



Keeyask Generation Project
Terrestrial Effects Monitoring Plan

Habitat Loss and Disturbance Monitoring Report

TEMP-2018-01



KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2018- 01

HABITAT LOSS AND DISTURBANCE MONITORING

A Report Prepared for

Manitoba Hydro

By

ECOSTEM Ltd.

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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 fourth 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 jack pine 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.

What was done?

Project clearing and physical disturbance were mapped from satellite imagery that was captured on July 11, 2017, and from helicopter surveys that took place on July 5 and September 19, 2017.

What was found?

Monitoring showed that approximately 5,297 ha of terrestrial habitat had been cleared or physically disturbed for the Project as of September 2017. About 94% of this total area was in the portions of the Project footprint that include the permanent infrastructure and future reservoir. Most (about 92%) of the clearing that happened between September 2016 and 2017 was in the future reservoir area.

About 95% 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. While

there was 5.63 ha of inadvertent clearing outside the approved Project footprint, this area was very small compared with the 7,510 ha of the licensed Project footprint that has 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 expected, the total amount of clearing and physical disturbance as of September 2017 is much less than included in the overall licensed area.

The inadvertent 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 only 0.07% of the currently undisturbed portion of the licensed Project footprint, and it is expected that the Project will not impact most of this undisturbed area.

What will be done next?

Monitoring to document the amount and locations of terrestrial habitat affected by the Project will continue in 2018.

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STUDY TEAM

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

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Data analysis and report writing in 2017 were completed by Brock Epp and James Ehnes. GIS analysis and cartography was completed by Brock Epp and Nathan Ricard.

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

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

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

Habitat loss and disturbance monitoring for the Project has been conducted in each year from 2015 to 2017. ECOSTEM (2016; 2017) provide results for the monitoring conducted in 2015 and 2016. This document reports on the monitoring conducted during 2017.

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 2017, which were the same as in 2016. Methods employed in 2017 were also the same as in 2015 with the exception that a less precise method was used to map clearing or disturbance in 2015 (ECOSTEM 2017).

In the terrestrial habitat, ecosystem and plant studies, clearing refers to complete vegetation removal (except for very low shrub, herbaceous and moss cover in some cases) in a terrestrial habitat patch that was at least 400 m² in size. Disturbance refers to either physical disturbance in an area of intact vegetation (e.g., machinery trail, test pits), use of a pre-existing trail or an area of clearing smaller than 400 m².

Many of the cleared areas also included topsoil or overburden excavation (e.g., in a borrow area).

In the reported results and maps, piles of excavated material are included as clearing since the vegetation was no longer visible.

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. Project environmental protection plans (EnvPPs) include provisions to minimize clearing or disturbance within the possibly Project footprint, and the avoidance of environmentally sensitive sites to the extent feasible within this area. Another study, Priority Habitats, monitors Project effects on environmentally sensitive terrestrial sites (see ECOSTEM 2018).

After the Project was licensed, several additional areas (called “subsequently approved Project areas” in this report) were approved for Project use by Manitoba Conservation and Water Stewardship (now Manitoba Sustainable Development (MSD)). 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 trails were evaluated for potential effects by terrestrial specialists prior to their submission to MSD, and their locations 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 evaluations of the subsequently approved areas was how these areas would alter predicted cumulative effects, which was largely related to the characteristics of the areas and the amount of the licensed Project footprint that was expected to remain undisturbed at the end of construction. 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 2016, the vast majority (90%) of the possibly disturbed Project footprint had not been impacted by the Project (ECOSTEM 2017).

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

The last type of Project area in this report is 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 DATA COLLECTION

In 2017, all areas cleared or disturbed for the Project were surveyed while flying in a Bell 206 helicopter around the perimeter of the cleared or disturbed areas. Project-related clearing, physical disturbance and other relevant conditions were documented with geo-referenced aerial photographs, marked-up maps and notes.

In the office, digital orthorectified imagery (DOI) obtained by Manitoba Hydro in July 2017 was also used to identify the spatial extents of Project clearing or physical disturbance.

2.4 MAPPING

Project clearing or disturbance boundaries as of September in 2016 and 2017 were precisely digitized from high resolution DOIs and the aerial survey data. All clearing or disturbance was digitized at a scale of 1 inch = 30 metres.

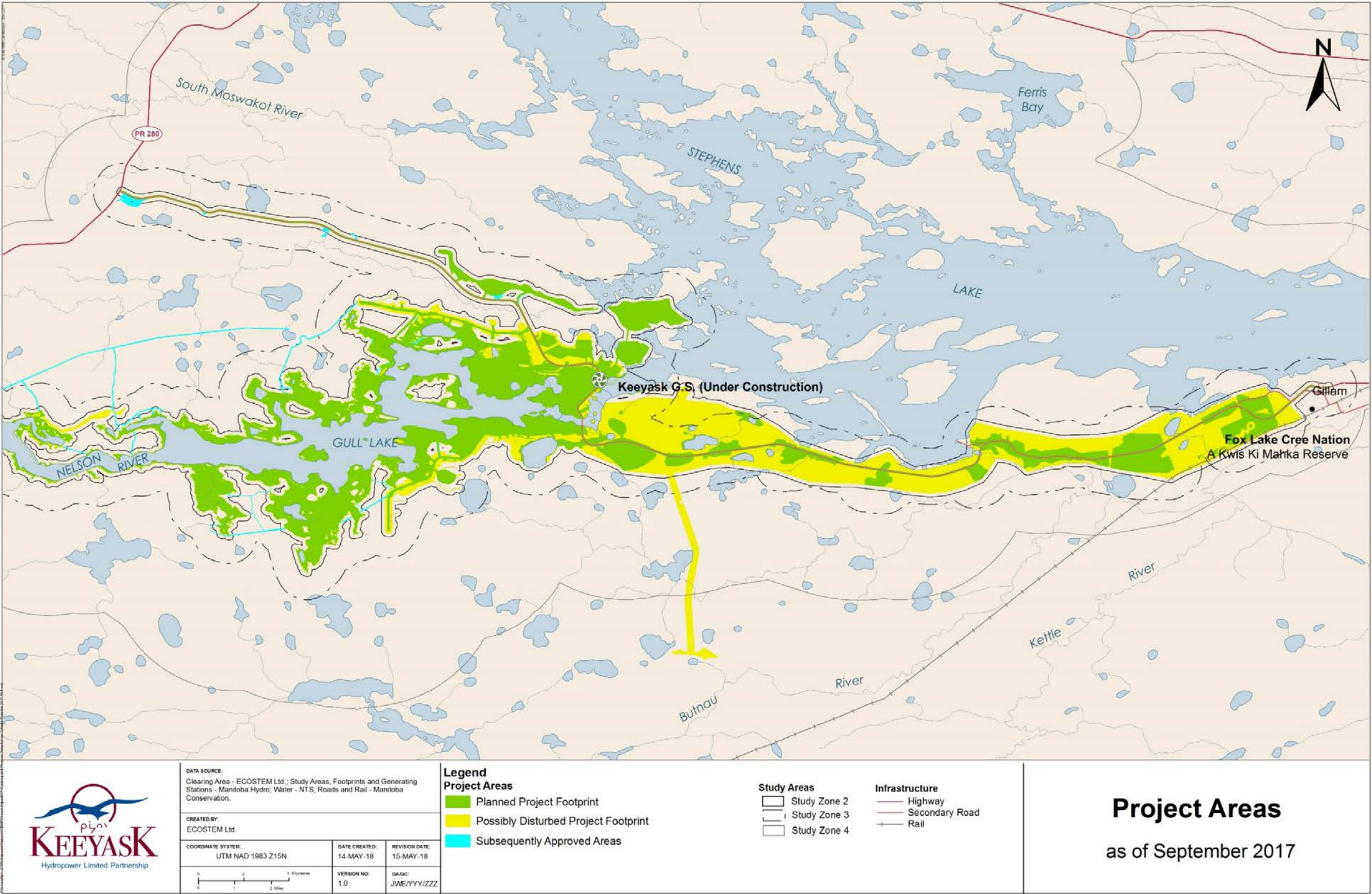
For the 2016 mapping, a DOI created from Worldview 2 imagery acquired on September 21, 2016 was the primary data source for clearing or disturbance boundaries, which covered most of the approved Project footprint area.

For the 2017 clearing or disturbance mapping, a DOI created from Worldview 2 imagery acquired on July 11, 2017 which covered the entire approved Project footprint area, was the primary data source for boundaries. However, this DOI did not provide information on clearing or development occurring after July 11. Aerial survey photos acquired on September 19, 2017 were used to identify clearing or development that occurred after July 11, 2017. Aerial survey photos acquired on July 5, 2017 confirmed areas that likely had not been cleared as of July 11.

In a GIS, the clearing or disturbance occurring between September 2016 and 2017 was appended to the 2016 clearing/disturbance dataset, which was already subdivided to identify the September 2015 clearing or disturbance limits.

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.

Clearing observed during the field surveys that was associated with other projects only was not considered in this report. This includes areas cleared for the Keeyask Infrastructure Project (KIP; which was completed under a separate license) that had no additional Project-related clearing or disturbance (effects on these areas had 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 these totals 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 2-1: Project areas as of September 2017

3.0 RESULTS

This section begins with an overview of Project clearing or disturbance. Subsequent sections detail clearing or disturbance in the various Project components.

3.1 OVERVIEW

As of September 2017, Project clearing or disturbance totaled 5,297 ha, or 42% of the originally licensed Project footprint area. This was an increase of 1,735 ha from that documented as of September 2016 (Table 3–1). Approximately 92% of the new clearing was in the future reservoir area. Clearing accounted for the vast majority of the Project impacts (99.2%) as of September 2017 (mapped clearing includes areas excavated, or built up due to material placement, and infrastructure). Disturbance accounted for the remaining 0.8% of the Project footprint as of September 2017.

Of the 5,297 ha of total clearing or disturbance, 91% was in areas classified as terrestrial habitat in the EIS analysis (the remainder was classified as aquatic).

Much of the planned Project footprint had been cleared by September 2016. Specific Project components included: the entire north access road (NAR) and south access road (SAR); main camp; borrow areas along both access roads; north dyke, south dyke; excavated material placement areas (EMPAs); short access roads used for dyke construction; north reservoir clearing area; camp well access road; cofferdam and cleared/dewatered area; and all work areas.

As of September 2017, additional clearing or disturbance were observed in the following Project components (Map 3-1): south reservoir clearing area and access trails, south dyke, north dyke, GS area, work area C, and in borrow areas N-21, Q-1, N-5 and G-1. Dewatering occurred with construction of the tailrace channel summer level cofferdam.

The photos in Figure 3–1 to Figure 3–16 show examples of clearing or disturbance in various Project areas at the time of the 2017 surveys (these photos are discussed in the relevant Project footprint sections below). As an informal means of demonstrating change, these photos can be compared with photos of the same locations in each year from 2012 to 2016 that were provided in previous monitoring reports (ECOSTEM 2013, 2014, 2015, 2016, 2017).

About 1,602 ha, or 92%, of the area that was cleared or disturbed between September of 2016 and 2017 was situated in the future reservoir area south of the Nelson River. Other footprint components with major contributions to the additional clearing or disturbance during this period were borrow areas N-21, Q-1 and N-5, and the south dyke.

The start-up camp (i.e., initially developed under the KIP as a temporary camp) was a subsequently approved Project area (Section 2.2). Staff working on the Project stayed in the trailers located within this site. 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 continued in 2017.

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, 2017 (i.e., observed clearing or disturbance was from previous projects or activities such as the KIP).

Table 3–1: Cumulative actual Project clearing or disturbance area as of September 2017, by Project component

Project Component ¹	Total Area Cleared or Disturbed (ha)				Change from Previous Year ⁴ (ha)		
	2014 (existing from KIP)	2015 ²	2016 ³	2017	2015	2016	2017
North access road	192	192	193	193	1	0	0
South access road	-	300	326	326	300	26	0
Camp and work areas	187	229	233	234	43	3	1
Borrow areas	49	269	361	414	220	92	53
North dyke and associated areas	19	134	183	198	115	50	15
South dyke and associated areas	-	25	122	180	25	97	58
Generating station and river works	11	198	221	227	187	23	6
Reservoir clearing and access trails	2	9	1,924	3,526	7	1,915	1,602
All cleared or disturbed areas	459	1,356	3,562	5,297	897	2,206	1,735

Notes: a "-" indicates no area, a 0 indicates an area less than 0.5 ha.

¹ Footprint types are coarse groupings of components. In general, they include adjacent EMPAs, and dykes include associated borrow areas.

² Areas for 2015 differ than those presented in the 2015 annual report because 2015 mapping was refined within the planned project footprint.

³ Areas for some footprint types differ slightly from those presented in the 2016 annual report because some clearing was reclassified into other project components as the footprint developed.

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



North Access Road (NAR)/PR 280 junction (looking southwest) on September 19, 2017



Approximately halfway along the NAR (looking north) on September 19, 2017

Figure 3–1: Clearing and other impacts along the NAR



Bridge at Looking Back Creek (looking southwest) on September 19, 2017



Near the south end of the NAR (looking east) on September 19, 2017

Figure 3–1: Continued...



West end of SAR (looking southwest) on September 19, 2017



View of the SAR camp and borrow area B-3 (looking south) on September 19, 2017

Figure 3–2: Clearing and other impacts along the SAR



Crossing at the Butnau River (looking north) on September 19, 2017



Near the east end, junction with the old Butnau Road (looking north) on September 19, 2017

Figure 3–2: Continued...



Main camp (looking east) on September 19, 2017



Helicopter pad (looking east) on September 19, 2017



Well road (looking northeast) on September 19, 2017

Figure 3–3: Main camp, helicopter pad and well road



Figure 3–4: Cemetery site along the North Access Road (September 19, 2017)



Work Area A (looking south) on September 19, 2017



Work Area X, B and C (looking west) on September 19, 2017

Figure 3–5: Work areas



Figure 3–6: Work Area A (looking south) on September 19, 2017. Yellow arrow identifies remediated sediment area



Borrow Area G-1 at KM-15 (looking south) on September 19, 2017



Borrow Area G-1 at KM-17 (looking southwest) on September 19, 2017

Figure 3–7: Clearing and excavation in borrow areas north of the Nelson River



Borrow Area G-3 (looking east) on September 19, 2017



Borrow Area N-5 (looking north) on September 19, 2017

Figure 3–7: Continued...



Borrow Area N-21 (looking northeast) on September 19, 2017

Figure 3–7: Continued...



Quarry Area Q-1 (looking west) on September 19, 2017



Borrow Area B-2 (looking south) on September 19, 2017

Figure 3–8: Clearing and excavation in borrow areas south of the Nelson River



Borrow Area S-2a (looking north) on September 19, 2017



Borrow Area S-2b (looking east) on September 19, 2017

Figure 3–8: Continued...



Quarry Area Q-9 (looking south) on September 19, 2017



Borrow Area B-3 (looking north) on September 19, 2017

Figure 3–8: Continued...



Borrow Area B-5 (looking southeast) on September 19, 2017



Borrow Area B-6 west portion (looking north) on September 19, 2017

Figure 3–8: Continued...



Borrow Area B-6 east portion (looking north) on September 19, 2017



Borrow Area B-8 (looking north) on September 19, 2017

Figure 3–8: Continued...



Borrow Area N-5 (looking south) on September 19, 2017. Yellow arrow identifies drainage hose and gully at location A



Borrow Area N-5 (looking south) on September 18, 2017, sedimentation in uncleared forest at location A

Figure 3–9: Sedimentation into adjacent undisturbed habitat at two locations in borrow area N-5



Borrow Area N-5 (looking southeast) on September 18, 2017. Yellow arrow identifies gully at location B



Borrow Area N-5 (looking north) on September 18, 2017, with sedimentation in uncleared forest at location B

Figure 3–9: Continued...



North dyke, east end (looking east) on September 19, 2017. Yellow arrow identifies dyke.



North dyke, west end (looking southwest) on September 19, 2017

Figure 3–10: North dyke



South dyke, southwest end (looking southeast) on September 19, 2017



South dyke, central area (looking south) on September 19, 2017

Figure 3–11: South dyke



EMPA D16 (looking south) on September 19, 2017



EMPA D17 (looking south) on September 19, 2017

Figure 3–12: Excavated material placement areas in use



EMPA D19-I (looking north) on September 19, 2017. Yellow arrow identifies EMPA.



Portion of EMPA D12 (looking east) on September 19, 2017

Figure 3–12: Continued...



EMPA D3-E (looking southwest) on September 19, 2017



EMPA D9-I (looking south) on September 19, 2017

Figure 3–12: Continued...



EMPA D16 (looking south) on September 19, 2017. Yellow arrows identify sediment entering wetland



Remediated sediment deposition area in EMPA D17 (looking west) on September 19, 2017

Figure 3–13: Sediment deposition into uncleared areas from EMPA slopes



Failed silt fence on east side of EMPA D16 (looking east) on August 25, 2017



Failed silt fence on northeast side of EMPA D17 (looking northwest) on September 19, 2017

Figure 3–13: Continued...



Powerhouse and tailrace channel summer cofferdam construction (looking northwest) on September 19, 2017



Spillway construction (looking north) on September 19, 2017

Figure 3–14: Powerhouse and Spillway construction



Spillway laydown area (looking north) on September 19, 2017

Figure 3–14: Continued...



Reservoir clearing south of Nelson River (looking northeast) on September 19, 2017



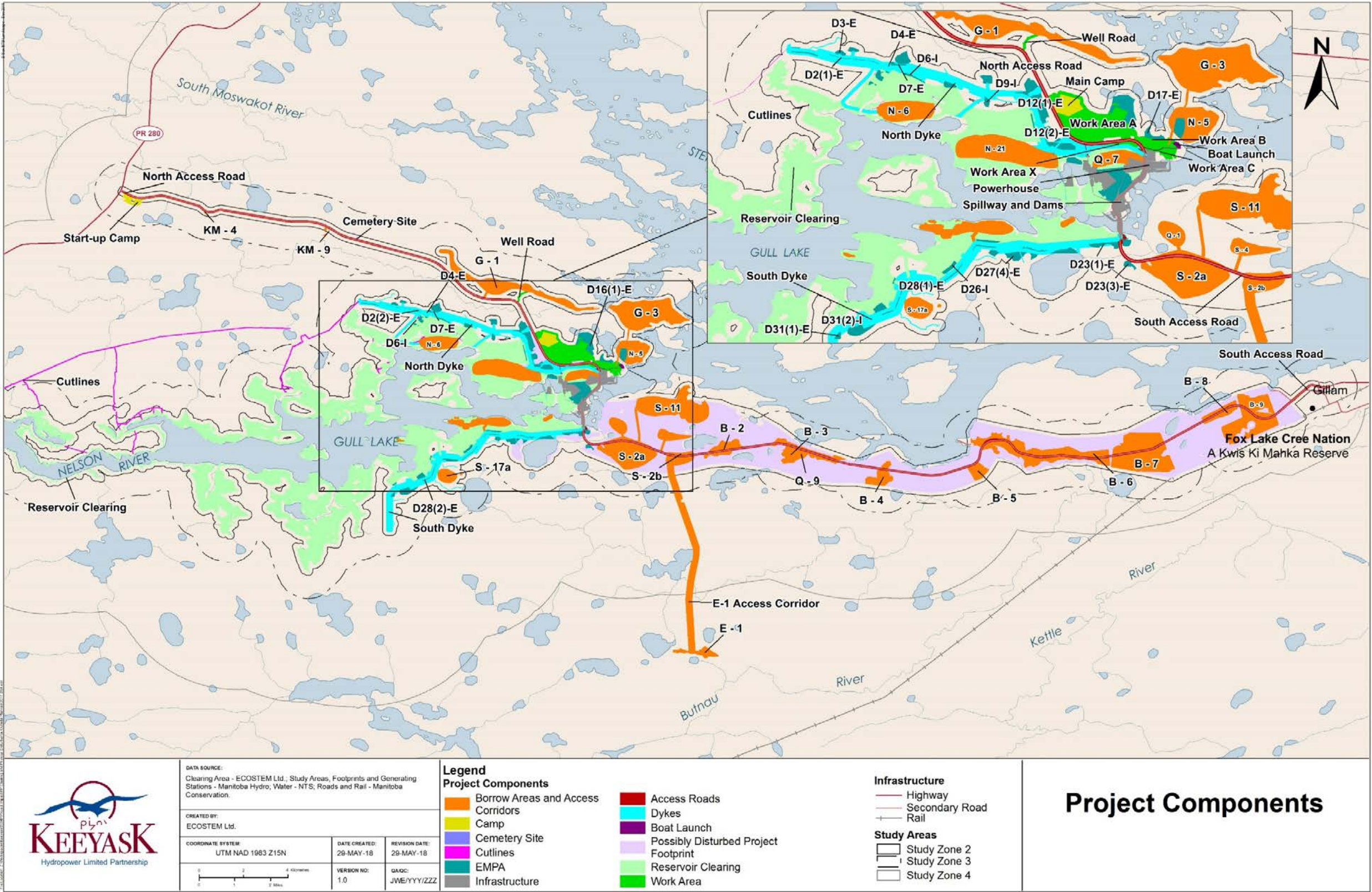
Reservoir clearing around future island south of Nelson River (looking north) on July 5, 2017

Figure 3–15: Reservoir clearing



Pre-existing cutline used for access to reservoir clearing areas (looking southwest) on July 5, 2017

Figure 3–16: Pre-existing cutline used for access to reservoir clearing (looking southwest) on July 5, 2017



Map 3-1: Project components

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 Manitoba Sustainable Development (MSD).

Of the 5,297 ha of total clearing or disturbance recorded in September 2017, 94% was within the planned Project footprint (Map 3-2). Clearing or disturbance within these areas had increased by 1,677 ha since September 2016 (Table 3-2).

Clearing or disturbance in the possibly disturbed Project footprint (Table 3-2; Map 3-2) amounted to approximately 244 ha as of September 2017. This was an increase of 51 ha over 2016. Most of the newly impacted area was situated in the south-side reservoir clearing area, and along the south and north dykes (Appendix Table 6–1).

As of September 2017, 60 ha of the clearing or disturbance was in subsequently approved Project areas, with nearly half of this area (48%) being in areas previously cleared for the KIP. These subsequently approved areas included the KIP start-up camp near PR 280, and portions of Borrow Area KM-4 and KM-9 (which had previously been used for the KIP), a cemetery site adjacent to the NAR, and several pre-existing and newly cleared access trails utilized for accessing the reservoir clearing areas north and south of the Nelson River. A portion of the area that was cleared during the KIP fell outside of the approved Project footprint for both KIP and the Project (access to G-1 at KM-17). This area was addressed in the KIP report (ECOSTEM 2015), and while it is still being used by the Project, it was not considered as an area outside the approved Project footprint for this report, but as area that was subsequently approved for use.

Areas cleared or disturbed outside of the approved Project footprint totalled 8 ha (Table 3-2; Map 3-2), or 0.16% of total impacted area as of September 2017. As illustrated in Map 3-2, this 8 ha of impacts was very small (0.11%) relative to the 7,510 ha of remaining undisturbed area within the licensed Project footprint. The Project is not expected to impact most of the area that was undisturbed in 2017.

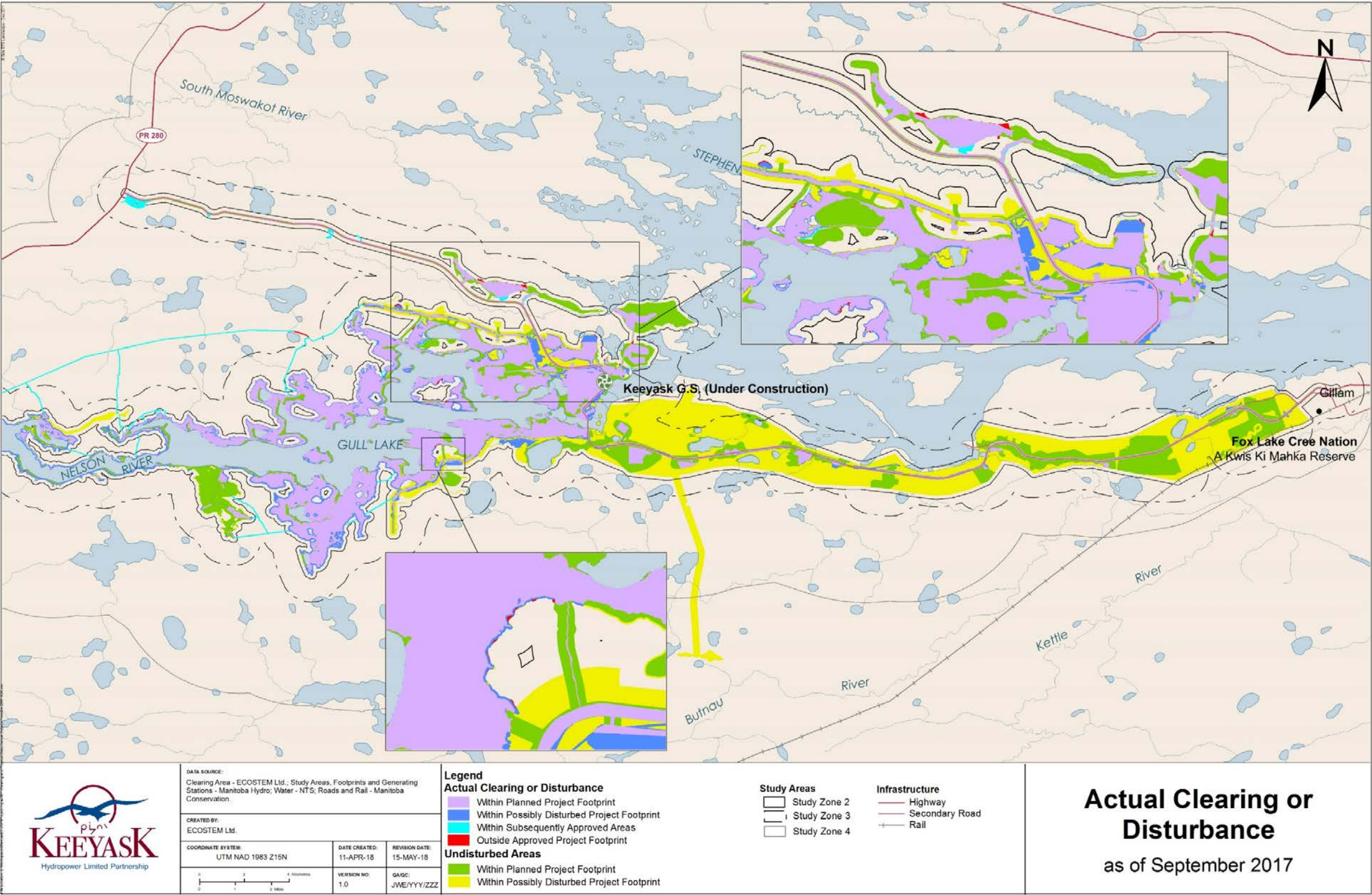
Most of the new area cleared or disturbed outside of the approved Project footprint was from new trails used to access the south reservoir areas for clearing, and from clearing outside of the approved Project footprint near the south reservoir and south dyke. Most of the remaining disturbance to areas outside the approved Project footprint was caused by sedimentation from eroding slopes on the north side of EMPA D16 and the west side of EMPA D17. The sediment in the latter case was subsequently removed in August, 2017, but the removal process damaged some trees, their roots and the organic substrate (Figure 3–13).

Table 3-2: Cumulative actual Project clearing or disturbance area as of September, 2017, by Project area

Project Area	Total Approved Area (ha)	Total Area (ha)				Change (ha) from Previous Year ¹		
		2014 (existing from KIP)	2015	2016	2017	2015	2016	2017
Planned Project Footprint	7,616	420	1,260	3,308	4,985	839	2,049	1,677
Possibly Disturbed Project Footprint	5,123	10	65	193	244	55	128	51
Subsequently Approved Project Areas ²	n/a	29	29	56	63	0	27	7
Areas Cleared or Disturbed Outside the Approved Project Footprint	n/a	-	2	5	6	2	3	1
All	12,738	459	1,356	3,562	5,297	897	2,206	1,735

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 MSD that are not part of the licensed Project footprint.



Map 3-2: Actual Project clearing or disturbance as of early September 2017

3.3 CLEARING OR DISTURBANCE BY PROJECT COMPONENT

3.3.1 ACCESS ROADS

All NAR and SAR clearing observed in September 2017 was within the planned Project footprint boundary, and was unchanged from September 2016 (Figure 3–1 and Figure 3–2; Table 3–1 and Table 3–3). No road construction activity was observed during 2017 surveys (although road maintenance was ongoing). The visible clearing outside of the SAR ROW was part of the Keeyask Transmission Project (KTP) and, as such, is not included in the results except where a Project borrow area overlaps the same area.

While no additional clearing had occurred along the NAR, an erosion gully on the south ditch bank adjacent to Borrow Area KM-1, which was identified during 2016 surveys, had expanded, and was beginning to remove the mineral material under a treed area between the ditch and borrow area (Map 3-3; Figure 3–17).

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 2017, by main Project component

Project Component	Clearing or Disturbance (ha)					
	Within the Possibly Disturbed Project Footprint			Outside the Approved Project Footprint		
	2016 ¹	2017	Change	2016	2017	Change
South Access Road	4.45	4.45	-	-	-	-
Camp & Work Areas	2.53	2.55	0.02	0.01	0.01	-
Generating Station Area	12.63	13.18	0.56	-	-	-
Borrow Areas	5.68	6.34	0.66	2.95	2.95	-
EMPAs	59.10	59.30	0.20	0.20	0.32	0.12
Dykes	21.12	32.86	11.74	-	0.03	0.03
Reservoir Clearing & Cutlines	77.54	115.35	37.81	1.44	2.32	0.88
Total	183.06	234.04	50.98	4.60	5.63	1.03

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

¹ Areas for some footprint types differ slightly from previous report because some clearing was reclassified into other Project components as the footprint developed.



Figure 3–17: Erosion gully in NAR ditch along treed bank, September 2017

3.3.2 MAIN CAMP, NORTH SHORE WORK AREAS AND WELL AREA

The extent of clearing for the main camp, well road and helicopter pad in September 2017 remained unchanged from 2016 (Figure 3–3). The extent of clearing in work areas A, B and X north of the Nelson River remained unchanged since 2015 (Figure 3–5). At the west side of work area C there was an additional 0.8 ha of clearing and excavation associated with expansion of a borrow pit (Table 3–3). Additionally, a boat launch, approximately 0.02 ha in size, was cleared and developed for the portage route at the east end of work area C. On the west side of the batch plant in work area A, sediment had been deposited from the work area edge over approximately 0.16 ha of uncleared vegetation (Map 3-3). This sediment was subsequently excavated from the area but the excavation disturbed the underlying vegetation and substrate (Figure 3–6).

The 0.02 ha of clearing associated with the boat launch was the only new clearing or disturbance within the possibly disturbed Project footprint that was observed for the main camp, north shore work areas or well area footprint components.

3.3.3 BORROW AREAS

Since September 2016, vegetation clearing in Borrow Area G-1 at KM-17 expanded to the southwest by approximately 3 ha, and an additional 0.15 ha had been cleared or disturbed in the northwest portion (Figure 3–7). At the west side of G-1, much of the area, which was disturbed in September 2016, was fully cleared and excavated as of September 2017.

At Borrow Area N-5, an additional 4.7 ha of clearing since September 2016 expanded to the northwest and southeast (Figure 3–7) into a previously undisturbed area. This new area had not yet been excavated as of September 2017. Approximately 0.1 ha of additional clearing occurred along the haul road adjacent to Borrow Area N-5 as well.

While Borrow Area G-3 was still under heavy use in 2017, no additional clearing beyond September 2016 boundaries had occurred. Excavation of Quarry Q-7 had expanded slightly since September 2016, but the excavation remained within previously cleared areas.

At Borrow Area N-21, there was 30 ha of new clearing and excavation since September 2016, situated along the ice boom road (Figure 3–7). A small portion of this borrow area was already developed in 2016 (this area was grouped with the north dyke component in the 2016 annual report), with the new clearing located in previously undisturbed areas. Just over 2 ha of new clearing and development served to widen the portion of the ice boom road accessing the borrow area.

On the south side of the Nelson River, Borrow Areas S-18, S-17a, S-2b, B-5 and B-8 had not been further developed since the 2016 mapping. Approximately 15 ha of new clearing associated with rock quarry Q-1 occurred since September 2016. This area was previously undisturbed. As of September 2017, the access road to the quarry was under construction. Borrow Area B-3 had also expanded by just under 0.2 ha, but the expansion occurred within the cleared Keeyask Transmission ROW. Excavation had expanded in Borrow Areas S-2a and B-2, and in rock quarry Q-9, but there had been no additional clearing (Figure 3–8). Small portions of Borrow Area B6 were developed or excavated, but there was no additional clearing since September 2016.

In total, 6.34 ha of borrow area clearing along the SAR fell within the possibly disturbed Project footprint as of September 2017 (Table 3–3). Borrow area clearing or disturbance outside of the approved Project footprint remained at 2.95 ha in 2017, unchanged from 2016 (Figure 3–7; Map 3-2; Appendix 1: Table 6–1).

During the 2017 surveys, it was observed that erosion gullies at two locations along the north slope of Borrow Area N-5 had deposited sediment into the adjacent uncleared forest (Figure 3–9; Map 3-3). At one of the locations (Location A), the gully was formed by an active drainage hose. This gully was continuing to expand, and sediment was being deposited several meters into the forest. At the other location (Location B), a gully had formed and deposited sediment into the adjacent cleared area, and slightly into the uncleared forest. The cause of the gully at this location was unclear. It was recommended in the field reports that erosion barriers be

constructed where needed, and that the drainage hose at Location A be extended to the base of the slope and secured.

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. Between September 2016 and 2017, an additional 15 ha of clearing had occurred along the north dyke and within its associated EMPAs. The dyke infrastructure had been constructed along its entire length to various stages of completion (Figure 3–10). Additionally, 58 ha of new clearing was present along the south dyke (Map 3-2; Figure 3–11). No portions of the south dyke were gravelled beyond what was present in 2016.

Dyke clearing within the possibly disturbed Project footprint in September 2017 totalled 32.86 ha, an increase of 11.74 ha since September 2016 (Table 3–3). This clearing was along both the north and south dykes (Appendix 1: Table 6–1). The largest segment of clearing in the possibly disturbed Project footprint along the north dyke was associated with a drainage ditch extending away from the dyke between EMPAs D12(1) and D12(2). Approximately 0.03 ha of clearing outside the approved Project footprint occurred at one new location, approximately midway along the south dyke on the north side (Map 3-2).

3.3.5 EXCAVATED MATERIAL PLACEMENT AREAS

Between September 2016 and 2017, there had been no additional clearing or expansion of EMPA D16 or D17 (Figure 3–12). However, rills and gullies formed by erosion on the EMPA slopes deposited sediment into uncleared vegetation at several locations around the perimeters of EMPA D16 and D17 (Figure 3–13). At several of these locations, the silt fence that had been erected to prevent sediment deposition had been overwhelmed.

The largest such disturbance was near the northeast corner of EMPA D16, where a large gully deposited sediment approximately 50 m into a wetland adjacent to Stephens Lake, disturbing approximately 0.13 ha (Map 3-3). At the time of the 2017 surveys, the sediment appeared to have reached the lake. It was recommended in the field reports that a barrier be erected to stop sediment entering the wetland north of EMPA D16, and that the silt fences along the east side of EMPA D16 be repaired and reinforced.

One disturbed area on the west side of EMPA D17 covered approximately 0.02 ha. The sediment was subsequently removed from the uncleared area using an excavator, and a silt fence was installed around the perimeter of the EMPA in fall, 2017. Removal of the sediment resulted in mechanical damage to the trees, their roots, and the surface organic substrate (Figure 3–13). Bark was stripped from some of the lower tree trunks, and roots were exposed

and/or torn from the organic substrate, and damaged by the excavator. Low vegetation and peat moss was removed along with the sediment.

For the D12 EMPAs along the north dyke, portions of all of them were further developed by September 2017. However, the only additional clearing since 2016, totalling approximately 1.9 ha in area, was associated with access roads in to EMPA D12(1) and D12(2) as well as a slight expansion of D12(2) (Figure 3–12). Erosion at two locations on the north and southeast slopes of EMPA D12(2) was beginning to deposit sediment into the adjacent uncleared vegetation (Map 3-3).

EMPA D9-I had also been developed since 2016, and had a small amount of additional clearing totalling 0.02 ha. EMPAs D3-E along the north dyke, and D19-I on William Smith Island had no additional clearing or disturbance since 2016.

South of the river, several EMPAs along the south dyke had been cleared, but were not yet in use. These included D23, D27, D28 and two D31 areas. There had been no additional clearing in these areas as of September 2017.

Clearing for the EMPAs within the possibly disturbed Project footprint covered an area of approximately 59.3 ha by September 2017 (Appendix 1: Table 6–1). In EMPA D16, approximately 0.04 ha of the sedimentation disturbance was in the possibly disturbed Project footprint, and in EMPA D12(1) 0.1 ha of the new clearing was in the possibly disturbed Project footprint. Most of the remaining EMPA-related clearing or disturbance was within the planned Project footprint.

A 0.12 ha portion of the sedimentation disturbances in EMPAs D16 and D17 were outside the approved Project footprint (Map 3-2). This included almost all of the disturbance on the west side of EMPA D17, and most of the large disturbed area in the wetland at the northeast edge of EMPA D16.

3.3.6 RIVER WORKS AREA

Construction of the spillway laydown area, spillway cofferdam, and dewatering area had been completed since the time of 2015 surveys. Construction of the powerhouse and spillway structures was also underway as of September 2016, and continuing as of September 2017 (Figure 3–14). At the time of the 2017 surveys, construction of the tailrace channel summer level cofferdam was underway. Since September 2016, an additional 6 ha had been cleared or developed.

In 2017, an additional 0.56 ha of river works development, including parts of the spillway and GS area, occurred within the possibly disturbed Project footprint, increasing the total to 13.18 ha. None of the river work areas were outside the approved Project footprint.

3.3.7 RESERVOIR CLEARING

More than three-quarters of the planned reservoir clearing south of the Nelson River was completed prior to the 2017 surveys, with the vast majority of this clearing happening when the ground was frozen. This Project component accounted for 1,595 ha of the clearing between September 2016 and 2017, the majority (92%) of all new clearing.

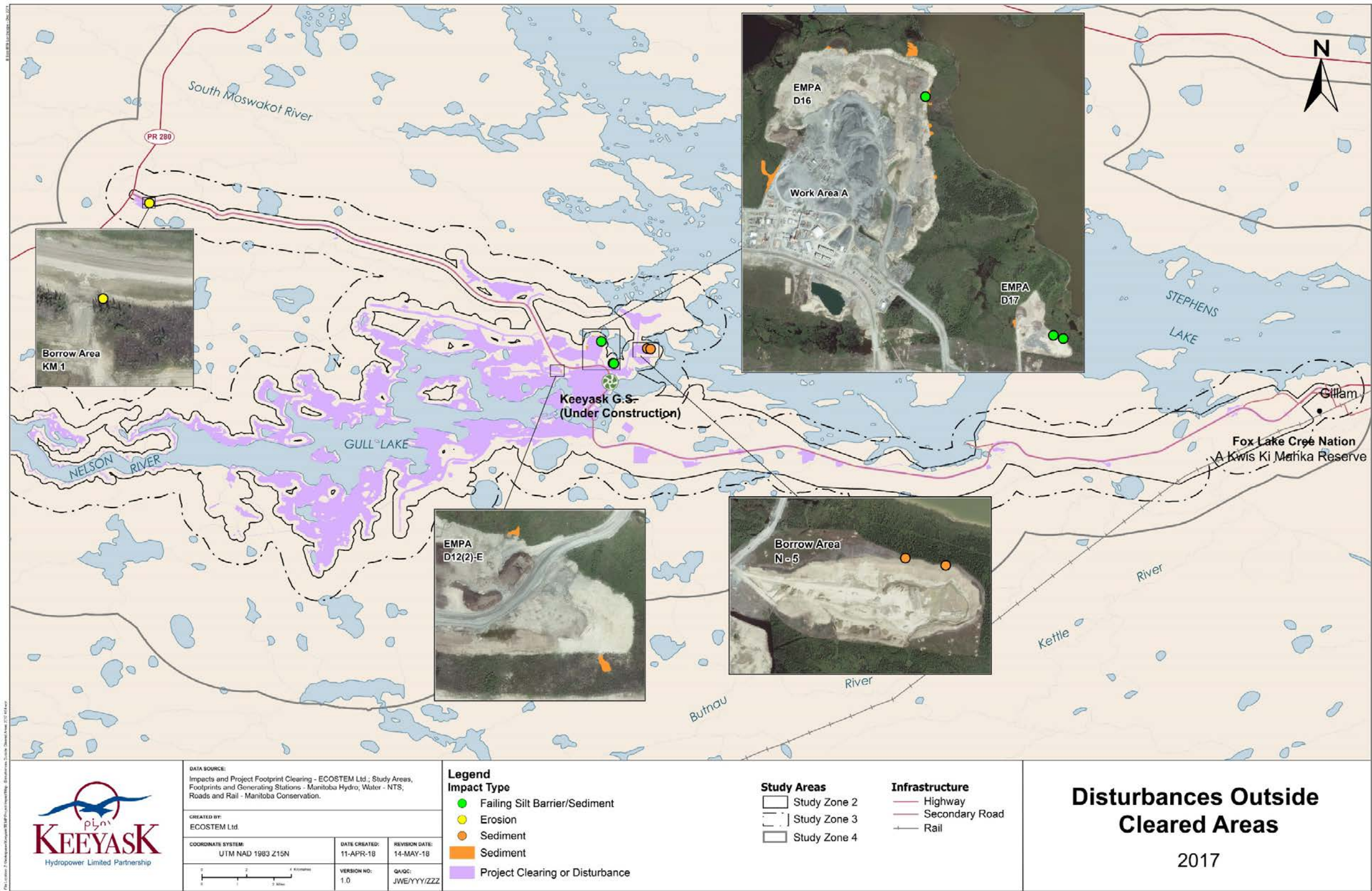
As of September 2017, approximately 115 ha of the reservoir clearing was within the possibly disturbed Project footprint, situated around the perimeter of the reservoir clearing footprint (Appendix 1: Table 6–1).

Approximately 1.60 ha of reservoir clearing was outside the approved Project footprint. This area was very small (0.05%) relative to the extensive reservoir clearing area that was covered; most of this area was in numerous scattered, small patches, primarily on Caribou Island and on the mainland just south of Caribou Island (Map 3-2).

3.3.8 TRAILS

Several access trails were used for reservoir clearing or to conduct geotechnical investigations near Little Gull Lake (Figure 3–16; Map 3-2). Some were created along existing cutlines, while others were newly cleared. By September 2017, the total impacted area in trails was 41 ha. Of this total, 10 hectares were newly cleared.

Approximately 0.30 ha of the trail clearing or disturbance fell within the possibly disturbed Project footprint (Appendix 1: Table 6–1). A total of 0.73 ha of the clearing or disturbance fell outside the approved Project footprint. These included two segments of pre-existing cutlines that were disturbed during north reservoir clearing which were not among the segments approved by the Province (Map 3-2). Three segments of newly cleared trails used for south reservoir clearing (totalling 2.68 ha) were outside of the licensed Project footprint, but they were subsequently approved by MSD for Project use.



Map 3-3: Disturbances outside of cleared areas in 2017

4.0 DISCUSSION

Sedimentation from eroding slopes on the west side of EMPA D17 and on the northeast side of EMPA D16 caused disturbance to areas outside the approved Project footprint. Additional damage to some trees, their roots and the organic substrate in at the former location occurred when much of this sediment was subsequently removed by an excavator. In this case, sediment removal may have done more damage to the vegetation than if nothing had been done. In the absence of removal, future rains could wash some of the sediment into the same areas, providing a larger area of habitat alteration for non-native plant colonization. Some options for similar situations in the future include limiting the spatial extent of remedial excavation, leaving more or all of the sediment in place and/or strengthening silt fences to limit the risk of failure.

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.

Most of the planned clearing had been completed by September 2017. The large exceptions were one-quarter of the south reservoir area and the Ellis Esker borrow area.

Habitat loss and disturbance monitoring documented approximately 5,297 ha of clearing or physical disturbance as of September 2017. This area was still only 42% of the total area included in the licensed Project footprint.

Of the total area cleared or disturbed to September 2017, 94.1% (4,985 ha) was within the planned Project footprint, while 4.6% (244 ha) was within the possibly disturbed Project footprint (Map 2-1). Impacts in the possibly disturbed Project footprint were only 4.8% of the 5,123 ha included for this Project area.

Clearing within the possibly disturbed Project footprint was mostly associated with reservoir clearing, EMPAs along the dykes, and the north and south dyke. The remaining clearing was in a few small areas along the SAR, within SAR borrow areas and within the river works area.

Most of the 5.63 ha of areas cleared or disturbed outside the approved Project footprint was located at Borrow Area G-1 and in the reservoir clearing area. Three segments of newly cleared trails used to access the south reservoir area have been subsequently approved by MSD for Project use.

Overall, this 5.63 ha area was very small relative to the 7,510 ha of still undisturbed area in the licensed Project footprint. As illustrated in Map 3-2, the area cleared or disturbed outside the approved Project footprint was only 0.07% of the remaining portions of the licensed Project footprint that have not yet been disturbed. Additionally, most of the still undisturbed area within the licensed Project footprint in 2017 was expected to remain undisturbed by the Project. The only Project components expected to have substantial clearing after September 2017 are the remainder of the south reservoir area and the Ellis Esker (E-1) borrow area.

To date, the Project has not created any major unanticipated removal or alteration of terrestrial habitat. As expected, the total amount of clearing and physical disturbance as of September 2017 is much less than included in the licensed Project footprint. At this time, there are no recommendations for additional mitigation, or modifications to the study methods based on results from this study.

5.1 NEXT STEPS

Monitoring fieldwork for the Habitat Clearing and Disturbance study will continue in 2018. No major changes to field methods are anticipated.

6.0 LITERATURE CITED

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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 2017, 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		
		2016	2017	Change	2016	2017	Change
Access Roads	South Access Road	4.45	4.45	-	-	-	-
Camp & Work Areas	Main Camp	0.00	0.00	-	-	-	-
	Work Area A	0.75	0.75	-	-	-	-
	Work Area B	0.42	0.42	-	0.01	0.01	-
	Work Area C	0.19	0.19	-	-	-	-
	Work Area X	0.11	0.11	-	-	-	-
	Portage Route	1.07	1.09	0.02	-	-	-
River Works Area	Generating Station	0.09	0.36	0.27	-	-	-
	Spillway & Cofferdam	12.53	12.82	0.29	-	-	-
Quarries and Borrow Areas	B-2	0.40	0.40	-	-	-	-
	B-3	2.55	2.72	0.18	-	-	-
	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	-	-	-	-
	D1(2)-I	-	0.03	0.03	-	-	-
EMPAs	D12(1)-E	0.01	0.01	-	-	-	-
	D12(2)-E	6.06	6.16	0.01	-	-	-
	D16(1)-E	15.07	15.11	0.04	0.15	0.25	0.11
	D17-E	0.00	0.00	-	0.01	0.02	0.01
	D23(1)-E	1.56	1.57	0.01	-	-	-
	D27(4)-E	26.06	26.06	-	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	-
	D7-E	-	0.02	0.02	-	-	-
Dykes	D9-I	0.01	0.01	-	-	-	-
	North Dyke	19.73	24.21	4.48	-	-	-
	South Dyke	1.39	8.65	7.26	-	0.03	0.03
Reservoir Clearing	Reservoir Clearing	77.41	115.05	37.64	0.71	1.60	0.88
	Trails	0.14	0.30	0.17	0.73	0.73	-
Total		183.06	234.04	50.98	4.60	5.63	1.03

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