



Keeyask Generation Project
Terrestrial Effects Monitoring Plan

Habitat Loss and Disturbance Monitoring Report

TEMP-2020-01



KEYYASK 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

This report should be cited as follows:

ECOSTEM Ltd. 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.

SUMMARY

Background

Construction of the Keeyask Generation Project (the Project) at Gull Rapids began in July 2014. The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the generating station on the terrestrial environment. Monitoring results will help the KHLP, government regulators, members of local First Nation communities, and the general public understand how construction and operation of the generating station 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 sixth summer of Project construction.

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.

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.

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.



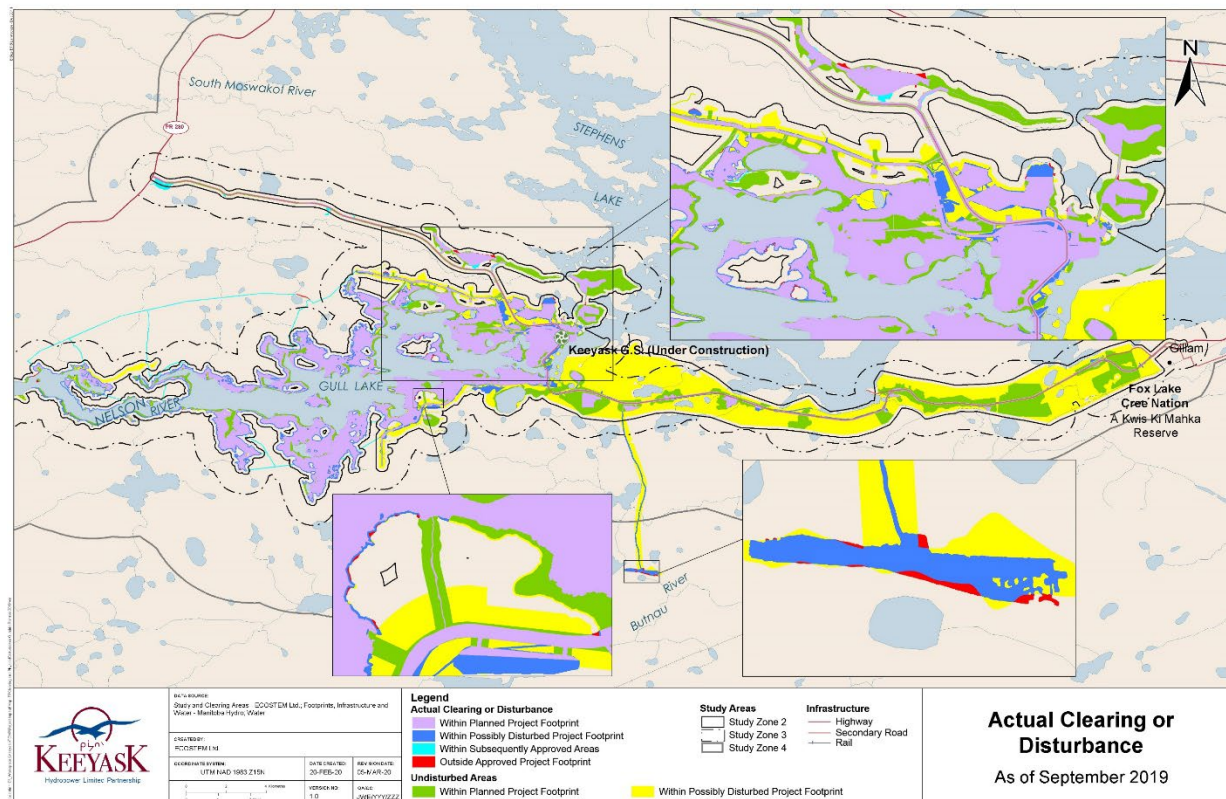
Black spruce habitat found throughout the Keeyask region

What was done?

In 2019, Project clearing and physical disturbance were mapped from satellite imagery that was captured on October 2, and from helicopter and ground surveys that took place from September 7 to 10.

What was found?

Monitoring showed the Project clearing or physical disturbance totaled 5,684 ha as of September 2019 (see map below), which was 28 ha more than in 2018. Clearing accounted for the vast majority (99.3%) of this area.



About 97% of the 5,684 ha of Project clearing, dewatering and disturbance was in areas that had been classified as terrestrial habitat in the environmental assessment. The remaining area was aquatic habitat that was dewatered or had Project infrastructure built in it.

As expected, the majority (about 93%) 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 future reservoir. Most (about 82%) of the clearing that happened between September 2018 and 2019 was split evenly between the south dyke and various borrow areas.

About 94% of the area in the “possibly disturbed” portion of the licensed footprint was still undisturbed, and most of this area was expected to remain undisturbed by the Project. There was no new clearing or disturbance outside the approved Project footprint (while there was 8.29 ha of inadvertent clearing outside the approved Project footprint before September 2018, this area was

equal to only 0.12% of the 7,126 ha of the licensed Project footprint that had not yet been impacted).

What does it mean?

To date, the Project has not created any major unanticipated removal or alteration of terrestrial habitat. As predicted in the environmental assessment, the total amount of clearing and physical disturbance as of September 2019 is much less than included in the overall licensed area.

The 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, this amount of additional clearing was equal to only 0.12% of the currently undisturbed portion of the licensed Project footprint and has not increased since September 2018. It is expected that the Project will not impact most of this remaining undisturbed area.

What will be done next?

Monitoring to document the amount and locations of terrestrial habitat affected by the Project during construction, and to evaluate the effectiveness of mitigation measures, will continue in 2020.

ACKNOWLEDGEMENTS

ECOSTEM Ltd. would like to thank Rachel Boone, Sherrie Mason and the on-site Manitoba Hydro staff, including Megan Anger, Rachelle Budge, Gord Macdonald and Linda Campbell 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 gratefully acknowledged for providing transportation during fieldwork and Nicole Pokornowska for coordinating the logistics.

STUDY TEAM

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

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Data analysis and report writing in 2019 were completed by Alex Snitowski, James Ehnes and Brock Epp. GIS analysis and cartography were completed by Alex Snitowski and Brock Epp.

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1.0 INTRODUCTION

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

The *Keeyask Generation Project Response to EIS Guidelines* (the EIS), completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project (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) was developed as part of the licensing process for the Project (KHLP 2015). Monitoring activities for various components of the terrestrial environment were described, including the focus of this report, habitat loss and disturbance, during the construction and operation phases.

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 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 the Project’s TEMP, two studies are monitoring terrestrial habitat effects. 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 clearing and disturbance by the KIP.

Habitat loss and disturbance monitoring for the Project has been conducted in each year from 2015 to 2019. Reports by ECOSTEM (2016; 2017; 2018; 2019a) provide results for the monitoring conducted in 2015, 2016, 2017 and 2018. This report presents the results of monitoring conducted during 2019.

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

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 areas where excavated material was piled on uncleared 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).

Disturbance refers to either physical disturbance in an area of intact vegetation (e.g., machinery trail, test pits, sediment deposition), use of a pre-existing trail or an 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 areas are a subdivision of the footprint licensed for Project use under the Project's *Environment Act* Licence (i.e., licensed Project footprint): the planned Project footprint and the possibly disturbed Project footprint. The planned Project footprint is largely comprised of permanent Project features. 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 2019b).

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 (initially Conservation and Water Stewardship, then Sustainable Development, now Conservation and

Climate). This is the third type of Project area. These subsequently approved areas primarily included the former KIP start-up camp (which was originally planned as only a temporary camp for the KIP) 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 2019, more than half (56%) 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 any areas cleared or disturbed outside the approved Project footprint. This includes all areas that are not part of the approved Project footprint.

2.3 APPROACH

For this study, terrestrial habitat loss and disturbance are being monitored as mapped Project clearing or disturbance in terrestrial areas. 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 from sources such as satellite imagery, digital stereo photos 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.

Project clearing and disturbance reporting includes breakdowns by Project footprint component and study zone.

2.4 DATA COLLECTION

In September of each year, all areas cleared or disturbed for the Project were surveyed while flying in a Bell 206 helicopter around the perimeter of all areas cleared or disturbed by the Project. Clearing, physical disturbance and other relevant conditions were documented with geo-referenced aerial photographs, marked-up maps and notes. Impacts of concern that had been identified in previous years, and new impacts of concern identified during the current year's aerial surveys were also 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 for sites that were surveyed while conducting ground surveys for other TEMP studies.

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

Year	Aerial Survey Dates	Ground Survey Dates ¹
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
Notes: ¹ Not including days for sites surveyed while conducting monitoring for other TEMP studies.		

2.5 MAPPING

Areas of Project clearing or disturbance were mapped from high resolution digital orthorectified imagery (DOI) and the field data (Section 2.4). A DOI is a digital 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 curved and has topography).

Project clearing or disturbance boundaries were digitized from 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 DOI spatial extents, 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.

Table 2-2 provides the specifications of the Worldview 2 satellite imagery used to create the DOIs for each year of monitoring. 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 metres.

Table 2-2: Specifications of Worldview 2 imagery used to create DOIs, by year

Year	Acquisition Date	Resolution	Approved Project Footprint Coverage
2016	September 21	50 cm	Most ¹
2017	July 11	50 cm	All
2018	July 9	30 cm	Most ¹
2019	October 2	30 cm	All

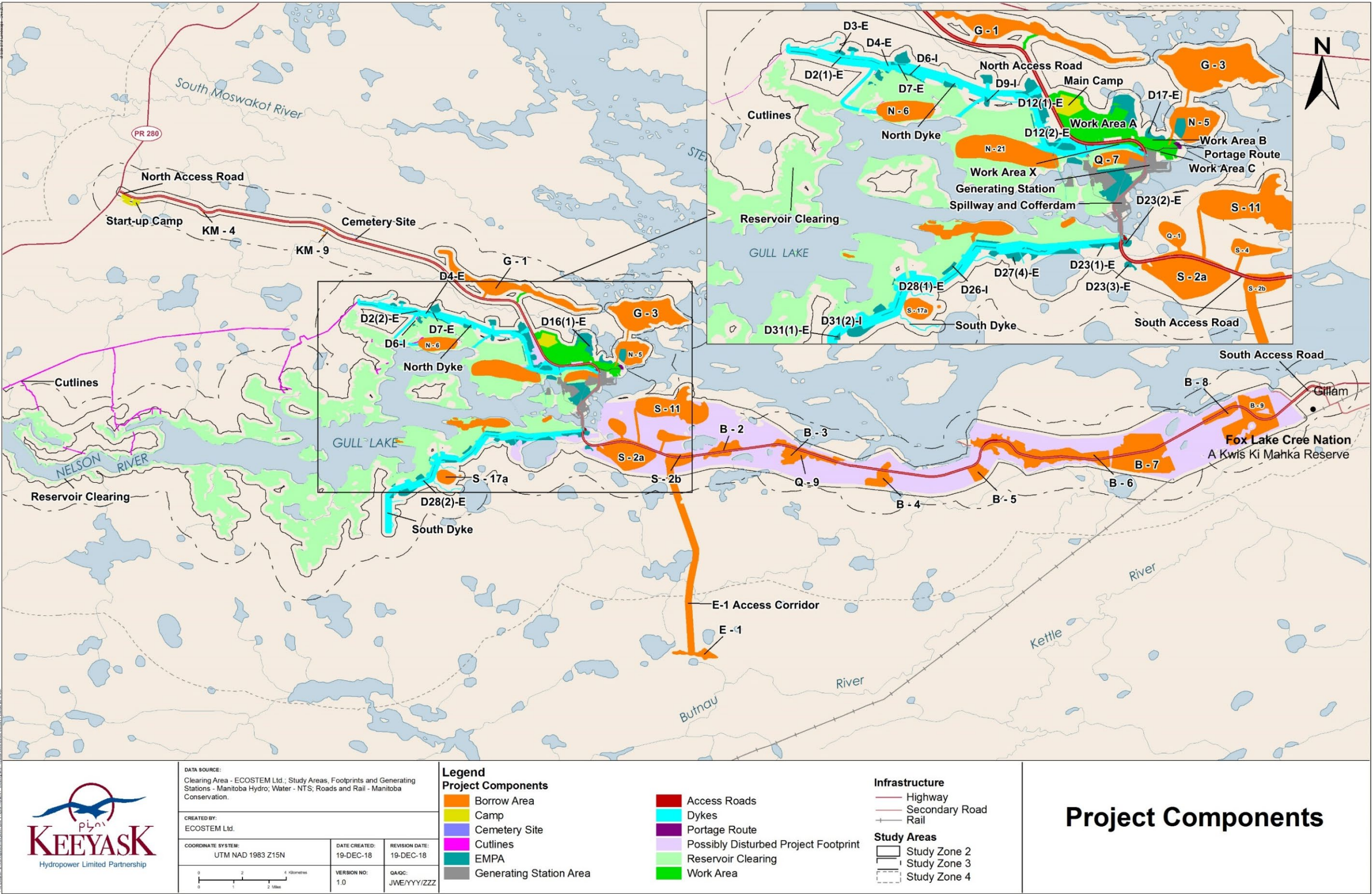
Notes: ¹ Aerial survey data used for areas outside of DOI coverage.

Dewatered areas outside of pre-existing terrestrial habitat were included in the Project impact mapping if they were expected to be permanent. Such changes are not direct impacts on terrestrial habitat. However, some permanent dewatered areas become terrestrial habitat while others are Project infrastructure. Dewatered areas downstream of the spillway were not mapped up to 2019 as it was not known which of them would remain during operation.

A focus of the reporting is the amount of clearing or disturbance within the possibly disturbed Project footprint since the 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, 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 DOIs used to digitize clearing.

Observed clearing that was associated with other projects only was not considered in this report. This includes areas cleared for the KIP (which was completed under a separate license) provided they had no additional Project-related clearing or disturbance. The KIP was developed under a separate license, 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.





Map 2-2: Project components

3.0 RESULTS

3.1 OVERVIEW

As of September 2019, Project clearing or disturbance totaled 5,684 ha, or 44% of the originally licensed Project footprint area (Map 3-1). This was an increase of 28 ha from September 2018.

Of the 5,684 ha Project footprint, 97% was in areas that had been classified as terrestrial habitat in the EIS analysis. The remainder was converted from aquatic to terrestrial habitat by dewatering or construction of infrastructure in aquatic areas. Project impacts in terrestrial habitat were 25 ha larger than in 2018.

Clearing accounted for the vast majority (99.3%) of Project impacts in 2019 (mapped clearing includes infrastructure, excavated material placement areas and dewatering). Dewatering (e.g. in areas behind cofferdams) accounted for 2.4% of the total area included in clearing. A very small part (0.02%) of the Project footprint included flooding of previously cleared areas on the upstream side of the tailrace channel.

Approximately 82% of the new clearing was split evenly between the south dyke and various borrow areas. An additional 14% of the new clearing was in the generating station area.

Project disturbance impacted a very small area (0.7% of the Project footprint) in 2019. Disturbances included mechanical types (machinery trails, test pits), re-use of pre-existing trails, Project-related erosion and sediment deposition, and flooding related to altered water flows.

Much of the planned Project footprint had been cleared by September 2017 and most of the reservoir clearing had been done by September 2018. Project components with additional clearing or disturbance (including dewatering) between September of 2018 and 2019 included: Borrow Areas N-21 and Q-1, portions of the South Dam, South Dyke, and EMPA D23(2)-E (Map 3-1).

Borrow Areas N-21 and Q-1 included about 11 ha, or 41%, of the area with new impacts (Table 3-1). An additional 6 ha, or 23% of the area was associated with the South Dyke and associated Borrow Area S-17a. Other footprint components with significant contributions to the additional clearing or disturbance during this period were EMPA D23(2)-E and the infilling of the South Dam.

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 ceased in 2019.

Borrow Area G-5, and most of Borrow Area 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, 2019 (i.e., observed clearing or disturbance was from previous projects or activities such as the KIP).

Table 3-1: Cumulative actual area of Project clearing¹ or disturbance as of September 2019, by year and Project component

Project Component ¹	Total Cleared or Disturbed (ha)						Change from Previous Year ³ (ha)				
	2014 (existing from KIP)	2015²	2016²	2017²	2018	2019	2015	2016	2017	2018	2019
North access road	191.6	192.4	192.6	192.6	192.6	192.6	0.8	0.2	-	-	-
South access road	0.0	299.5	325.5	325.5	325.5	325.5	299.5	26.0	0.1	-	-
Camp and work areas	186.5	232.0	235.3	236.5	238.1	238.7	45.4	3.3	1.2	1.7	0.5
Borrow areas	49.5	266.6	358.4	411.4	469.6	480.8	217.1	91.8	53.1	58.2	11.3
North dyke and associated areas	18.5	133.4	183.2	197.8	199.0	199.5	114.9	49.7	14.6	1.2	0.4
South dyke and associated areas	0.0	24.9	121.9	180.3	188.5	199.9	24.9	97.0	58.4	8.1	11.5
Generating station and river works	10.9	181.8	204.9	210.6	231.2	235.2	170.9	23.2	5.7	20.6	3.9
Reservoir clearing and access trails	1.7	9.0	1,923.9	3,526.5	3,811.3	3,811.6	7.3	1,914.9	1,602.7	284.8	0.2
All cleared or disturbed areas	458.7	1,339.5	3,545.6	5,281.3	5,655.9	5,683.8	880.8	2,206.1	1,735.8	374.6	27.8

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. Dykes include associated small borrow areas.

³ Areas for some footprint types differ slightly from those presented in the 2016 through 2018 annual reports because some clearing was reclassified into other project components as the footprint developed, and some infrastructure in the river works area was removed.

⁴ Due to rounding, some of the values are slightly different than what results from subtracting the numbers in the table.

3.2 CLEARING OR DISTURBANCE IN PROJECT AREAS

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.

Of the 5,684 ha of Project impacts (i.e., clearing or disturbance) recorded up to September 2019, 93% was within the planned Project footprint (Map 3-1). Impacts within the planned Project footprint areas increased by 20 ha between September 2018 and 2019 (Table 3-2).

Impacts in the possibly disturbed Project footprint (Table 3-2; Map 3-1) totaled approximately 313 ha as of September 2019. This was an increase of 7 ha over 2018. Most of the newly impacted area was situated in EMPA D23(2)-E and along the South Dyke (Appendix 1: Table 6-1).

As of September 2019, 63 ha of the impacts were in subsequently approved Project areas. This area has remained constant since September 2017. Nearly half of this area (45%) was in areas previously cleared for the KIP. These subsequently approved areas included the KIP Start-up Camp near PR 280, and portions of Borrow Areas KM-4, KM-9 and G-1 (which had previously been used for 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 ha (Table 3-2; Map 3-1), or 0.15% of total impacted area as of September 2019, and was the same size as in 2018. As illustrated in Map 3-1, this 8 ha of impacts was very small (0.12%) relative to the 7,126 ha of remaining undisturbed area within the licensed Project footprint.

Table 3-2: Cumulative actual Project clearing or disturbance area as of September 2019, by year and Project area

Project Area	Total Approved Area (ha)	Total Area (ha)						Change (ha) from Previous Year ¹				
		2014 (existing from KIP)	2015 ³	2016 ³	2017 ³	2018	2019	2015	2016	2017	2018	2019
Planned Project Footprint	7,615.6	420.2	1,245.7	3,294.3	4,970.9	5,278.6	5,299.0	825.5	2,048.6	1,676.6	307.7	20.4
Possibly Disturbed Project Footprint	5,122.6	9.6	62.6	190.5	241.5	305.7	313.2	53.1	127.9	51.0	64.2	7.5
Subsequently Approved Project Areas ²	n/a	28.9	29.4	56.1	63.3	63.3	63.3	0.5	26.7	7.2	-	-
Outside the Approved Project Footprint	n/a	-	1.7	4.6	5.6	8.3	8.3	1.7	2.9	1.0	2.7	-
All	12,738.3	458.7	1,339.5	3,545.6	5,281.3	5,655.9	5,683.8	880.8	2,206.1	1,735.8	374.6	27.8

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 Areas for some Project areas differ slightly from those presented in the 2016 through 2018 annual reports because some infrastructure in the waterworks area was removed.

3.3 CLEARING OR DISTURBANCE BY PROJECT COMPONENT

This section describes clearing and disturbance observed within each Project component. Table 6-2 (Appendix 2) summarizes mitigation recommendations provided since monitoring began, as well as the associated follow-up actions.

3.3.1 ACCESS ROADS

The North Access Road (NAR) and South Access Road (SAR) clearing remained unchanged from September 2017 to 2019 (Table 3-1 and Table 3-3). No road construction activity was observed during 2019 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.

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 noted in 2019 (Photo 3-1), but the bank was subsequently covered with organic material. The site will be monitored for substantive changes in 2020.

Table 3-3: Clearing or disturbance within the possibly disturbed Project footprint, and areas cleared or disturbed outside the approved Project footprint as of September 2019, by main Project component

Project Component	Clearing or Disturbance (ha)					
	Within the Possibly Disturbed Project Footprint			Outside the Approved Project Footprint		
	2018	2019	Change	2018	2019	Change
Access Roads	4.45	4.45	-	-	-	-
Camp & Work Areas	3.33	3.49	0.16	0.01	0.01	-
Generating Station Area	11.58	11.92	0.35	-	-	-
Borrow Areas	58.00	58.00	0.00	5.39	5.39	-
EMPAs	61.08	66.33	5.25	0.52	0.52	-
Dykes	34.31	35.82	1.51	0.05	0.05	-
Reservoir Clearing & Cutlines	123.25	123.45	0.20	2.32	2.32	-
Total	296.01	303.47	7.46	8.29	8.29	0.00

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



Photo 3-1: Erosion around fringes of excavated area adjacent to Borrow Area KM1

3.3.2 MAIN CAMP, NORTH SHORE WORK AREAS AND WELL AREA

With one exception, the extent of clearing for the Main Camp, North Shore Work Areas, Well Area and Helicopter Pad did not change from September 2018 to 2019. The exception was 0.2 ha of new dewatered area in a North Shore Work Area at the downstream boat launch (Appendix 1: Table 6-1). A breakwater was constructed in the newly cleared area. Of this clearing, half was in the planned Project footprint and half was within the possibly disturbed Project footprint.

At the northeast corner of the Main Camp, a disturbance created by water outflow from a culvert extended approximately 80 metres into the uncleared forest in 2019. This was an increase of 20 metres over 2018. Rapidly flowing water had created a channel through the vegetation. Eventually, this water started flowing underground, causing mass wasting and creating a hollow area within the substrate (Photo 3-2 and Photo 3-3). Trees were dying back and toppling in towards the hollowed area (Map 3-2; Photo 3-4). At the time of the 2019 survey, the edge of this disturbance was only 25 metres from the approved Project footprint boundary, and its spatial extent may stabilize in the future. If it does expand, it would affect a common habitat type (black spruce dominant vegetation on thin peatland).

At Work Area A, a site where sediment was deposited into uncleared areas was remediated in 2018 by excavating the deposited sediment. The excavation disturbed the underlying vegetation and substrate, but surveys in 2019 found that new vegetation was colonizing the excavated area.

Silt fencing was installed at the base of the mineral slope. These efforts appeared to have mitigated further disturbance in 2019.



Photo 3-2: Channel created by running water from culvert northeast of Main Camp



Photo 3-3: Hollow in substrate created by running water northeast of Main Camp



Photo 3-4: Trees toppling into hollowed out area northeast of Main Camp

3.3.3 BORROW AREAS

Between September 2018 and 2019, the majority of the new borrow area clearing was in borrow areas N-21 (5.9 ha) and Q-1 (5.1 ha). The remaining clearing included a 2.6 ha expansion of Borrow Area S-17a in the South Dyke area, and 0.2 ha of clearing between Borrow Area S-2b and the SAR. There was no borrow area clearing within the possibly disturbed Project footprint between September 2018 and 2019 (Table 3-3).

Excavation continued in 2019 at borrow areas G-1, G-3, N-5, S-2a, B-3 and E-1, but this did not require any new clearing.

New or expanding disturbance was observed at several borrow areas during the 2019 surveys. The following paragraphs detail the occurrences.

On the south side of the Nelson River, a portion of Borrow Area B-2 had been developed into a temporary camp area in 2018. In 2019, all but two of the trailers had been removed. At the time of the 2019 surveys, it appeared that the camp and trailers were not in use.

In Borrow Area G-3, erosion on the mineral slopes around the perimeter was depositing sediment into the uncleared forest at several locations (Map 3-2). A silt fence had been installed along a portion of the south side of the borrow area in spring of 2019, but sediment continued to bypass it as of September. It appeared that sediment deposition had slowed or ceased at some locations around the perimeter, and vegetation was colonizing on old sediment deposits. There is potential for future sediment deposition at two other locations on the northeast and north edge of the borrow area. Erosion occurring on the slopes at these locations could deposit sediment past the tree line into the adjacent uncleared forest in the future.

Along the north side of Borrow Area N-5, surveys up to September 2018 found that water from drainage hoses had eroded mineral slopes and deposited sediment into the uncleared forest. Subsequently, hoses had been moved or removed from the area. In 2019, sediment was being deposited from the most recent hose location into the surrounding uncleared forest (Map 3-2; Photo 3-5). Also, approximately 20 dead and dying black spruce trees were observed in the forest near the original hose location. The subsequent hose locations prior to 2019 showed signs of stabilization as evidenced by re-establishing vegetation.

On the south side of Borrow Area N-5 (Map 3-2), sediment deposition from a drainage hose and a detached silt bag were mitigated by the removal of the drainage hose. As of the 2019 surveys, the silt bag was present and vegetation was colonizing the sediment.

In Borrow Area B-6, mass wasting continued to create a disturbance along a natural drainage channel, affecting otherwise undisturbed habitat (Map 3-2). Significant water flow from the SAR to the east edge of the pit undermined the uncleared forest and created a deep, wide channel (Photo 3-6). Surveys in 2019 found that the impacted area did not expand substantially since 2018.

Sediment was being deposited several metres into uncleared adjacent forest on the eastern edge of Borrow Area N-21 where new clearing was found in 2019 (Map 3-2).

In Borrow Area KM1, the 2019 surveys found that erosion runnels were widening and deepening (Photo 3-7). These runnels were washing away vegetation and could eventually affect tree seedlings that had been planted nearby.



Photo 3-5: Sediment deposition into adjacent forest on north edge of Borrow Area N-5



Photo 3-6: Undermined forest and channel in Borrow Area B-6



Photo 3-7: Erosion in Borrow Area KM1

3.3.4 DYKES

For this section, the term dyke includes the dyke areas, the associated possibly disturbed Project footprint, and the narrow linear EMPAs that run parallel to the dykes within the planned footprint.

New clearing since September, 2018 was not observed along the North Dyke.

There was approximately 11.5 ha of new clearing along the South Dyke between September 2018 and 2019. (Map 3-1). Since September 2018, the main portion of the South Dyke infrastructure was extended further west and south within previously and newly cleared areas, and some adjacent EMPAs were utilized.

Dyke clearing within the possibly disturbed Project footprint increased by 1.5 ha between September 2018 and 2019 (Table 3-3). The bulk of this new clearing was on the South Dyke, adjacent to the planned D29(2)-I EMPA (Appendix 1: Table 6-1).

3.3.5 EXCAVATED MATERIAL PLACEMENT AREAS

While ten EMPAs were being used in 2019, only three had new clearing or disturbance since 2018. Approximately 5.3 ha of new clearing was found in EMPAs D16, D23(2) and D27(4).

Between September 2018 and 2019, the following measures to mitigate erosion and sediment deposition around the edges of EMPA D16 were implemented: (i) the northern portion of the EMPA was graded to smooth out the gullies caused by previous erosion; (ii) a continuous rock berm was constructed around the northern and eastern edges to curb erosion; and, (iii) straw wattles were placed in gullies along the western edges to reduce the movement of sediment downhill. Grading expanded EMPA D16 by approximately 0.2 ha (Appendix 1: Table 6-1).

Along the northern and eastern slopes of EMPA D16, the 2019 surveys found that sediment deposition from bank erosion had reduced or stopped with the exception of a few small areas on the eastern edge (Photo 3-8; Map 3-2). Water and sediment were still flowing under the rock berm into the surrounding uncleared vegetation in a small stretch close to where a peat plateau bog was disturbed in 2018. Near the northeastern corner of this EMPA, sediment deposition had disturbed another 0.02 ha of uncleared vegetation.

Silt fences along the western edge of EMPA D16 had been removed since September 2018. Straw wattles that were placed into gullies appeared to have reduced sediment flow beyond the EMPA, although the 2019 surveys found that sediment was still getting to the bottom of the hill and into the adjacent marsh area because it was bypassing, and/or flowing over and under the wattles (Photo 3-9; Map 3-2).

At EMPA D17, surveys in 2019 found that sediment from slope erosion had continued to overwhelm silt fences and was being deposited into uncleared vegetation adjacent to the northeastern slopes (Photo 3-10; Map 3-2). Runoff was found entering a pond approximately 30 metres northeast of the EMPA but no visible effects on the vegetation was observed at that time.

Approximately 0.4 ha of disturbance was found along the northern edge of EMPA D27(4). Here, localized water had collected at the base of the EMPA slope and formed several ponds by 2018. These ponds extended into the adjacent undisturbed forest causing vegetation mortality (Photo 3-11; Map 3-2). At the same time, emergent marsh plants (likely sedges) were colonizing some of the ponds in 2018 (Photo 3-12), however these plants appear to have mostly disappeared by September 2019. These ponds will be surveyed for marsh vegetation in 2020.

The EMPAs along the North Dyke had no additional clearing or disturbance since September 2017.

The remaining EMPAs being used in 2019 included D12(2), D23(1), D27(2), D28(1), D28(3), D31(1) and D35(1). None had additional clearing. The eastern portion of D23(1) was no longer being utilized as a rock crusher area in September 2019.

Impacts associated with EMPAs within the possibly disturbed Project footprint were limited. The majority of new clearing occurred in EMPA D23(2), covering approximately 4.8 ha. The remaining clearing was within EMPA D16. (0.2 ha). Disturbance was only found in EMPA D27(4) (0.2 ha).



Photo 3-8: Aerial view of sediment deposition into adjacent vegetation, along eastern edge of EMPA D16



Photo 3-9: Straw wattles in gully along western edge of EMPA D16



Photo 3-10: Sediment from EMPA D17 entering uncultivated vegetation



Photo 3-11: Aerial view of flooding and dying trees on northern edge of EMPA D27(4)

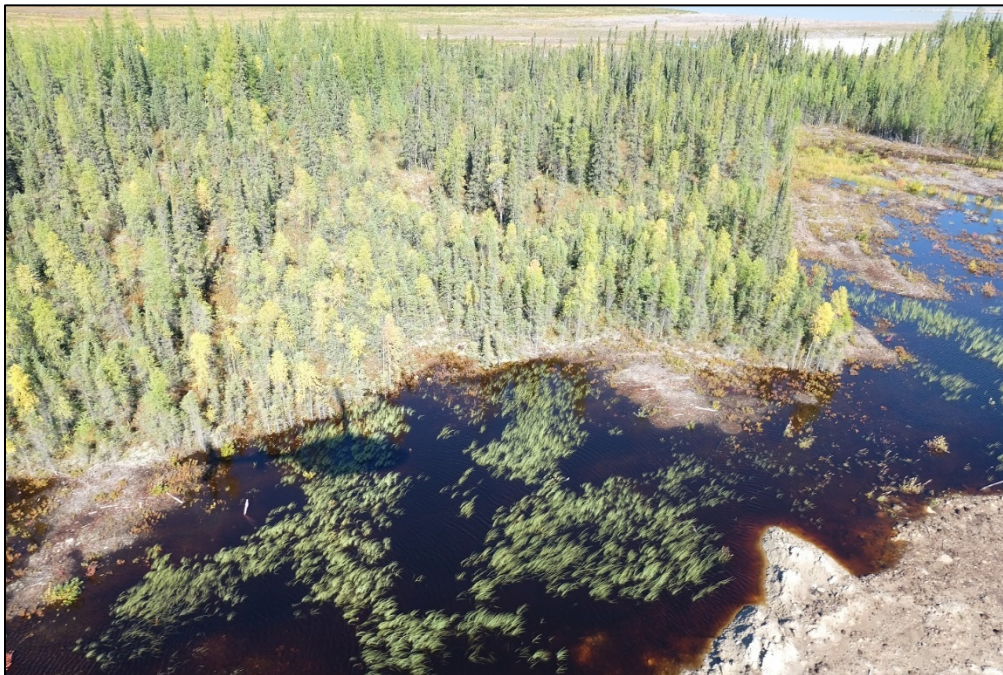


Photo 3-12: Aerial view of emergent vegetation in pond along the northern edge of EMPA D27(4) in September 2018

3.3.6 RIVER WORKS AREA

Approximately 2.7 ha was dewatered in the South Dam and Spillway areas between September 2018 and September 2019 and 0.7 ha was cleared in the Generating Station area, adjacent to the Spillway (Map 3-1). Approximately 0.2 ha of uncleared forest and 1.2 ha of previously cleared terrestrial habitat was flooded northwest of the tailrace channel as a result of removing portions of a previously installed coffer dam. Since this latter area was previously cleared and subsequently flooded, this area did not add to the total amount of clearing or disturbance in 2019. Excavation continued in the Powerhouse tailrace area and much of the construction equipment and materials had been removed from the Powerhouse intake channel. The south reach of the main dam was also completed since September 2018.

The remaining portions of the South Dam completed between September 2018 and 2019 accounted for approximately 0.3 ha of dewatered area within the possibly disturbed Project footprint. (Appendix 1: Table 6-1).

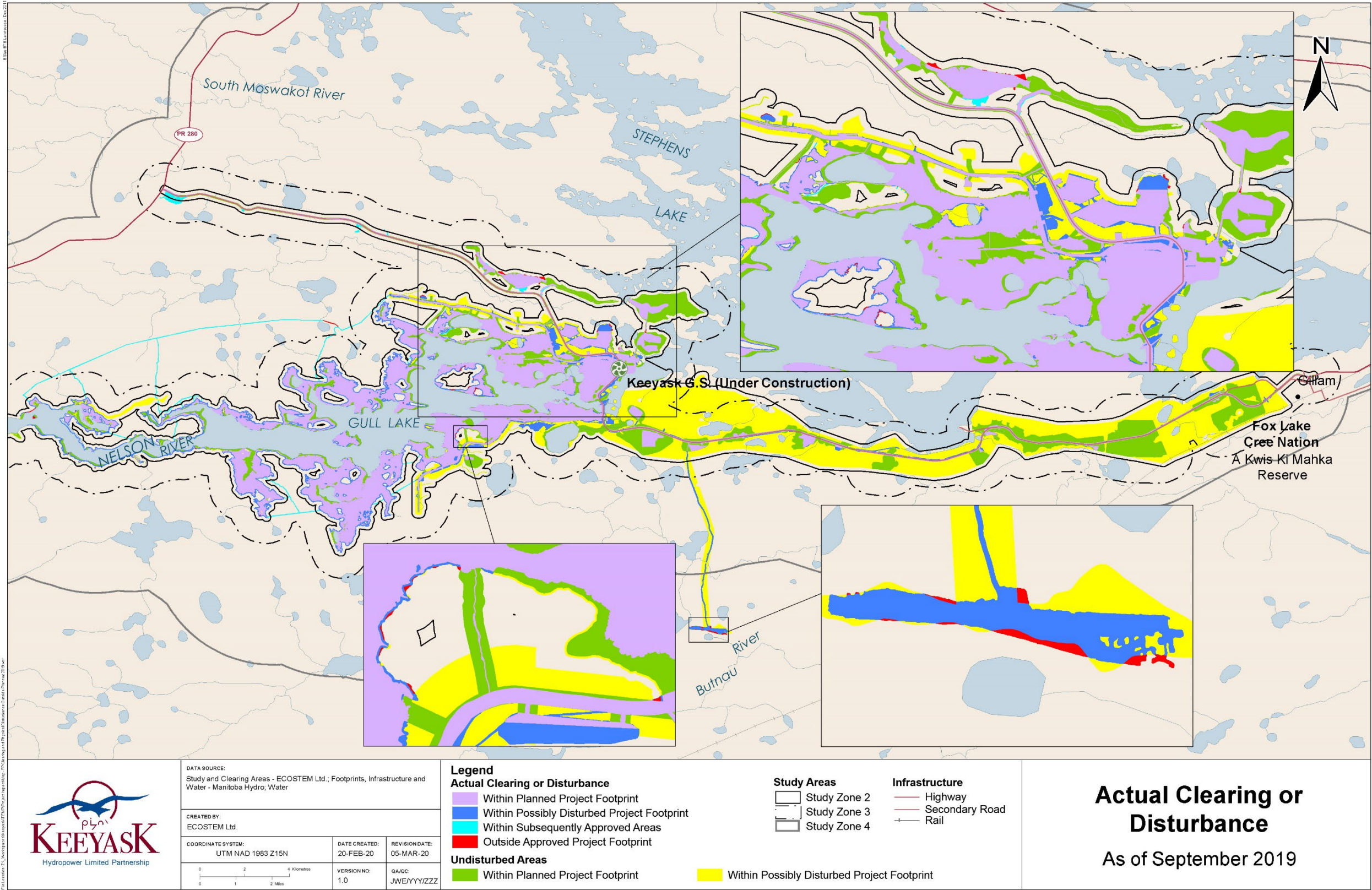
3.3.7 RESERVOIR CLEARING

A small amount of clearing was found (approximately 0.2 ha) within the reservoir area bounds in 2019, along the fringes of new South Dyke clearing (Map 3-1; Appendix 1: Table 6-1). 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.

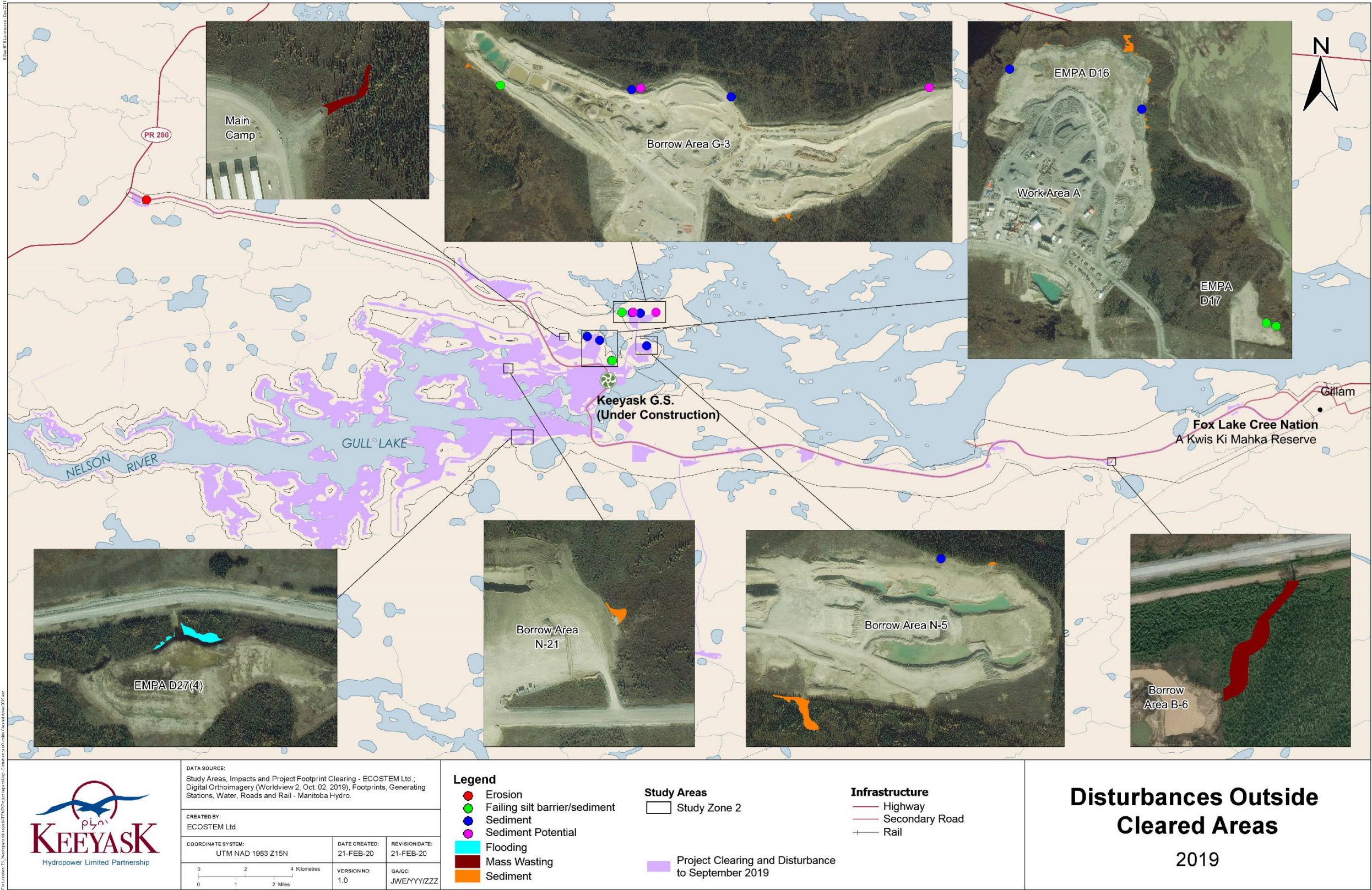
As of September 2019, approximately 123 ha of reservoir clearing was within the possibly disturbed Project footprint, situated around the perimeter of the reservoir clearing footprint (Appendix 1: Table 6-1). New clearing within the possibly disturbed Project footprint totalled 0.2 ha in 2019.

3.3.8 TRAILS

Only one trail was cleared between September 2018 and 2019. This trail ran from the North Dyke to Little Gull Lake, and encompassed approximately 0.4 ha. No new trails were found in the possibly disturbed Project footprint (Appendix 1: Table 6-1).



Map 3-1: Actual Project clearing or disturbance as of early September 2019



Map 3-2: Disturbances outside of cleared areas in 2019

4.0 DISCUSSION

Project clearing or disturbance between September 2018 and 2019 totalled approximately 28 ha. This was the lowest annual amount of clearing and disturbance since the start of Project construction. This was consistent with Manitoba Hydro's indication in May, 2018 that the vast majority of Project clearing was complete. Additional clearing after May, 2020 is not anticipated. Reservoir impoundment is planned to begin in early fall, 2020.

Recommendations regarding impacts that may merit mitigation were provided following field surveys and in annual reports since the habitat monitoring began in 2014. In general, the mitigation carried out in response to these recommendations addressed the original concern. The exceptions included situations where the mitigation shifted the same issue to a different location at the same footprint, the implemented measure was not adequate to address the concern or new measures were required due to changing conditions.

The remainder of this section discusses the exceptions just referred to. It also provides mitigation recommendations for the more substantive ongoing disturbances. Table 6-2 (Appendix 2) summarizes all the mitigation recommendations provided since construction-phase monitoring began, and the associated follow-up actions.

In 2017, water from a drainage hose on the north side of Borrow Area N-5 was eroding the bank and depositing sediment into otherwise undisturbed terrestrial habitat. The drainage hose was re-located three times. At the most recent location, a silt bag was added to the end of the hose. Surveys in 2019 found that although the silt bag was somewhat effective, sediment was still depositing into the adjacent uncleared forest at its most recent location. While erosion and sediment deposition had stopped or been reduced at two of the previous hose locations, tree mortality was observed at the original hose location. No additional mitigation measures were recommended after the 2019 field survey because moss hummocks appeared to be containing the deposition area, the total deposition area was small and the deposition area was well within the planned Project footprint. Surveys in 2020 will determine if further mitigation measures for these areas are required.

The removal of the drainage hose at the southern edge of Borrow Area N-5 appeared to aid the reestablishment of vegetation on the old sediment deposits, and to prevent any new erosion or sediment deposition in the area. It is recommended that the silt bag in this location be removed.

Localized sediment deposition from erosion was impacting otherwise undisturbed terrestrial habitat in Borrow Area G-3 in 2019. Sediment from eroding banks was bypassing silt fences along its southeast and southwest edges. Potential sediment deposition at several other locations around the borrow area perimeter could become an issue and will be monitored in future surveys. It was recommended after 2019 surveys that Manitoba Hydro site staff inspect and evaluate these areas and implement erosion control measures as needed. Site staff is currently developing a plan to address these issues.

At Borrow Area N-21, sediment was being deposited into the adjacent forest along the eastern edge where new clearing was located. It is recommended that Manitoba Hydro site staff inspect and evaluate these areas and implement erosion control measures as needed.

Erosion runnels were widening and deepening in Borrow Area KM1, potentially affecting the surrounding planted seedlings. It is recommended that site staff inspect and evaluate these areas and implement erosion control measures as needed.

Significant water flow from the SAR into Borrow Area B-6 continued to erode the substrate in undisturbed adjacent forest. By 2018, a deep runnel had been created in a low-lying area. The associated erosion caused mass wasting along the runnel between the ditch and Borrow Area B-6, causing trees along the runnel to slump and collapse inward. The 2019 surveys found the size of the disturbed area had not increased substantially since 2018. At this time, no mitigation measures are recommended for this disturbance as it does not appear to be expanding significantly. This conclusion will be reevaluated following the 2020 field surveys.

At EMPAs D16 and D17, sediment had been overwhelming silt fences since 2017. Surface water runoff was depositing the sediment into a water channel connected to Stephens Lake and into a wetland adjacent to Stephens Lake. Up to 2018, slope grading and silt fences had done little to reduce or stop the erosion and sediment deposition in both EMPAs. This continued to be an issue in 2019.

As of 2019, the installation of check dams and armouring along the north and east edges of EMPA D16 appeared to reduce or stop the expansion of erosion and sediment deposition in most locations. While straw wattles placed in gullies on the western edge of EMPA D16 reduced the movement of sediment downhill, it did not completely stop sediment from reaching the adjacent wetland. Following the 2019 surveys, it was recommended that site staff enhance containment measures where needed and assess if further measures were feasible to prevent sediment from entering surrounding uncleared areas. Site staff is currently developing a plan to address these issues.

Water collecting along the northern edge of EMPA D27(4) created several ponds, causing vegetation mortality in approximately 0.4 ha of adjacent uncleared forest. The area of vegetation mortality could expand over time. At the same time, marsh plants have colonized some of the ponds. No mitigation is recommended at this time as the potentially affected area is small, the disturbance is within the planned and possibly disturbed footprint, and the development of off-system marsh is a positive effect even if only a temporary one. These ponds will be surveyed for marsh vegetation in 2020.

At the northeast corner of the Main Camp, water outflow from the culvert continued to deteriorate the surrounding otherwise undisturbed vegetation. At the time of the 2019 surveys, this disturbance extended approximately 80 metres into the uncleared forest and was within 25 m of the approved Project footprint limit. The flowing water had undermined the substrate, toppled trees and appeared to be the cause of some additional tree mortality. If this disturbance expands, it would only affect a common habitat type (black spruce dominant vegetation on thin peatland) and would not threaten any sensitive sites identified in the EnvPPs. This disturbance will be

revisited in September, 2020 and an evaluation will be made as to whether any mitigation is recommended.

5.0 SUMMARY AND CONCLUSIONS

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.

As of September 2019, the Project had cleared or disturbed 5,684 ha (including dewatered areas). This was an increase of 28 ha (or 25 ha of terrestrial habitat) from September 2018, which was the lowest annual change since the start of Project construction. Clearing accounted for the vast majority (99.3%) of the impacted area in 2019. By 2019, 44% of the originally licensed Project footprint had been cleared or disturbed.

Of the total area cleared or disturbed to September 2019, 93.2% (5,299 ha) was within the planned Project footprint, while 5.5% (313 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.

In 2019, there was 8.29 ha of clearing or disturbance outside the approved Project footprint, which was unchanged from 2018. Most of this area was located at Borrow Area G-1, in the future reservoir area and around Borrow Area E-1.

The 8.29 ha of clearing or disturbance outside the approved Project footprint was very small (0.12%) relative to the 7,126 ha of still undisturbed area in the licensed Project footprint. Additionally, virtually all of the still undisturbed area within the licensed Project footprint in 2019 is expected to remain undisturbed by the Project.

To date, the Project has not created any major unanticipated removal or alteration of terrestrial habitat. As predicted in the environmental assessment, the total amount of clearing and physical disturbance as of September 2019 is much less than included in the licensed Project footprint. The 2019 monitoring led to recommendations for additional mitigation in seven localized areas. There are no recommendations to modify the study methods based on monitoring results to date.

Monitoring fieldwork for the Habitat Clearing and Disturbance study will continue in 2020.

6.0 LITERATURE CITED

- ECOSTEM. 2015. Keeyask Infrastructure Project: Terrestrial plant, habitat and ecosystem monitoring during construction: Annual report 2014 - 2015.
- 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. 2019a. 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. 2019b. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2019-02: Priority Habitats Monitoring. A report prepared for Manitoba Hydro by ECOSTEM Ltd., June 2019.
- 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: DETAILED RESULTS

Table 6-1: Clearing or physical disturbance within the possibly disturbed areas and outside of the combined planned, possibly disturbed and subsequently approved areas as of September 2019, 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		
		2018	2019	Change	2018	2019	Change
Access Roads	South Access Road	4.45	4.45	-	-	-	-
Camp & Work Areas	Main Camp	0.00	0.07	0.07	-	-	-
	Work Area A	0.75	0.75	-	-	-	-
	Work Area B	0.42	0.42	-	0.01	0.01	-
	Work Area C	0.29	0.29	-	-	-	-
	Work Area X	0.11	0.11	-	-	-	-
	Hydro Offices South	0.37	0.37	-	-	-	-
	Portage Route	1.40	1.49	0.10	-	-	-
River Works Area	Generating Station	0.72	0.72	-	-	-	-
Quarries and Borrow Areas	Spillway & Cofferdam	10.85	11.14	0.29	-	-	-
	B-2	0.40	0.40	-	-	-	-
	B-3	2.72	2.72	-	-	-	-
	B-5	0.75	0.75	-	-	-	-
	B-6	0.05	0.05	-	-	-	-
	B-8	1.79	1.79	-	-	-	-
	G-1	-	-	-	2.75	2.75	-
	G-3	-	-	-	0.00	0.00	-
	N-5	-	-	-	0.20	0.20	-
	Q-1	0.48	0.48	-	-	-	-
	Q-9	0.14	0.14	-	-	-	-
	E-1	24.95	24.95	-	2.42	2.42	-
	E-1 Access	26.72	26.72	-	0.01	0.01	-
	D1(2)-I	0.03	0.03	-	-	-	-
	D12(1)-E	0.01	0.01	-	-	-	-
	D12(2)-E	6.16	6.16	-	-	-	-
	D16(1)-E	15.31	15.52	0.21	0.46	0.46	-
Excavated Material Placement Areas	D17-E	0.00	0.00	-	0.02	0.02	-
	D23(1)-E	1.57	1.57	-	-	-	-
	D23(2)-E	1.58	6.40	4.81	-	-	-
	D27(4)-E	26.06	26.29	0.23	0.01	0.01	-
	D28(1)-E	5.85	5.85	-	-	-	-
	D31(1)-E	1.28	1.28	-	-	-	-
	D31(2)-I	0.12	0.12	-	0.00	0.00	-
	D3-E	3.08	3.08	-	0.03	0.03	-

Project Component	Component Name	Clearing or Disturbance (ha)					
		Within Possibly Disturbed Areas			Outside of Combined Planned, Possibly Disturbed and Subsequently Approved Areas		
		2018	2019	Change	2018	2019	Change
	D7-E	0.02	0.02	-	-	-	-
	D9-I	0.01	0.01	-	-	-	-
Dykes	North Dyke	24.81	24.81	-	0.01	0.01	-
	South Dyke	9.50	11.01	1.51	0.04	0.04	-
Reservoir	Reservoir Clearing	122.93	123.13	0.20	1.60	1.60	-
Clearing	Trails	0.33	0.33	-	0.73	0.73	-
Total		296.01	303.08	7.40	8.29	8.29	0.00

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

APPENDIX 2: MITIGATION RECOMMENDATIONS

Table 6-2: Summary of Mitigation Recommendations

Location	Year	Project Impact	Mitigation Recommendation ¹	Mitigation Implemented
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.	Silt fence installed.
	2018	Sediment bypassing silt fences along SE perimeter. Erosion depositing sediment at several other locations around area perimeter.	Sep. 2018: Site staff inspect the area, reinforce silt fences where needed, and evaluate and implement additional erosion control measures as needed.	Silt fence installed along part of the south side.
	2019	Sediment bypassing new silt 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.	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.
Borrow Area N-5	2017	Drainage hose on north side of area eroded slope and depositing sediment into uncleared 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 uncleared 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 silt bag was installed.
	2018	Erosion and sediment deposition from drainage hose and failed silt 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.
	2019	Silt bag remained at old drainage hose location on south side of N-5.	Jun. 2020: Remove silt bag from location.	None to date. Will be removed in summer, 2020.
Borrow Area N-21	2019	Sediment depositing several metres into uncleared 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. Site will be evaluated in spring, 2020.

Location	Year	Project Impact	Mitigation Recommendation ¹	Mitigation Implemented
Borrow Area B-6	2019	Mass wasting causing disturbance along drainage channel between borrow area and South Access Road.	Jun. 2020: None.	None to date.
Main Camp	2019	Water outflow from culvert at northeast corner causing mass wasting and disturbance	Jun. 2020: Surveys in 2020 will monitor area for expansion of erosion.	None to date.
	2017	Erosion and sediment deposition into uncleared habitat on north and east sides of the area.	Aug. 2017: Repair and reinforce silt fence on east side and install silt fence on the north side.	Silt fence installed at north side, repaired at east side.
Excavated Material Placement Area D16	2018	Sediment deposition into bay of Stephens Lake on north side of area, water flow from calcareous pond. Silt 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.	Silt fences were repaired or reinforced in the fall of 2018. Installation of rock berm and organic material armouring along base of northeast slope in March, 2019. Silt fencing removed and straw wattles placed in gullies along west slopes in April, 2019.
	2019	Sediment deposition into surrounding uncleared areas past rock berm on eastern edge.	Sep. 2019: Enhance containment measures where needed and assess if further measures are feasible.	None to date.
	2019	Sediment deposition into surrounding cleared areas past straw wattles and removal of silt fences on western edge.	Jun. 2020: Enhance containment measures where needed and assess if further measures are feasible.	None to date.
Excavated Material Placement Area D17	2017	Sediment overwhelmed silt fences along northeast slope.	Sep. 2017: Repair and reinforce silt fences as needed.	Silt fences were reinforced between 2017 and 2018.
	2018	Sediment overwhelmed silt 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.	Silt fences were repaired or reinforced in fall, 2018.

Location	Year	Project Impact	Mitigation Recommendation ¹	Mitigation Implemented
	2019	Sediment overwhelmed silt fences along northeast slope.	Sep. 2019: Enhance containment measures where needed and assess if further measures are feasible.	None to date.
Excavated Material Placement Area D27(4)	2019	Flooding along northern edge caused tree mortality.	Jun. 2020: None.	None to date.
	2016	Erosion of ditch bank under trees.	Aug. 2016: Consider erosion control measures at this location.	None to date.
North Access Road at KM-1	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. Surveys in 2020 will monitor area for expansion of erosion and sediment deposition.	None to date.
South Dyke	2016	Sunken ATV in wetland.	Aug. 2016: Remove ATV as soon as possible.	ATV removed.

Notes: ¹ Recommendations in addition to continued monitoring. The date at the beginning of a line indicates the month and year that the recommendation was made. "Jun. 2020" is this report.