



Keeyask Generation Project Terrestrial Effects Monitoring Plan

Habitat Loss and Disturbance Monitoring Report

TEMP-2023-01



KEYYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2023-01

HABITAT LOSS AND DISTURBANCE MONITORING YEAR 1 OPERATION 2022

A Report Prepared for
Manitoba Hydro

By
ECOSTEM Ltd.
June 2023

This report should be cited as follows:

ECOSTEM Ltd. 2023. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2023-01: Habitat Loss and Disturbance Monitoring – Year 1 Operation, 2022. A report prepared for Manitoba Hydro by ECOSTEM Ltd., June 2023.

SUMMARY

Background

Construction of the Keeyask Generation Project (the Project) at Gull Rapids began in July 2014. The vast majority of construction activities were completed by fall 2021 and all seven units were in operation by 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 (land) 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 are affecting the environment, and whether or not more needs to be done to reduce harmful effects.

This report describes the results of the habitat loss and disturbance monitoring conducted during 2022.

Why is the study being done?

Habitat is the place where a plant, animal or its population lives. Terrestrial habitat includes all land habitat for all species. The habitat for a particular species is named for that species (e.g., moose habitat, rusty blackbird nesting habitat or black spruce habitat). Each habitat type represents a different kind of ecosystem.



Black spruce habitat found throughout the Keeyask region

The partner First Nations have said that all terrestrial habitats are important. Changes to terrestrial habitat can affect many species and ecosystems. Plants and animals need habitat to exist, and having more good quality habitat helps them to be more widespread and abundant.

Because changes to terrestrial habitat can have such wide-ranging effects across the environment, terrestrial habitat monitoring provides the single best way to see important changes, and to discover any unexpected effects on that environment.

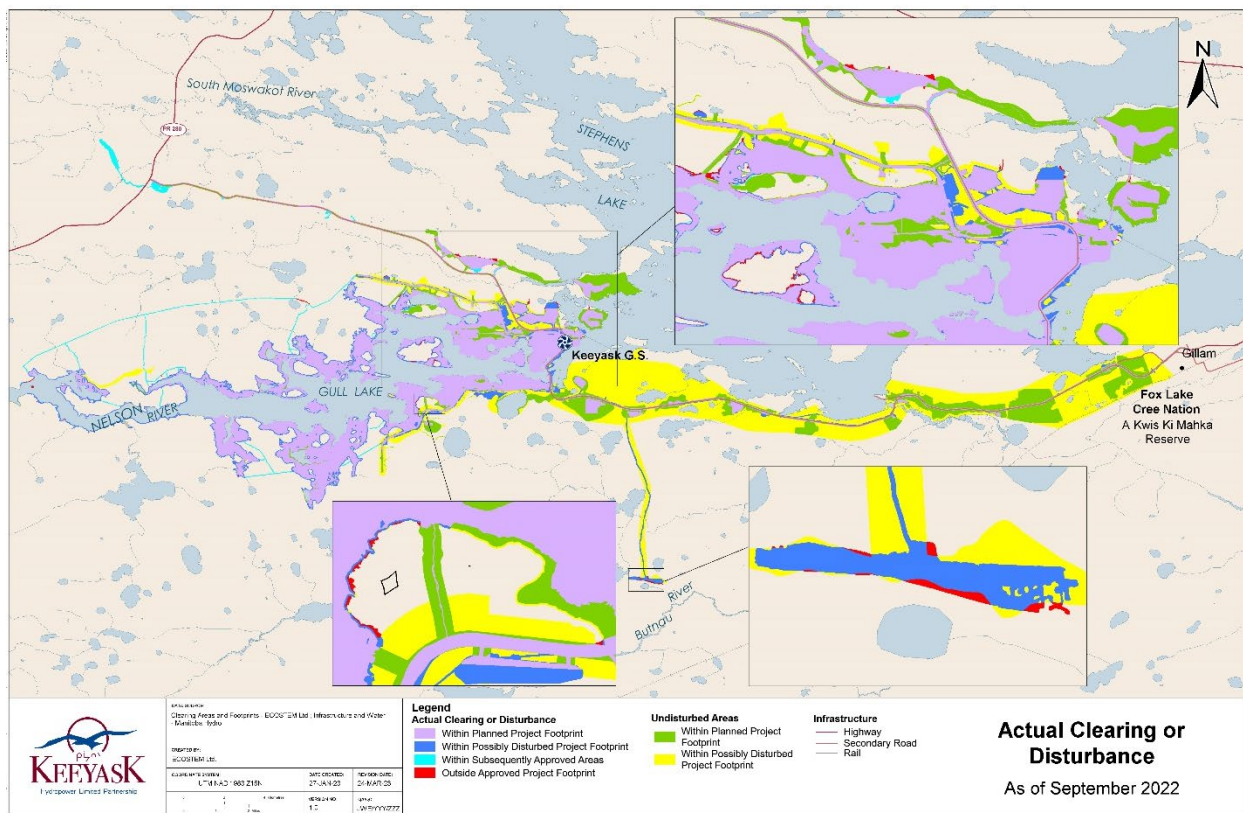
What was done?

The previous annual report had mapped Project clearing and physical disturbance as of September 2021. This entire area is referred to as the Construction Footprint as it essentially represents Project impacts on the terrestrial environment during the construction phase.

The 2022 monitoring documented new Project-related clearing or physical disturbance changes that occurred between September 2021 and 2022. These areas were mapped from stereo photos acquired from an airplane (captured October 2, 2021) and from helicopter, drone and ground surveys that took place on August 23, 26, 29 and 31 and September 1, 2022.

What was found?

Monitoring in 2022 found that Project clearing and physical disturbance increased by 0.4 ha in total between September 2021 and September 2022 (see map below). Clearing accounted for about 58% of this increase. This clearing occurred on the southern edge of Work Area C, where safety fencing was installed.



Approximately 0.2 ha of the new clearing or disturbance was outside of the approved Project footprint.

At several locations within the Construction Footprint, previously documented erosion and sediment deposition caused by rainfall was ongoing in September 2022. New erosion and potential sediment deposition were found at 4 locations. The ongoing erosion and sediment deposition at some locations could potentially expand outside of the approved Project Footprint bounds.

What does it mean?

To date, the Project has not created any major unanticipated removal or alteration of terrestrial habitat. The area of new impacts outside of the approved Project Footprint was very small and equal to only 0.1% of the 7,122 ha of the licensed Project Footprint that was not impacted during construction.

Mitigation was recommended for sites where erosion and sediment deposition could impact tree plantings or undisturbed native habitat, or expand outside of the approved Project Footprint.

What will be done next?

Monitoring to document the amount and locations of terrestrial habitat affected by the Project during operation, and to evaluate the effectiveness of mitigation measures, will continue in 2024. Terrestrial areas that have been affected by reservoir expansion will also be mapped.

ACKNOWLEDGEMENTS

ECOSTEM Ltd. would like to thank Rachel Boone, Sherrie Mason and the on-site Manitoba Hydro staff, including Martial Lemoine, James Teskey and Jodi Ross for their support and assistance in planning field activities and providing access to the sites. Rachel Boone and Sherrie Mason are also gratefully acknowledged for coordinating the terrestrial monitoring studies.

Chiefs and Councils of Tataskweyak Cree Nation (TCN), War Lake First Nation (WLFN), York Factory First Nation (YFFN) and Fox Lake Cree Nation (FLCN) are gratefully acknowledged for their support of this program.

We would also like to thank North/South Consultants Inc., in particular Ron Bretecher and Shari Fournier, for their guidance, logistical support and other resources that made these studies possible.

Custom Helicopters is thanked for providing transportation during fieldwork and Claire Brueckner for coordinating the logistics.

STUDY TEAM

Dr. James Ehnes was the project manager and study designer.

Fieldwork in 2022 was conducted by Alex Snitowski.

Data analysis and report writing in 2022 were completed by Alex Snitowski, with contributions from James Ehnes and Brock Epp. GIS analysis and cartography were completed by Alex Snitowski, with contributions from Brock Epp.

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 METHODS..... 3

 2.1 INTRODUCTION 3

 2.2 PROJECT AREAS 3

 2.3 OVERALL APPROACH..... 6

 2.4 DATA COLLECTION 8

 2.5 MAPPING 8

 2.5.1 Approach..... 8

 2.5.2 Methods..... 9

3.0 RESULTS..... 11

 3.1 OVERVIEW 11

 3.2 CLEARING OR DISTURBANCE BY PROJECT AREA..... 14

 3.3 CLEARING OR DISTURBANCE BY PROJECT COMPONENT 14

 3.3.1 Access Roads 15

 3.3.2 Main Camp, North Shore Work Areas, Start-up Camp and Well Area 17

 3.3.3 Borrow Areas 23

 3.3.3.1 Borrow Area G-1 23

 3.3.3.2 Borrow Area G-3 25

 3.3.3.3 Borrow Area KM-1..... 27

 3.3.3.4 Borrow Area N-5..... 28

 3.3.3.5 Borrow Area B-6..... 29

 3.3.3.6 Borrow Area E-1..... 31

 3.3.3.7 Borrow Areas S-2a and S-2b..... 32

 3.3.4 Dikes..... 32

 3.3.5 Excavated Material Placement Areas..... 32

 3.3.5.1 EMPA D16(1)-E..... 33

 3.3.5.2 EMPA D17-E 36

 3.3.5.3 EMPA D23(2)-E..... 38

 3.3.5.4 EMPA D35(1)-E..... 39

 3.3.6 River Works Area 40

 3.3.7 Trails..... 40



4.0 DISCUSSION AND RECOMMENDATIONS 41
5.0 SUMMARY AND CONCLUSIONS..... 45
6.0 LITERATURE CITED..... 46



LIST OF TABLES

Table 2-1:	Dates of aerial and ground surveys, by year	8
Table 2-2:	Specifications of imagery used for the 2022 Project clearing and disturbance mapping	9
Table 3-1:	Total Project clearing and physical disturbance up to September 2022, by impact type.....	12
Table 3-2:	Cumulative actual Project clearing or disturbance area as of September 2022, by year and Project area.....	14
Table 3-3:	Project clearing ¹ or disturbance as of September 2021 and 2022, by Project component	15
Table 3-4:	Clearing or disturbance within the possibly disturbed Project Footprint, and areas cleared or disturbed outside the approved Project Footprint as of September 2022, by main Project component.....	15
Table 6-1:	Summary of Mitigation Recommendations	48

LIST OF MAPS

Map 2-1:	Approved Project areas as of September 2022	5
Map 2-2:	Construction Footprint as of September 2021	7
Map 2-3:	Project Footprint components.....	10
Map 3-1:	Actual Project clearing or physical disturbance as of September 2022	13
Map 3-2:	New disturbances outside of the Construction Footprint as of September 2022.....	22

LIST OF FIGURES

Figure 3-1: Mass wasting (in orange) and ponded water (in blue) outside Main Camp..... 17

Figure 3-2: Sediment deposition near approved Project Footprint bounds at EMPA D17-E in 2022..... 37

Figure 3-3: Erosion and sediment deposition from EMPA D23(2)-E in 2022..... 38

Figure 4-1: Grading and site preparation parallel to slope direction in G-3 (2022 imagery)
42

LIST OF PHOTOS

Photo 3-1: Forest fire south of SAR in 2022..... 11

Photo 3-2: Erosion on NAR side bank adjacent to Borrow Area KM-1 in 2022..... 16

Photo 3-3: Flowing water, subsidence and toppled trees outside Main Camp in 2022..... 18

Photo 3-4: Construction debris along the excavated crater walls in Quarry A in 2022 19

Photo 3-5: New locations where erosion may potentially cause sediment deposition into undisturbed vegetation (yellow arrows) along northern edge of Work Area A
20

Photo 3-6: New clearing for safety fencing (yellow arrow) along the southern edge of Work Area C in 2022..... 21

Photo 3-7: Rock placed in old erosion channels and new erosion channel (yellow arrow) at the northern edge of Borrow Area G-1 at KM 17 in 2022..... 23

Photo 3-8: Erosion and sediment deposition (yellow arrows) on the northern edge of Borrow Area G-1 at KM 15 in 2022 24

Photo 3-9: Sediment deposits in marsh (yellow arrow) adjacent to Borrow Area G-3 in 2022..... 25

Photo 3-10: Erosion affecting planted seedlings in Borrow Area G-3 in 2022 26

Photo 3-11: Erosion and affected planted seedlings in Borrow Area KM-1 in 2022 27

Photo 3-12: Sediment bag (yellow arrow) on south side of Borrow Area N-5 in 2022..... 28

Photo 3-13: New mass wasting (yellow arrow) along depression edges northeast of Borrow Area B-6 in 2022..... 29

Photo 3-14: Erosion on the northern edge of the excavated crater in Borrow Area B-6 in 2022..... 30

Photo 3-15: ATV trails in Borrow Area E-1 access corridor in 2022..... 31

Photo 3-16: Plywood planks in Borrow Area E-1 access corridor in 2022..... 31

Photo 3-17: Construction debris (yellow arrows) along the eastern edge of Borrow Area S-2a in 2022..... 32

Photo 3-18: Reinforced rock berm in EMPA D16(1)-E in 2022..... 33

Photo 3-19: Sediment deposition and flowing water at the southwestern corner of EMPA D16(1)-E in 2022 34

Photo 3-20: Flowing water from boulder pile in EMPA D16(1)-E in 2022..... 34

Photo 3-21: Water from culvert in EMPA D16(1)-E in 2022 35

Photo 3-22: Filled-in gap in rock berm (center-top) adjacent to marsh (foreground) on western edge of EMPA D16(1)-E in 2022..... 36

Photo 3-23: Runoff and sediment deposition (yellow arrow) along decommissioned road to EMPA D17-E in 2022 37

Photo 3-24: Sediment (yellow arrows) overtopping rock berm in EMPA D23(2)-E in 2022
38

Photo 3-25: Ponded water and tree dieback at the eastern edge of EMPA D35(1)-E in 2022..... 39

Photo 3-26: Portions of ice boom (yellow circle) washed up on the south shore of the Nelson River, downstream of the dam (dewatered area) in 2022 40

LIST OF APPENDICES

Appendix 1: Mitigation Recommendations..... 47

GLOSSARY

Term	Definition
approved Project Footprint areas	All areas that were either initially licenced or subsequently approved for use by the Government of Manitoba.
DOI	A spatial dataset produced from satellite images or digital stereo photos that have been stitched together and processed so that all pixels are positioned in an accurate ground position. Such processing is necessary because the earth's surface is round and has topography.
flooding	Areas cleared within the reservoir that were flooded as of September 2021.
habitat disturbance	Physical disturbance in an area of intact vegetation or use of pre-existing trails or borrow areas.
habitat loss	Permanent physical removal or alteration of previously undisturbed habitat.
licensed Project Footprint	Footprint licensed for Project use under the Project's <i>Environment Act</i> Licence.
planned Project Footprint	A subdivision of the licensed Project footprint where clearing or disturbance was expected and is largely comprised of permanent Project features.
ponded water	Water accumulation due to altered water flows related to the Project outside of the reservoir area. Includes overland water-flow.
possibly disturbed Project Footprint	A subdivision of the licensed Project footprint where clearing or disturbance could potentially occur.
Project clearing	Project areas with complete removal of trees and tall shrubs. Includes terrestrial areas that were flooded, or formerly aquatic areas that were dewatered.
Project component	Defined areas within the Project footprint that serve a specified general purpose.
Project Footprint	Boundary of all areas affected by Project activities.
re-inundated	Area of previously dewatered aquatic habitat that has been flooded again.

ACRONYMS

Acronym	Name
DOI	Digital orthorectified imagery
EIS	Environmental Impact Statement
EMPA	Excavated material placement area
EnvPP	Environmental Protection Plan
GIS	Geographic Information System
GS	Generating Station
KHLP	Keeyask Hydropower Limited Partnership
KIP	Keeyask Infrastructure Project
KM	Kilometre
KTP	Keeyask Transmission Project
NAR	North Access Road
SAR	South Access Road
TEMP	Terrestrial Effects Monitoring Plan

1.0 INTRODUCTION

The Keeyask Generation Project (the Project) is a 695-megawatt hydroelectric generating station (GS) and the associated facilities. The Project is located at the former 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. Project construction began in July 2014 and the vast majority of construction activities were completed by fall 2021. The reservoir was first brought to full supply level in September 2020 and the final generating unit went into service on March 9, 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 (KHLP 2012a). 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 2012b). The *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, habitat loss and disturbance, during the construction phase.

Habitat is the place where an organism or a population lives. Because all natural areas are habitat for something, “terrestrial habitat” refers to all land habitat for all species. Habitat for a particular species is identified with the species name of interest, such as moose habitat, rusty blackbird nesting habitat or jack pine (*Pinus banksiana*) habitat. Terrestrial habitat is a keystone driver for ecosystems and, for many reasons, provides the best single indicator for Project effects on terrestrial ecosystems.

Two TEMP studies are monitoring Project effects on terrestrial habitat as a whole. The Terrestrial Habitat Loss and Disturbance study (TEMP, Section 2.1.2) focuses on direct Project effects on stand level habitat composition due to terrestrial habitat loss and disturbance.

The Long-term Effects on Terrestrial Habitat study (TEMP, Section 2.1.3) focuses on the long-term indirect effects of construction clearing, reservoir flooding and other Project impacts on terrestrial habitat. This monitoring begins during operation because it is expected that such effects take several years to become substantive and because some areas are still being impacted until the end of construction. To establish the baseline conditions for monitoring long-term indirect effects on terrestrial habitat, this report provides the initial reservoir shoreline location in 2021.

Several other TEMP studies focus on key terrestrial habitat or ecosystem topics, such as ecosystem diversity and wetland function.

The Habitat Loss and Disturbance study is the subject of this report.

The goal of the Habitat Loss and Disturbance study is to document and evaluate direct Project effects on terrestrial habitat composition. The associated objectives are to:

- Quantify and locate terrestrial habitat loss and physical disturbance; and,

- Quantify and locate Project effects on terrestrial habitat composition.

Habitat loss and disturbance monitoring for the Project were conducted throughout the construction phase, from 2015 to 2021. Previous ECOSTEM reports (ECOSTEM 2016; 2017; 2018; 2019; 2020; 2021; 2022) provide the results of this monitoring.

ECOSTEM (2022) also compared actual with predicted Project effects on terrestrial habitat composition during construction. It was concluded that the size of the Project Footprint and effects on terrestrial habitat during construction were consistent with EIS predictions, which were cautious in nature. The size of the Construction Footprint is 28% lower for terrestrial habitat than assumed for the EIS. Also, the Project did not create any major unanticipated removal or alteration of terrestrial habitat.

This report presents the results of monitoring conducted during 2022. The focus of this monitoring is on changes that have occurred between September of 2021 and 2022.

2.0 METHODS

2.1 INTRODUCTION

Section 2.1.2 of the TEMP details methods for this study. The following summarizes the methods employed in 2022, which were the same as in previous years.

All of the terrestrial habitat, ecosystems and plant studies use the same definitions of clearing and disturbance. Clearing refers to the complete removal of trees and tall shrubs (e.g., the herbaceous and moss cover can be intact) in an area that is at least 400 m² in size. In the results, “clearing” also includes constructed infrastructure and areas where excavated material was piled on undisturbed vegetation since the vegetation was no longer visible. Many of the cleared areas also included excavation of topsoil and overburden (e.g., in a borrow area). Clearing also includes terrestrial areas that were temporarily flooded by Project activities prior to impoundment, or formerly aquatic areas that were dewatered.

Disturbance refers to either physical disturbance in an area of intact vegetation (e.g., machinery trail, test pits, Project-related erosion or sediment deposition, ponding water related to altered hydrological conditions), use of pre-existing trails or borrow areas, or an isolated area of clearing smaller than 400 m².

2.2 PROJECT AREAS

Four distinct Project areas are used when reporting on where Project clearing or disturbance occurred. This is being done to facilitate comparisons with EIS predictions. See ECOSTEM (2022) for a detailed description of what is included in each Project area.

The first two Project areas are a subdivision of the Footprint licensed for Project use under the Project’s *Environment Act* Licence (i.e., licensed Project Footprint) into: the planned Project Footprint; and, the possibly disturbed Project Footprint (Map 2-1). The planned Project Footprint is largely comprised of permanent Project components. The possibly disturbed Project Footprint provided for some of the unknown components of the Project design at the time the Project was being licensed.

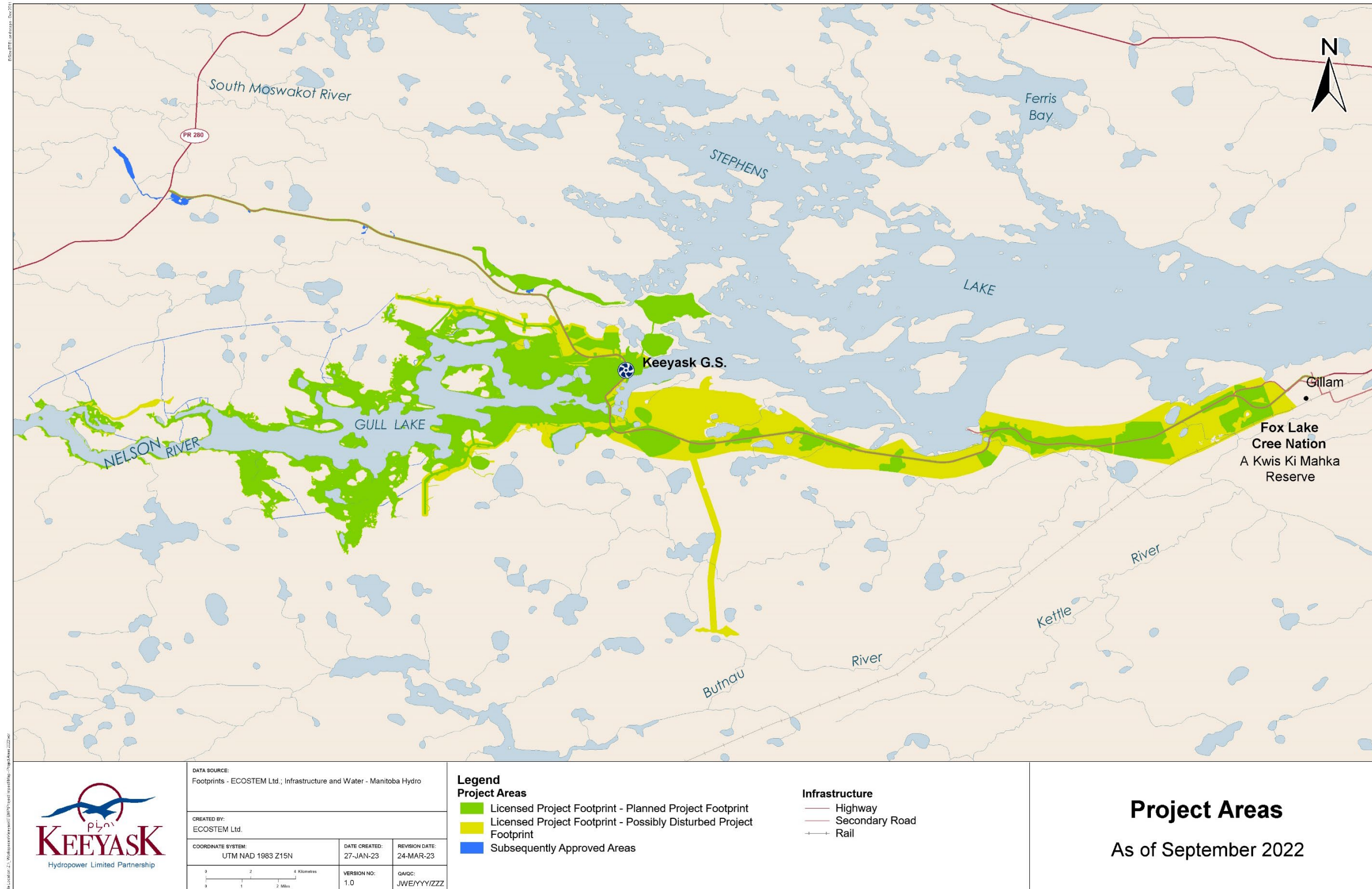
Subsequently approved Project areas include areas approved for Project use by the Government of Manitoba after the Project was licensed (Map 2-1).

The preceding three Project areas are collectively referred to as the “approved Project Footprint”.

The fourth type of Project area includes all cleared or disturbed areas that are outside of the approved Project Footprint.

In summary, the Project areas are the:

- Approved Project Footprint
 - Planned Project Footprint;
 - Possibly disturbed Project Footprint;
 - Subsequently approved Project areas; and,
- Areas outside of the approved Project Footprint.



Map 2-1: Approved Project areas as of September 2022

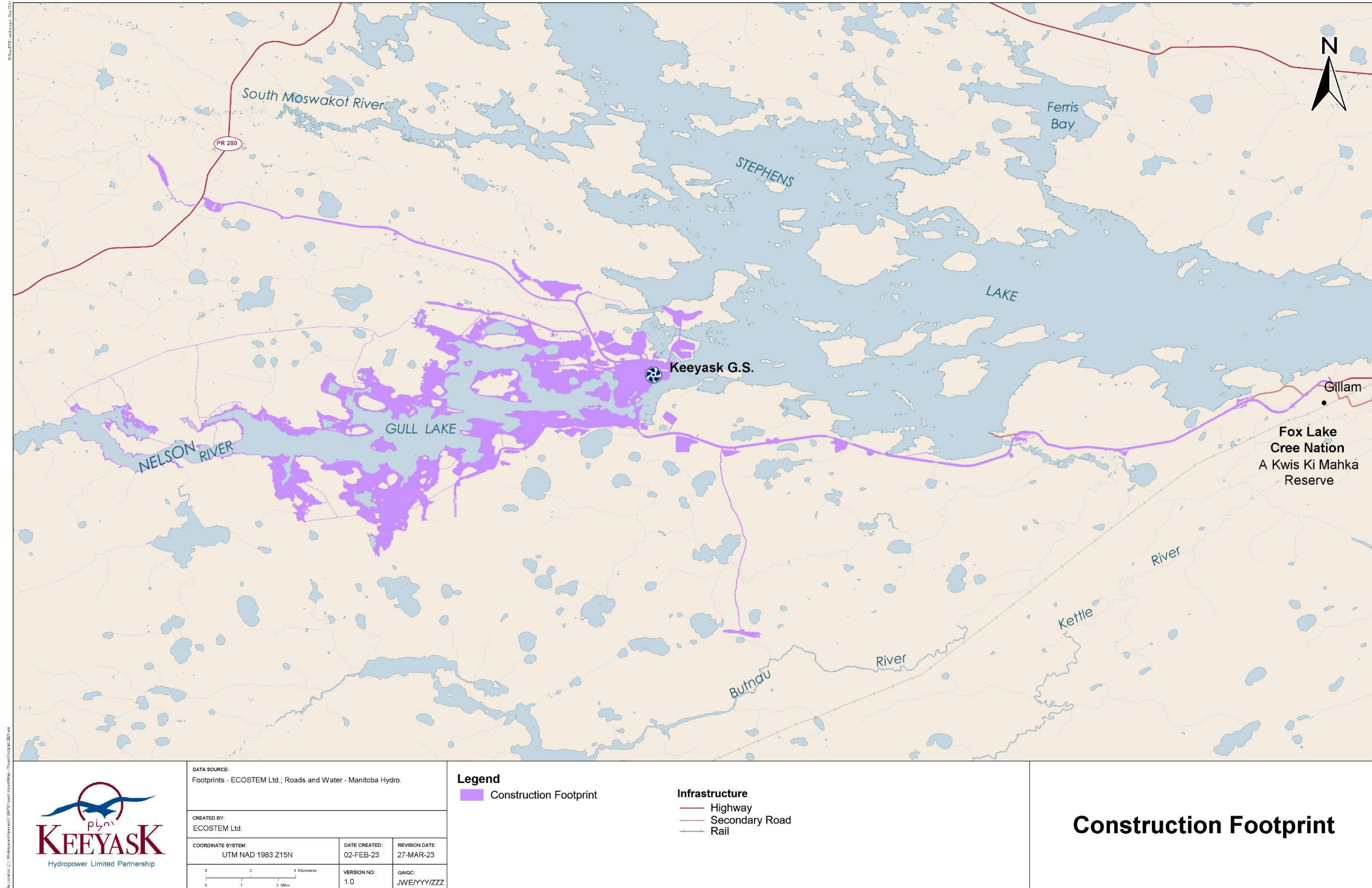
2.3 OVERALL APPROACH

For this study, terrestrial habitat loss and disturbance are being mapped and monitored as Project clearing or disturbance in terrestrial areas. Project clearing and disturbance in aquatic areas are also mapped to document the entire Project Footprint.

Areas of Project clearing or disturbance are mapped using a combination of remote sensing and ground surveys (remote sensing refers to data obtained from above the ground such as satellite imagery, digital stereo photos acquired from an airplane or photos taken from a helicopter). Remote sensing identifies the spatial extent and nature of clearing or disturbance. Ground surveys collect more detailed data at sites identified as having impacts of special concern (e.g., erosion of a magnitude to merit installation of containment measures). Areas of Project clearing and disturbance are mapped annually as of September in each year.

The vast majority of construction activities had been completed by fall 2021. The reservoir was first brought to full supply level in September 2020 and was maintained continuously above 158.0 m ASL since then. The final generating unit went into service on March 9, 2022. Most of remaining construction activities include the decommissioning of temporary features (e.g., borrow areas and excavated material placement areas (EMPAs)) and the revegetation of areas not needed for Project operation.

As prescribed in the TEMP (Section 2.1.2.3.3), the *Keeyask Generation Project Terrestrial Footprint Map for Construction* (i.e., the Construction Footprint) was mapped within one year of construction phase completion. ECOSTEM (2022) provides the Construction Footprint (Map 2-2), which was mapped based on Project impacts as of September 2021.



Map 2-2: Construction Footprint as of September 2021

2.4 DATA COLLECTION

In September of each year that monitoring has occurred, all areas cleared or disturbed for the Project were surveyed while flying in a Bell 206 helicopter around the perimeter of these areas. Clearing, physical disturbance and other relevant conditions were documented with geo-referenced aerial photographs, marked-up maps and notes. Additionally, impacts of concern that had been identified in previous years, and new impacts of concern identified during the current year’s aerial surveys were surveyed by drone or on foot.

Table 2-1 provides the dates when the aerial and ground surveys were conducted in 2021 and 2022. Ground survey dates do not include the days in which sites were surveyed while conducting monitoring for other TEMP studies. The aerial surveys in July 2021 and June 2022 included the reservoir shoreline to document conditions.

Table 2-1: Dates of aerial and ground surveys, by year

Year	Aerial Survey Dates	Ground Survey Dates ¹
2021	July 16, 17, 18 and 19; September 10 and 13	September 11, 12, 13 and 14
2022	June 19 to 22 and 24; August 26 and 31	August 23 and 29; September 1

Notes: ¹ Not including days for sites surveyed while conducting monitoring for other TEMP studies.

2.5 MAPPING

2.5.1 APPROACH

As noted above, Project impacts as of September 2021 were mapped as the Construction Footprint. See ECOSTEM (2022) for details regarding how Project clearing and disturbance were monitored during construction, and how the Construction Footprint was mapped.

Monitoring during operation focuses on ongoing or new disturbance within the Construction Footprint as well as clearing and disturbance outside of the Construction Footprint.

Observed clearing that was associated solely with other projects was not mapped for this study. This includes areas cleared for the Keeyask Infrastructure Project (which was completed under a separate license) provided the areas were neither used for the Project nor experienced additional Project-related clearing or disturbance. The cumulative effects of these and other projects in combination with the Project will be evaluated as a component of the Long-Term Effects on Habitat study.

2.5.2 METHODS

Project clearing and disturbance were mapped regardless of whether they occurred in terrestrial or in aquatic habitat.

Areas of Project clearing or disturbance outside of the Construction Footprint as of September 2022 were mapped from aerial photos, drone imagery, ground surveys and digital stereo photos acquired on October 2, 2021 (Section 0). Table 2-2 provides the specifications of the imagery used for the monitoring in 2022.

Table 2-2: Specifications of imagery used for the 2022 Project clearing and disturbance mapping

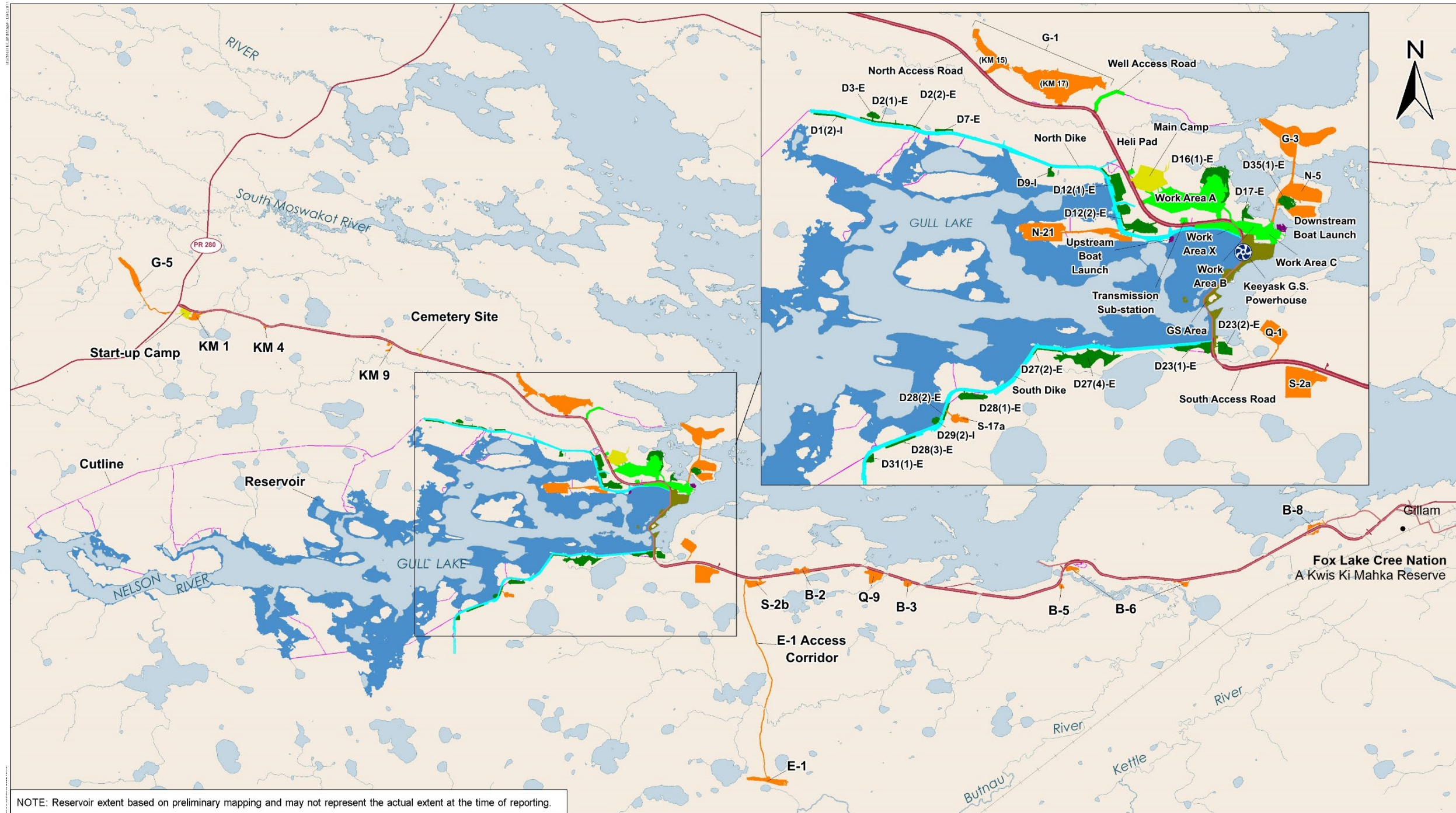
Acquisition Year	Acquisition Date	Resolution	Construction Footprint Coverage	Type	Acquisition Mode
2021	October 2	10 cm	All	Stereo Photo	Fixed Wing
2021	October 2	10 cm	All	Digital Ortho Image	Stereo photos in previous row
2022	August 26 and 31	Variable	Most	Still Photo	Helicopter
2022	September 1	3 cm	Localized	Stereo Photo	Drone
2022	September 1	3 cm	Localized	Digital Ortho Image	Stereo photos in previous row

Notes: ¹ Aerial survey data used for areas outside of DOI coverage.

Project clearing or disturbance outside of the Construction Footprint as of September 2022 were digitized primarily from the aerial photos using the 2021 digital orthorectified imagery (DOI) as the base map. Localized areas of concern were digitized from drone imagery using the 2021 DOI to correct for areas where the drone had poor positional accuracy relative to the features on the ground. The other field data and the 2021 stereo photos assisted in interpreting where the clearing or disturbance ended. The 2021 stereo photos provided the most detailed and accurate baseline data for the operation phase over the entire Project area whereas the drone imagery was the most detailed for small, localized areas of concern.

Boundaries mapped from aerial survey photography were not as precise as those digitized from the DOIs because they were taken from an oblique angle. These boundaries will be reviewed and revised, if needed, in the subsequent year using more recent satellite imagery.

Digitized impact polygons were classified into a Project component type (Map 2-3).



NOTE: Reservoir extent based on preliminary mapping and may not represent the actual extent at the time of reporting.

	DATA SOURCE: Components and Water - ECOSTEM Ltd.; Roads and Rail - Manitoba Hydro.		Legend Project Components Borrow Area Camp/Cemetery Site Cutline or Access Trail EMPA GS Area Access Road Dike Portage Route Work Area Reservoir	Infrastructure Highway Secondary Road Rail	<h2>Project Components</h2>
	CREATED BY: ECOSTEM Ltd.				
	COORDINATE SYSTEM: UTM NAD 1983 Z15N	DATE CREATED: 21-MAR-23			
		VERSION NO: 1.0	QA/QC: JWENYYZZZ		

Map 2-3: Project Footprint components

3.0 RESULTS

3.1 OVERVIEW

The size of the Construction Footprint increased by 0.4 ha between September of 2021 and 2022 (Table 3-1; Map 3-1).

Clearing accounted for the majority (58.4%) of the 0.4 ha increase in impacts (Table 3-1). Clearing mainly consisted of vegetation removal for placement of safety fencing along the southern edge of Work Area C. The Project disturbance that accounted for the remainder of the above noted area increase included ponding and mass wasting due to altered water flows.

All of the 0.4 ha of new Project impacts were in areas that had been mapped as terrestrial habitat for the EIS.

A wildfire in 2022 burned approximately 125 ha of forest area south of the SAR about halfway between the Butnau dam and the town of Gillam (Photo 3-1). The fire overlapped approximately 25 ha of the approved project Footprint.

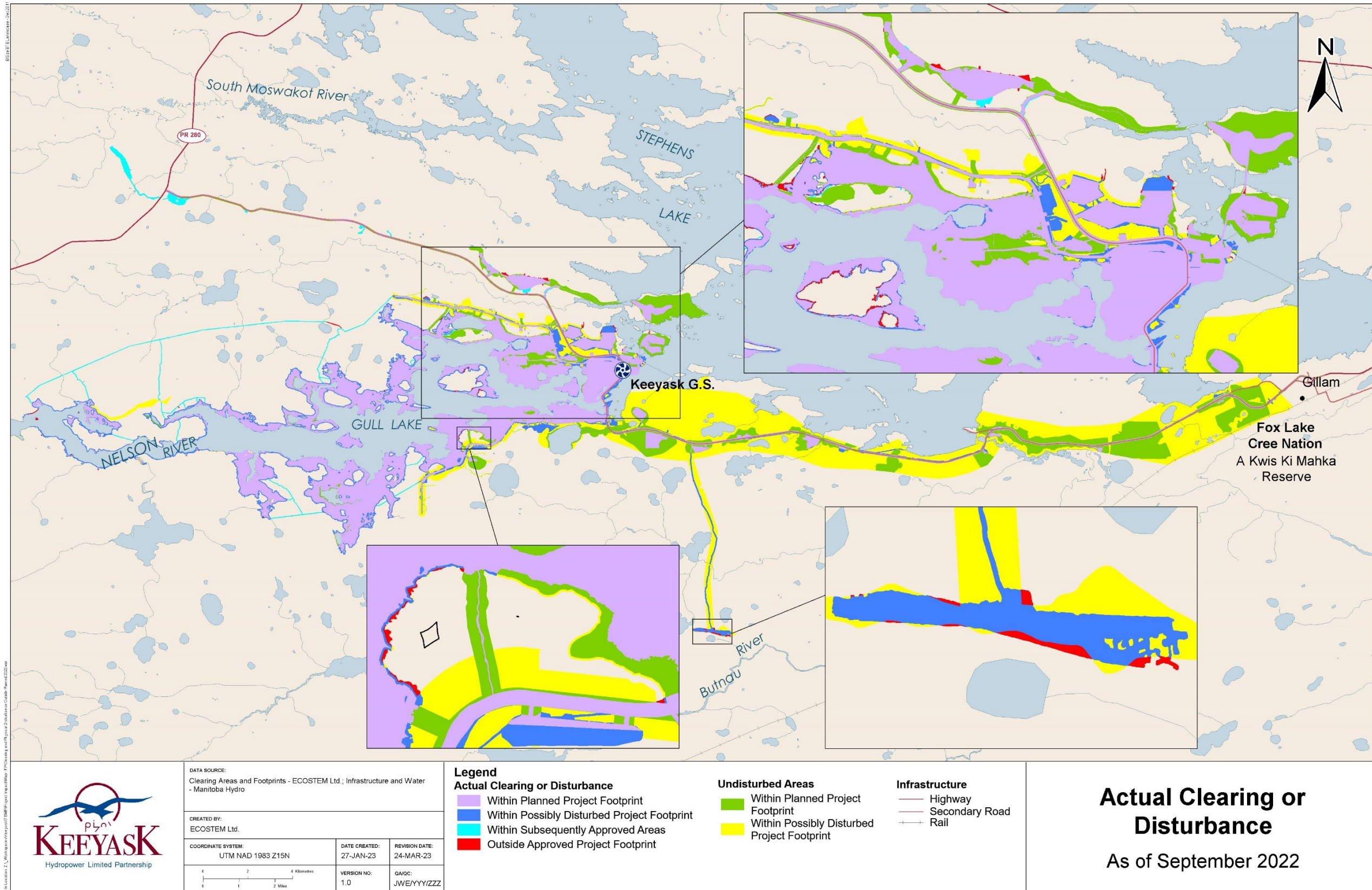


Photo 3-1: Forest fire south of SAR in 2022

Table 3-1: Total Project clearing and physical disturbance up to September 2022, by impact type

Impact Type	Impacts Up to 2022		Change in Impacts From 2021 to 2022	
	Area Impacted (ha)	Percentage of Total Impacted Area	Area Impacted (ha)	Percentage of New Impacted Area
Clearing ¹				
Terrestrial habitat clearing	5,508.0	96.2	0.2	58.4
Portion outside of Reservoir	1,671.2	29.2	0.2	58.4
Portion within Reservoir	3,835.4	67.0	-	-
Dewatered	22.0	0.4	-	-
Re-inundated ²	112.7	2.0	-	-
Disturbance	81.8	1.4	0.2	41.6
Total Project Footprint	5,724.5	100.0	0.4	100.0

Notes: A "0.0" value indicates an area less than 0.05 ha; a "-" value indicates no area. ¹ "Clearing" includes EMPAs, dewatering and constructed infrastructure. ² These areas were dewatered in a previous year. ³ Includes previously cleared or disturbed areas.



Map 3-1: Actual Project clearing or physical disturbance as of September 2022

3.2 CLEARING OR DISTURBANCE BY PROJECT AREA

Impacts within the planned Project Footprint areas (Section 2.2) increased by approximately 0.2 ha between September 2021 and 2022 (Table 3-2; Map 3-1). About 89% of this was due to new clearing in Work Area C and the remaining 11% was due to disturbance in EMPA D35(1)-E.

Impacts within the possibly disturbed Project Footprint increased by approximately 0.1 ha between September 2021 and September 2022 (Table 3-2; Map 3-1). This was as a result of ponding water and mass wasting adjacent to the Main Camp.

No additional impacts were found in the subsequently approved Project areas.

Impacts outside of the approved Project Footprint increased by approximately 0.2 ha from 2021 (Table 3-2; Map 3-1). This increase was as a result of ponding water adjacent to the Main Camp and clearing at the southern edge of Work Area C.

A wildfire in 2022, south of the SAR burned approximately 25 ha within the approved Project Footprint. Approximately 96% of the of burned area was in the planned Project Footprint with the remaining 4% in the possibly disturbed Project Footprint.

Table 3-2: Cumulative actual Project clearing or disturbance area as of September 2022, by year and Project area

Project Area	Total Approved Area (ha)	Total Area (ha)		Change (ha) from Previous Year ¹	
		2021	2022	2021	2022
Planned Project Footprint	7,616	5,302	5,302	1	0
Possibly Disturbed Project Footprint	5,123	314	314	0	0
Subsequently Approved Project Areas ²	n/a	100	100	-	-
Outside the Approved Project Footprint	n/a	9	9	0	0
All	12,738	5,724	5,724	1	0

Notes:¹ Due to rounding, some of the change values are slightly different than obtained from subtracting the numbers in the table. ² Areas subsequently approved by the provincial government that are not part of the licensed Project Footprint.

3.3 CLEARING OR DISTURBANCE BY PROJECT COMPONENT

Of the 0.4 ha of additional Project impacts between September 2021 and 2022, 58% was related to Work Area C, 37% to the Main Camp area and the remaining 5% to EMPA D35(1)-E (Table 3-3; Map 3-1).

Table 3-3: Project clearing¹ or disturbance as of September 2021 and 2022, by Project component

Project Component ²	Total Cleared or Disturbed (ha)		Change from Previous Year ³ (ha)	
	2021	2022	2021	2022
	(Construction Footprint)		(Construction Footprint)	
North access road	193	193	-	-
South access road	326	326	-	-
Camp and work areas	240	240	1	0
Borrow areas	522	522	0	0
North dike and associated areas	200	200	0	-
South dike and associated areas	203	203	0	-
Generating station area	237	237	0	-
Reservoir clearing	3764	3764	-	-
Cutlines and access trails for reservoir clearing	41	41	-	-
All cleared or disturbed areas	5,724	5,724	1	0

Notes: A "0" value indicates an area less than 0.5 ha; a "-" value indicates no area. ¹ "Clearing" includes EMPAs, dewatering and constructed infrastructure. ² Footprint types are coarse groupings of components. In general, a component includes any adjacent EMPAs. Dikes include associated small borrow areas. ³ Due to rounding, some of the values are slightly different than what results from subtracting the numbers in the table.

3.3.1 ACCESS ROADS

The North Access Road (NAR) and South Access Road (SAR) clearing remained unchanged from September 2021 to 2022 (Table 3-3 and Table 3-4).

Table 3-4: Clearing or disturbance within the possibly disturbed Project Footprint, and areas cleared or disturbed outside the approved Project Footprint as of September 2022, by main Project component

Project Component	Clearing or Disturbance (ha)					
	Within the Possibly Disturbed Project Footprint			Outside the Approved Project Footprint		
	2021	2022	Change	2021	2022	Change
Access Roads	4.45	4.45	-	-	-	-
Camp & Work Areas	3.57	3.63	0.06	0.14	0.30	0.16
Generating Station Area	12.80	12.80	-	-	-	-
Borrow Areas	58.05	58.05	-	5.55	5.55	-
EMPAs	66.81	66.81	-	0.52	0.52	-
Dikes	35.81	35.81	-	0.05	0.05	-
Reservoir Clearing & Cutlines	122.59	122.59	-	2.32	2.32	-
Total	304.08	304.14	0.06	8.59	8.74	0.16

Notes: a "-" indicates no area, a 0 indicates a very small (negligible) area.

Erosion disturbance of the NAR bank adjacent to Borrow Area KM-1 first identified during 2016 surveys continued in 2022, however the effects were minor and not likely to increase in extent (Photo 3-2). Monitoring of this site will continue.



Photo 3-2: Erosion on NAR side bank adjacent to Borrow Area KM-1 in 2022

3.3.2 MAIN CAMP, NORTH SHORE WORK AREAS, START-UP CAMP AND WELL AREA

The extent of clearing for the Main Camp, Start-up Camp Well Area and Helicopter Pad did not change from September 2021 to 2022.

By September 2022, the flowing water from the culvert at the northeast corner of the Main Camp extended approximately 350 m into the undisturbed forest (Map 3-2; Figure 3-1). This was an increase of 90 m since September 2021. The total associated disturbed area expanded by 0.06 ha in the possibly disturbed Project area, and by 0.08 ha outside of the planned and possibly disturbed Project Footprint areas. At the time of the 2022 survey, this disturbance extended more than 250 metres past the approved Project Footprint boundary.

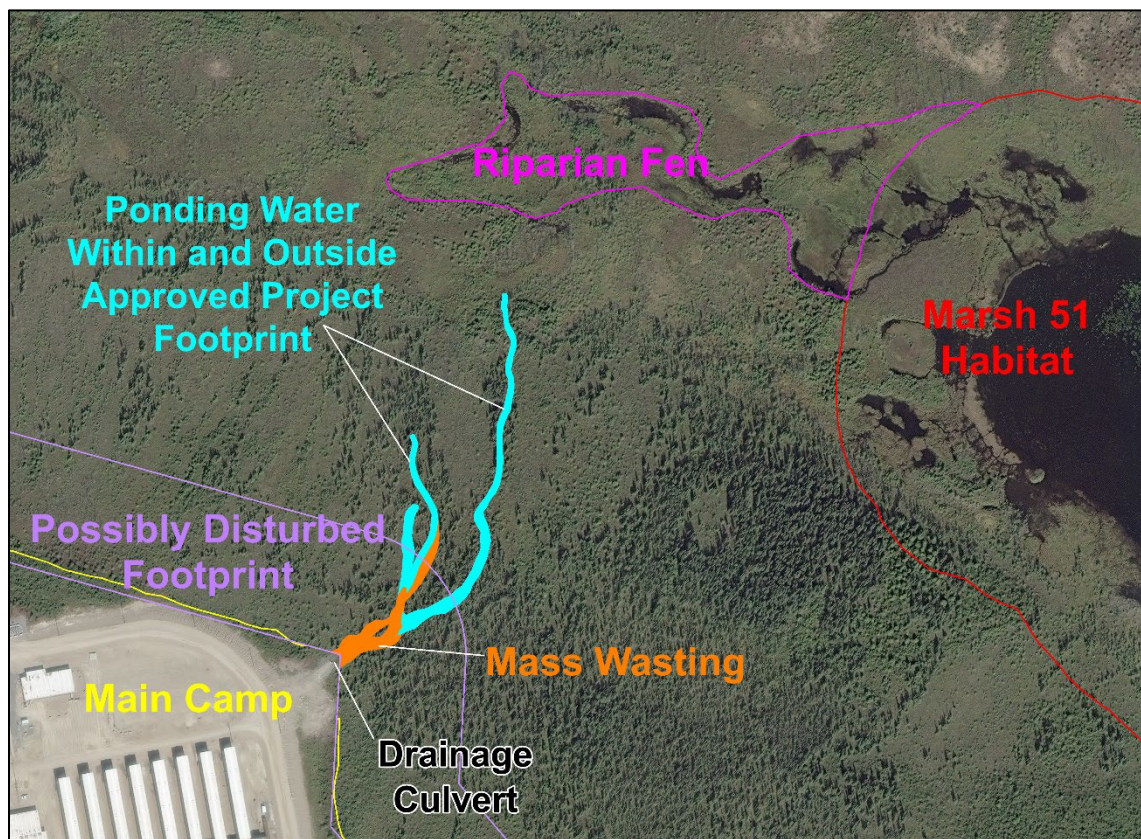


Figure 3-1: Mass wasting (in orange) and ponded water (in blue) outside Main Camp

In 2022, the flowing water continued to run underground in spots, topple trees and deposit sediment (Photo 3-3). The flowing water continued causing the substrate to subside, and by up to a metre or more in some areas (Photo 3-3). Outside of the Project Footprint, this disturbance was affecting a common habitat type (black spruce (*Picea mariana*) dominant vegetation on thin peatland). At the time of the 2022 survey, this disturbance had also reached the low area adjacent

to an off-system marsh, which could affect water flows into the marsh habitat (Figure 3-1). See Wetland Loss and Disturbance Monitoring report for details (ECOSTEM 2023).



Photo 3-3: Flowing water, subsidence and toppled trees outside Main Camp in 2022

A large amount of construction debris was observed along the edges of the excavated crater in Quarry A (in the southeast corner of Work Area A; Map 3-2; Photo 3-4). Small, broken up pieces of Styrofoam and other debris were observed to be floating in the water, encircling the crater walls. This quarry was still active in 2022 and was being used in support of site decommissioning.



Photo 3-4: Construction debris along the excavated crater walls in Quarry A in 2022

New locations of erosion at the northern edge of Work Area A were observed during the 2022 survey (Map 3-2; Photo 3-5). These locations had the potential to deposit sediment into the adjacent undisturbed vegetation.

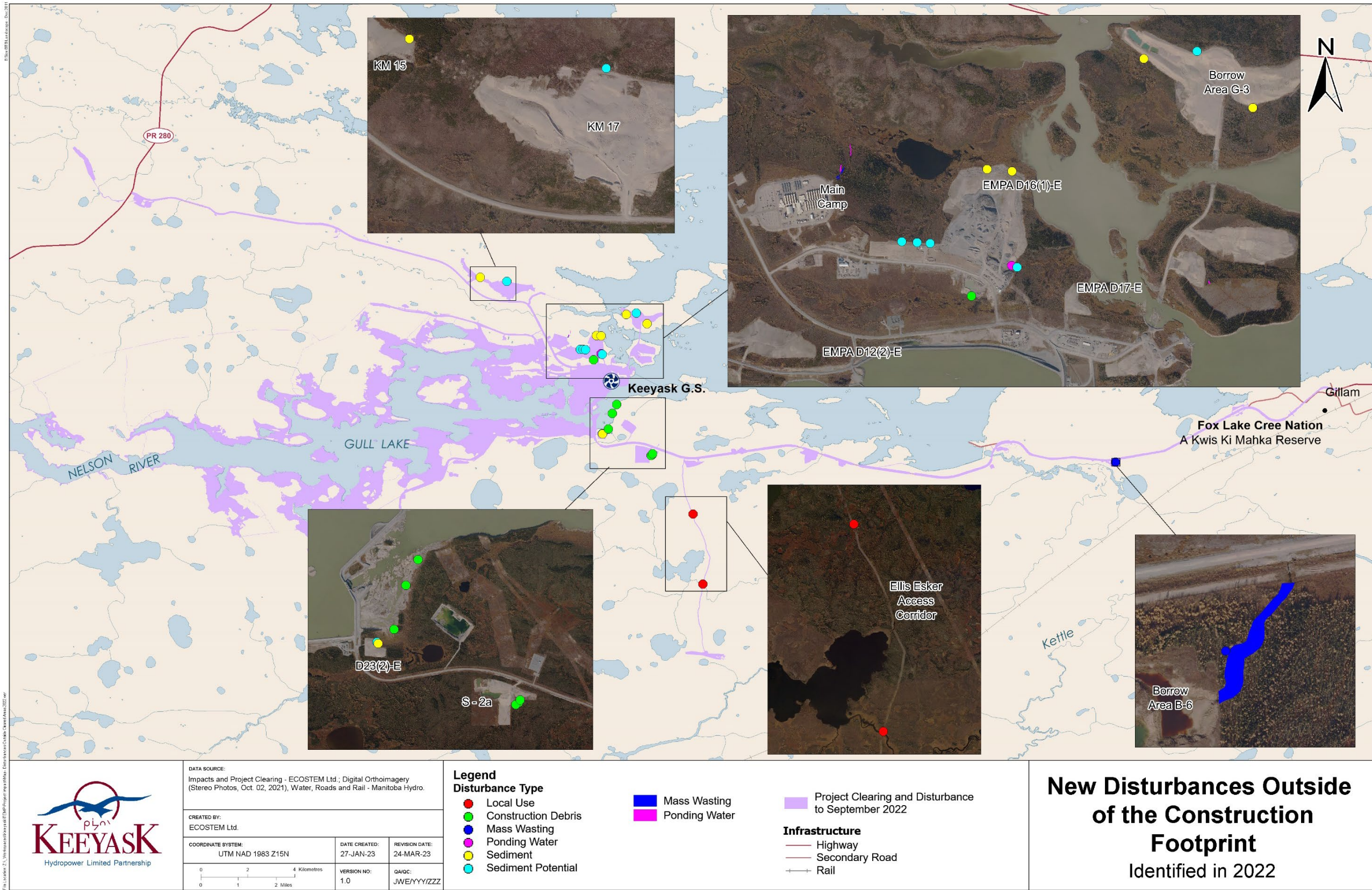


Photo 3-5: New locations where erosion may potentially cause sediment deposition into undisturbed vegetation (yellow arrows) along northern edge of Work Area A

Approximately 0.2 ha of new clearing was identified during 2022 surveys in Work Area C (Map 3-2; Photo 3-6). About 64% of the additional clearing was within the planned Project Footprint and the remainder was outside of the planned and possibly affected portions of the Project Footprint. This clearing was the result of new safety fencing installed on the southern edge of the work area.



Photo 3-6: New clearing for safety fencing (yellow arrow) along the southern edge of Work Area C in 2022



Map 3-2: New disturbances outside of the Construction Footprint as of September 2022

3.3.3 BORROW AREAS

No borrow area clearing or rapidly expanding disturbance was observed during surveys in 2022, however some potential disturbance areas were observed. The following sections provide detail.

3.3.3.1 BORROW AREA G-1

Previously identified erosion and sediment deposition on the northern edge of Borrow Area G-1 at KM 17 were addressed in 2022 with the placement of rock within the erosion channels (Photo 3-7). Sediment deposition from this area had stopped. However, a new erosion channel had formed adjacent to the old ones. This new erosion area may continue depositing sediment into the undisturbed vegetation.



Photo 3-7: Rock placed in old erosion channels and new erosion channel (yellow arrow) at the northern edge of Borrow Area G-1 at KM 17 in 2022

Previously identified erosion and sediment deposition on the northern edge of Borrow Area G-1 at KM 15 were also ongoing at the time of the 2022 survey (Photo 3-8).



Photo 3-8: Erosion and sediment deposition (yellow arrows) on the northern edge of Borrow Area G-1 at KM 15 in 2022

3.3.3.2 BORROW AREA G-3

Surveys in 2022 found that sediment deposition on mineral slopes around the perimeter was ongoing in several spots (Map 3-1; Map 3-2). Sediment deposition into an adjacent marsh on the southwestern edge of the borrow area was also ongoing but had not increased since September 2021 (Photo 3-9).



Photo 3-9: Sediment deposits in marsh (yellow arrow) adjacent to Borrow Area G-3 in 2022

Surveys in 2020 found that erosion on excavated slopes in the eastern half of Borrow Area G-3 had been washing away planted tree seedlings. Monitoring in 2022 found that erosion continued to wash away planted tree seedlings throughout the exposed slopes of the borrow area (Photo 3-10).



Photo 3-10: Erosion affecting planted seedlings in Borrow Area G-3 in 2022

3.3.3.3 BORROW AREA KM-1

In Borrow Area KM-1, 2022 surveys found that erosion runnels continued to widen and deepen (Photo 3-11). The erosion had washed away planted tree seedlings and saplings.



Photo 3-11: Erosion and affected planted seedlings in Borrow Area KM-1 in 2022

3.3.3.4 BORROW AREA N-5

On the south side of Borrow Area N-5, a sediment bag left after a drainage hose was removed was still in place as of September 2022 (Photo 3-12).



Photo 3-12: Sediment bag (yellow arrow) on south side of Borrow Area N-5 in 2022

3.3.3.5 BORROW AREA B-6

In Borrow Area B-6, mass wasting continued to create a disturbance along a natural drainage channel, affecting otherwise undisturbed habitat (Map 3-2). The 2022 surveys found that although the impacted area had not expanded substantially since 2019, mass wasting along the disturbances edges was still occurring (Photo 3-13). Erosion and mass wasting also continued on the northern edge of the excavated crater in Borrow Area B-6 (Photo 3-14).



Photo 3-13: New mass wasting (yellow arrow) along depression edges northeast of Borrow Area B-6 in 2022



Photo 3-14: Erosion on the northern edge of the excavated crater in Borrow Area B-6 in 2022

3.3.3.6 BORROW AREA E-1

Disturbance along the Ellis Esker (E-1) access corridor in the form of ATV trails and plywood planks near to Joslin Lake continued to be used at the time of the September 2022 survey (Photo 3-15; Photo 3-16; Map 3-2).



Photo 3-15: ATV trails in Borrow Area E-1 access corridor in 2022



Photo 3-16: Plywood planks in Borrow Area E-1 access corridor in 2022

3.3.3.7 BORROW AREAS S-2A AND S-2B

Construction debris found along the eastern edges of Borrow Area S-2a in 2021 remained in place as of September 2022 (Photo 3-17).

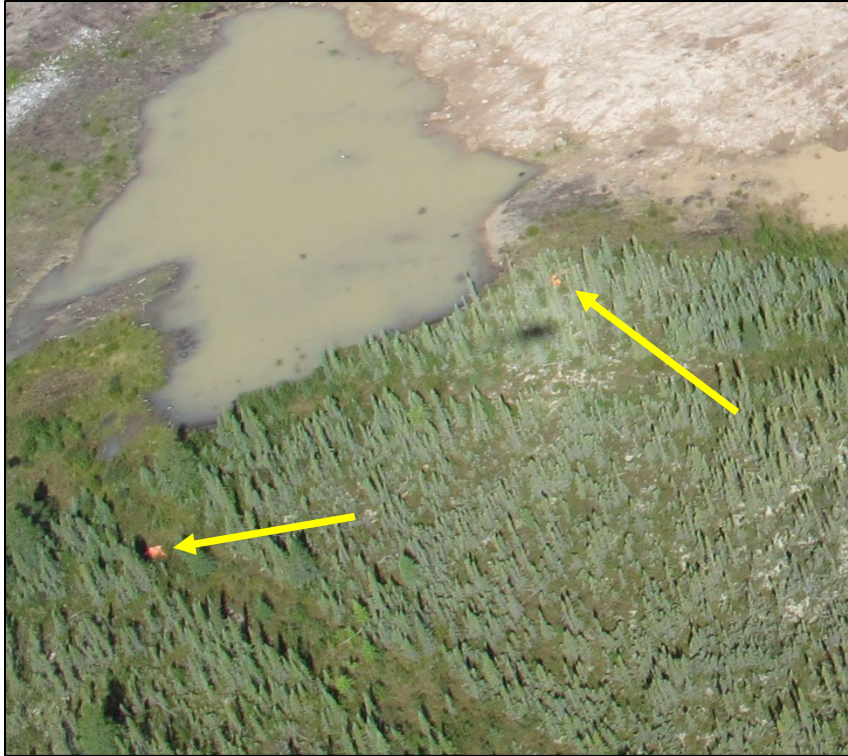


Photo 3-17: Construction debris (yellow arrows) along the eastern edge of Borrow Area S-2a in 2022

3.3.4 DIKES

No disturbance was found along the north or south dikes during 2022 surveys.

3.3.5 EXCAVATED MATERIAL PLACEMENT AREAS

No new clearing was found in EMPAs throughout the Construction Footprint during surveys in 2022. There were many additional disturbances observed for this Project component. The following paragraphs detail the occurrences.

3.3.5.1 EMPA D16(1)-E

Surveys in 2022 found that the rock berms along the edges of the EMPA were reinforced with additional material. The various inconsistencies identified in previous surveys such as coarse rock composition and low elevation had been addressed by filling in sparse areas and raising elevations (Photo 3-18). No new disturbances were observed at the time of the 2022 survey, however some erosion issues still exist, as described in the following paragraphs.



Photo 3-18: Reinforced rock berm in EMPA D16(1)-E in 2022

Erosion at the southwestern corner that had deposited sediment and created a flowing channel of water into previously undisturbed vegetation was ongoing at the time of the 2022 survey (Map 3-2; Photo 3-19). While the erosion effects had not expanded compared to previous surveys, water still flowed through the area into the adjacent vegetation. The source of the water appeared to have come from 30 metres south of the disturbance, where water was observed to flow from underneath a large pile of boulders (Photo 3-20). The source of the water coming from underneath the boulder pile could not be determined at the time of the survey, however a culvert was observed approximately 70 metres west of the boulder pile and was assumed to be the main source of water runoff (Photo 3-21).



Photo 3-19: Sediment deposition and flowing water at the southwestern corner of EMPA D16(1)-E in 2022



Photo 3-20: Flowing water from boulder pile in EMPA D16(1)-E in 2022

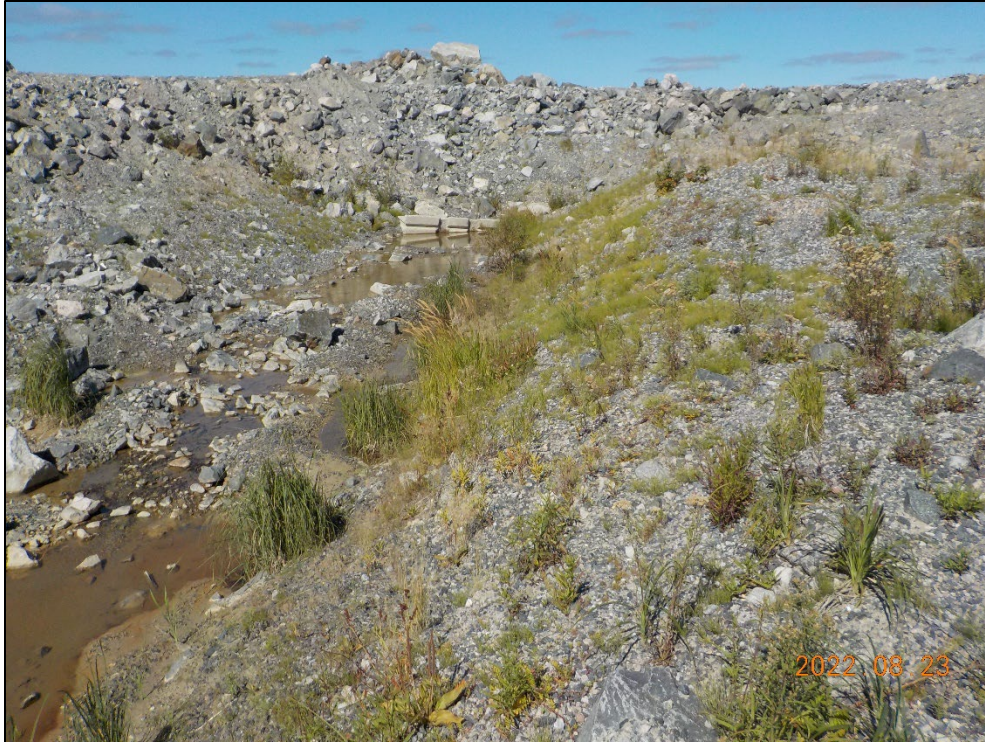


Photo 3-21: Water from culvert in EMPA D16(1)-E in 2022

A gap left in the rock berm on the western edge of EMPA D16(1)-E, observed in 2020, had allowed sediment to pass through into the adjacent marsh habitat. This gap was filled in at the time of the 2022 survey (Photo 3-22). Erosion and sediment deposition had stopped at the location, and the water that had pooled adjacent to the marsh appeared clearer than in previous surveys. Monitoring of this site will continue.



Photo 3-22: Filled-in gap in rock berm (center-top) adjacent to marsh (foreground) on western edge of EMPA D16(1)-E in 2022

Surveys in 2022 identified some locations on the northern edge of EMPA D16(1)-E where erosion and sediment deposition appeared to continue. However, these were diminished compared to previous surveys as a result of earthworks done to increase rock berm density and elevation (Map 3-2).

3.3.5.2 EMPA D17-E

As of September 2022, the removal of the temporary road to EMPA D17-E in 2021 appeared to have created conditions where runoff from the adjoining access road flowed north towards the EMPA, depositing sediment adjacent to it (Photo 3-23). If sediment deposition continues, there is potential to extend past previously cleared bounds and outside of the planned and possibly disturbed Project Footprint areas (Figure 3-2).



Photo 3-23: Runoff and sediment deposition (yellow arrow) along decommissioned road to EMPA D17-E in 2022

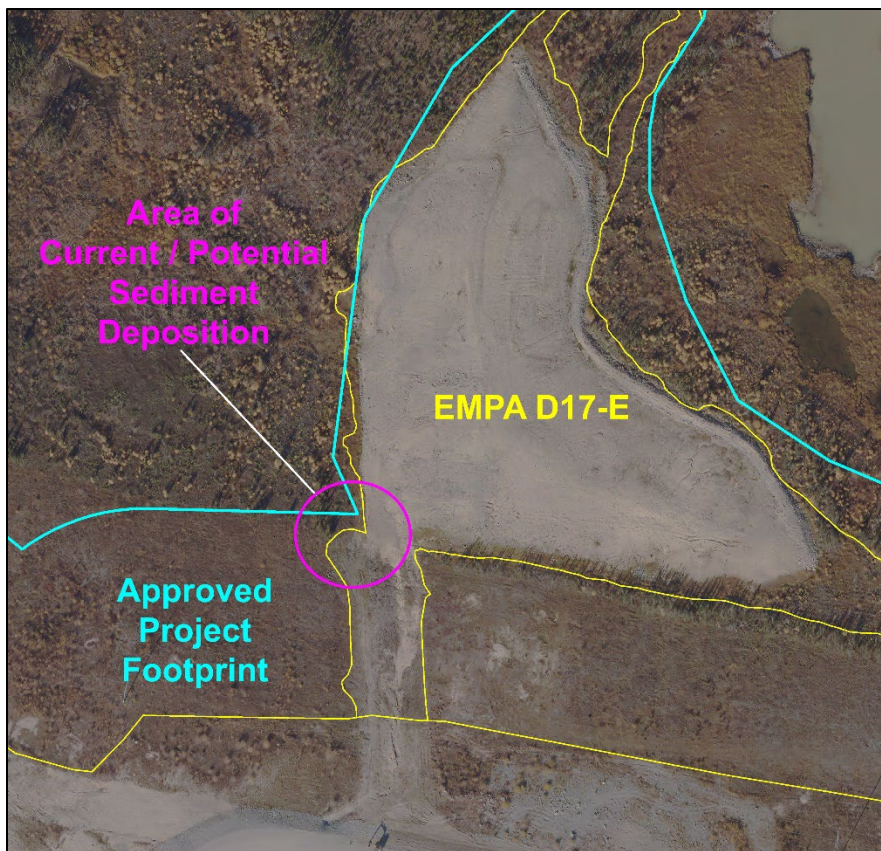


Figure 3-2: Sediment deposition near approved Project Footprint bounds at EMPA D17-E in 2022

3.3.5.3 EMPA D23(2)-E

Erosion and sediment deposition within the planned Project Footprint area was overtopping previously installed rock berms at the northeastern edge of EMPA D23(2)-E in 2022 (Photo 3-24). These impacts were at a location that could potentially affect the dewatered portion of Stephens Lake to the northeast if the disturbance should expand (Map 3-1; Figure 3-3).



Photo 3-24: Sediment (yellow arrows) overtopping rock berm in EMPA D23(2)-E in 2022

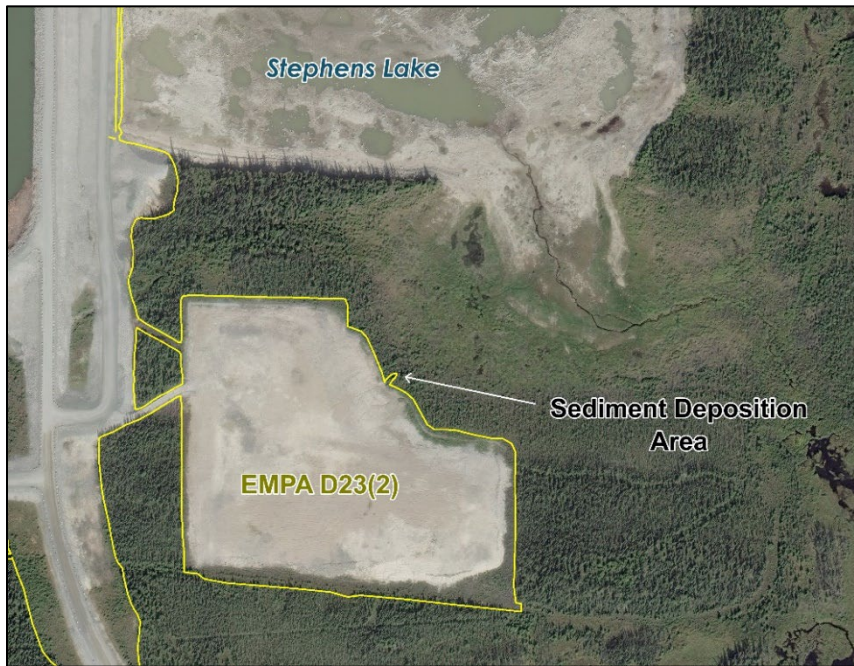


Figure 3-3: Erosion and sediment deposition from EMPA D23(2)-E in 2022

3.3.5.4 EMPA D35(1)-E

At the eastern edge of EMPA D35(1)-E, ponded water and tree dieback in the adjacent undisturbed forest continued to be an issue in 2022, where the area of dieback had increased by 0.02 ha within the planned Project Footprint (Table 3-2; Photo 3-25). This was despite water levels remaining lower than in previous surveys. Monitoring of this site will continue.

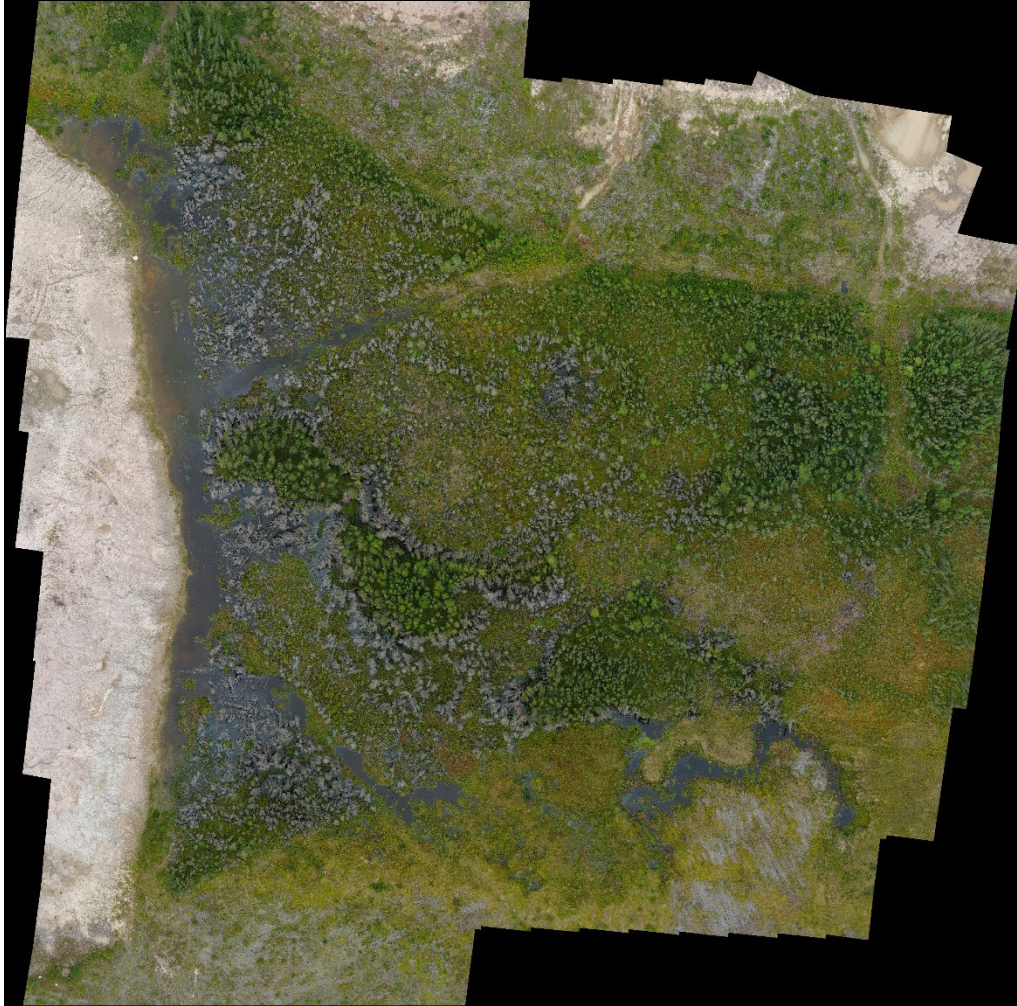


Photo 3-25: Ponded water and tree dieback at the eastern edge of EMPA D35(1)-E in 2022

3.3.6 RIVER WORKS AREA

As of September 2022, the portions of ice boom identified in 2021 surveys remained at each of the three previously identified locations (Photo 3-26; Map 3-2).



Photo 3-26: Portions of ice boom (yellow circle) washed up on the south shore of the Nelson River, downstream of the dam (dewatered area) in 2022

3.3.7 TRAILS

No new trails were cleared or disturbed between September 2021 and 2022.

4.0 DISCUSSION AND RECOMMENDATIONS

This section discusses the impacts that were ongoing at the time of the 2022 surveys and provides mitigation recommendations for the more substantive of these. Table 6-1 (Appendix 2) summarizes the mitigation recommendations to date as well as the associated follow-up actions. Monitoring will continue for all of these impacts.

Mitigation recommendations for some impacts that have been ongoing for several years have been eased for several reasons. The predominant reason is that the construction phase evaluation (ECOSTEM 2022) found that direct Project effects on terrestrial habitat during construction were much lower than assumed for the effects assessment, which was expected. Other reasons that may apply to specific situations are that the potentially affected area is small, the affected terrestrial habitat is a common type, and/or the impacts are well within the approved Project Footprint.

At the northeast corner of the Main Camp, the intermittent stream extending 350 metres beyond the camp perimeter, as well as mass wasting and vegetation collapse continued in 2022 (see Section 3.3.2 for details). Given that the terrain surrounding the camp slopes towards the culvert location, it is not possible to redirect a portion of the flow elsewhere. While the area impacted to date is small and in a common habitat type, it is progressing towards an off-system marsh. The Wetland Loss and Disturbance monitoring concluded that this disturbance may adversely affect the nearby off-system marsh in the future (ECOSTEM 2023). Therefore, it is recommended that measures be implemented to slow the water flow and contain the flow and sediment within the approved Project Footprint (Figure 3-1).

In Quarry A, in the southeastern corner of Work Area A, construction debris encircling the excavated crater walls was composed mostly of small broken pieces of Styrofoam (see Section 3.3.2 for details). Wind could carry the small pieces of Styrofoam a substantial distance. It is recommended that the debris and small pieces of Styrofoam be removed as soon as feasible.

New locations where erosion could potentially deposit sediment into the adjacent undisturbed vegetation along the northern edge of Work Area A were identified in 2022 (see Section 3.3.2 for details). It is recommended that measures such as sediment barriers or slope grading be implemented to prevent any possible deposition from extending into the adjacent possibly disturbed Project Footprint.

Mass wasting and erosion had continued along the excavated crater banks and the depression edges northeast of Borrow Area B-6 (See Section 3.3.3.5). No mitigation is recommended for this site at this time given that it is small in area, substantial expansion of the deposition area is not anticipated, it is affecting common habitat types, and it is well within the approved Project Footprint.

Erosion along the northern edge of Borrow Area G-1 was depositing sediment into the adjacent undisturbed terrestrial habitat (see Section 3.3.3.1 for details). The disturbances are only a few metres from the approved Project Footprint bounds. It is recommended that measures such as sediment barriers or slope grading be implemented to prevent the deposition from extending outside of the approved Project Footprint.

At Borrow Area G-3, ongoing erosion and runoff was impacting otherwise undisturbed terrestrial habitat as well as planted tree seedlings (see Section 3.3.3.2 for details). The area potentially affected is relatively large. It is recommended that measures such as sediment barriers be installed or extended at the locations where sediment deposition is impacting otherwise undisturbed terrestrial habitat.

In Borrow Area G-3, erosion on the bank slopes is washing away planted tree seedlings. Mitigation is not recommended as it is unlikely that further impacts can be prevented or reduced. These slopes are long and have been planted with seedlings. It is noted that a factor contributing to the amount of erosion and tree seedling loss is that in some areas the grading and site preparation were implemented in the same direction as the bank slope (Figure 4-1), which increases the amount of downslope water flow and its velocity. Where this is safe to do, a recommendation for future grading and site preparation is to complete the machine work in a direction that is perpendicular to the bank slope direction.



Area on northern slope of G-3 with parallel grading pattern

Figure 4-1: Grading and site preparation parallel to slope direction in G-3 (2022 imagery)

Within Borrow Area KM-1, there is potential for planted tree seedlings to be impacted by erosion, water runoff and the associated sediment deposition (see Section 3.3.3.3 for details). It is recommended that site staff inspect and evaluate these areas to determine if tree seedlings are likely to be lost or damaged and, if so, to implement erosion control measures as needed.

Disturbances were found along the access corridor to the Ellis Esker borrow area (see Section 3.3.3.6 for details). These disturbances did not appear to be caused by the Project. Ongoing consultations with local resource users are recommended to determine if access to this corridor should be blocked.

At EMPA D16(1)-E, erosion and sediment deposition was being well contained within the rock berm, (see Section 3.3.5.1 for details). Sediment deposition on the northern edge of the EMPA had slowed as a result of rock berm reinforcement. It is recommended that site staff monitor the rock berm for any breakdown and reinforce where necessary.

At the southeastern corner of EMPA D16(1)-E, water runoff created a channel that was transporting water and sediment into the adjacent undisturbed forest (see Section 3.3.5.1 for details). No mitigation is recommended for this site at this time given that it is small in area, substantial expansion of the deposition area is not anticipated, and it is within the approved Project Footprint.

At EMPA D17-E, runoff and sediment deposition along the decommissioned road has the potential to extend past the approved Project Footprint. The disturbance is only a few metres from the approved Project Footprint bounds. It is recommended that measures such as sediment barriers or slope grading be implemented to prevent increase outside of the approved Project Footprint.

At the northeastern edge of EMPA D23(2)-E, erosion-related sediment deposition is approaching the dewatered portion of Stephens Lake (see Section 3.3.5.3 for details). It is recommended that measures be implemented to eliminate or reduce sediment movement beyond the existing rock berm.

Project-related water ponding in EMPA D35(1)-E did not increase in size at the time of the 2022 survey, however tree dieback had increased since 2021. No mitigation is recommended for this location at this time as the impacted area is relatively small, affecting a common habitat type and within the approved Project Footprint.

Erosion and potential sediment deposition into undisturbed native terrestrial habitat was observed in several other sites around the Construction Footprint. No mitigation is recommended for these sites at this time given that each of these sites is small in area, substantial expansion of the deposition area is not anticipated, a common habitat type is being affected, and they are within the approved Project Footprint.

Construction debris observed in previous surveys remained in several areas during site surveys in 2022. These included the southern and western edges of Borrow Area S-2a (an active borrow area in 2022) and along the southern shore of the Nelson River, downstream of the dam, in the

dewatered area. Additionally, a relict sediment bag remained at the southern edge of Borrow Area N-5. It is recommended that the debris and relict sediment bag be removed.

5.0 SUMMARY AND CONCLUSIONS

The Habitat Loss and Disturbance study is monitoring Project-related clearing and physical disturbance. This is the largest direct Project effect on terrestrial habitat, ecosystems and plants. As such, the monitoring study provides the single best way to monitor effects on the terrestrial environment, and to discover any unanticipated effects on that environment.

As the vast majority of construction activities had been completed by fall 2021, the *Keeyask Generation Project Terrestrial Footprint Map for Construction* (i.e., the Construction Footprint) was mapped as of September 2021. This report focuses on changes to clearing and physical disturbance that occurred since the Construction Footprint was mapped.

The size of the cleared and disturbed Project Footprint increased by 0.4 ha between September 2021 and 2022. Clearing accounted for the majority (58.4%) of this total. This clearing occurred on the southern edge of Work Area C for the installation of safety fencing.

Erosion and sediment deposition at the western and northern edges of EMPA D16(1)-E had decreased considerably as a result of rock berm reinforcements since September 2021.

Previously documented erosion and sediment deposition had continued at several other locations. Most of these locations were within the approved Project Footprint. However, at some locations, these impacts were either already outside of or could potentially expand outside of the approved Project Footprint.

Some new locations where erosion and sediment deposition had the potential to extend past the approved Project Footprint were observed at the time of the 2022 surveys.

Construction debris identified during previous surveys also remained in several locations as of September 2022.

Recommendations for additional mitigation are provided for 13 of the locations where physical disturbance continued between September of 2021 and 2022. Additional mitigation is not recommended for the remaining locations with ongoing disturbance because direct Project effects on terrestrial habitat during construction were much lower than assumed for the effects assessment, the potentially affected area is small, the affected terrestrial habitat is a common type, and/or the impacts are well within the approved Project Footprint.

There are no recommendations to modify the study methods based on monitoring results to date.

As per the schedule in TEMP, monitoring fieldwork for the Habitat Loss and Disturbance study will continue in 2024.

6.0 LITERATURE CITED

- ECOSTEM. 2016. Terrestrial Effects Monitoring Plan Annual Report 2015 – 2016: Keeyask Generation Project: Terrestrial Plant, Habitat, and Ecosystem Monitoring: Annual Report 2015-2016. A report prepared for Manitoba Hydro by ECOSTEM Ltd., June 2016.
- ECOSTEM. 2017. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2017-01: Habitat Loss and Disturbance Monitoring Report. A report prepared for Manitoba Hydro by ECOSTEM Ltd., June 2017.
- ECOSTEM. 2018. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2018-01: Habitat Loss and Disturbance Monitoring Report. A report prepared for Manitoba Hydro by ECOSTEM Ltd., June 2018.
- ECOSTEM. 2019. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2019-01: Habitat Loss and Disturbance Monitoring. A report prepared for Manitoba Hydro by ECOSTEM Ltd., June 2019.
- ECOSTEM. 2020. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2020-01: Habitat Loss and Disturbance Monitoring. A report prepared for Manitoba Hydro by ECOSTEM Ltd., June 2020.
- ECOSTEM. 2021. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2021-01: Habitat Loss and Disturbance Monitoring. A report prepared for Manitoba Hydro by ECOSTEM Ltd., June 2021.
- ECOSTEM. 2022. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2022-01: Habitat Loss and Disturbance Monitoring. A report prepared for Manitoba Hydro by ECOSTEM Ltd., June 2022.
- ECOSTEM. 2023. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2023-04: Wetland Loss and Disturbance Monitoring. A report prepared for Manitoba Hydro by ECOSTEM Ltd., June 2023.
- Keeyask Hydropower Limited Partnership (KHLP). 2012a. Keeyask Generation Project Environmental Impact Statement: Response to EIS Guidelines, Winnipeg, Manitoba. June 2012.
- Keeyask Hydropower Limited Partnership (KHLP). 2012b. Keeyask Generation Project Environmental Impact Statement: Terrestrial Environment Supporting Volume, Winnipeg, Manitoba. June 2012.
- Keeyask Hydropower Limited Partnership (KHLP). 2015. Keeyask Generation Project Terrestrial Effects Monitoring Plan. Winnipeg, Manitoba. December 2015.

APPENDIX 1: MITIGATION RECOMMENDATIONS

Table 6-1: Summary of Mitigation Recommendations

Location	Identified Impact	Year	Mitigation Recommendation	Mitigation Implemented
North Access Road at KM-1	Minor erosion and sediment deposition around the eastern fringes and downslope.	2021	Jun. 2022: Site staff inspect and evaluate these areas, and implement erosion control measures as needed.	None to date.
		2022	None.	None applicable.
Main Camp	Water outflow from culvert at northeast corner causing mass wasting and disturbance.	2021	Jun. 2022: Implement measures to slow water flow and contain disturbance within the possibly disturbed Project Footprint.	None to date.
		2022	Jun. 2023: Implement measures to slow water flow and contain disturbance within the possibly disturbed Project Footprint.	None to date.
Work Area A	Construction debris encircling walls of excavated crater at southeastern corner in Quarry A.	2022	Jun. 2023: Clean up debris and small pieces of Styrofoam.	None to date.
	New erosion and potential sediment deposition on northern edge.	2022	Jun. 2023: Install measures such as sediment barriers and/or regrade slopes as needed.	None to date.
Helicopter Pad	Erosion and sediment deposition on northern corner of pad.	2021	None.	None applicable.
		2022	None.	None applicable.
Borrow Area G-1	Erosion and sediment deposition in undisturbed forest.	2021	Jun. 2022: Install measures such as sediment barriers and/or regrade slopes as needed.	Rock added into erosion channels at KM 17 in 2021.
		2022	Jun. 2023: Install measures such as sediment barriers and/or regrade slopes as needed.	None to date.
Borrow Area G-3	Sediment deposition in various locations around perimeter.	2021	Jun. 2022: Install or extend sediment barriers where needed.	None to date.
		2022	Jun. 2023: Install or extend sediment barriers where needed.	None to date.
Borrow Area KM-1	Erosion runnels widening/deepening in pit area.	2021	Jun. 2022: Site staff inspect the excavated areas to evaluate and implement erosion control measures as needed.	None to date.

Location	Identified Impact	Year	Mitigation Recommendation	Mitigation Implemented
		2022	Jun. 2023: Site staff inspect the excavated areas to evaluate and implement erosion control measures as needed.	None to date.
Borrow Area N-5	Sediment bag remained at old drainage hose location on south side of N-5.	2021	Jun. 2022: Remove sediment bag from location.	None to date.
		2022	Jun. 2023: Remove sediment bag from location.	None to date.
Borrow Area B-6	Mass wasting causing disturbance along drainage channel between borrow area and South Access Road.	2021	None.	None applicable.
		2022	None.	None applicable.
Borrow Area E-1 (Ellis Esker) Access Corridor	Local use of right-of-way causing disturbance in undisturbed forest.	2021	Jun. 2022: Continued consultation with partner First Nations on use of this area.	None to date.
		2022	Jun. 2023: Continued consultation with partner First Nations on use of this area.	None to date.
Borrow Area S-2a	Construction debris outside Borrow Area S-2a bounds.	2021	Jun. 2022: Site staff remove debris.	Debris will be removed when S2-A is decommissioned.
		2022	Jun. 2023: Site staff remove debris.	None to date.
EMPA D16(1)-E	Erosion, sediment deposition and disturbance into surrounding undisturbed areas.	2021	Jun. 2022: None.	None to date.
		2022	Jun. 2023: Site staff monitor rock berm for breakdowns and reinforce as necessary.	None to date.
EMPA D17-E	Erosion and sediment deposition potential into surrounding undisturbed areas.	2022	Jun. 2023: Install measures such as sediment barriers and/or regrade slopes as needed.	None to date.
EMPA D23(2)-E	Erosion and sediment deposition along northeastern edge close to Stephens Lake.	2021	Jun. 2022: Implement measures to stop or reduce movement of sediment past rock barrier.	None to date.
		2022	Jun. 2023: Implement measures to stop or reduce movement of sediment past rock barrier.	None to date.
EMPA D35(1)-E	Ponding of water along eastern edge causing tree dieback.	2022	None.	None applicable.

Location	Identified Impact	Year	Mitigation Recommendation	Mitigation Implemented
South shore	Portions of ice boom washed up along shore.	2021	Jun. 2022: Remove ice boom portions	None to date.
Nelson River (Dewatered Area)		2022	Jun. 2023: Remove ice boom portions	None to date.