



Keeyask Generation Project Terrestrial Effects Monitoring Plan

Habitat Loss and Disturbance Monitoring Report

TEMP-2022-01



KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2022-01

HABITAT LOSS AND DISTURBANCE MONITORING

A Report Prepared for
Manitoba Hydro

By
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SUMMARY

Background

Construction of the Keeyask Generation Project (the Project) at Gull Rapids began in July 2014. The vast majority of construction activities had been completed by fall 2021.

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 terrestrial habitat loss and disturbance monitoring conducted during the eighth summer of Project construction and summarizes the overall effects on terrestrial habitat during the construction phase.

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. Plants and animals need habitat to exist and having more good quality habitat helps them to be more widespread and abundant. Changes to terrestrial habitat can affect many species and ecosystems.

What was done?

What was found?

[illegible]

As expected, the majority (about 92.6%) of the Project clearing and disturbance was in the planned portions of the Project footprint, which are the areas that include the permanent infrastructure and reservoir.

To date, there has been no flooding, Project clearing, or disturbance in about 94% of the area in the “possibly disturbed” portion of the licensed footprint. Most of this undisturbed area is expected to remain this way after the end of construction.

Between September 2020 and 2021, there was 0.1 ha of new clearing or disturbance outside of the approved Project footprint. This area was equal to only 0.1% of the 7,123 ha of the licensed Project footprint that has not been impacted.

What does it mean?

To date, the Project has not created any major unanticipated removal or alteration of terrestrial habitat. The very small area of unintended clearing outside the areas approved for Project use was not a concern from the terrestrial habitat, ecosystem or plant perspectives. The Priority Habitats, Wetland Function and Priority Plant studies did not identify any major concerns with the specific areas affected. Also, the very small amount of additional clearing was equal to only 0.1% of the currently undisturbed portion of the licensed Project footprint, and it is expected that the Project will not impact most of this remaining undisturbed area.

Monitoring has shown 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 20% lower than assumed for the EIS. This is partially because the mitigation measures outlined in the EIS were generally implemented as prescribed and have been effective.

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 2022. Additionally, terrestrial areas that are now permanently flooded by reservoir impoundment will be mapped to monitor incremental change over time.

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STUDY TEAM

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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.
initial flooding	Flooding within the Project reservoir area mapped 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 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.

As described in TEMP, two studies are monitoring Project general effects on terrestrial habitat. During construction, the Terrestrial Habitat Loss and Disturbance study is focusing on Project-related effects on stand level habitat composition due to terrestrial habitat loss and disturbance. During operation, the Long-Term Effects on Habitat study will monitor indirect Project effects on terrestrial habitat. This latter study will also monitor recovery to native habitat in Project-affected areas and in areas where trails intersect the Project footprint. The Habitat Loss and Disturbance study is the subject of this report.

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

- Quantify and locate terrestrial habitat loss and physical disturbance; and,
- Quantify and locate Project effects on terrestrial habitat composition during construction.

Some components of the Keeyask Infrastructure Project (KIP), a related project completed in June 2014, are being used for the Project. ECOSTEM (2015) documented previous clearing and disturbance by the KIP.

Habitat loss and disturbance monitoring for the Project has been conducted during construction from 2015 to 2021. Previous reports (ECOSTEM 2016; 2017; 2018; 2019; 2020; 2021) provide results for the monitoring conducted in each year from 2015 to 2020. This report presents the results of monitoring conducted during 2021. This report also evaluates direct Project effects on terrestrial habitat during the construction phase, with the majority of construction activities completed by fall 2021.

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 2021, which were the same as in 2016, 2017, 2018, 2019 and 2020 (ECOSTEM 2017; 2018; 2019; 2020; 2021).

In the terrestrial habitat, ecosystem and plant studies, 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, flooding or ponding related to altered water flows), use of pre-existing trails or borrow areas, or an isolated area of clearing smaller than 400 m².

2.2 PROJECT AREAS

In this study, four distinct Project areas are used when reporting on where Project clearing or disturbance occurred. This is being done to facilitate future comparisons with EIS predictions.

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. There is little to no opportunity to reduce Project impacts in these areas.

The possibly disturbed Project footprint provided for some of the unknown components of the Project design at the time the Project was being licensed (e.g., the actual volume of suitable material available in each borrow area, or the actual area needed for each of the Excavated Material Placement Areas (EMPAs)). There is some flexibility in locating clearing, disturbance or material placement within the possibly disturbed Project footprint. The Project's environmental protection plans (EnvPPs) include provisions to minimize clearing and disturbance and to avoid environmentally sensitive sites, to the extent feasible, within the possibly disturbed Project footprint. Another study, Priority Habitats, monitors Project effects on environmentally sensitive terrestrial sites (see ECOSTEM 2022a).

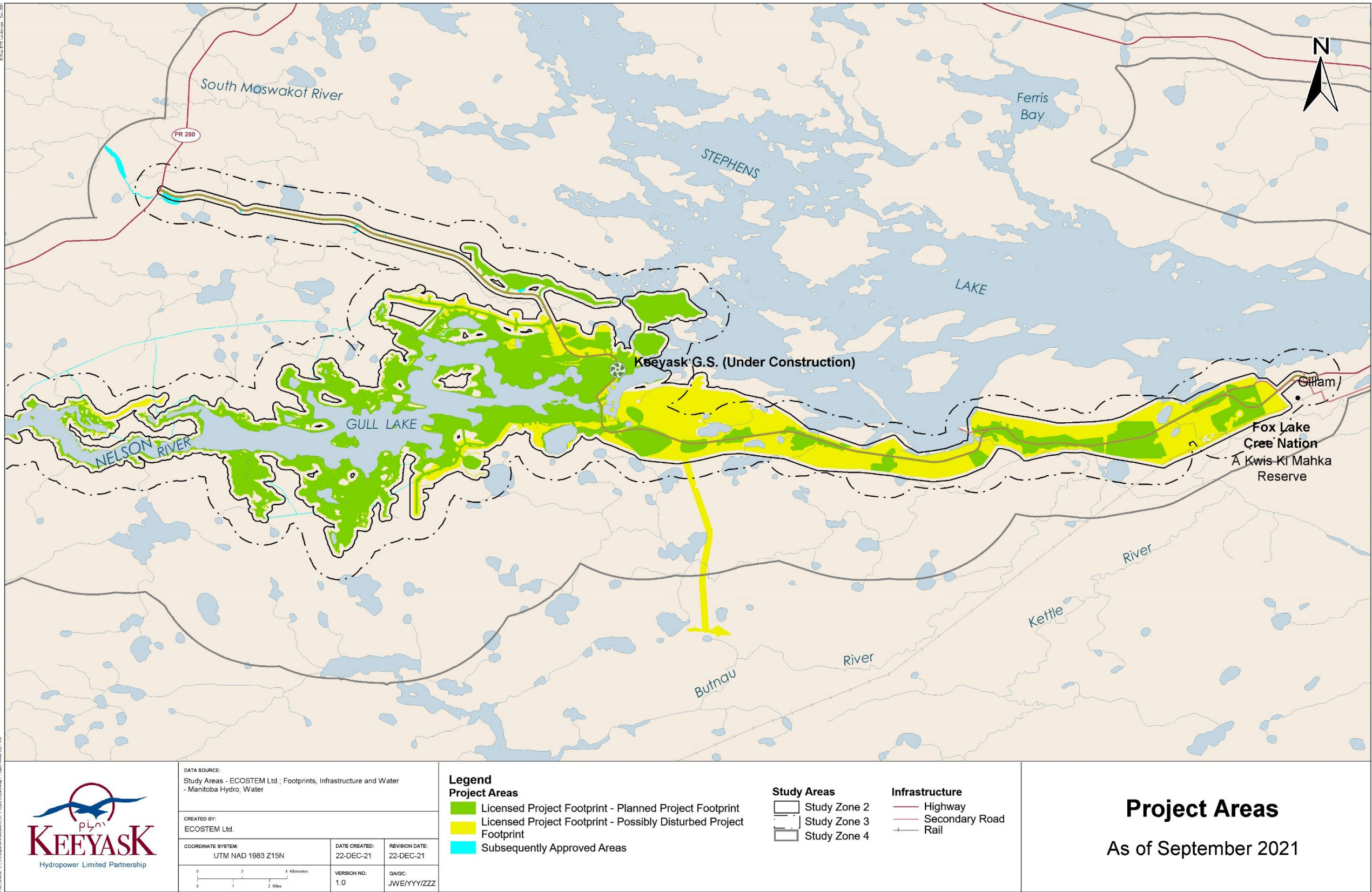
After the Project was licensed, several additional areas (called “subsequently approved Project areas” in this report) were approved for Project use by the Government of Manitoba (Environment, Climate and Parks). This is the third type of Project area. This category also includes Project areas that were originally licensed as part of the KIP project. These areas primarily include the former KIP start-up camp (which was originally planned as only a temporary camp for the KIP), Borrow Area G-5 and trails that were used to access reservoir clearing areas.

The subsequently approved trails were evaluated for potential effects by the Project’s terrestrial specialists prior to their submission to the Government of Manitoba, and their locations were modified to alleviate any ecological concerns that were identified at that time. Given the modifications recommended by terrestrial specialists, the subsequently approved areas were not a concern from the terrestrial ecosystem health perspective.

An important consideration for the evaluation of areas that were subsequently submitted for approval was how these potential additions would alter predicted cumulative effects. This evaluation primarily focused on the characteristics of the potentially affected areas and the amount of the licensed Project footprint that was expected to remain undisturbed at the end of construction. For the latter factor, it was expected that a large proportion of the licensed Project footprint would remain undisturbed because the EIS intentionally erred on the side of overestimating the amount of habitat loss and disturbance. As of September 2021, more than half (54%) of the licensed Project footprint had not been impacted by the Project.

This report refers to the licensed Project footprint and the subsequently approved areas as the “approved Project footprint”.

The fourth, and final, type of Project area used in this report includes all cleared or disturbed areas that are outside of the approved Project footprint.



Map 2-1: Project areas as of September 2021

2.3 OVERALL APPROACH

For this study, terrestrial habitat loss and disturbance are being monitored as mapped 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. Remaining activities generally included much of the decommissioning of temporary features (e.g., borrow areas and EMPAs) and revegetation of areas not needed for Project operation. 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.

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) is to be mapped within one year of construction phase completion. This report provides the Construction Footprint, which was mapped based on Project impacts as of September, 2021. It also documents the conversion of prior Project construction impacts to initial flooding, where applicable.

The Long-term Effects on Terrestrial Habitat study (TEMP, Section 2.1.3) will monitor 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 a number of 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.

2.4 DATA COLLECTION

In September of each year during Project construction, 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 foot.

Table 2-1 provides the dates when the aerial and ground surveys were conducted in each year. Ground survey dates do not include the days in which sites were surveyed while conducting ground surveys for other TEMP studies. The aerial surveys in July 2021 were conducted to document reservoir shoreline conditions at the beginning of the first growing season following impoundment.

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

Year	Aerial Survey Dates	Ground Survey Dates ¹
2015	August 24 – 27	-
2016	August 20 and 21; September 7	September 4 and 6
2017	July 5; September 19	September 17, 18 and 19
2018	July 5; September 15	September 11, 12, 13, 15, 16 and 17
2019	September 9 and 10	September 7 and 8
2020	September 10 and 13	September 9, 10 and 12
2021	July 16, 17, 18 and 19; September 10 and 13	September 11, 12, 13 and 14

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

2.5 MAPPING

2.5.1 APPROACH

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

Aquatic areas dewatered during construction were included under the “Project clearing” umbrella. Dewatered area mapping was completed for two reasons: some of these former aquatic areas will permanently become infrastructure or terrestrial habitat; and, the remaining mapped areas provide complete documentation of the overall Project footprint during construction. The only dewatered areas that have not been mapped are the areas downstream of the spillway because they were not expected to be permanent. The extent of permanently dewatered areas will be mapped once the temporary footprint components are decommissioned and the extent of the constructed wetland are finalized.

While aquatic areas in the altered water zone that were not dewatered are technically part of the licensed Project footprint, this report does not include them in the overall Project footprint if they never became temporary terrestrial habitat.

By September 2021, most of the temporary Project infrastructure constructed in dewatered or aquatic areas (e.g., causeways, cofferdams) within the reservoir had either been removed or were in the process of being removed. These components were previously reclassified from dewatered to “re-inundated” in the Project footprint mapping and subsequently reclassified to initial flooding once the initial reservoir shoreline (as of September 2021) was mapped. Similarly, dewatered areas that remained as exposed river bottom during construction (e.g., the tailrace, portions of the Generating Station area) downstream of the dam, were reclassified as re-inundated after cofferdams were removed. Reclassification of these areas will be assessed once the dewatered areas are mapped out, however, the re-inundated areas did not add to or subtract from the total amount of clearing within the Project footprint as they were simply a change in “clearing” type.

Initial flooding was mapped using the terrestrial habitat shoreline position in September 2021. The terrestrial habitat shoreline is defined as the visible current and historical limit of water and ice regime effects. The equivalent pre-construction terrestrial habitat shoreline position was mapped for the EIS (KHLP 2012a) using the imagery available at the time. Compared with the imagery used in the EIS, the imagery available for the 2021 shoreline mapping was much higher quality. For this reason, and because erosion had affected segments of the pre-construction shoreline inland, the shoreline mapped for the EIS had some limitations. An example of this can be seen in some back bay areas where the shoreline location did not extend far enough into creeks to account for the water and ice effects.

As construction progressed, there were changes in boundaries or the type of use for some Project footprint areas. By September 2020, small portions of what had previously been reservoir clearing became either the Generating Station, South Dike or borrow area component type. These transitions explain small differences in the areas of some Project component types when annual reports are compared with one another.

One focus of the reporting is on the amount of clearing or disturbance within the possibly disturbed Project footprint because the Project EnvPPs include provisions to minimize impacts in this Project area. To identify whether the clearing or disturbance fell within or outside of the possibly disturbed Project footprint, Geographic Information System (GIS) polygons for the planned and possibly disturbed Project footprint were used to subdivide the actual clearing or disturbance into the relevant Project footprint area. Any resulting long slivers along linear features that were less than 1 m wide were deleted on the basis that they fell within the spatial accuracy of the digital orthorectified imagery (DOI) used to digitize clearing.

Observed clearing that was associated solely with other projects was not considered in this report. This includes areas cleared for the KIP (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 KIP was developed prior to the Project, and the actual project effects on terrestrial habitat had already been assessed in the final KIP monitoring report (ECOSTEM 2015). Similarly, clearing solely for the Keeyask Transmission Project (KTP) that was adjacent to the approved Project footprint was not included in the data as this is a separate and independently licensed project. 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.

As of September 2020, portions of Borrow Area G-5, which had been a KIP footprint component, were now being used by the Project for re-surfacing the North Access Road starting in July 2020. As the specific areas within G-5 being used by the Project could not be determined from the available data, all of the excavated areas within it were included in the Project footprint as physical disturbance. New clearing beyond what had been completed for KIP was also observed, and this was included as Project clearing. All of these areas are included in the KIP Environment Act License and are categorized as subsequently approved for this report.

Most of Borrow Areas KM-4 and KM-9, which were developed for KIP, are not discussed in this report since aerial surveys and information provided by Manitoba Hydro indicated they had not been incrementally cleared or used by the Project as of September 2021 (i.e., observed clearing or disturbance was from previous projects or activities such as the KIP).

Bringing the reservoir to full supply level in September 2020 introduced initial flooding as a Project source of habitat loss for the first time during the construction period. This report identifies which elements of the Construction Footprint were converted to initial flooding.

2.5.2 METHODS

Areas of Project clearing, disturbance or initial flooding as of September 2021 were mapped from high resolution DOIs acquired on August 30, 2021, digital stereo photos acquired on October 2, 2021, and the ground surveys (Section 2.4). Table 2-2 provides the specifications of the imagery used for each year of monitoring.

Table 2-2: Specifications of imagery used for mapping, by year

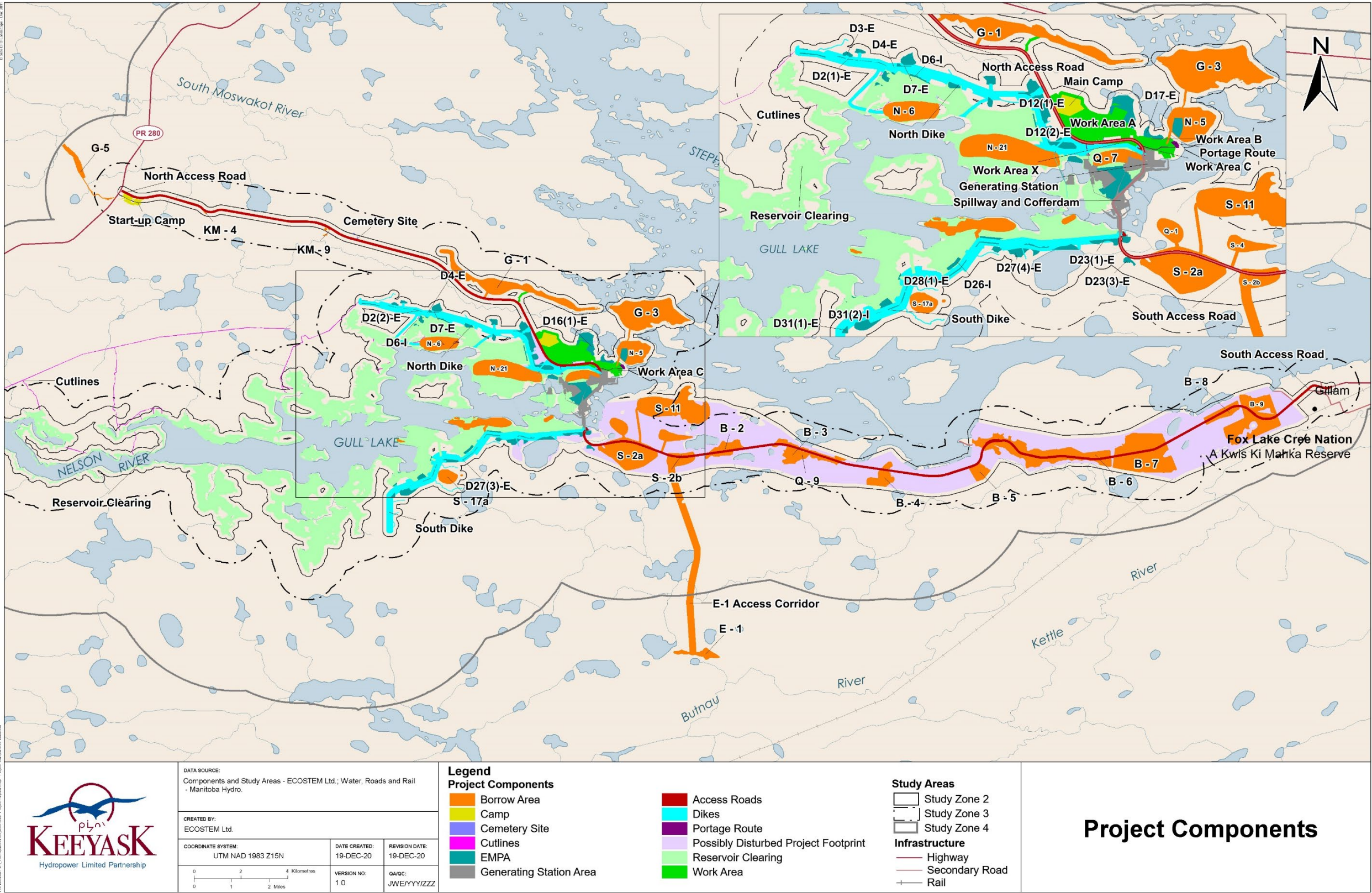
Year	Acquisition Date	Resolution	Approved Project Footprint Coverage	Type	Source
2016	September 21	50 cm	Most ¹	Satellite	Worldview 2
2017	July 11	50 cm	All	Satellite	Worldview 2
2018	July 9	30 cm	Most ¹	Satellite	Worldview 2
2019	October 2	30 cm	All	Satellite	Worldview 2
2020	August 3 and 27, September 10	30 cm	Most ¹	Satellite	Worldview 2
2021	August 30	30 cm	Most ¹	Satellite	Worldview 2
2021	October 2	10 cm	All	Stereo Photo	Fixed Wing

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

Project clearing, disturbance and initial flooding boundaries as of September 2021 were digitized from the stereo photos and DOIs while using the field data to assist in interpreting where the clearing or disturbance ended. In some years, the field data were also used to map boundaries for areas that were outside of the spatial extents of the stereo photos and DOI, or when the remote sensing for the DOI was acquired before September. Boundaries mapped from aerial survey photography were not as precise as those digitized from the DOI because they were taken from an oblique angle. These boundaries were reviewed and revised in the subsequent year using more recent satellite imagery. The 2021 stereo photos provided the most detailed and accurate data for the construction phase. These photos were also needed to provide coverage for areas not included in the 2021 DOI.

For the years when the satellite imagery was acquired in July, aerial survey photos acquired in September were used to determine which areas had been cleared since July. All clearing or disturbance was digitized at a scale of 1 inch = 30 meters.

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



Map 2-2: Project components

3.0 RESULTS

3.1 OVERVIEW

As of September 2021, overall actual Project clearing or disturbance (i.e., the Construction Footprint) totaled 5,724 ha (Table 3-1; Map 3-1). This was an increase of 0.9 ha since September 2020.

Disturbance accounted for the majority (56.7%) of the 0.9 ha increase in Project footprint area between September 2020 and 2021 (Table 3-1). The majority (64.2%) of the new disturbance since 2020 was related to slope grading and road retirement in EMPAs throughout the Project footprint.

Clearing accounted for the remainder (43.3%) of the increase. Clearing mainly consisted of new excavation near the transmission station and the repositioning of the road to the permanent downstream boat launch area. The removal of cofferdams and other structures in the Project footprint resulted in the re-inundation of 2% of the Project footprint in 2021, which was an increase of 0.1% over that of 2020. This decommissioning did not alter the total Project footprint area as it was a transfer from dewatering.

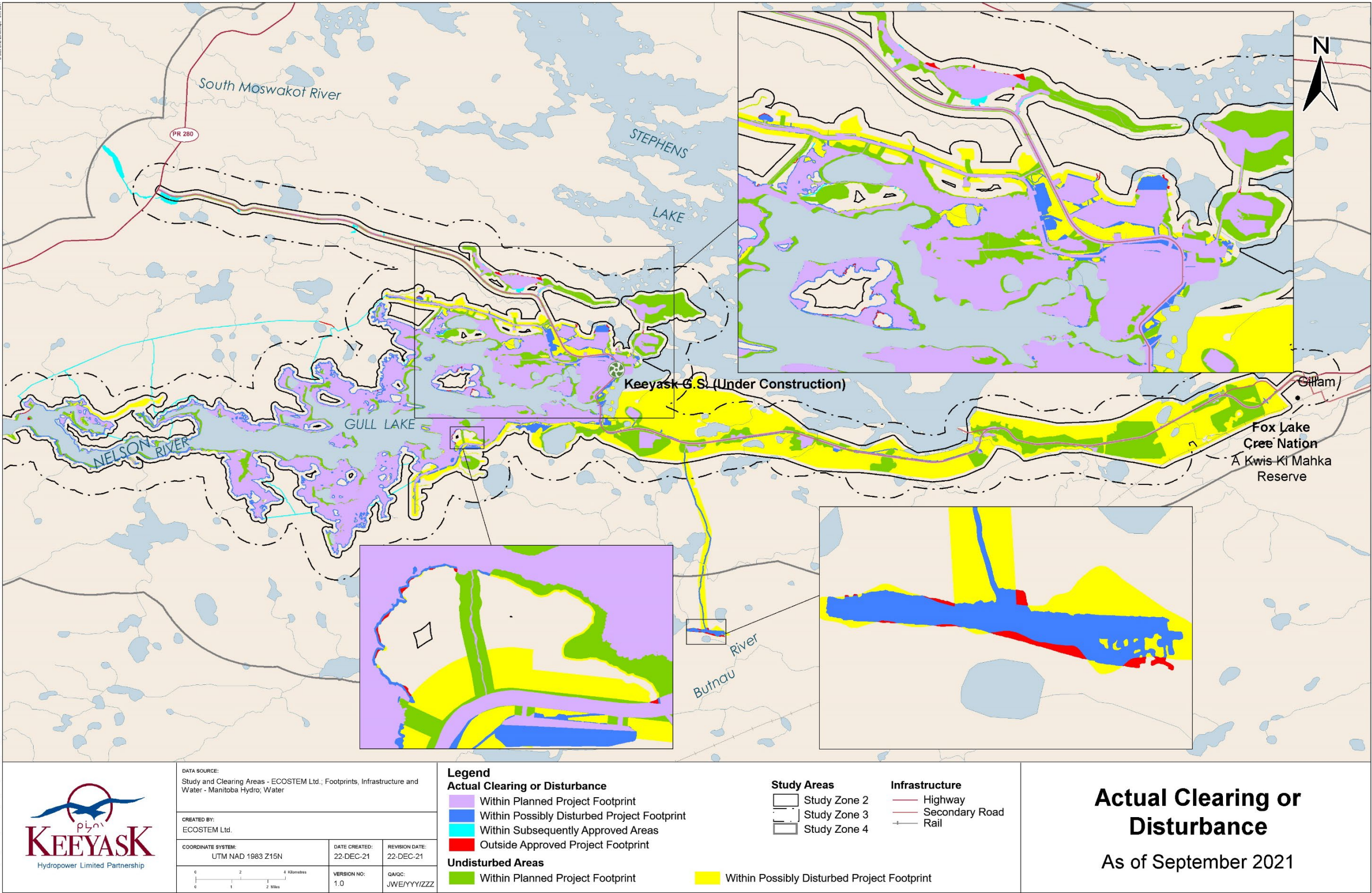
Project disturbance comprised a small percentage (1.4%) of the Project footprint up to September 2021. Disturbances included new trails and cutlines, re-use of pre-existing trails, Project-related erosion and sediment deposition, and ponding related to altered water flows.

Approximately 97% of the 5,724 ha Construction Footprint was in areas that had been mapped as terrestrial habitat for the EIS. The remainder of the Construction Footprint was: aquatic habitat that had been converted to terrestrial habitat by either dewatering or displacement by Project infrastructure; and, previously dewatered aquatic habitat that was re-inundated.

Table 3-1: Total initial flooding, Project clearing and disturbance up to September 2021, by type

Impact Type	Impacts Up to 2021		Change in Impacts From 2020 to 2021	
	Area Impacted (ha)	Percentage of Total Impacted Area	Area Impacted (ha)	Percentage of Total Impacted Area
Clearing ¹				
Terrestrial habitat clearing	5,506.4	96.2	0.4	43.3
Dewatered	22.0	0.4	-	-
Re-inundated ²	112.7	2.0	-	-
Flooding or ponded water outside reservoir area	1.4	0.0	-	-
Disturbance	81.6	1.4	0.5	56.7
Total Project footprint	5,724.1	100.0	0.9	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 disturbance as of September 2021

3.2 CLEARING OR DISTURBANCE BY PROJECT APPROVAL AREA

As described in Section 2.2, the approved Project footprint areas included all areas that were either initially licenced or subsequently approved for use by the Government of Manitoba.

As of September 2021, only 45% of the originally licensed Project footprint area had been impacted by the Project.

Of the 5,724 ha of Project impacts (i.e., clearing or disturbance) recorded up to September 2021, 93% was within the planned Project footprint (Map 3-1). Impacts within the planned Project footprint areas increased by 0.7 ha between September 2020 and 2021 (Table 3-2).

Impacts in the possibly disturbed Project footprint (Table 3-2; Map 3-1) totaled approximately 314 ha as of September 2021. This was an increase of about 0.1 ha over 2020. The newly impacted area was distributed between EMPAs D17-E, D12(2)-E and D16(1)-E, along the Ellis Esker access corridor, the GS area and the Main Camp (Appendix 1: Table 7-1).

As of September 2021, 100 ha of the impacts were in subsequently approved Project areas. Over half of this area (65%) was in areas previously cleared for the KIP. These subsequently approved areas included the KIP Start-up Camp near PR 280, portions of Borrow Areas KM-4, KM-9, G-1 and G-5 (which had previously been used and licensed under the KIP), the cemetery site adjacent to the NAR, and several pre-existing access trails utilized for accessing the reservoir clearing areas north and south of the Nelson River.

Areas impacted outside of the approved Project footprint totalled 8.6 ha (Table 3-2; Map 3-1), or 0.15% of total impacted area as of September 2021. As illustrated in Map 3-1, this 8.6 ha of impacts was very small (0.12%) relative to the 7,123 ha of remaining undisturbed area within the licensed Project footprint.

The total area impacted outside of the approved Project footprint increased by 0.08 ha from 2020. This increase was due to erosion and runoff effects in the Main Camp area and erosion effects in Borrow Area G-1.

Table 3-2: Cumulative actual Project clearing or disturbance area as of September 2021, by year and Project area

Project Area	Total Approved Area (ha)	Total Area (ha) ¹								Change (ha) from Previous Year ²						
		2014 (from KIP)	2015	2016	2017	2018	2019	2020	2021	2015	2016	2017	2018	2019	2020	2021
Planned Project Footprint	7,616	420	1,246	3,294	4,971	5,279	5,299	5,301	5,302	826	2,049	1,677	308	20	2	1
Possibly Disturbed Project Footprint	5,123	10	63	191	242	306	313	314	314	53	128	51	64	8	1	0
Subsequently Approved Project Areas ³	n/a	29	29	56	63	63	63	100	100	1	27	7	-	-	37	-
Outside the Approved Project Footprint	n/a	-	2	5	6	8	8	9	9	2	3	1	3	-	0	0
All	12,738	459	1,340	3,546	5,281	5,656	5,684	5,723	5,724	881	2,206	1,736	375	28	40	1

Notes:¹ Areas for some Project areas differ slightly from those presented in the 2016 through 2020 annual reports because some infrastructure downstream of the spillway was removed. ² Due to rounding, some of the change values are slightly different than obtained from subtracting the numbers in the table.³ Areas subsequently approved by the provincial government that are not part of the licensed Project footprint [*DN: Value may change following confirmation of subsequently approved areas.*].

3.3 CLEARING OR DISTURBANCE BY PROJECT COMPONENT

Of the 0.9 ha of additional Project impacts that occurred between September 2020 and 2021, approximately 41% was attributed to EMPAs D12(2)-E, D17-E and D16(1)-E, 36% to Work Area C and adjacent to the Transmission Station and 11% to the Main Camp area (Table 3-3; Map 3-1). The remaining new area was evenly distributed among several other footprint components.

Slopes within various Project footprints were graded since September 2020. Several locations were identified throughout the Project footprint where slopes were graded parallel to the slope direction. Parallel slope grading has greater potential to cause erosion through an increase in downslope water flow and velocity versus perpendicular grading (ECOSTEM 2021).

This section details clearing and disturbance observed within each Project component. Table 7-2 (Appendix 2) summarizes mitigation recommendations provided since monitoring began, as well as the associated follow-up actions.

Table 3-3: Cumulative actual area of Project clearing¹ or disturbance as of September 2021, by year and Project component

Project Component ²	Total Cleared or Disturbed ³ (ha)								Change from Previous Year ⁴ (ha)						
	2014 (from KIP)	2015	2016	2017	2018	2019	2020	2021	2015	2016	2017	2018	2019	2020	2021
North access road	192	192	193	193	193	193	193	193	1	0	-	-	-	-	-
South access road	0	300	326	326	326	326	326	326	300	26	0	-	-	-	-
Camp and work areas	187	232	236	237	239	239	239	240	46	3	1	2	1	0	1
Borrow areas	49	266	360	413	472	483	522	522	217	94	53	58	11	39	0
North dike and associated areas	19	133	183	198	199	200	200	200	115	50	15	1	0	-	0
South dike and associated areas	0	25	122	182	191	202	203	203	25	97	61	8	12	1	0
Generating station and river works	11	182	205	212	233	237	237	237	171	24	7	21	4	0	0
Reservoir clearing and access trails	2	9	1921	3520	3805	3805	3805	3805	7	1912	1599	285	0	-	-
All cleared or disturbed areas	459	1,340	3,546	5,281	5,656	5,684	5,723	5,724	881	2,206	1,736	375	28	40	1

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 Areas for some footprint types differ slightly from those presented in the 2016 through 2020 annual reports because some clearing was reclassified into other project components as construction progressed, some infrastructure in the river works area was removed and some cleared or disturbed area was part of initial flooding. ⁴ 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 2017 to 2021 (Table 3-3 and Table 3-4). No road construction activity was observed during 2021 surveys (although road maintenance was ongoing). All NAR clearing was within the planned Project footprint, and a small amount of SAR clearing was in the possibly disturbed Project footprint.

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 2021, by main Project component

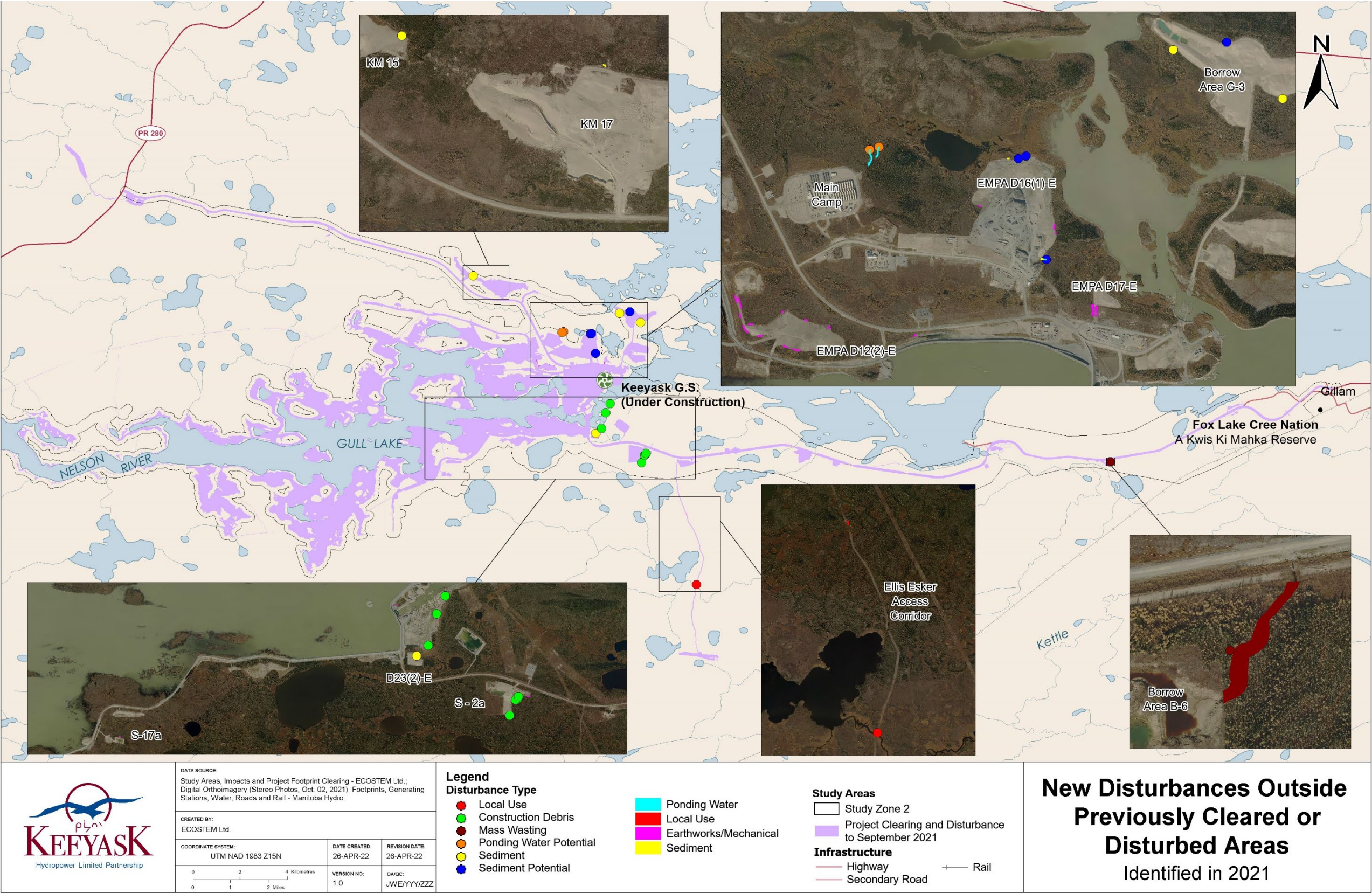
Project Component	Clearing or Disturbance (ha)					
	Within the Possibly Disturbed Project Footprint			Outside the Approved Project Footprint		
	2020	2021	Change	2020	2021	Change
Access Roads	4.45	4.45	-	-	-	-
Camp & Work Areas	3.55	3.57	0.02	0.06	0.14	0.08
Generating Station Area	12.80	12.80	0.00	-	-	-
Borrow Areas	58.03	58.05	0.02	5.54	5.55	0.00
EMPAs	66.75	66.81	0.06	0.52	0.52	-
Dikes	35.81	35.81	-	0.05	0.05	-
Reservoir Clearing & Cutlines	122.60	122.60	-	2.32	2.32	-
Total	303.99	304.09	0.10	8.50	8.59	0.08

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

Erosion disturbance on the south ditch bank of the NAR adjacent to Borrow Area KM-1 had created a gully since it was first identified during 2016 surveys. Erosion had expanded the gully between the ditch and the borrow area between 2016 and 2018 (Map 3-2). Field surveys in 2019 found that the area had since been remediated by filling the eroded area. Some minor erosion and sediment deposition around the eastern fringes of the remediated area was noted in 2019. The bank was subsequently covered with organic material, however minor erosion on the ditch slope was found during surveys in 2020. The 2021 monitoring recorded a slight expansion of erosion on the ditch slope and an increase in vegetation cover (Photo 3-1). The site will be monitored for substantive changes in 2022.



Photo 3-1: Erosion on ditch bank adjacent to Borrow Area KM-1



Map 3-2: New disturbances outside of previously cleared or disturbed areas identified in September 2021

3.3.2 MAIN CAMP, NORTH SHORE WORK AREAS AND WELL AREA

The extent of clearing for the Main Camp, Well Area and Helicopter Pad did not change from September 2020 to 2021.

At the northeast corner of the Main Camp, a disturbance in the form of outflow from a drainage culvert, produced a channel of water that flowed through previously undisturbed vegetation. By September 2021, the flowing water extended approximately 250 m into the undisturbed forest (Map 3-2; Figure 3-1). This was an increase of 90 m since September 2020 and an increase of 170 m since September 2019. Water percolating up from the ground, depositing sediment and forming an additional channel of flowing water, was identified during surveys in 2021 (Photo 3-2 and Photo 3-3). This new channel extended 130 m into the previously undisturbed forest. The total associated disturbed area expanded by 0.02 ha in the possibly disturbed Project area, and by 0.08 ha outside of the planned and possibly disturbed Project footprint area. At the time of the 2021 survey, this disturbance extended more than 160 metres past the approved Project footprint boundary, which was an increase of 85 m since September 2020.

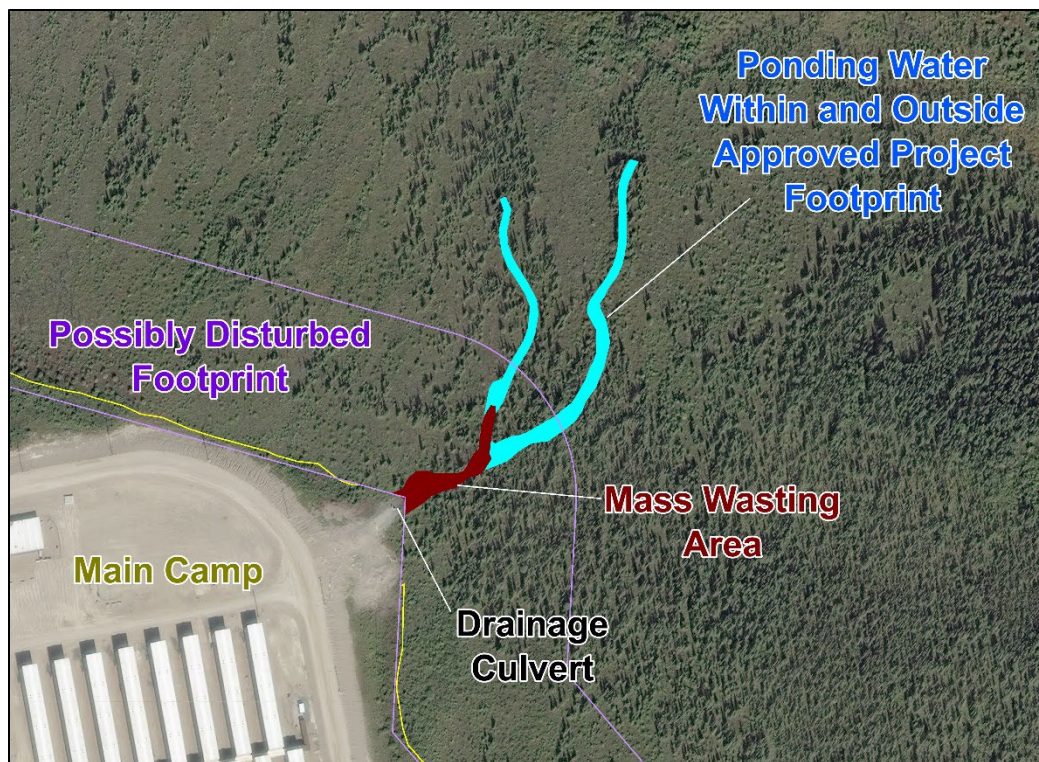


Figure 3-1: Mass wasting (in brown) and ponded water (in blue) outside Main Camp in 2021



Photo 3-2: Water percolating up from the ground northeast of Main Camp



Photo 3-3: Sediment deposition and new water channel northeast of Main Camp

Within this disturbed area, rapidly flowing water started flowing underground in spots, which created mass wasting and hollow areas within the substrate (Photo 3-4). Trees were also toppling in towards the hollowed areas. Outside of the Project footprint, this disturbance was affecting a common habitat type (black spruce (*Picea mariana*) dominant vegetation on thin peatland). This disturbance also has the potential to affect an off-system marsh if it reaches the low area adjacent to the marsh.



Photo 3-4: Water flowing into hollow area and then underground northeast of Main Camp

Approximately 0.16 ha of new clearing was identified during 2021 surveys in Work Area C (Map 3-2). This additional clearing within the planned Project footprint was the result of repositioning the road leading to the downstream boat launch area.

New clearing within the possibly disturbed Project footprint was also identified adjacent to the transmission sub-station totaling approximately 0.15 ha in 2021 (Map 3-2). This was due to transmission tower repairs.

In the northwestern edge of Work Area A, a site where sediment had been deposited into undisturbed areas was remediated in 2018 by excavating the deposited sediment. The excavation disturbed the buried vegetation and substrate. By the time of the 2019 surveys, new vegetation was colonizing the excavated area and sediment fencing had been installed at the base of the mineral slope. These mitigation efforts appeared to have prevented further disturbance in 2019, 2020 and 2021.

Construction debris found at the northwestern edge of Work Area A in 2020 had been removed at the time of the 2021 survey.

Issues noted during field surveys in 2020 included erosion and sediment deposition into undisturbed forest at the northern corner of the helicopter pad and ponded water at the western edge of Work Area X, between the NAR and North Dike. By September 2021, the sediment deposition at the helicopter pad had not increased and the ponding water at Work Area X had decreased due to recent earthwork in the area.

Approximately 0.1 ha of previously cleared area at the eastern edge of the downstream boat launch was also flooded by September 2020 and remained so in 2021.

3.3.3 START-UP CAMP

The Start-up Camp (i.e., initially developed under the KIP as a temporary camp) was a subsequently approved Project area (Section 2.2). While there has been no additional clearing in this area since the end of the KIP, vehicle traffic and other forms of activity created ongoing physical disturbance within previously cleared areas. Use of the Start-up Camp for accommodations ceased in 2019. In 2020 and 2021, the parking lot was being used to store the vehicles of staff staying at the Main Camp.

3.3.4 BORROW AREAS

Between September 2020 and 2021, the locations of new borrow area clearing was limited to Q-1 (0.05 ha) within the planned Project footprint. Excavation continued in 2021 at Borrow Area G-1 but this did not require any new clearing.

There was no borrow area clearing within the possibly disturbed Project footprint between September 2020 and 2021 (Table 3-4).

New or expanding disturbance totaling 0.03 ha was observed at several borrow areas during the 2020 surveys. The following paragraphs detail the occurrences.

3.3.4.1 BORROW AREA G-1

Erosion and sediment deposition into undisturbed forest was observed in 2020 at one location on the northern edge of Borrow Area G-1 at KM 17. Although sediment deposition continued to occur at this location in 2021, the area affected had not increased (Photo 3-5; Map 3-1). An additional area of sediment deposition was found adjacent to this location in 2021, however only a small area had been affected at the time of the survey and only a small portion of that was found to be outside of the planned and possibly disturbed Project footprint area. Sediment deposition on the southeastern edge of G-1 at KM 17 identified during 2020 surveys had not increased in size at the time of the 2021 survey. Erosion and sediment deposition was also observed at the eastern

corner of G-1 at KM 15 in 2020 and continued at the time of the 2021 survey, however the area affected had not increased (Map 3-2).



Photo 3-5: Erosion and sediment deposition at northern edge of Borrow Area G-1 at KM 17

3.3.4.2 BORROW AREA G-3

In past years at Borrow Area G-3, erosion on mineral slopes around the perimeter had been depositing sediment into the undisturbed forest at several locations. Sediment fences had been installed along portions of the south side of the borrow area in spring of 2019, but September surveys found that sediment was bypassing them. Surveys in 2020 and 2021 found that sediment deposition was ongoing in several spots around the perimeter despite all slopes being graded and sediment fences removed in the borrow area (Map 3-1; Map 3-2). Two adjacent locations on the northern edge where sediment deposition into undisturbed vegetation were taking place had the potential to affect a much greater area due to the natural topography. Sediment deposition into an adjacent marsh on the southwestern edge of the borrow area was also ongoing and increased slightly as of September 2021 (Photo 3-6).



Photo 3-6: Sediment deposits in marsh adjacent to Borrow Area G-3

Rock barriers were installed on the western edge of G-3 in mid-June 2020 and appeared to have been effective at retaining sediment within its bounds during surveys in 2021. Also found was sediment deposition into undisturbed forest past the eastern end of the rock barrier. A very small portion of this sediment deposition at the eastern end of the rock barrier was outside of the Approved Project footprint (Appendix 1: Table 7-1).

Erosion on excavated slopes in the eastern half of Borrow Area G-3 was observed to be washing away planted seedlings in 2020 (Photo 3-7). Surveys in 2021 found that erosion continued not only in this area but all throughout the excavated slopes of the borrow area (Photo 3-8). Seedling mortality and dieback of a large number of planted seedlings as a result of ponding water in the basin were also observed during surveys in 2020. By September 2021, all of the flooded seedlings at the bottom of the excavated crater had died (Figure 3-2; Photo 3-8).



Photo 3-7: Erosion affecting planted seedlings in Borrow Area G-3



Photo 3-8: Planted seedling mortality in Borrow Area G-3

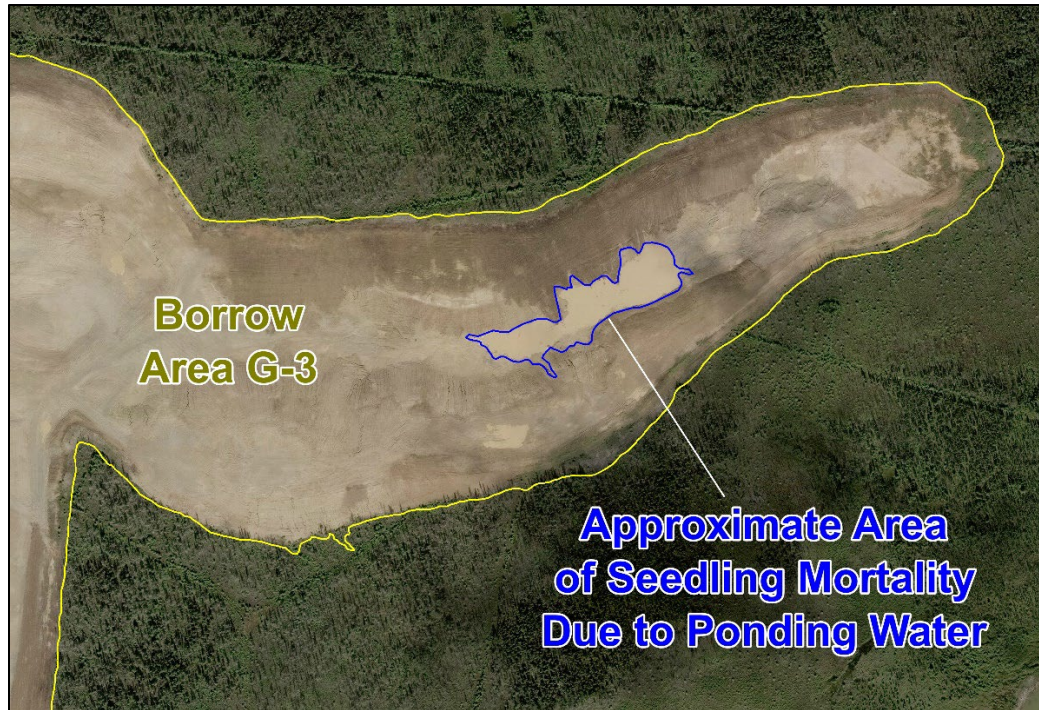


Figure 3-2: Approximate area where erosion and ponded water affected planted seedlings in the eastern portion of Borrow Area G-3

3.3.4.3 BORROW AREA G-5

At the time of the 2021 survey, all of the construction equipment that had been using Borrow Area G-5 since 2020 had been removed and access had been restricted with the placement of a gate at the entrance. No new clearing or disturbance was observed in the borrow area.

3.3.4.4 BORROW AREA KM-1

In Borrow Area KM-1, 2021 surveys found that erosion runnels continued to widen and deepen (Photo 3-9). The erosion was beginning to wash away planted seedlings and saplings.



Photo 3-9: Erosion in Borrow Area KM-1

3.3.4.5 BORROW AREA N-5

Surveys in Borrow Area N-5 up to September 2019 found that water from drainage hoses in various locations had eroded mineral slopes and deposited sediment into the undisturbed forest. Subsequently, hoses had been moved or removed from the area. Surveys in 2020 found that all the slopes had been graded, sometimes right to the treeline. These actions have been effective at slowing or stopping any further erosion and sediment deposition into undisturbed forest at the time of the 2021 survey. This site will be monitored for additional adverse effects in 2022.

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 2021 (Photo 3-10).



Photo 3-10: Sediment bag on south side of Borrow Area N-5 on September 13, 2021

3.3.4.6 BORROW AREA N-21

As of September 2021, the sediment deposition into adjacent otherwise undisturbed forest on the eastern edge of Borrow Area N-21 had remained stable since 2020 and had not increased in size or extent (Map 3-2).

3.3.4.7 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 3-1). Significant water flow from the SAR to the east edge of the pit undermined the previously undisturbed forest and created a deep, wide depression (Figure 3-3). The 2021 surveys found that although the impacted area had not expanded substantially since 2019, mass wasting along the disturbances edges was still occurring (Photo 3-11). Erosion and mass wasting was also identified on the northern edge of the excavated crater in Borrow Area B-6 (Photo 3-12).

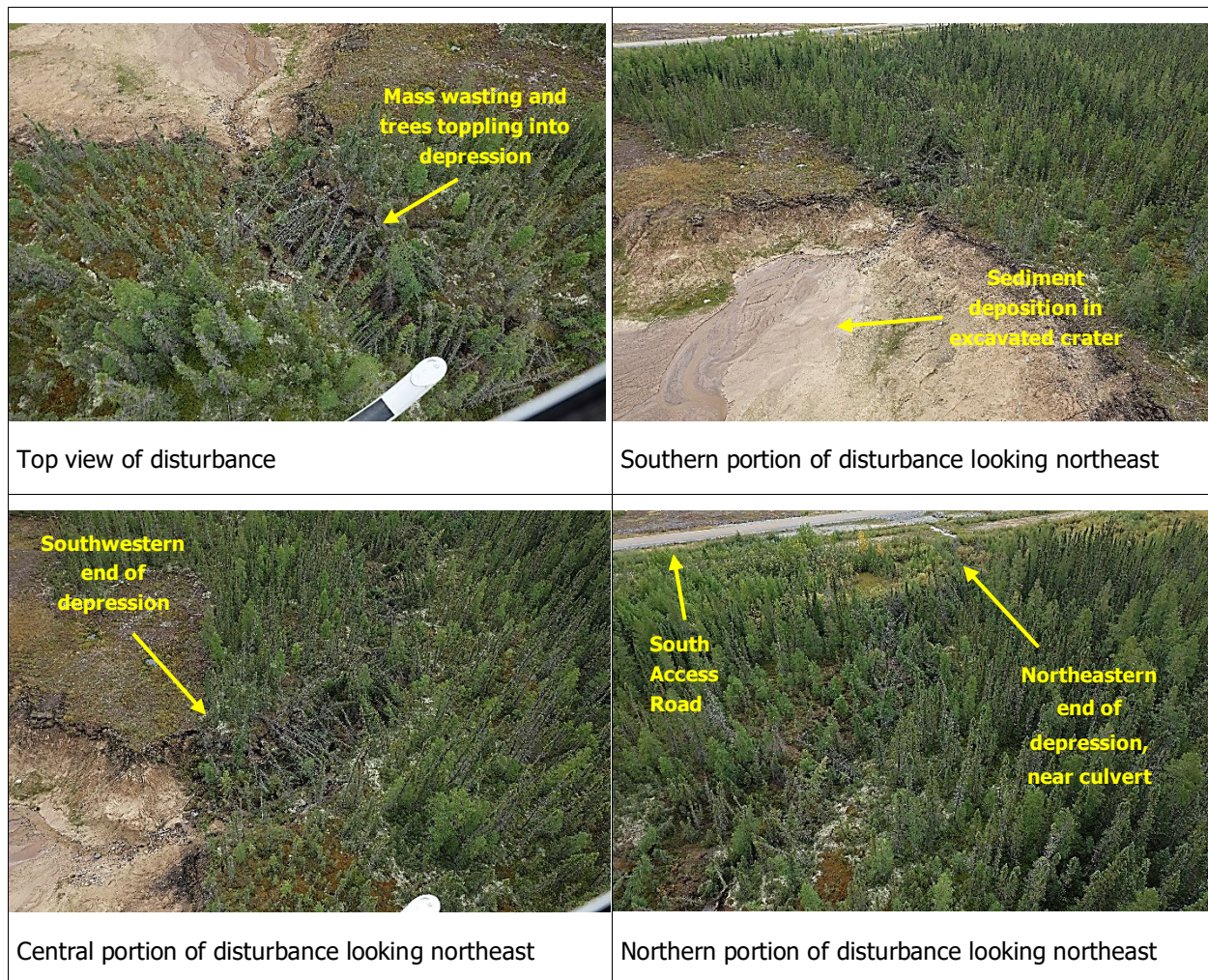


Figure 3-3: Aerial view of disturbance at Borrow Area B-6 showing extent of effects



Photo 3-11: New mass wasting along depression edges northeast of Borrow Area B-6

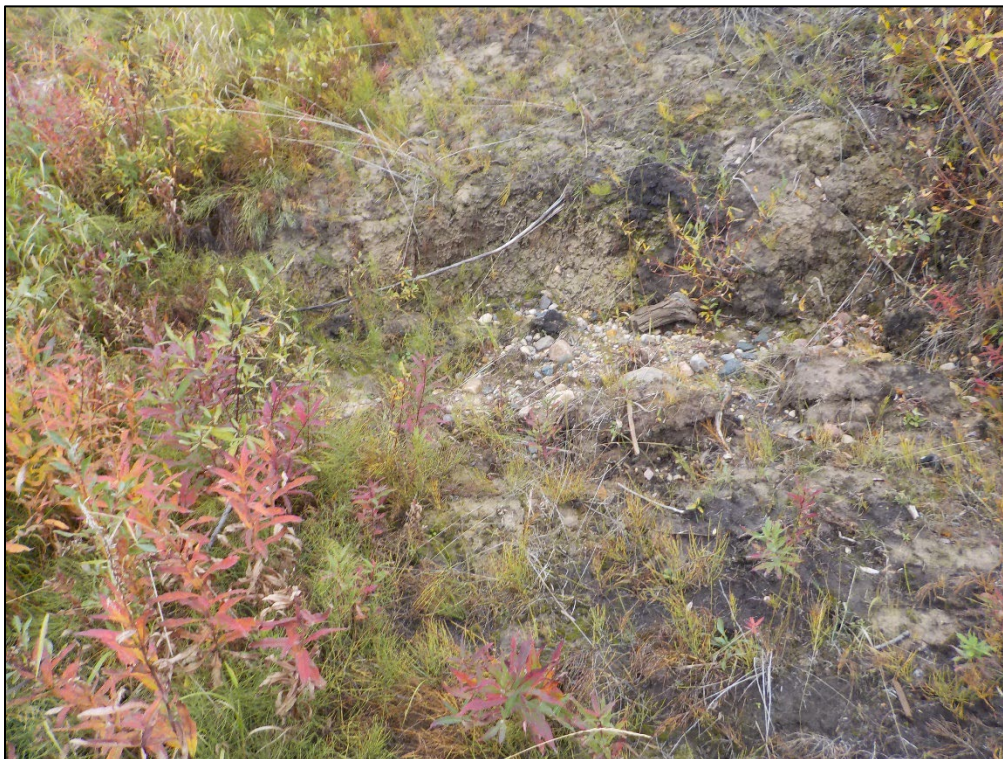


Photo 3-12: Erosion on the northern edge of the excavated crater in Borrow Area B-6

3.3.4.8 BORROW AREA E-1

Additional disturbance along the Ellis Esker (E-1) access corridor was observed in 2021 outside previously cleared areas (Map 3-1). These additional disturbances, which were ATV trails, totaled 0.02 ha within the possibly disturbed Project footprint (Appendix 1: Table 7-1; Photo 3-13). Other disturbances in the corridor observed in 2021 included two boats and several plywood planks located where the corridor intersected the stream flowing from Joslin Lake (Photo 3-14; Map 3-2).



Photo 3-13: ATV trails in Borrow Area E-1 access corridor



Photo 3-14: Boats and plywood planks in Borrow Area E-1 access corridor

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

Ponding water in Borrow Areas S-2a and S-2b found during 2020 surveys did not increase in size at the time of the 2021 surveys and no vegetation mortality was observed in adjacent undisturbed vegetation (Map 3-2). These locations will be monitored for adverse effects in 2022. No new clearing or disturbance was found outside of the planned Project footprint, however construction debris was found along the southern and eastern edges of Borrow Area S-2a (Photo 3-15).

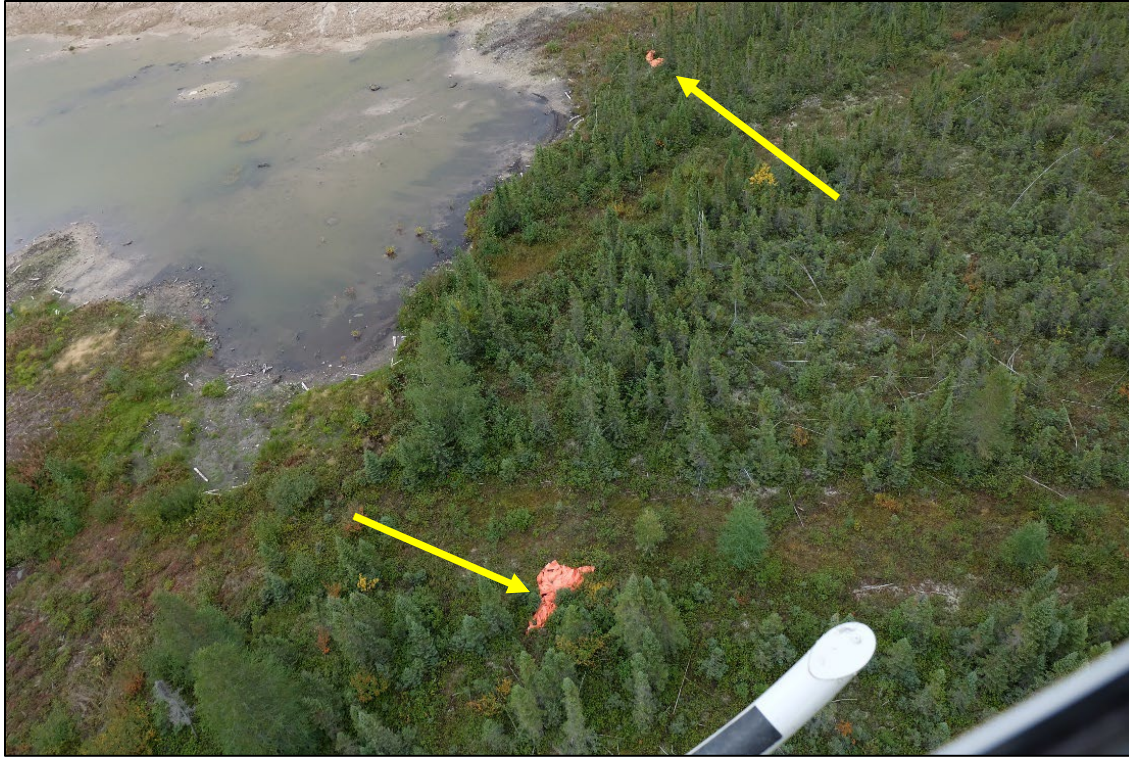


Photo 3-15: Construction debris along the eastern edge of Borrow Area S-2a

3.3.5 DIKES

For this report, the term dike includes the dike areas, the associated possibly disturbed Project footprint, and the narrow linear EMPAs that run parallel to the dikes within the planned Project footprint.

New clearing since September 2018 was not observed along the North Dike. Similarly, no new clearing was observed on the South Dike in 2021.

Ponded water disturbance was observed inside the South Dike bounds in 2020 and had not increased in size by the time of the 2021 survey. This ponding was entirely within planned Construction Footprint bounds at the time of the 2021 survey.

No disturbance was found within the possibly disturbed Project footprint along the north or south dikes during 2021 surveys (Appendix 1: Table 7-1).

3.3.6 EXCAVATED MATERIAL PLACEMENT AREAS

No new clearing was found in EMPAs throughout the Construction Footprint during surveys in 2021.

3.3.6.1 EMPA D12(2)-E

Approximately 0.17 ha of disturbed area was identified in various locations around the perimeter of EMPA D12(2)-E in 2021 (Map 3-2; Photo 3-16). Of which, 7% was within the possibly disturbed Project footprint (Appendix 1: Table 7-1). This disturbance can be attributed to the regrading of slopes in the area.



Photo 3-16: Regraded slopes and associated disturbance around perimeter of EMPA D12(2)-E

3.3.6.2 EMPA D16(1)-E

In previous years, several measures to mitigate erosion and sediment deposition around the edges of EMPA D16(1)-E were implemented, including:

- The northern portion of the EMPA was graded to smooth out the gullies caused by previous erosion;
- A continuous rock berm was constructed around the northern and eastern edges to curb erosion; and,
- Straw wattles were placed in gullies along the western edges to reduce the movement of sediment downhill.

Surveys in 2021 found that an additional 105 m of rock berm was constructed along the western edge of the EMPA and other portions of the rock berm were reinforced with additional material. Additional clay material was placed outside of the rock berm at the northern fringes of the EMPA (Photo 3-17). Straw wattles placed in gullies were removed along the western edges of the EMPA

and slopes here were regraded. A rock-lined drainage channel with turnouts that ran parallel to the rock berm further upslope was constructed in late 2020.



Photo 3-17: Mounded clay material (left), rock-lined drainage channel with turnouts (center) and regraded slopes (right) at northern and western edges of EMPA D16(1)-E

Erosion and sediment deposition into previously undisturbed vegetation was identified at various locations around the perimeter of EMPA D16(1)-E in 2020 and stemmed mainly from inconsistencies in the rock berm. The various mitigation measures implemented above alleviated many of the issues, however surveys in 2021 identified other issues that required attention.

As of September 2021, disturbance totaling 0.03 ha (8% of which was within the possibly disturbed Project footprint) was identified at four locations around the perimeter of EMPA D16(1)-E (Map 3-2; Appendix 1: Table 7-1). More than half (59%) of the new disturbance was located at the southwestern corner where erosion deposited sediment and created a flowing channel of water into previously undisturbed vegetation (Photo 3-18). The habitat affected was split evenly between tall shrub on thin peatland and black spruce dominant on thin peatland. The remaining disturbed area was the result of earthwork and grading efforts prior to the 2021 survey.



Photo 3-18: Sediment deposition and flowing water at the southwestern corner of EMPA D16(1)-E

A gap left in the rock berm on the western edge of EMPA D16(1)-E, which allowed sediment to pass through into the adjacent marsh habitat in 2020, was still present at the time of the 2021 survey. The runnel created by erosion leading to the gap in the rock berm was excavated, lined with rock and converted into a turnout for the drainage channel further upslope (Photo 3-19). Sediment deposition at this location had decreased from previous years as of September 2021, however it was unclear if this was a result of the recent earthworks in the area or due to decreased rainfall from previous years. This area will be monitored for additional adverse effects in 2022.



Photo 3-19: Gap in rock berm (center) and rock-lined turnout (top-center) adjacent to marsh (foreground) on western edge of EMPA D16(1)-E

Issues such as coarse rock berm composition, erosion and low rock berm elevation identified in 2020 were improved with the addition of material and reinforcing affected areas of EMPA D16(1)-E as of September 2021. A 75 m section of rock berm along the eastern edge of the EMPA was lower in elevation than the adjacent area and had potential to allow sediment over top, however nothing to that effect was observed at the time of the 2021 survey.

Surveys in 2021 identified some locations on the northern edge of EMPA D16(1)-E where erosion of the newly mounded clay outside of the recently reinforced rock berm was starting to occur (Photo 3-20). These locations had potential to deposit sediment into the adjacent undisturbed forest in the event of further erosion however it was not observed at the time of the survey in 2021.

The 2020 surveys also found construction debris at several sites within and outside of EMPA D16(1)-E. At the time of the 2021 surveys, no construction debris was found at any of the sites.



Photo 3-20: Erosion of mounded clay outside rock berm at northern edge of EMPA D16(1)-E

3.3.6.3 EMPA D17-E

Previous surveys at EMPA D17-E found that sediment from slope erosion was overwhelming sediment fences and being deposited into undisturbed vegetation. Additionally, runoff was entering an adjacent pond to the northeast. As of September 2021, a rock berm had been constructed along the northwestern edges (Photo 3-21). This area will continue to be monitored for adverse effects in 2022.



Photo 3-21: Rock berm constructed along northwestern edges of EMPA D17-E

Approximately 0.15 ha of new disturbance in previously undisturbed vegetation was identified at the entrance of EMPA D17-E at the time of the 2021 surveys (Map 3-2; Photo 3-22). About 31% of the new disturbance was within the possibly disturbed Project footprint (Appendix 1: Table 7-1). This disturbance can be attributed to road decommissioning efforts within the Construction Footprint.



Photo 3-22: Road decommissioning and associated adjacent disturbance at entrance of EMPA D17-E

3.3.6.4 EMPA D23(1)-E

At the time of the 2021 survey, the eastern half of EMPA D23(1)-E was being used as a granular material storage area. Construction debris in the adjacent undisturbed forest at the southern edge of the EMPA noted during 2020 surveys was removed by September 2021.

3.3.6.5 EMPA D23(2)-E

Erosion and sediment deposition within the planned Project footprint area was found overtopping previously installed rock berms at the northeastern edge of EMPA D23(2)-E in 2020 and conditions remained the same at the time of the 2021 surveys (Photo 3-23). 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 3-4).

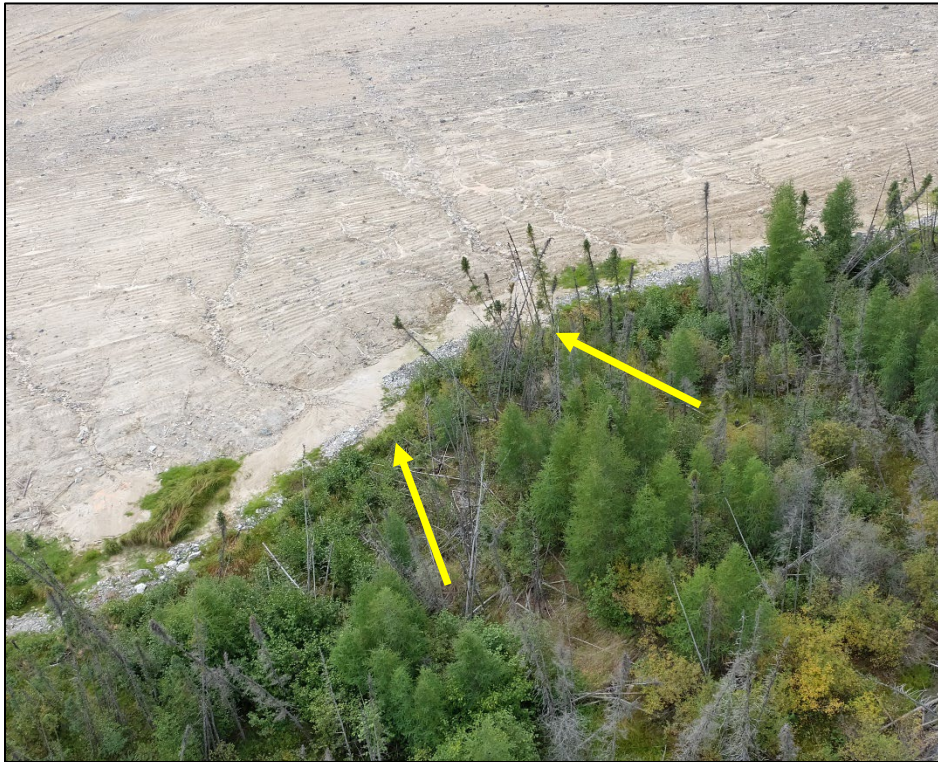


Photo 3-23: Sediment overtopping rock berm in EMPA D23(2)-E

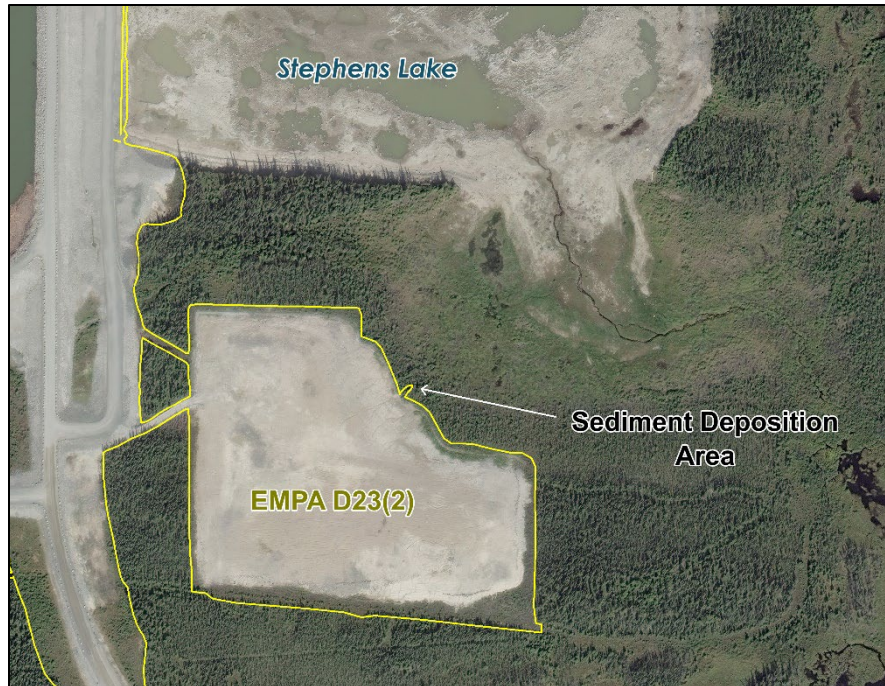


Figure 3-4: Erosion and sediment deposition from EMPA D23(2)-E

3.3.6.6 EMPA D27(4)-E

In previous years, water had collected in localized sites at the base of the EMPA slope and formed ponds which extended into the adjacent undisturbed forest, causing vegetation mortality. While emergent marsh plants (likely sedges) had initially been colonizing the ponds, these plants had mostly disappeared by September 2019. At the time of the 2021 surveys, water levels in the ponds were considerably lower and some vegetation was observed in the dried ponds (Photo 3-24). The amount of tree and vegetation dieback had not increased since September 2020. A strong stagnant odour noted in the general area around the pools in 2020 was not noticed at the time of the 2021 survey. Monitoring for adverse effects in this area will continue in 2022.



Photo 3-24: Dried ponds with some vegetation regeneration on the northern edge of EMPA D27(4)-E

3.3.6.7 EMPA D28(1)-E

Vegetation dieback was observed along the northern edge of EMPA D28(1)-E in 2020 as a result of ponding water. By September 2021, water levels had gone down considerably and the amount of vegetation dieback had not increased (Photo 3-25). Monitoring for adverse effects in this area will continue in 2022.



Photo 3-25: Aerial view of ponded water and dying vegetation on northern edge of EMPA D28(1)-E

3.3.6.8 EMPA D35(1)-E

At the eastern edge of EMPA D35(1)-E in 2020, ponded water as well as significant tree dieback was observed in the adjacent undisturbed forest. Water levels had gone down considerably by September 2021 and the area of dieback had not increased (Photo 3-26). Monitoring for adverse effects in this area will continue in 2022.



Photo 3-26: Ponded water and tree dieback at the eastern edge of EMPA D35(1)-E

3.3.7 RIVER WORKS AREA

Removal of causeways and cofferdams since September 2020 re-inundated about 1.2 ha of previously dewatered area south of the powerhouse. Since these areas were previously dewatered and subsequently flooded, this did not add to the total amount of clearing or disturbance in 2021.

Surveys in 2021 found three areas along the southern shore of the Nelson River downstream of the dam where portions of ice booms had washed up onto the shore (Photo 3-27; Map 3-2).



Photo 3-27: Portions of ice boom (yellow area) washed up on the south shore of the Nelson River, downstream of the dam (dewatered area)

3.3.8 RESERVOIR CLEARING

The planned reservoir clearing was completed prior to the time of the 2018 surveys and as of 2019, reservoir clearing accounted for the majority (66%) of all Project clearing to date.

As of September 2020, approximately 122 ha of reservoir clearing was within the possibly disturbed Project footprint, situated around the perimeter of the reservoir clearing footprint (Appendix 1: Table 7-1).

3.3.9 TRAILS

No new trails were cleared between September 2020 and 2021. No new trails were found in the possibly disturbed Project footprint (Appendix 1: Table 7-1).

4.0 DISCUSSION AND RECOMMENDATIONS

Project clearing or disturbance between September 2020 and 2021 increased by less than 1 ha. Only about 0.4 ha of this total was clearing. This was by far the lowest annual amount of clearing since the start of Project construction, which was consistent with Manitoba Hydro's indication in May 2018 that the vast majority of Project clearing was complete.

Since habitat monitoring began in 2015, recommendations regarding impacts that may merit mitigation have been provided to Manitoba Hydro following the annual field surveys, and in annual reports. In general, the mitigation carried out in response to these recommendations effectively addressed the identified concern.

The exceptions to the immediately effective mitigation included situations where the implemented measure was not adequate to address the concern or new measures were required to respond to changing conditions. This section discusses the exceptions that were ongoing at the time of the 2021 surveys and provides mitigation recommendations for the more substantive ongoing disturbances. Table 7-2 (Appendix 2) summarizes all of the mitigation recommendations provided since Project construction began, as well as the associated follow-up actions.

At the northeast corner of the Main Camp, water outflow from the culvert draining the camp area has been impacting otherwise undisturbed terrestrial habitat adjacent to the camp footprint. These impacts include the creation of an intermittent stream extending up to 250 metres beyond the camp perimeter as well as mass wasting and vegetation collapse in the portion of the disturbance that is nearest to the camp (see Section 1.1.1 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. Therefore, it is recommended that measures be implemented to slow the water flow and contain it within the possibly disturbed Project footprint (Figure 3-1). The potential effects of this disturbance on the nearby off-system marsh is examined in the Wetland Loss and Disturbance Monitoring report for 2021 monitoring (ECOSTEM 2022b).

At Borrow Area G-1, erosion is depositing sediment into adjacent undisturbed vegetation along the northern edge (see Section 3.3.4.1 for details). To prevent an expansion of the sediment deposition area, it is recommended that sediment barriers be installed and/or slopes be regraded as needed at these locations.

At Borrow Area G-3, ongoing erosion and runoff is impacting otherwise undisturbed terrestrial habitat as well as planted tree seedlings (see Section 3.3.4.2 for details). For the locations where sediment deposition is impacting otherwise undisturbed terrestrial habitat, it is recommended that sediment barriers be installed or extended.

Planted tree seedlings in G-3 are being affected by upslope water runoff or erosion. In the area where planted tree seedlings are being inundated by upslope water runoff, it is not feasible to

prevent further seedling mortality from occurring as the surrounding area is at a higher elevation. Additionally, it is possible that the ground surface of this area is at or below the top of the groundwater table. On this basis, it is recommended that trees not be planted at the bottom of low areas where periodic ponding of water may occur.

Mitigation is not recommended for the slopes in G-3 where planted tree seedlings are being washed away 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 parallel to the slope (Figure 4-1), which increases the amount of downslope water flow and its velocity. A recommendation for future grading and site preparation is to complete the machine work in a direction that is perpendicular to the slope direction where this is safe to do.



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



Example of erosion and water ponding in low areas, with seedlings washing away in same area

Figure 4-1: Grading and site preparation parallel to slope direction in G-3, and associated erosion and tree impacts

It was noted that grading was parallel rather than perpendicular to the slopes in EMPA D16(1)-E, Borrow Area G-1 at KM17 and at EMPA D12(2)-E. Although no erosion or runoff effects were observed at those locations during 2021 surveys, it is recommended that parallel slope grading be reserved for areas where perpendicular grading is not possible for safety or other reasons.

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 3.3.4.4 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.

Several disturbances were found along the access corridor to the Ellis Esker borrow area (see Section 3.3.4.8 for details). These disturbances did not appear to be caused by the Project. Ongoing consultations with the partner First Nations will determine if access to this corridor should be blocked.

At EMPA D16(1)-E, rock berms and other structures had been constructed to stop the erosion and sediment deposition that was impacting otherwise undisturbed terrestrial habitat. At the time of the 2021 surveys, erosion and sediment deposition was being well contained within the rock berm with the exception of the western edge where there was a gap (see Section 3.3.6.1 for details). As the sediment deposition occurring on the western edge of this EMPA D16(1)-E was extending towards an off-system marsh, it is recommended that the rock berm be reinforced where it is inadequately containing sediment. It is also recommended that site staff monitor the rock berm for other locations where this situation is occurring and implement reinforcement measures as appropriate.

A disturbance at the southwestern corner of EMPA D16(1)-E created a channel of water into undisturbed forest and deposited sediment in the area (see Section 3.3.6.2 for details). No mitigation is recommended for this site at this time given that it is small in area and substantial expansion of the deposition area is not anticipated. This site will be monitored for additional effects in 2022.

At the northeastern edge of EMPA D23(2)-E, erosion-related sediment deposition was approaching the dewatered portion of Stephens Lake (see Section 3.3.6.5 for details). It is recommended that measures be implemented to eliminate or reduce sediment movement beyond the existing rock berm.

Project-related water ponding observed in many locations in previous years had not increased at the time of the 2021 survey and in some cases receded somewhat, likely due to lack of precipitation during the summer months. This ponding has been present for several years in some of these locations. The ponding water has caused substantial tree and vegetation dieback in some locations (i.e., at EMPAs D27(4)-E, D28(1)-E and D35(1)-E) and has the potential to do so at additional locations (i.e., interior portions of the South Dike). No mitigation is recommended for these locations at this time as they mostly lie between the EMPAs and the dike, all of the impacted areas are relatively small, and/or they exist as a narrow band along the dike.

Erosion and sediment deposition into undisturbed vegetation was observed in several other sites around the Construction Footprint. No mitigation is recommended for these sites at this time given

that each of the impacted sites is small in area, substantial expansion of the deposition area is not anticipated and a common habitat type is being affected.

Construction debris was also found in several areas during site surveys in 2021. These included the southern and western edges of Borrow Area S-2a 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 during continued decommissioning efforts.

5.0 COMPARISON WITH PREDICTED EFFECTS

5.1 PREDICTED EFFECTS

The *Keeyask Generation Project Response to EIS Guidelines* (EIS; KHLP 2012b) included predictions as to how the Project was expected to effect terrestrial habitat as a whole. The EIS predicted that Project construction could directly affect up to 6,872 ha of terrestrial habitat, but this could increase to 6,952 ha if borrow area E-1 (Ellis esker) was used.

5.2 MITIGATION

The EIS predictions were based on the following mitigation measures being implemented during the construction period:

1. It was anticipated that substantial portions of the potential disturbance and borrow areas would not be used;
2. Clearing within the south access road right-of-way (ROW) will be minimized to the extent possible, which could further reduce the total area affected;
3. The EnvPPs include measures intended to minimize clearing and disturbance outside of the permanent Project components (e.g., in the potential disturbance areas); and,
4. It was anticipated to be highly unlikely that Borrow Area E-1 would be used.

Borrow Area E-1 ended up being used for the Project because it was subsequently discovered that sufficient suitable material for constructing the Project was not available in other borrow areas. The footprint of this Project feature was 80.3 ha, which included 40.5 ha for the winter access road to it.

EnvPP measures directed towards minimizing Project clearing and disturbance (applies to mitigation measures 1 to 3 above) were generally implemented as prescribed and were effective. While the EIS assumed that the terrestrial habitat component of the Construction Footprint would be 6,952 ha if the Ellis Esker borrow area was used (see next section), the actual Construction Footprint was 20% smaller in area (see next section). Additionally, areas impacted outside of the approved Project footprint as of September 2021 totalled only 8.6 ha, or 0.15% of total impacted area. This 8.6 ha of impacts was also very small (0.12%) relative to the 7,123 ha of habitat area within the licensed Project footprint was undisturbed at the end of construction.

5.3 RESIDUAL PROJECT EFFECTS

Direct Project effects on terrestrial habitat during the construction phase were evaluated by identifying which terrestrial habitat areas were within the Construction Footprint.

Monitoring has shown that the size of the Construction Footprint as well as direct Project effects on terrestrial habitat during construction were consistent with EIS predictions. The Construction Footprint included approximately 5,578 ha of terrestrial habitat. While this was 1,374 ha less than predicted in the EIS, a large reduction in area was anticipated due to the cautious approach used to define areas that could possibly be impacted by the Project.

The total terrestrial habitat area included 587 ha of pre-existing human infrastructure. The total native habitat area was 4,987 ha.

With one exception, every native land cover type had lower direct effects than assumed for the EIS (Table 5-1). In descending order, the highest differences were for Needleleaf treed on mineral or thin peatland cover types, Needleleaf treed on other peatlands and Low vegetation on mineral or thin peatland cover types. The exception was for the Shrub/ low vegetation on riparian peatland cover type, where actual direct effects were 6.5 ha more than assumed for the EIS.

Table 5-1. Predicted and actual area (ha) of terrestrial habitat in the Construction Footprint, by land cover type

Land Cover	EIS			Actual Construction Footprint	Difference
	NO Ellis Esker	Ellis Esker	Total EIS		
Needleleaf treed on mineral or thin peatland	3,083.7	45.5	3,129.2	2,162.8	-966.4
Needleleaf treed on other peatlands	2,062.0	17.8	2,079.7	1,780.5	-299.2
Low vegetation on mineral or thin peatland	419.0	7.6	426.6	160.6	-266.0
Nelson River shore zone	282.8	0.0	282.8	72.7	-210.1
Tall shrub on other peatlands	40.7	0.0	40.7	35.3	-5.3
Broadleaf treed on all ecosites	189.2	0.0	189.2	71.5	-117.8
Low vegetation on other peatlands	522.9	9.4	532.3	445.4	-86.9
Tall shrub on mineral or thin peatland	49.4	0.0	49.4	33.3	-16.1
Off-system shore zone	8.4	0.0	8.4	4.3	-4.1
Shrub/ low vegetation on riparian peatland	214.0	0.0	214.0	220.5	6.5
All	6,872.0	80.3	6,952.3	4,987.0	-1,965.3

6.0 SUMMARY AND CONCLUSIONS

6.1 SUMMARY

The Habitat Loss and Disturbance study is monitoring the actual extent of Project-related clearing and disturbance during construction. This is the largest direct Project effect on terrestrial habitat, ecosystems and plants.

Much of the planned Project footprint had been cleared by September 2017, and most of the future reservoir area had been cleared by September 2018. Additional Project clearing from 2018 to 2021 totaled approximately 28 ha.

As of September 2021, the Project clearing (includes dewatered areas) or disturbance (i.e., the Construction Footprint) totalled 5,724 ha (not including additional initial flooding areas).

The size of the cleared and disturbed Project footprint increased by less than 1 ha between September 2020 and 2021. Disturbance accounted for the majority (57.6%) of this total. Most of this disturbance was found in the EMPAs where road retirement and slope grading were occurring.

As of September 2021, 45% of the originally licensed Project footprint had been cleared or disturbed.

Of the total area cleared or disturbed by September 2021, 93% (5,302 ha) was within the planned Project footprint, and 5.5% (314 ha) was within the possibly disturbed Project footprint (Map 2-1). The total impacted area in the possibly disturbed Project footprint was only 6.1% of the 5,123 ha included within this Project area.

To date, there has been 8.5 ha of clearing or disturbance outside the approved Project footprint. Most of this area was located at Borrow Areas G-1 and E-1, around EMPA D16(1)-E and around the fringes of the reservoir clearing area (Map 3-1).

The 8.6 ha of clearing or disturbance outside the approved Project footprint was very small (0.15%) relative to the 7,123 ha of still undisturbed area within the licensed Project footprint. Additionally, virtually all of the still undisturbed area within the licensed Project footprint in 2021 is expected to remain undisturbed by the Project.

Monitoring has shown that the size of the Construction Footprint as well as direct Project effects on terrestrial habitat during construction were consistent with EIS predictions. The size of the Construction Footprint is 20% lower than predicted in the EIS. Additionally, the Project has not created any major unanticipated removal or alteration of terrestrial habitat. EIS mitigation measures were generally implemented and have been effective.

6.2 RECOMMENDATIONS

Results from the 2021 monitoring led to recommendations for additional mitigation in 12 localized areas. There are no recommendations to modify the study methods based on monitoring results to date.

Monitoring fieldwork for the Habitat Loss and Disturbance study will continue in 2022.

7.0 LITERATURE CITED

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APPENDIX 1: DETAILED RESULTS

Table 7-1: Clearing or physical disturbance within the possibly disturbed areas and outside of the combined planned, possibly disturbed and subsequently approved areas as of September 2021, by Project component and Project Areas

Project Component	Component Name	Clearing or Disturbance (ha)					
		Within Possibly Disturbed Areas			Outside of Combined Planned, Possibly Disturbed and Subsequently Approved Areas		
		2020	2021	Change	2020	2021	Change
Access Roads	South Access Road	4.45	4.45	-	-	-	-
	Main Camp	0.13	0.15	0.02	0.06	0.14	0.08
Camp & Work Areas	Work Area A	-	-	-	-	-	-
	Work Area B	0.75	0.75	-	-	-	-
	Work Area C	0.42	0.42	-	0.01	0.01	-
	Work Area X	0.29	0.29	-	-	-	-
	Hydro Offices South	0.11	0.11	-	-	-	-
	Portage Route	0.37	0.37	-	-	-	-
River Works Area	Generating Station	1.49	1.49	-	-	-	-
	Spillway & Cofferdam	1.54	1.54	-	-	-	-
Quarries and Borrow Areas	B-2	11.26	11.26	0.00	-	-	-
	B-3	0.40	0.40	-	-	-	-
	B-5	2.72	2.72	-	-	-	-
	B-6	0.75	0.75	-	-	-	-
	B-8	0.05	0.05	-	-	-	-
	G-1	1.79	1.79	-	-	-	-
	G-3	-	-	-	2.91	2.91	0.00
	N-5	-	-	-	0.01	0.01	-
	Q-1	-	-	-	0.20	0.20	-
	Q-9	0.48	0.48	-	-	-	-
	E-1	0.14	0.14	-	-	-	-
	E-1 Access	24.95	24.95	-	2.42	2.42	-
	D1(2)-I	26.75	26.77	0.02	0.01	0.01	-
	D12(1)-E	0.03	0.03	-	-	-	-
	D12(2)-E	0.01	0.01	-	-	-	-
Excavated Material Placement Areas	D16(1)-E	6.16	6.17	0.01	-	-	-
	D17-E	15.60	15.60	0.00	0.46	0.46	-
	D23(1)-E	0.00	0.05	0.05	0.02	0.02	-
	D23(2)-E	1.57	1.57	-	-	-	-
	D27(4)-E	6.40	6.40	-	-	-	-
	D28(1)-E	26.46	26.46	-	0.01	0.01	-
	D31(1)-E	6.02	6.02	-	-	-	-
	D31(2)-I	1.28	1.28	-	-	-	-
	D3-E	0.12	0.12	-	0.00	0.00	-

Project Component	Component Name	Clearing or Disturbance (ha)					
		Within Possibly Disturbed Areas			Outside of Combined Planned, Possibly Disturbed and Subsequently Approved Areas		
		2020	2021	Change	2020	2021	Change
	D7-E	0.02	0.02	-	-	-	-
	D9-I	0.01	0.01	-	-	-	-
Dikes	North Dike	24.80	24.80	-	0.01	0.01	-
	South Dike	11.01	11.01	-	0.04	0.04	-
Reservoir	Reservoir Clearing	122.27	122.27	-	1.60	1.60	-
Clearing	Trails	0.33	0.33	-	0.73	0.73	-
Total		303.99	304.09	0.10	8.50	8.59	0.08

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

APPENDIX 2: MITIGATION RECOMMENDATIONS

Table 7-2: Summary of Mitigation Recommendations

Location	Year	Identified Impact	Mitigation Recommendation¹	Mitigation Implemented
North Access Road at KM-1	2016	Erosion of ditch bank under trees.	Aug. 2016: Consider erosion control measures at this location.	Eroded area filled with earth in late summer, 2019.
	2017	Erosion of ditch bank under trees.	Sep. 2017: Consider mitigation options to prevent further erosion or collapse of the bank.	Eroded area filled with earth in late summer, 2019.
	2019	Minor erosion and sediment deposition around the eastern fringes of the remediated area in 2019.	Jun. 2020: Site staff inspect and evaluate these areas, and implement erosion control measures as needed.	None to date.
	2020	Minor erosion and sediment deposition around the eastern fringes and downslope of the remediated area in 2019.	Jun. 2021: Site staff inspect and evaluate these areas, and implement erosion control measures as needed.	None to date.
	2021	Minor erosion and sediment deposition around the eastern fringes and downslope of the remediated area in 2019.	Jun. 2022: Site staff inspect and evaluate these areas, and implement erosion control measures as needed.	None to date.
Main Camp	2019	Water outflow from culvert at northeast corner causing mass wasting and disturbance.	Sep. 2019: None.	None applicable to date.
	2020	Water outflow from culvert at northeast corner causing mass wasting and disturbance.	Jun. 2021: Implement measures to slow water flow and contain disturbance within the possibly disturbed Project footprint.	None to date.
	2021	Water outflow from culvert at northeast corner causing mass wasting and disturbance.	Jun. 2022: Implement measures to slow water flow and contain disturbance within the possibly disturbed Project footprint.	None to date.
Helicopter Pad	2020	Erosion and sediment deposition on northern corner of pad.	None to date.	None applicable to date.
	2021	Erosion and sediment deposition on northern corner of pad.	None to date.	None applicable to date.
Borrow Area G-1	2020	Erosion and sediment deposition in undisturbed forest	Jun. 2021: Install sediment barriers and/or regrade slopes as needed.	None to date.

Location	Year	Identified Impact	Mitigation Recommendation ¹	Mitigation Implemented
Borrow Area G-1	2021	Erosion and sediment deposition in undisturbed forest	Jun. 2022: Install sediment barriers and/or regrade slopes as needed.	None to date.
Borrow Area G-3	2016	Sediment deposition toward Stephens Lake from BA G-3.	Sep. 2016: Further mitigation methods in area were discussed with site staff.	Sediment fence installed.
	2018	Sediment bypassing sediment fences along SE perimeter. Erosion depositing sediment at several other locations around area perimeter.	Sep. 2018: Site staff inspect the area, reinforce sediment fences where needed, and evaluate and implement additional erosion control measures as needed.	Sediment fence installed along part of the south side.
	2019	Sediment bypassing new sediment fences along south perimeter. Erosion depositing or has potential to deposit sediment at several other locations around G-3 perimeter.	Sep. 2019: Site staff inspect the perimeter to evaluate and implement additional or enhanced erosion control measures as needed.	Slopes graded and sediment fences removed. Rock barriers constructed along western edges.
	2020	Sediment deposition in various locations around perimeter.	Jun. 2021: Install or extend sediment barriers where needed.	None to date.
	2020	Erosion and ponded water washing away and killing planted seedlings in eastern half of G-3.	Jun. 2021: In future, low areas within excavated borrow areas that are susceptible to ponding water will not be planted with trees.	Implemented in 2021.
	2021	Sediment deposition in various locations around perimeter.	Jun. 2022: Install or extend sediment barriers where needed.	None to date.
	2021	Erosion washing away seedlings on excavated slopes.	Jun. 2022: Site staff inspect the perimeter to evaluate and implement erosion control measures as needed.	None to date.
Borrow Area KM-1	2019	Erosion runnels widening/deepening in pit area.	Jun. 2020: Site staff inspect the perimeter to evaluate and implement erosion control measures as needed.	None to date.
	2020	Erosion runnels widening/deepening in pit area.	Jun. 2021: Site staff inspect the excavated areas to evaluate and implement erosion control measures as needed.	None to date.

Location	Year	Identified Impact	Mitigation Recommendation ¹	Mitigation Implemented
Borrow Area KM-1	2021	Erosion runnels widening/deepening in pit area.	Jun. 2022: Site staff inspect the excavated areas to evaluate and implement erosion control measures as needed.	None to date.
Borrow Area N-5	2017	Drainage hose on north side of area eroded slope and depositing sediment into undisturbed area.	Sep. 2017: Relocate the water discharge off the bank, extend the hose to the bottom of the bank.	Drainage hose moved to different location.
	2018	Drainage hose on north side of area eroded slope and depositing sediment into undisturbed area.	Jul. 2018: Take steps to eliminate bank erosion at this new location - site staff notified following discovery.	Drainage hose extended to base of slope and sediment bag was installed.
	2018	Erosion and sediment deposition from drainage hose and failed sediment bag on south side of N-5.	Sep. 2018: Evaluate whether or not future sediment will be naturally contained within the existing deposition area and, if not, implement appropriate containment measures.	Drainage hose removed in 2019 and all slopes graded in 2020.
	2019	Sediment bag remained at old drainage hose location on south side of N-5.	Jun. 2020: Remove sediment bag from location.	None to date.
	2021	Sediment bag remained at old drainage hose location on south side of N-5.	Jun. 2022: Remove sediment bag from location.	None to date.
Borrow Area N-21	2019	Sediment depositing several meters into undisturbed adjacent forest on the eastern edge.	Jun. 2020: Site staff inspect and evaluate these areas and implement erosion control measures as needed.	None to date.
	2020	Sediment depositing several meters into undisturbed adjacent forest on the eastern edge.	Jun. 2021: Install sediment barriers and/or regrade slopes along eastern edge.	None to date.
Borrow Area B-6	2019	Mass wasting causing disturbance along drainage channel between borrow area and South Access Road.	None to date.	None applicable to date.
	2020	Mass wasting causing disturbance along drainage channel between borrow area and South Access Road.	None to date.	None applicable to date.

Location	Year	Identified Impact	Mitigation Recommendation ¹	Mitigation Implemented
Borrow Area B-6	2021	Mass wasting causing disturbance along drainage channel between borrow area and South Access Road.	None to date.	None applicable to date.
Borrow Area E-1 (Ellis Esker) Access Corridor	2020	Local use of right-of-way causing disturbance in undisturbed forest.	Sep. 2020: Site staff informed of local usage. Jun. 2021: Continued consultation with partner First Nations on use of this area.	None to date.
	2021	Local use of right-of-way causing disturbance in undisturbed forest.	Jun. 2022: Continued consultation with partner First Nations on use of this area.	None to date.
Borrow Areas S-2a and S-2b, Work Area X	2020	Inland water ponding with potential to affect surrounding undisturbed vegetation.	None to date.	None applicable to date.
	2021	Construction debris outside Borrow Area S-2a bounds.	Jun. 2022: Site staff remove debris.	Debris will be removed when S2-A is decommissioned.
South Dike	2016	Sunken ATV in wetland.	Aug. 2016: Remove ATV as soon as possible.	ATV removed.
	2020	Water ponding in areas inside dike bounds.	None to date.	None applicable to date.
EMPA ² D16(1)-E	2017	Erosion and sediment deposition into undisturbed habitat on north and east sides of the area.	Aug. 2017: Repair and reinforce sediment fence on east side and install sediment fence on the north side.	Sediment fence installed at north side, repaired at east side.
	2018	Sediment deposition into bay of Stephens Lake on north side of area, water flow from calcareous pond. Sediment fences overwhelmed.	Sep. 2018: Inspect the entire northeast side of area, and repair existing and/or add new erosion containment measures to prevent sediment from entering Stephens Lake.	Sediment fences were repaired or reinforced in the fall of 2018. Installation of rock berms and organic material armouring along base of northeast slope in March 2019. Sediment fencing removed and straw wattles placed in gullies along west slopes in April 2019.
	2019	Sediment deposition into surrounding undisturbed areas past rock barrier on eastern edge.	Sep. 2019: Enhance containment measures where needed and assess if further measures are feasible.	Cover crop seeding for erosion control planted in summer 2021.

Location	Year	Identified Impact	Mitigation Recommendation ¹	Mitigation Implemented
EMPA ² D16(1)-E	2019	Sediment deposition into surrounding cleared areas past straw wattles and removal of sediment fences on western edge.	Jun. 2020: Enhance containment measures where needed and assess if further measures are feasible.	Expansion of rock berm on western edges in 2019. Cover crop seeding for erosion control planted in mid-August 2021.
	2020	Sediment deposition into surrounding cleared areas around the EMPA and past straw wattles, through gap in rock berm.	Jun. 2021: Repair and reinforce sections of rock barrier that are insufficiently containing sediment.	Rock berm extended and reinforced and an additional drainage channel constructed in late 2020.
	2020	Construction debris inside and outside EMPA bounds.	Sep. 2020: Site staff informed of areas to focus on to clean up construction debris.	Cleaned up in 2021.
	2021	Erosion, sediment deposition and disturbance into surrounding undisturbed areas.	Jun. 2022: Continue to monitor this site.	None to date.
EMPA D17-E	2017	Sediment overwhelmed sediment fences along northeast slope.	Sep. 2017: Repair and reinforce sediment fences as needed.	Sediment fences were reinforced between 2017 and 2018.
	2018	Sediment overwhelmed sediment fences along northeast slope.	Sep. 2018: Inspect the entire northeast slope of area, repair existing, and add new erosion containment measures as needed to prevent sediment from entering Stephens Lake.	Sediment fences were repaired or reinforced in fall 2018.
	2019	Sediment overwhelmed sediment fences along northeast slope.	Sep. 2019: Enhance containment measures where needed and assess if further measures are feasible.	Cover crop seeding for erosion control planted in late June 2021.
	2020	Sediment overwhelmed sediment fences along northeast slope.	None to date.	Rock berm constructed along northeastern edge in late 2020.
EMPA D23(1)-E, Work Area A	2020	Construction debris on western edge of Work Area A and southern edge of EMPA D23(1)-E.	Jun. 2021: Site staff remove debris.	Debris removed as of September 2021.
EMPA D23(2)-E	2020	Erosion and sediment deposition along northeastern edge close to Stephens Lake.	Jun. 2021: Implement measures to stop or reduce movement of sediment past rock barrier.	None to date.

Location	Year	Identified Impact	Mitigation Recommendation¹	Mitigation Implemented
EMPA D23(2)-E	2021	Erosion and sediment deposition along northeastern edge close to Stephens Lake.	Jun. 2022: Implement measures to stop or reduce movement of sediment past rock barrier.	None to date.
EMPA D27(4)-E	2019	Ponding of water along northern edge causing tree mortality.	None to date.	None applicable to date.
	2020	Ponding of water along northern edge causing tree mortality.	None to date.	None applicable to date.
EMPA D28(1)-E	2020	Ponding of water along northern edge causing vegetation dieback.	None to date.	None applicable to date.
EMPA D35(1)-E	2020	Ponding of water along eastern edge causing large area of tree dieback.	None to date.	None applicable to date.
South shore Nelson River (Dewatered Area)	2021	Portions of ice boom washed up along shore.	Jun. 2022: Remove ice boom portions from locations	None to date.