		✓		✓	15 V 351273 6239255
			Unknown	10	✓	✓	✓		15 V 350340 6241985
				13	✓	✓			15 V 351400 6239812
				48	✓	✓			15 V 357659 6248977
				61	✓	✓			15 V 349495 6244954
				90	✓	✓			15 V 351017 6239887
				316	✓	✓	✓		15 V 358077 6244726
				544		✓			15 V 353342 6249485
				294	✓	✓	✓		15 V 357113 6252729
				305	✓	✓	✓		15 V 355593 6250487
				42	✓	✓			15 V 350893 6247017
				42a	✓	✓			15 V 350893 6247017
		Bank	Active	47	✓	✓		✓	15 V 356235 6249205
	River	Standard	Active	33	✓	✓	✓	✓	15 V 342489 6242996
				423	✓	✓		✓	15 V 350996 6246888
				604			✓	✓	15 V 340125 6245213
				664				✓	15 V 360388 6248725
				665				✓	15 V 346126 6245654
				666				✓	15 V 345332 6245690
			Inactive	22	✓	✓		✓	15 V 347053 6242142
			Unknown	7	✓	✓	✓		15 V 357953 6244918
				41	✓	✓			15 V 349788 6246612
				49	✓				15 V 360821 6245253
				50	✓				15 V 349836 6243243
				52	✓				15 V 347692 6242573
				236	✓	✓			15 V 334324 6243045

Study Zone	Waterbody Type	Lodge Type	Lodge Status	Lodge	Observed in 2018	Observed in 2019	Observed in 2020	Observed in 2021	UTM
1 (Project footprint)	River	Standard	Unknown	472		✓			15 V 360842 6245235
				473		✓	✓		15 V 358014 6244765
				475		✓			15 V 351943 6241349
				476		✓			15 V 351844 6241297
				539			✓		15 V 349018 6245146
				605					15 V 357896 6249315
				607					15 V 353973 6247157
				606			✓		15 V 343099 6244874
	Stream	Standard	Active	27	✓	✓		✓	15 V 348053 6240534
				24	✓	✓		✓	15 V 347731 6241880
			Unknown	26	✓	✓	✓	✓	15 V 347840 6240828
				17	✓	✓	✓		15 V 353522 6241457
				18	✓	✓			15 V 353520 6241425
				19	✓	✓			15 V 353529 6241161
				20	✓	✓	✓		15 V 353486 6240991
				21	✓	✓			15 V 351672 6240425
				23	✓	✓			15 V 347618 6241985
				25	✓	✓			15 V 347886 6241224
				51	✓	✓	✓		15 V 348102 6241330
				89	✓	✓			15 V 351560 6240039
				211	✓	✓	✓		15 V 353468 6240653
	Unknown	Standard	Inactive	474		✓			15 V 353073 6241744
				477		✓			15 V 351732 6241005
				478		✓			15 V 351835 6240671
		Bank	Unknown	88	✓				15 V 351618 6240248
				51a	✓	✓			15 V 348102 6241330
		Unknown	Standard	315	✓	✓		✓	15 V 360221 6244857
				29	✓				15 V 348739 6241404
				43	✓	✓			15 V 353799 6249401
				480		✓	✓		15 V 351325 6239087

Study Zone	Waterbody Type	Lodge Type	Lodge Status	Lodge	Observed in 2018	Observed in 2019	Observed in 2020	Observed in 2021	UTM
1 (Project footprint)	Unknown	Standard	Unknown	458		✓	✓		15 V 365747 6246397
				14	✓	✓			15 V 351272 6239132
				15	✓				15 V 351355 6239079
2	Lake	Standard	Active	66	✓			✓	15 V 343099 6244888
			Inactive	65	✓	✓	✓	✓	15 V 343104 6244610
	River	Standard	Unknown	79	✓				15 V 329558 6242865
				492		✓			15 V 334453 6243094
	Unknown	Standard	Inactive	2	✓	✓	✓	✓	15 V 360253 6244291
3	Lake	Standard	Inactive	541		✓	✓	✓	15 V 351681 6247888
				542		✓		✓	15 V 351943 6248268
				543		✓	✓	✓	15 V 351821 6248160
				622			✓	✓	15 V 328103 6240022
				641			✓	✓	15 V 351684 6247677
		Bank	Unknown	642			✓		15 V 364251 6248278
	River	Standard	Inactive	534		✓		✓	15 V 329818 6243756
	Stream	Standard	Active	4	✓	✓	✓	✓	15 V 362770 6244449
				39	✓	✓	✓	✓	15 V 338688 6246045
				54	✓	✓	✓	✓	15 V 338612 6246151
				57	✓	✓	✓	✓	15 V 349786 6247923
				239	✓	✓	✓	✓	15 V 326598 6238810
				496		✓	✓	✓	15 V 328835 6240626
				499		✓	✓	✓	15 V 324842 6239008
				538		✓	✓	✓	15 V 346244 6246061
			Inactive	56	✓	✓		✓	15 V 350000 6247789
				62	✓	✓	✓	✓	15 V 346564 6246337
				67	✓	✓	✓	✓	15 V 338695 6246581
				82	✓			✓	15 V 328951 6243756
				226	✓	✓	✓	✓	15 V 347120 6240994
				227	✓	✓	✓	✓	15 V 346656 6241043
				228	✓	✓	✓	✓	15 V 346321 6240955

Study Zone	Waterbody Type	Lodge Type	Lodge Status	Lodge	Observed in 2018	Observed in 2019	Observed in 2020	Observed in 2021	UTM
3	Stream	Standard	Inactive	235	✓	✓	✓	✓	15 V 336517 6243676
				489		✓	✓	✓	15 V 339106 6242764
				490		✓	✓	✓	15 V 336667 6243375
				491		✓	✓	✓	15 V 336623 6243472
				500		✓	✓	✓	15 V 324758 6238427
				621			✓	✓	15 V 328265 6240268
				623			✓	✓	15 V 328281 6240165
				624			✓	✓	15 V 324658 6238808
	Bank	Unknown	Inactive	81	✓				15 V 329249 6243728
				3	✓	✓	✓	✓	15 V 362328 6244562
				34	✓			✓	15 V 342802 6242456
				35	✓		✓		15 V 347627 6241981
	Unknown	Standard	Inactive	31	✓			✓	15 V 344734 6243126
				32	✓			✓	15 V 344840 6242872
				459		✓		✓	15 V 359675 6244274
4	Lake	Standard	Active	497		✓	✓	✓	15 V 329512 6238532
			Inactive	105	✓	✓	✓	✓	15 V 320484 6242870
				498		✓	✓	✓	15 V 326940 6238566
				506		✓	✓	✓	15 V 317188 6241757
				532		✓	✓	✓	15 V 320710 6243381
	Bank	Unknown	Inactive	635			✓	✓	15 V 318997 6242932
				238	✓	✓	✓	✓	15 V 329654 6238879
	Stream	Standard	Active	238	✓	✓	✓	✓	15 V 329654 6238879
	Unknown	Standard	Inactive	639			✓	✓	15 V 320918 6243197
			Unknown	533		✓			15 V 327129 6242676