Keeyask Generation Project

Terrestrial Effects Monitoring Plan

Beaver Habitat Effects Monitoring Report

TEMP-2024-13

KEEYASK

Manitoba Environment and Climate Change Client File 5550.00
Manitoba Environment Act Licence No. 3107

2023 -2024

KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2024-13

BEAVER HABITAT EFFECTS
YEAR 2 OPERATION
2023

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Services MB, Inc.

June 2024

This report should be cited as follows:

Wildlife Resource Consulting Services MB Inc. 2024. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2024-13: Beaver Habitat Effects 2023 – Year 2 Operation, 2023. A report prepared for Manitoba Hydro by Wildlife Resource Consulting Services MB Inc., June 2024.

SUMMARY

Background

Construction of the Keeyask Generation Project (the Project) at the former Gull Rapids began in July 2014. The reservoir was impounded in early September 2020, and the generating station was fully operational in March 2022. 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 2023, the second year of Project operation monitoring.

Why is the study being done?

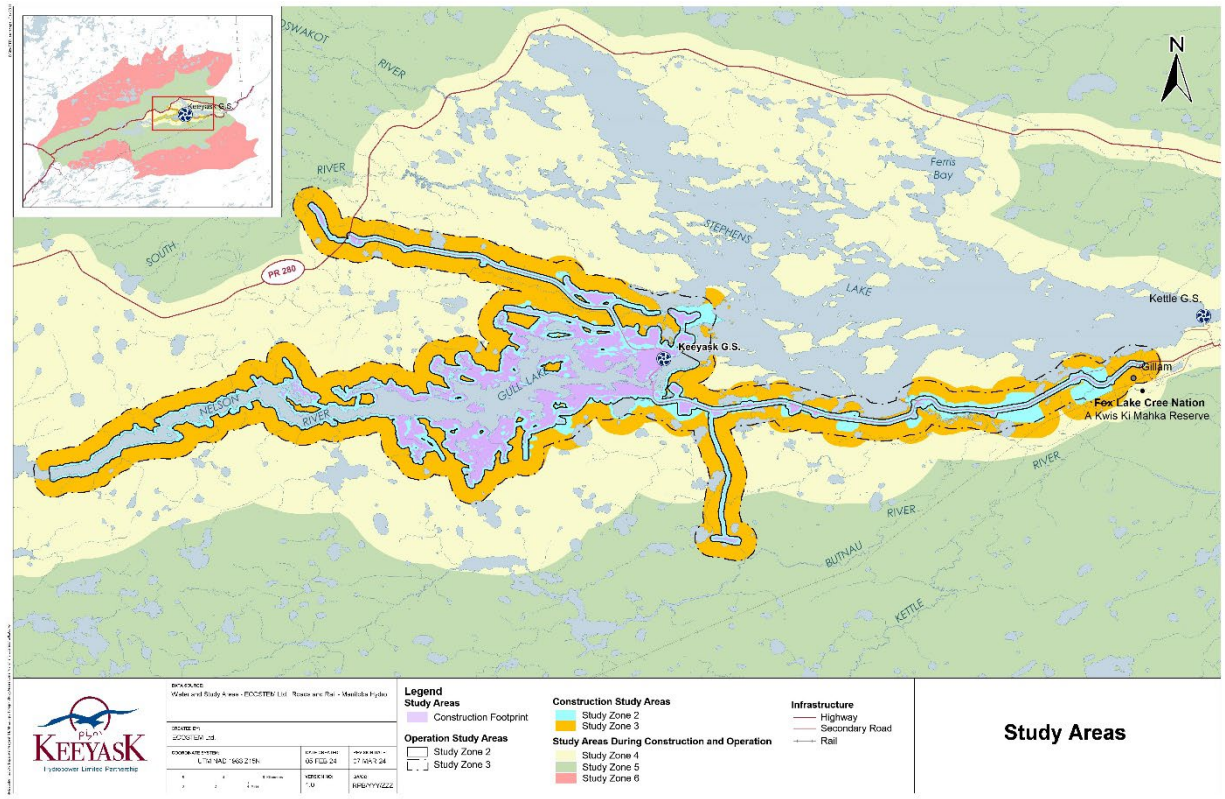
Predicted Project effects on beavers during operation were mainly habitat loss and alteration. Reservoir impoundment has resulted in a permanent loss of local beaver habitat because creeks, tributaries, small ponds, and lakes were flooded. The objective of beaver monitoring is to estimate how much of their habitat is lost or altered due to the Project by observing their use of the reservoir and nearby areas during Project operation.

Active Beaver Lodge in the Keeyask Region

What was done?

The characteristics of some beaver lodges found in the Keeyask region were measured from October 2 - 6, 2023 to examine if Project operation is affecting beaver lodges. Lodges in areas

near the Project footprint (Construction Study Zones 1–3) were compared to those in the broader Keeyask region (Study Zones 4–5; see map below).



What was found?

A total of 63 beaver lodges were measured in 2023, with 43 active and 20 inactive. Of the total lodges, 41 were in Construction Study Zones 1–3 (in or near the Project footprint) and 22 were in Study Zones 4–5 (the surrounding region). No significant differences in lodge characteristics were detected between Study Zones 1–3 and 4–5, except for shrub height at inactive lodges.

What does it mean?

No difference in most lodge characteristics suggests that there continues to be suitable beaver habitat in or near the Project footprint (Construction Study Zones 1–3) after reservoir impoundment and during early Project operation.

What will be done next?

Beaver habitat effects monitoring will continue in 2025, when the local population has had more time to adjust to the new conditions in and around the reservoir.

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
- Thomas Wood, WRCS – Data collection, analysis, and reporting
- Levi Warkentine, WRCS – Data collection

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1.0 INTRODUCTION

The Keeyask Generation Project (the Project) is a 695-megawatt hydroelectric generating station (GS) located at the former Gull Rapids on the lower Nelson River in northern Manitoba where Gull Lake flows into Stephens Lake. Project construction began in July 2014, the reservoir was impounded in early September 2020, and the GS was fully operational in March 2022.

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*) habitat, during the operation 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 during operation were mainly habitat loss and alteration. Reservoir impoundment has resulted in a permanent loss of local beaver habitat because creeks, tributaries, small ponds, and lakes were flooded. Additional, long-term habitat loss due to shoreline erosion and peatland disintegration within the reservoir is anticipated. Water level fluctuations in the reservoir could 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. Once these peatlands break down, beavers will most likely abandon the reservoir and seek habitat in the surrounding area. The objective of beaver monitoring is to quantify how much of their habitat is lost or altered due to the Project by characterizing their use of the reservoir and nearby areas during operation.

2.0 METHODS

From October 2 to 6, 2023, a sample of active (Photo 1) and inactive standard lodges (Photo 2) and bank burrows (Photo 3) observed during the fall 2022 beaver aerial survey were visited for measurement of lodge characteristics (Map 1). Some active lodges that were opportunistically encountered during the ground survey were also sampled.

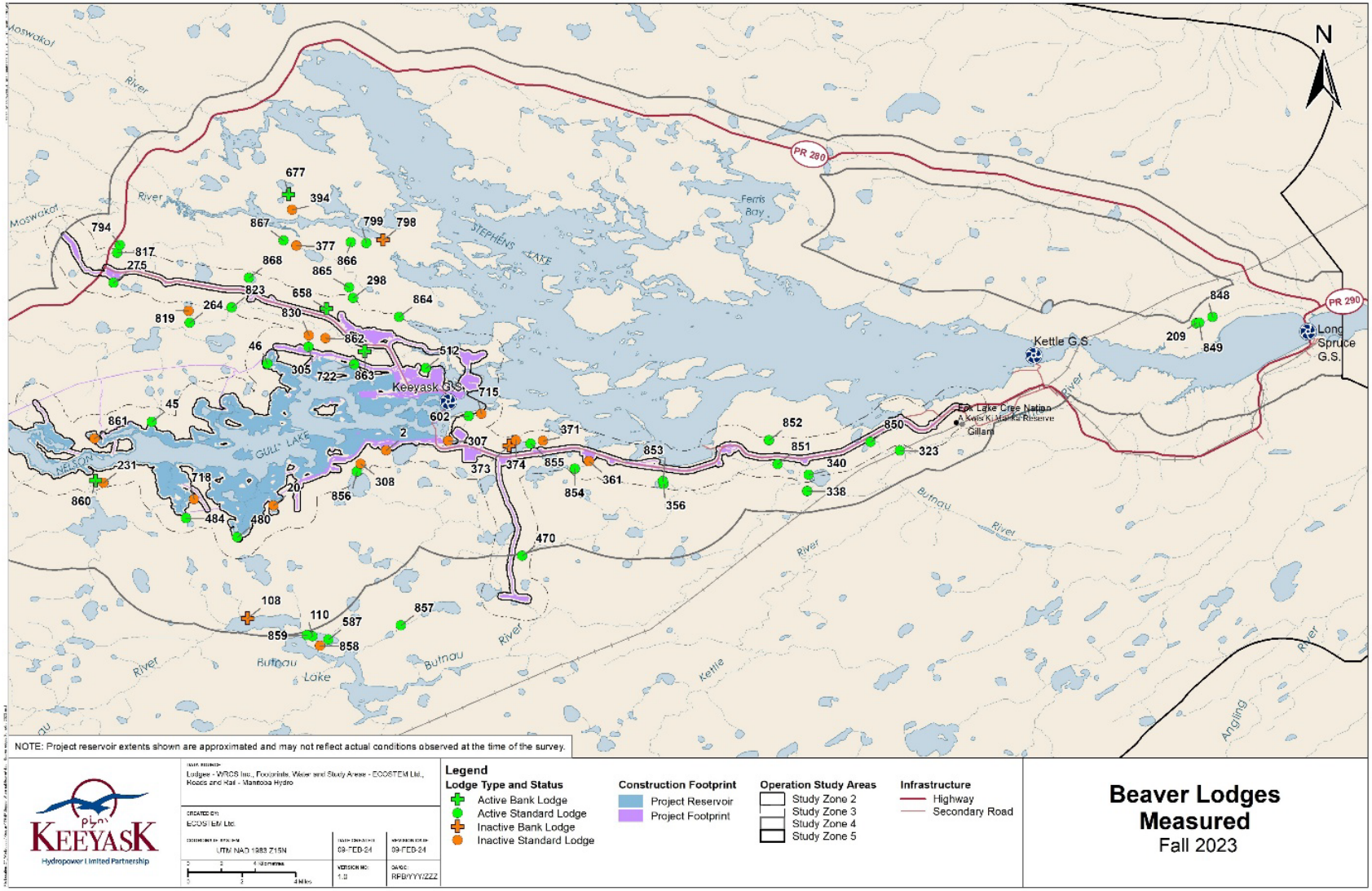
The length, width, and height of the above-water portion of each lodge was measured with a measuring tape. Water depth at the lodges was measured from the surface of the water to the point at which the lodge met the bottom of the waterbody. To calculate total lodge height, water depth was added to the above-water height of each lodge. Size measurements taken for beaver lodges were approximate due to their irregular shape. Lodge volume for standard lodges was based on a cubic structure by multiplying the length, width, and total height measurements, which is not a precise measure of actual lodge size but allowed relative comparisons among lodges. The volume of bank burrows is difficult to determine due to their subterranean construction and was not calculated.

Characteristics of the surrounding area were also recorded at beaver lodges. The width and length of the portion of food caches visible above the water were estimated from their associated lodges. The depth of food caches could not be measured from the lodges. At bank burrows, shoreline slope was measured in degrees with a clinometer from the edge of the water up the bank. Shoreline slope was not assessed at standard lodges as they were often far from shore. For standard lodges, the distance to nearest bank was measured from the shoreline over open water to the nearest portion of the beaver lodge. Bank burrows were, by definition, on the banks of shorelines. The general height of nearby trees was estimated, as was the distance to the nearest standing food source. To explore whether Project operation was affecting beaver lodges, lodge characteristics in and near the Project footprint (Study Zones 1–3) were compared with lodges in the surrounding region (Study Zones 4–5) using a Student's *t*-test. Statistical significance was determined at the $\alpha = 0.05$ level.

Photo 1: Active Standard Beaver Lodge with Food Cache

Photo 2: Inactive Standard Beaver Lodge

Photo 3: Active Beaver Bank Burrow with Food Cache

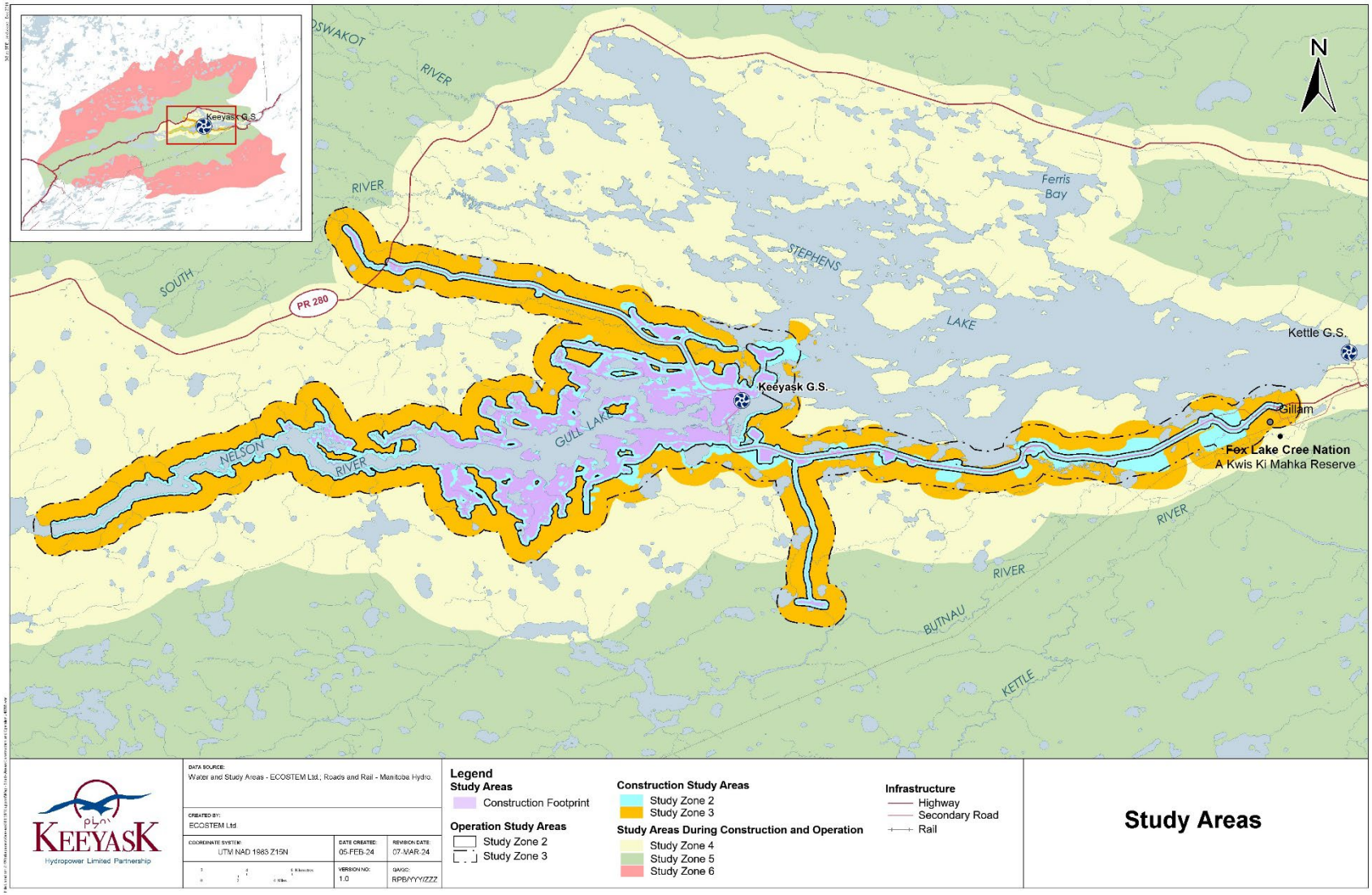


Map 1: Beaver Lodges Measured in Fall 2023

2.1 REFERENCE TO STUDY ZONES

During the creation of the Project's Environmental Impact Statement (EIS) a cautious approach was used to estimate the area of the Project construction footprint (Study Zone 1) and associated local study zones (Study Zones 2 and 3). This cautious approach included all of the possibly disturbed areas and areas that were unlikely to be affected in the licensed Project footprint.

Once the Project was fully operational, the Project footprint and associated local study zones were refined to represent the actual areas affected by the Project during construction, as many areas included for the effects assessment were not disturbed by the Project. Study Zone 1 was remapped to only include areas that were actually cleared or physically disturbed by the Project. Study zones 2 and 3, the indirect Project zones of influence, were delineated using the same buffer distances of Study Zone 1 that were used in the EIS - 150 m and 1,150 m, respectively. (ECOSTEM Ltd 2024). Information provided in this report shows the revised Operations Study Zones (Map 2).



Map 2: Updates to Construction Footprint and Revised Operation Study Zones

3.0 RESULTS

During the fall 2023 beaver lodge ground survey, characteristics of 63 beaver lodges in Study Zones 1 through 5 were measured and described (Appendix 1 Table 1-1). Of these, 56 were standard lodges (39 active and 17 inactive) and 7 were bank burrows (4 active and 3 inactive).

Of the active standard lodges, 24 were measured in Study Zones 1–3 and 15 were measured in Study Zones 4–5. Characteristics of active standard lodges in Study Zones 1–3 were not significantly different from active standard lodges in Study Zones 4–5 (Table 1). Of the inactive standard lodges, 13 were measured in Study Zones 1–3 and four were measured in Study Zones 4–5. There was no significant difference in characteristics of inactive standard lodges between Study Zones 1–3 and Study Zones 4–5, except for shrub height (Table 2). A post-hoc comparison found no difference between shrub height at active and inactive lodges (X_{active} = 1.6 m, SD_{active} = 1.2 m, $X_{inactive}$ = 1.9 m, $SD_{inactive}$ = 0.89 m, t = -0.84, p = 0.40). While characteristics of bank lodges were measured (Table 3), no statistical comparisons were made due to the small sample size.

Table 1: Comparisons Between Active Standard Lodge Characteristics in Study Zones 1–3 and 4–5, 2023

	Study Zones 1–3		Study Zones 4–5			
Lodge Characteristics	**Mean**	**SD**	**Mean**	**SD**	**t**	**p**
Lodge volume (m^3)	83.4	53.2	86.7	31.8	-0.23	0.82
Distance to nearest shore (m)	30.0	39.4	34.4	31.7	-0.35	0.73
Tree height (m)	10.1	4.5	8.2	5.8	1.1	0.30
Shrub height (m)	1.3	1.1	1.8	1.4	1.69	0.17
Distance from lodge to food source (m)	13.5	22.4	18.0	18.3	-0.62	0.54
Food cache size (m^2)	32.7	17.1	25.8	28.1	0.82	0.42

Table 2: Comparisons Between Inactive Standard Lodge Characteristics in Study Zones 1–3 and 4–5, 2023

	Study Zones 1–3		Study Zones 4–5			
Lodge Characteristics	**Mean**	**SD**	**Mean**	**SD**	**t**	**p**
Lodge volume (m^3)	75.0	40.8	87.5	38.1	-0.60	0.55
Distance to nearest shore (m)	22.6	11.9	23.2	13.9	-0.10	0.92
Tree height (m)	10.6	3.5	8.3	6.8	0.72	0.50
Shrub height (m)	2.1	0.7	1.2	1.0	-2.29	0.03
Distance from lodge to food source (m)	14.5	11.25	25.8	20.7	-1.60	0.13

Table 3: Characteristics of Beaver Bank Lodges in Study Zones 1–3 and 4–5, 2023

Study Zone	Lodge Status	Number of Lodges	Average Shoreline Slope (°)	Average Tree Height (m)	Average Shrub Height (m)	Average Distance Lodge to Food (m)	Average Cache Size (m^2)
1–3	Active	3	16	4.5	2.7	0.67	18
	Inactive	1	50	11	2.5	0	–
4–5	Active	1	50	2	2	1	18
	Inactive	2	30	7.8	2.8	9	–

Lodge volume of standard lodges was relatively similar across all monitoring years for both Study Zones 1–3 and Study Zones 4–5 (Table 4–7), except for inactive lodges in Study Zone 4–5 measured in 2019 which were smaller compared to other years (Table 7). Shrub height at inactive lodges in Study Zone 1–3 showed a slight increasing trend from 2019 to 2023 (Table 6). Other lodge characteristics tended to be highly variable and did not have consistent trends across time.

Table 4: Characteristics of Active Standard Lodges in Study Zones 1–3 in 2018, 2019, 2020 and 2023

	2018		2019		2020		2023	
Lodge Characteristics	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Lodge volume (m^3)	77.2	62.1	84.3	53.1	92.1	63.0	83.4	53.2
Distance to nearest shore (m)	27.0	18.7	42.0	41.4	31.6	24.9	30.0	39.4
Tree height (m)	6.9	3.0	14.8	6.5	16.3	5.5	10.1	4.5
Shrub height (m)	1.7	0.6	1.0	0.6	2.6	3.4	1.3	1.1
Distance from lodge to food source (m)	22.7	29.9	45.6	38.5	25.1	36.7	13.5	22.4
Food cache size (m^2)	15.7	7.9	21.6	10.5	19.1	10.0	32.7	17.1

Table 5: Characteristics of Active Standard Lodges in Study Zones 4–5 in 2018, 2019, 2020, and 2023.

	2018		2019		2020		2023	
Lodge Characteristics	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Lodge volume (m^3)	64.4	51.4	75.2	40.4	74.2	49.0	86.7	31.8
Distance to nearest shore (m)	38.2	17.2	43.8	33.5	51.1	28.5	34.4	31.7
Tree height (m)	7.9	2.3	12.5	4.5	16.6	5.1	8.2	5.8
Shrub height (m)	1.3	0.4	0.8	0.4	1.7	1.0	1.8	1.4
Distance from lodge to food source (m)	23.6	24.6	62.0	52.2	62.9	72.0	18.0	18.3
Food cache size (m^2)	13.6	8.0	15.6	8.1	36.2	34.5	25.8	28.1

Table 6: Characteristics of Inactive Standard Lodges in Study Zones 1–3 in 2018, 2019, 2020, and 2023

	2018		2019		2020		2023	
Lodge Characteristics	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Lodge volume (m^3)	101.7	75.2	94.8	74.0	56.0	28.5	75.0	40.8
Distance to nearest shore (m)	46.0	28.9	24.8	21.0	31.7	24.1	22.6	11.9
Tree height (m)	10.7	1.2	15.0	7.0	17.2	4.7	10.6	3.5
Shrub height (m)	0.5	NA	1.4	0.7	2.0	0.5	2.1	0.7
Distance from lodge to food source (m)	42.0	43.1	41.8	39.5	41.8	24.5	14.5	11.3

Table 7: Characteristics of Inactive Standard Lodges in Study Zones 4–5 in 2018, 2019, 2020, and 2023

	2018		2019		2020		2023	
Lodge Characteristics	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Lodge volume (m^3)	79.1	57.3	38.5	40.4	74.0	51.4	87.5	38.1
Distance to nearest shore (m)	46.0	29.1	25.8	20.4	35.4	19.3	23.2	13.9
Tree height (m)	7.7	1.5	15.0	7.1	14.4	5.0	8.3	6.8
Shrub height (m)	1.0	NA	0.8	0.6	1.8	1.0	1.2	1.0
Distance from lodge to food source (m)	11.7	9.3	96.0	84.2	66.9	62.6	25.8	20.7

4.0 DISCUSSION

In the first year of Project operation monitoring, 2022, the density of active beaver lodges increased in the Keeyask region and beaver populations returned to pre-construction levels (WRCS 2023). While active lodge density increased in the Keeyask region, most lodge characteristics were not significantly different between Study Zones 1–3 and 4–5. This suggests that the availability of food and lodge materials was adequate in both areas since no differences in lodge or cache size could be detected. However, food caches were not measured in three dimensions (only width and length could be measured) and it is possible that some food caches were significantly larger than estimated. Consequently, confidence that food cache size was not statistically different in Study Zones 1–3 and 4–5 is low.

In 2023, active standard beaver lodges in Study Zones 1–3 were slightly smaller and were found closer to shore than in Study Zones 4–5. Food cache size tended to be slightly larger in Study Zones 1–3 compared to Study Zones 4–5, but neither active standard beaver lodges nor food caches differed significantly. Shrub height differed between Study Zones 1–3 and 4–5 at inactive lodges, where shrubs in Study Zones 1–3 were taller, but it did not differ for active lodges. Shrub height also did not differ significantly between active and inactive lodges measured. Small sample size might account for the detected difference, as only four inactive lodges were measured in Study Zones 4–5.

Lodge volume of active lodges was similar across surveyed years. Inactive lodges measured in 2019 were smaller in Study Zones 1–3 compared to inactive lodges in Study Zones 4–5 and to inactive lodges measured in other years. Beavers trapped out of the future reservoir area in the winters preceding impoundment may have contributed to smaller lodges in Study Zones 1–3. Beavers removed in winter would not add new material to their lodges in the following spring and summer, perhaps resulting in smaller inactive lodges when compared to areas and years without similar trapping efforts.

Beavers prefer to live in water bodies with little variation in water levels (Slough and Sadlier 1977 in Allen 1983) and have been found to be sensitive to winter water level decreases over 0.7 m (Smith *et al.* 1991). As Project operation continues, fluctuations in water levels may affect beaver inhabiting some portions of the reservoir (where there may be up to 1 m of water level fluctuation). Monitoring will continue during Project operation to examine how beavers respond as the reservoir shorelines stabilize over time.

5.0 SUMMARY AND CONCLUSIONS

Lodge characteristics did not substantively differ between areas near the Project footprint and the broader Keeyask region, suggesting that food and lodge materials were equally available. Coupled with the increase of beaver lodge density across the Keeyask region detected by the 2022 beaver aerial survey, this supports the conclusion that suitable habitat is at least temporarily available along the new reservoir shoreline and surrounding area, allowing beaver to recolonize the area.

Beaver habitat effects monitoring will continue in 2025, when the local population has had more time to adjust to the new conditions in the reservoir.

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APPENDIX 1:
BEAVER LODGE AND FOOD CACHE CHARACTERISTICS 2023

Table 1-1: Characteristics of Beaver Lodges and Food Caches in Fall 2023

Study Zone	Lodge Type	Lodge Status	Lodge	Lodge Materials	Lodge Volume (m^3)	Cache Composition	Cache Size (m^2)
1 (Project Footprint)	Standard	active	46	Mud, willow, birch, peat	111	Willow, birch, grass	35
			305	Mud, willow, birch, peat, tamarack	100	Willow, birch	15
			480	Mud, willow, birch, alder, peat	114	Willow, birch	54
		inactive	20	Mud, birch, alder, peat	84	–	–
			718	Willow, alder, peat, black spruce	118	–	–
			722	Mud, willow, alder	58	Willow, alder	4[1]
			861	Mud, willow, alder, peat, black spruce	39	–	–
2	Bank	inactive	373	Mud, willow, birch, alder, grass	43	–	–
	Standard	inactive	2	Mud, willow, birch, alder	39	–	–
			307	Mud, willow, birch, alder, peat	29	–	–
			361	Mud, willow, birch, black spruce	185	–	–
			715	Mud, willow, alder, black spruce	43	–	–
3	Bank	active	658	Mud, willow, birch, black spruce	45	Birch	24
			863	Mud, willow, birch	13	Willow, birch	24
			860	Mud, willow	7	Willow, alder	6
	Standard	active	45	Mud, willow, alder, aquatic vegetation, grass	104	Willow, birch, alder	36
			275	Mud, willow, birch, peat	68	Willow, birch	21
			298	Mud, willow, birch, alder	37	Birch, black spruce	35
			340	Mud, willow, birch	150	Willow	12
			356	Mud, willow, birch, alder, peat	44	Willow, alder	20
			470	Mud, willow, birch, peat, black spruce aquatic vegetation	89	Willow, birch, aquatic vegetation	27
			484	Mud, willow, alder, peat, black spruce, grass	96	Willow, alder	51
			512	Mud, birch, alder	262	Birch, black spruce	10
			602	Willow, alder	121	Willow, alder	30

Study Zone	Lodge Type	Lodge Status	Lodge	Lodge Materials	Lodge Volume (m^3)	Cache Composition	Cache Size (m^2)
			823	Mud, willow	29	Willow	4
			854	Mud, willow, birch, alder, peat, black spruce	49	Birch, alder, black spruce	32
			851	Mud, willow, birch	77	Willow	35
			864	Mud, willow, birch, peat	42	Willow, alder, birch	32
			856	Mud, birch, alder, peat, black spruce	39	Willow, birch, alder	80
			852	Mud, willow, alder, peat, black spruce	60	Willow, birch	50
			850	Mud, willow, alder, birch	29	Willow, alder, black spruce	35
			868	Mud, willow, birch, peat	51	Willow, birch	32
			855	Mud, willow, birch, alder, peat	79	Willow, birch, alder, black spruce	40
		inactive	231	Mud, willow	60	Willow	4
			308	Mud, willow, birch, alder	70	Willow	2
			371	Willow, birch	105	–	–
			374	Mud, alder, black spruce	95	–	–
			817	Mud, willow, alder, aquatic vegetation, grass	23	Willow	6[1]
			830	Mud, willow, peat	102	–	–
			853	Mud, willow, birch, peat	78	Willow, birch	9[1]
			862	Mud, willow	74	–	–
4	Bank	active	677	Mud, black spruce, jack pine, birch	2.415	Willow, birch, alder	18
		inactive	798	Black spruce, willow, alder, peat, mud	119.016	–	–
			108	Willow, alder, rock, mud, dogwood	66.96	–	–
	Standard	active	209	Willow, alder, black spruce, mud, peat	100.548	Willow, alder	6
			323	Black spruce, willow, mud, grass	96.096	Black spruce, willow	40
			338	Willow, birch, mud	91.924	Willow	24
			794	Alder, mud, willow	75.174	Willow	4
			799	Birch, willow, aquatic vegetation, grass, mud, black spruce	72.2475	Willow, birch	112

Study Zone	Lodge Type	Lodge Status	Lodge	Lodge Materials	Lodge Volume (m^3)	Cache Composition	Cache Size (m^2)
			866	Willow, birch, aquatic vegetation, grass, mud	146.224	Willow, birch	38.5
			867	Willow, alder, mud, aquatic vegetation, grass	68.544	Willow, birch, alder	24
			865	willow, mud, peat, black spruce, aquatic vegetation	76.95	Willow	15
			849	Willow, black spruce, mud	90.9685	Spruce, water plants, willow	2
			848	Willow, birch, mud	92.4	Willow, grass/sedge, birch	6
			264	Willow, alder, mud, water vegetation	33.325	Willow, alder	9
		inactive	377	Black spruce, willow, mud	87.6645	–	–
			394	Mud, peat, willow, alder, overgrown	94.872	–	–
			819	Willow, mud	25.327	–	–
5	Standard	active	110	Willow, mud, grass, alder, aquatic vegetation	60.9	Willow, grass/sedge	10
			587	Willow, mud, peat	51.465	Willow, birch	15
			857	Willow, birch, alder, mud, peat, black spruce	117.18	Willow, birch	20
			859	Willow, mud, grass, birch	141.12	Willow	42
		inactive	858	Willow, birch, mud	129.109	–	–

1. Old food cache, visibly degraded or covered in sediment; not being used