Keeyask Infrastructure Project

Terrestrial and Aquatic Monitoring Plan

Plants, Habitat and Ecosystems Monitoring

Annual Report 2014-2015

KEEYASK

Hydropower Limited Partnership

December 2015

KEEYASK INFRASTRUCTURE PROJECT

TERRESTRIAL AND AQUATIC MONITORING PLAN

Plants, Habitat, and Ecosystems Monitoring

Annual Report 2014 - 2015

Report for

MANITOBA CONSERVATION AND WATER STEWARDSHIP

Prepared on Behalf the
Keeyask Hydropower Limited Partnership

Prepared By
ECOSTEM Ltd.

December 2015

EXECUTIVE SUMMARY

The Keeyask Hydropower Limited Partnership constructed the Keeyask Infrastructure Project (the Project or KIP) between 2012 to July 2014, after which construction of the Keeyask Generation Project began.

The KIP is located approximately 40 km southwest of Gillam in the Split Lake Resource Management Area, extending between Provincial Road (PR) 280 and Gull Rapids on the Nelson River. The Project includes a start-up camp and associated infrastructure, a 25 km all-weather access road and the first phase of a main camp. The start-up camp is located near the intersection of PR 280 and the access road, while the first phase of the main camp is located at the end of the access road on the north side of Gull Rapids.

As a KIP licensing condition (Environment Act Licence No. 2952R), the Keeyask Hydropower Limited Partnership is conducting terrestrial effects monitoring during the KIP construction. This report covers the period from April 1, 2011 to March 31, 2015. Terrestrial habitat, ecosystem and plant monitoring for the KIP conducted during these years included clearing and physical disturbance mapping, rare plant surveys, invasive plant surveys and fire extent reconnaissance surveys. The areas encompassed by these studies reflected alterations to the licensed Project Footprint approved by Manitoba Conservation and Water Stewardship to address an unanticipated shortage of suitable construction materials and to include the addition of wells for the main camp and start-up camp. As this is the final reporting year, this report also provides a synthesis of KIP effects during the entire construction phase

Studies conducted to compare the actual with the planned extent of KIP direct effects on terrestrial habitat showed that actual KIP clearing and physical disturbance were considerably lower (47%) than included in the planned KIP Footprint. With minor exceptions totalling 10.1 ha, all clearing and disturbance were within the 1,025 ha planned KIP footprint. The exceptions were either small slivers along planned footprint edges, small borrow area extensions or exploration trails, none of which had any local effects beyond what was assessed in the KIP EA Report.

Invasive and non-native plants ground surveys were limited in extent up to the 2014 growing season due to safety concerns related to the ongoing construction activities. Spring and fall surveys in 2014 found an increase in the distribution and number of species over the growing season, and relative to previous years. Factors thought to have contributed to the increase included higher detectability in the fall, spreading by construction activities and spreading via hydroseeding.

Several large wildfires swept through the Local Study Area during the summer of 2013. The fires were not Project related, but they did burn up to or through the Project Footprint at multiple locations. Data obtained from satellite imagery, ground surveys and aerial surveys indicated that KIP likely had small localized effects on fire behaviour. However, there were no indications that KIP had any effects on the fire regime.

Terrestrial plant, habitat, and ecosystem monitoring results to March 2015 determined that actual KIP effects on habitat, ecosystems and plants were generally less than predicted in the EA Report. A notable exception was that the spreading of invasive plants was greater than anticipated. Recommendations for potential modifications to monitoring programs, mitigation measures or EnvPP guidelines relating to invasive plant control will be developed for other initiatives since this project is complete.

ACKNOWLEDGEMENTS

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Chiefs and Councils of Tataskweyak Cree Nation (TCN), War Lake First Nation (WLCN), 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 Clayton Flett and Douglas Kitchekeesik of TCN for arranging logistic support and providing field staff for studies.

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

STUDY TEAM

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

Fieldwork was conducted by Alanna Sutton, Brock Epp, Alex Snitowski and Charles Enns.

Data analysis and report writing were completed by Alanna Sutton and James Ehnes. GIS analysis was primarily completed by Alanna Sutton and Alex Snitowski. Alex Snitowski completed the cartography.

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LIST OF ABBREVIATIONS AND ACRONYMS

EA	Environmental Assessment
EnvPP	Environmental Protection Plan
GIS	Geographic Information System
KHLP	Keeyask Hydropower Limited Partnership
KIP	Keeyask Infrastructure Project
PR	Provincial Road

GLOSSARY

Actual KIP Footprint- The actual extent of clearing and physical disturbance by the Project.

Planned KIP Footprint- The planned extent of clearing and physical disturbance for Project use.

S-Rank – "Subnational Rank" seeks to ascertain the rarity of species within subnational boundaries, in this case the subnational boundary is the Province of Manitoba.

S1 Species - A ranking denoting that the plant is very rare throughout its range or in the province.

S2 Species - A ranking denoting the plant is rare throughout its range or in the province.

S3 Species - A ranking denoting the plant is uncommon throughout its range or in the province.

S1S2 Species – A numeric range rank where there is a range of uncertainty about the exact rarity of the species, in this case whether it is very rare or rare throughout its range or in the province.

1.0 INTRODUCTION

The Keeyask Hydropower Limited Partnership constructed the Keeyask Infrastructure Project (the Project or KIP) between 2012 to July 2014, after which construction of the Keeyask Generation Project began.

The KIP is located approximately 40 km southwest of Gillam in the Split Lake Resource Management Area, extending between Provincial Road (PR) 280 and Gull Rapids on the Nelson River. The Project includes a start-up camp and associated infrastructure, a 25 km all-weather access road and the first phase of a main camp. The start-up camp is located near the intersection of PR 280 and the access road, while the first phase of the main camp is located at the end of the access road on the north side of Gull Rapids.

The predicted environmental effects of the KIP were described in the KIP Environmental Assessment Report (KHLP 2009; the EA Report). KIP was expected to affect terrestrial ecosystems through the direct and indirect effects of vegetation clearing, overburden excavation, road use and camp operation. This report describes the terrestrial habitat, plant, intactness and fire regime monitoring conducted from April 1, 2014 to March 31, 2015. It also provides a synthesis of KIP effects during the entire construction phase.

Construction activities during the April, 2014 to March 2015 monitoring period included: operation of the Start-Up Camp, construction of the Main Camp (Phase 1) and the installation and commissioning of the wastewater treatment plant.

KIP terrestrial plants, habitats and broad ecosystem monitoring addressed two types of considerations: implementation compliance and unanticipated events. The purpose of implementation compliance monitoring was to document the actual extent of the KIP-related clearing and physical disturbance as well as implementation of mitigation measures. Unanticipated event monitoring focused on potential low likelihood events or conditions that could substantially alter the effects predictions provided in the EA Report. Examples of such low likelihood events included wildfires accidentally started by KIP, finding provincially rare plant species or the substantial spreading of invasive and/or non-native plants.

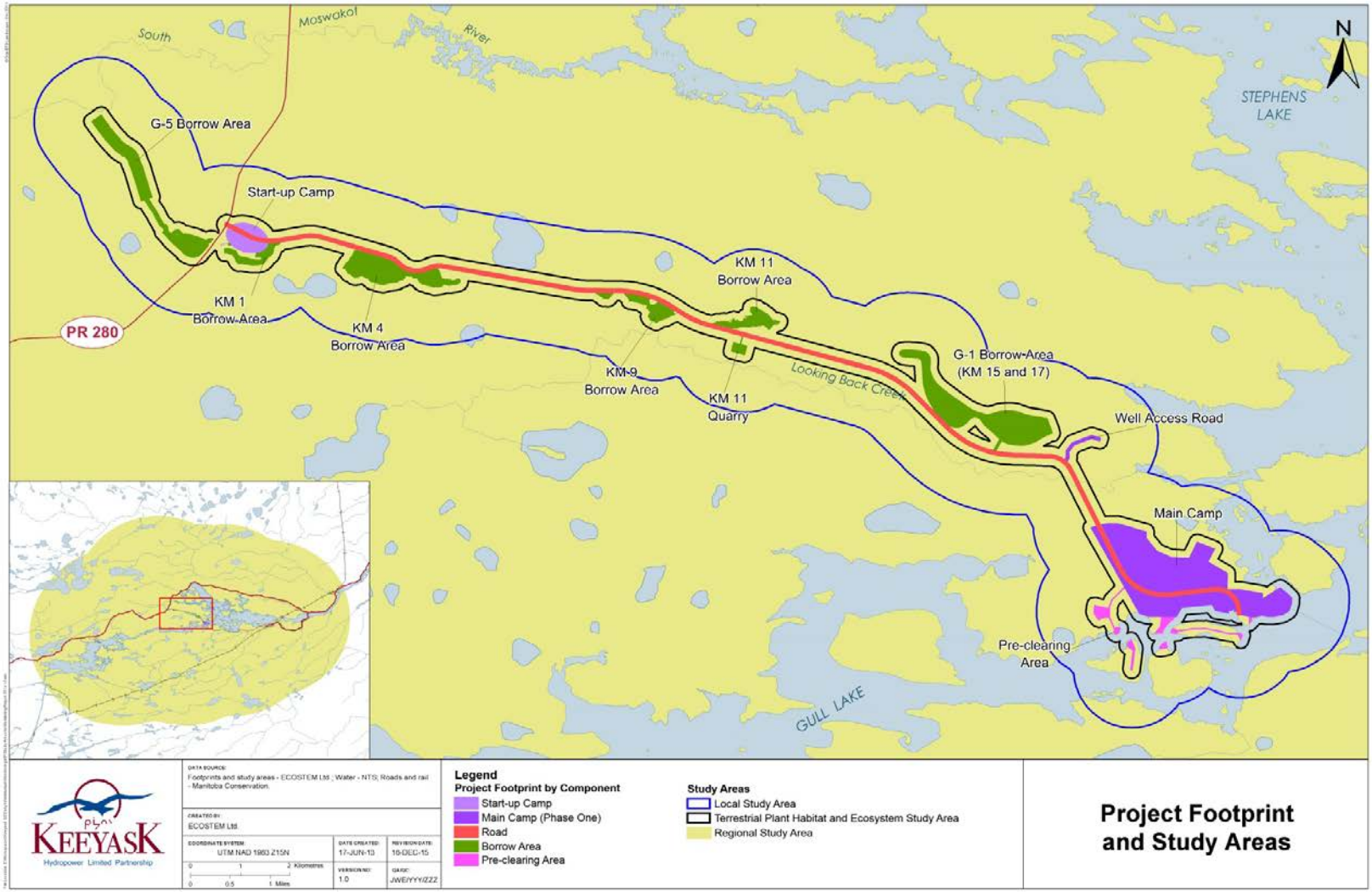
The KIP Footprint used for the terrestrial monitoring program has undergone a number of alterations since 2009, all of which were approved by Manitoba Conservation and Water Stewardship – for more details on how the KIP Footprint changed from 2009 to 2013, see the KIP Terrestrial Habitat, Ecosystems and Plants 2012 – 2013 Annual Report (KHLP 2013). In July 2013, the KHLP requested another alteration to the KIP Footprint. In order to avoid clearing impacts on breeding birds, 31 ha of additional area was added to the KIP Footprint.

All of the alterations to the licensed KIP Footprint are located within areas assumed to be affected by the Keeyask Generation Project cumulative effects assessment (KHLP 2012). That cumulative effects assessment concluded that ecologically significant effects on terrestrial ecosystems, habitat and plants were not expected based on the mitigation measures outlined in the Keeyask Generation Project in effects assessment and the KIP EA Report (KHLP 2009). On this basis, and in combination with the environmentally sensitive sites review completed prior to approval of the KIP licence alterations, significant KIP effects on terrestrial habitat, ecosystems and plants were not anticipated and did not occur.

Map 1-1 shows the updated planned KIP Footprint and the revised study areas used for the terrestrial environment monitoring program in 2014, based on the licensed KIP Footprint as of August 2014. As was the case for the KIP EA Report, a 150 m buffer of the planned KIP Footprint defined the maximum expected potential extent of indirect KIP effects on terrestrial habitat and plants (i.e., the Terrestrial Plant, Habitat and Ecosystem Study Area). This 150 m buffer also ensured that the monitoring area would detect any KIP related clearing and physical disturbance located outside of the planned KIP Footprint. As was the case for the KIP EA Report, the Local Study Area used for all terrestrial habitat, plant and ecosystem monitoring studies (Map 1-1) was a 1,150 m buffer of the planned KIP Footprint, which also provided for potential KIP effects on intactness and the fire regime.

The report is organized into the following main sections: introduction (this section), methods, results and conclusions. Each section after this one is organized by the following studies:

- Construction clearing and disturbance;
- S1 and S2 plant species;
- Introduction and spread of invasive and non-native plants; and,
- Fire regime effects.



Map 1-1: Planned KIP Footprint and terrestrial plant habitat and ecosystem study area as of spring 2014.

2.0 METHODS

2.1 CONSTRUCTION CLEARING AND DISTURBANCE

2.1.1 RATIONALE

Potential KIP effects on terrestrial ecosystems included a reduction in the total number of habitat types, changes in the proportions of the habitat types, area reductions for certain types of habitats, and a risk that the natural fire regime would be altered (KHLP 2009). Construction clearing and physical disturbance of terrestrial habitat was a keystone indicator for effects on terrestrial plants, habitats and overarching ecosystem topics (e.g., intactness). Terrestrial habitat was fundamental because plants and animals use habitat for survival and reproduction and habitat effects were of interest in themselves. Terrestrial habitat also served as a proxy for effects on many broader ecosystem attributes such as ecosystem diversity, wetland function and soil quantity and quality. Terrestrial habitat monitoring provided an effective means for identifying anticipated and unexpected effects on the terrestrial environment.

2.1.2 OBJECTIVES

The objectives of clearing and disturbance monitoring were to:

- Document the actual extent of clearing and physical disturbance, referred to as the actual KIP Footprint; and,
- Assess whether there were substantial differences between the actual extent of clearing and physical disturbance and the area planned for Project use, referred to as the planned KIP Footprint.

If substantial differences between the actual and the planned KIP Footprint were detected, then objectives would have also included:

- Assessing whether these differences substantially change predicted KIP effects and, if they had:
    - Develop additional monitoring studies as needed; and,
    - Recommend modifications to mitigation measures and the environmental protection plans (EnvPPs), where appropriate and to the extent feasible with available data.

2.1.3 DESIGN

Remote sensing, aerial surveys, pedestrian surveys and GIS mapping were used to map KIP related clearing and physical disturbance (i.e., KIP Footprint mapping). High resolution Worldview 2 satellite imagery collected on July 17 and 28 and September 24, 2014 provided additional habitat clearing data and served as the base reference layer for mapping KIP clearing and physical disturbance in a Geographic Information System (GIS). All of these data were used to produce the final KIP Construction Footprint Map. To support fragmentation analysis, roads and trails were also mapped as a component of this study.

2.1.4 PARAMETERS OF CONCERN

Parameters being measured were:

- Area cleared or disturbed by habitat type; and
- Width and lengths of roads and trails by type.

2.1.5 STUDY AREA

The Terrestrial Plant, Habitat and Ecosystem Study Area (Map 1-1) was the study area for monitoring the KIP impacts since this area included all of the planned clearing and physical disturbance, as well as a buffer to search for unanticipated clearing and physical disturbance.

2.1.6 SAMPLE LOCATIONS

Habitat loss and alteration from clearing and physical disturbance were expected to occur inside the planned KIP Footprint (Map 1-1) and in adjacent areas. Any KIP related clearing and physical disturbance that could not be spatially defined prior to construction (e.g., an access trail to a relocated well or a new borrow area) was not expected to occur outside of the Terrestrial Plant, Habitat and Ecosystem Study Area since it is a 150 m buffer of the planned KIP Footprint. For this reason, field studies were confined to the Terrestrial Plant, Habitat and Ecosystem Study Area. Ground surveys were confined to locations where there was potential understorey disturbance.

2.1.7 SAMPLING FREQUENCY AND SCHEDULE

Aerial surveys occurred in September 2012, 2013 and 2014. Ground surveys within the KIP Footprint were conducted in September 2014.

2.1.8 DATA COLLECTION

The aerial extent of vegetation clearing, physical disturbance and overburden excavation were mapped from helicopter-based aerial surveys and photography in 2012, 2013 and 2014. In 2014, truck and foot-based ground surveys were also completed to identify understorey and ground disturbance that is not visible from the air. The satellite imagery acquired in 2014 was also used to map the KIP Footprint.

Cleared and physically disturbed areas were recorded on field maps and/or in georeferenced photos. Notes on the type, size and severity of clearing and physical disturbance were taken. The satellite imagery acquired in 2014 provides additional habitat clearing data and serves as the base reference layer for mapping KIP clearing and physical disturbance.

2.2 S1 AND S2 RARE PLANT SPECIES

2.2.1 RATIONALE

Rare plant populations can be highly sensitive to the loss or disturbance of even a few individuals. The KIP EA (KHLP 2009) predicted that substantial effects on S1 and S2 plants were not expected since previous studies had not detected these species in the Terrestrial Plant, Habitat and Ecosystem Study Area. However, some of the species that have the potential to occur in the KIP Footprint area may have gone undetected due to their rarity. Consequently, KIP mitigation included pre-construction rare plant surveys for species ranked S1 and S2 by the Manitoba Conservation Data Centre. In the unlikely event that any patches of S1 or S2 plant species were found within the planned borrow areas, KIP would have avoided any S1 plant patches and S2 plant patches to the extent practicable.

This study includes pre-clearing surveys for S1 and S2 plants. In the event that any patches of such species were found, then this study would have also monitored the extent to which the

mitigation was effectively implemented and whether there were any ongoing effects on these plants.

2.2.2 OBJECTIVES

The objective of this study was to monitor effects on S1 and S2 plants discovered in the Terrestrial Plant, Habitat and Ecosystem Study Area during pre-construction surveys or other terrestrial habitat and plant field studies.

2.2.3 DESIGN

S1 and S2 plant surveys were conducted in KIP Footprint areas that were not previously surveyed and had the highest potential to include these species. If S1 and S2 plant patches were discovered during pre-construction surveys or other terrestrial habitat and plant monitoring studies, then ground surveys in and around these patches would be conducted to monitor the extent to which these patches were preserved and whether there were any ongoing effects. Plant patch mapping would occur as soon as possible after the patch was discovered and would have been coordinated with other field studies, to the extent feasible.

2.2.4 PARAMETERS OF CONCERN

Parameters being measured were:

- Locations and sizes of S1 and S2 plant patches by species; and,
- Extent and degree of KIP effects on any identified S1 or S2 plant patches.

2.2.5 STUDY AREA

The Terrestrial Plant, Habitat and Ecosystem Study Area (Map 1-1) was the study area for monitoring S1 and S2 plant species.

2.2.6 SAMPLE LOCATIONS

Field studies were confined to the Terrestrial Plant, Habitat and Ecosystem Study Area (Map 1-1) because all of the Project impacts were expected to occur inside this area. Pre-clearing ground surveys were conducted in KIP Footprint areas that were not previously surveyed and had the highest potential to include these species. If any S1 and S2 plant patches were identified, additional ground surveys would occur in the immediately adjacent area.

2.2.7 SAMPLING FREQUENCY AND SCHEDULE

Pre-clearing surveys were conducted in the areas designated for clearing during the following year that have the highest potential to include S1 and S2 plant species, provided these areas were not already surveyed by other studies prior to construction. Additional growing season field studies would be triggered in the unlikely event that patches of S1 or S2 plant species were identified.

2.2.8 DATA COLLECTION

Any areas identified for pre-clearing surveys were searched for S1 and S2 species that had the potential to occur in the Terrestrial Plant, Habitat and Ecosystem Study Area. The list of potential species included approximately 40 species based on species distribution records and past observations (see KHLP 2012). No S1 species have been previously recorded within the Regional Study Area. The three previously recorded S2 and one S1S2 species were elegant hawk's beard (*Crepis elegans*; S1S2); small pondweed (*Potamogeton pusillus ssp. tenuissimus*; S2); Robbin's pondweed (*Potamogeton robbinsii*; S2); swamp lousewort (*Pedicularis macrodonta*; S2). Field botanists searched for all species that could potentially occur in the KIP Footprint.

Searches were conducted along meandering and/or parallel transects located in the most likely habitats for these species, as well as other areas with the potential to support them. Incidental S1 and S2 plant observations were recorded while travelling between sampling areas, or while conducting other terrestrial habitat and plants fieldwork in the area.

If S1 or S2 plant species were observed in the Terrestrial Plant, Habitat and Ecosystem Study Area, field surveys would have included documenting the location and patch size of the species. The extent and degree of KIP effects on any identified S1 and S2 plant patches were documented.

2.3 INTRODUCTION AND SPREAD OF INVASIVE AND NON-NATIVE PLANTS

2.3.1 RATIONALE

Invasive plants are plant species that are growing outside of their country or region of origin and are able to out-compete or replace native plants (ISCM 2014), while non-native plants are plant species that are growing outside of their country or region of origin (referred to as 'alien' species by White et al. 1993). Invasive and/or non-native plants are of concern because they can crowd out other plant species and, in extreme cases, change vegetation composition. The KIP EA (KHLP 2009) predicted that the KIP was not expected to significantly increase the risk that invasive and/or non-native plants would crowd out sensitive species or convert habitat. There was a need to verify this prediction by documenting invasive plant spread in and around the KIP Footprint, determining the degree to which the KIP contributes to any invasive or non-native plant spread and assessing the effectiveness of mitigation measures in response to colonization of invasive plants.

2.3.2 OBJECTIVES

The objectives were to:

- Document the degree of invasive and non-native plant introduction and spread;
- If there was substantial introduction and/or spread, then:
    - Assess how EA predictions should be modified; and,
    - Recommend modifications to mitigation measures and EnvPP where appropriate.

2.3.3 DESIGN

Invasive and non-native plant distributions were generally monitored annually through vehicle and foot-based ground surveys in the KIP Footprint and areas at the edges of clearing and physical disturbance. A low altitude aerial survey accompanied by spot ground checks were used when safety concerns precluded ground surveys.

In the event that invasive or non-native plants were found at the edges of cleared or physically disturbed areas, foot-based surveys extended further into undisturbed areas. Incidental observations were also recorded during other field studies.

2.3.4 PARAMETERS OF CONCERN

Locations and sizes of invasive or non-native plant species patches were mapped in a GIS.

2.3.5 STUDY AREA

The Terrestrial Plant, Habitat and Ecosystem Study Area (Map 1-1) was the study area for monitoring the introduction and/or spread of invasive and non-native plant species.

2.3.6 SAMPLE LOCATIONS

Field studies were confined to the Terrestrial Plant, Habitat and Ecosystem Study Area because all of the KIP activities that could spread invasive and non-native plants were expected to occur inside this area.

2.3.7 SAMPLING FREQUENCY AND SCHEDULE

Ground surveys were conducted in the summer of each construction year subject to safety considerations.

2.3.8 DATA COLLECTION

During the 2012 low altitude aerial survey, construction and road areas were visually searched by the botanist for invasive plant patches; spot ground checks were also completed.

During the 2013 and 2014 ground surveys, 200 m transects were surveyed by the botanist at stops located every 2 km along the access road, where it was safe to stop. Ground surveys were also conducted in cleared areas, particularly along the edges of cleared areas, and where heavy machinery activity was evident or remnant vegetation communities existed. Invasive plant patches that were encountered were marked, photographed and mapped, and the species name recorded.

2.4 FIRE REGIME

2.4.1 RATIONALE

Effects predictions and significance assessments made for terrestrial habitat, ecosystems and plants in the EA Report could be substantially altered if the KIP caused fires that would not

otherwise occur, or if the KIP altered the behaviour of fires started by other sources (e.g., slash produced from clearing could affect fire behaviour by allowing a naturally occurring fire to spread through areas that might otherwise serve as a fire break). Changes to the frequency and/or severity of fires could adversely affect ecosystem health. Accidental fire monitoring provided a means to determine whether there had been any KIP related fires or fire behaviour effects and whether or not the effects change predictions made in the EA.

2.4.2 OBJECTIVES

The objectives were to:

- Determine if the KIP caused any fires or influenced the behaviour of naturally occurring fires; and,
- If the KIP caused or influenced fires:
    - Assess whether the fires substantially altered any of the predicted KIP effects; and,
    - Recommend modifications to mitigation measures and the EnvPP to the extent feasible with available data.

2.4.3 DESIGN

A review of Manitoba Hydro fire incident reports and helicopter surveys of the area determined if any new burns that have occurred since mapping was completed for the EA. If KIP caused or affected any fires that were larger than 30 ha, or if the cumulative area of KIP related fire effects reached at least 50 ha, then a ground inspection of the burned areas would be conducted. If ground surveys indicate that the aerial extent of the habitats affected were significant enough to substantially alter any KIP effects, then a fire effects report would have been completed.

2.4.4 PARAMETERS OF CONCERN

Parameters being measured were the:

- Number, type and extent of fires caused or influenced by the KIP;
- Area and types of habitat affected; and,
- Nature of effects on vegetation, soils and permafrost.

2.4.5 STUDY AREA

The Local Study Area (Map 1-1) was the study area for accidental fire monitoring.

2.4.6 SAMPLE LOCATIONS

Aerial surveys to identify new burns were confined to the Local Study Area because all of the KIP impacts were expected to occur inside this area. If KIP caused any fires or altered the behaviour of natural fires, then ground surveys were confined to areas where the fire effects occurred.

2.4.7 SAMPLING FREQUENCY AND SCHEDULE

The terrestrial ecologist mapped new burns using documentation from Manitoba Hydro and helicopter-based aerial surveys conducted during the summer of each construction year. The mapping was done during the helicopter-based aerial surveys conducted to develop the KIP Footprint map.

2.4.8 DATA COLLECTION

Mapped burns and associated Manitoba Hydro fire incident reports were reviewed to determine whether KIP caused any fires or influenced any natural fires. In the event that a large fire occurred, an aerial survey was conducted to photograph and document the general extent of burned area in the Local Study Area. Satellite imagery was also used to map the spatial extent and nature of the burned areas and to select areas of interest for further ground surveys in the Local Study Area.

3.0 RESULTS

3.1 CONSTRUCTION CLEARING AND DISTURBANCE

Map 3-1 shows the construction areas surveyed by helicopter in September 2012, 2013 and 2014. During the 2012 - 2014 surveys, the entire road length, the start-up camp, the main camp, borrow areas at km 4, 9, 15 and 17, the borrow area adjacent to the start-up camp, and the borrow area north of PR 280 were photographed from a helicopter. In 2013 and 2014, the camp well access road and the newly cleared areas in the first phase of the main camp were also surveyed. Photos showing the extent of clearing and physical disturbance in 2014 are provided in Figure 3-1 to Figure 3-11.

Total clearing and physical disturbance were considerably less than planned (Map 3-2) and predicted in the EA Report. Table 3-1 shows the actual amount of clearing and physical disturbance was 544.4 ha, which was 480.4 ha, or 47%, less than the planned amount of 1,024.8 ha. The borrow area and start-up camp footprints had the largest relative differences between the planned and actual sizes.

Table 3-1: Actual and planned clearing and physical disturbance (ha) by main project component

Footprint Component	Area (ha)		Difference Between Actual and Planned Areas (%)
	Planned	Actual	
Start-up Camp	32.5	11.5	-65
Access Road	234.7	186.2	-21
Borrow Areas	389.0	150.6	-61
Main Camp, Work and Well Areas	368.6	196.2	-47
Total	1,024.8	544.4[1]	-47

[1] Total value does not equal the sum of the individual footprint components in Table 3-1 due to rounding.

Clearing in a number of small areas outside of the planned areas (Map 3-1), most of which were slivers along the planned footprint edge, amounted to approximately 10.1 ha (Table 3-2).

Table 3-2: Clearing and physical disturbance (ha) outside of the planned KIP footprint by main project component and footprint

Footprint Component	Footprint Name	Area (ha)
Access Road	KIP Access Road	0.2
Borrow Area	G-1	3.8
	G-5	0.8
	KM-1	1.4
	KM-9	0.7
	Test pits and trails	1.8
Generating Station	Coffer Dam and N-21 Access Road	0.5
	Main Camp	0.6
	Work Areas A, B and C	0.0
	Well Access Road	0.3
Total		**10.1**

3.1.1 ACCESS ROAD

Figure 3-1 shows various photos of the access road. At the time of the 2012 aerial survey, road construction was underway on the access road, the base of which had been covered with gravel up to Looking Back Creek, where the bridge was being built. At the time of the 2014 survey, the access road was complete, except for work that was occurring in the ditches south of the main camp.

The access road footprint, mapped from helicopter-based photos, ground surveys and satellite imagery, indicated the actual clearing and physical disturbance was 186.2 ha in 2014 (Table 3-1). This was substantially less (21%) than the planned amount. Access road clearing was within the planned KIP Footprint boundary with the exception of approximately 0.2 ha (Table 3-2).

3.1.2 START-UP CAMP AND WORK AREA

The start-up camp and associated work area was cleared and covered with gravel in 2012. This camp was in use by the time the aerial survey in 2014 took place (Figure 3-2).

Actual clearing and physical disturbance for the start-up camp and work area footprint, as mapped from field surveys and satellite imagery, was 11.5 ha in 2014 (Table 3-1), which was 65% less than the planned amount. Clearing and construction in this area was within the planned KIP Footprint boundary with the exception of one small path at the southern edge of the area, representing 0.04 ha.

3.1.3 BORROW AREAS

Portions of the borrow area north of PR280 (G-5) were being cleared at the time of the 2012 aerial survey. In 2013, the rest of the area had been cleared and portions of the borrow area were in use. By the time of the 2014 survey, activity had ceased in this borrow area (Figure 3-3). Construction activities in this area were within the planned KIP Footprint boundary, except for a few small areas at the northwestern edges of the borrow area, which represent 0.8 ha.

The borrow area next to the start-up camp (KM-1) was cleared and in use at the time of the 2012 survey. While activity was not observed during the 2013 or 2014 surveys, it appeared that the borrow area was still being used in 2013. In 2014, seeded grass was observed growing within the septic/drainage field and the surrounding area (top left of Figure 3-4). The majority of construction activities in this area were within the planned KIP Footprint boundary with the exception of approximately 1.4 ha.

The borrow area near the access road located four kilometres from PR 280 (KM-4) had been cleared and was in use during the 2012 aerial surveys. In 2013 and 2014 (Figure 3-5), no additional clearing was observed from what had been cleared during the 2012 surveys. All construction activities in this area were within the planned KIP Footprint boundary.

The borrow area near the access road located nine kilometres from PR 280 (KM-9), was cleared and in use in 2012. A 0.7 ha portion of the cleared borrow area was observed outside of the planned KIP Footprint (Map 3-1). No additional clearing was observed at this location in 2013 compared with what had been cleared at the time of the 2012 survey. The reported area increased from the 2012 report because more accurate mapping data was available after information was collected during the 2013 ground surveys. In 2014, an additional 0.04 ha of clearing was observed at this location after ground surveys. Three large gravel berms had been piled between

the storage trailer and a gravel road had been extended around these berms. This can be seen in the lower right corner of the cleared area shown in Figure 3-6.

The G-1 borrow area, accessed at kilometre 15 and 17 along the access road, was in use at the time of the 2012 and 2013 surveys. This borrow area included access roads, two cleared areas, several geotechnical test sites and cutlines. A 3.8 ha cleared area was observed outside of the planned KIP Footprint on the south side of this borrow area in 2012 (Map 3-1). Figure 3-7 shows that in 2014, the storage area and most of the machinery had been removed from G-1 at km 15 and the area was not in use. G-1 was in use at km 17 during the 2014 season (Figure 3-8); however, no additional clearing was observed from the previous years.

Except for in the active portions of borrow areas G-1 and G-5, ponded water was present in all of the borrow areas when surveys were conducted in 2012 and 2013. In 2014, ponding was observed in the borrow areas at kms 1, 4 and 9. Semi-aquatic vegetation was observed growing on the margins of the pond in the KM-4 borrow area (Figure 3-9).

KIP-related trails observed outside of the planned KIP Footprint were all assigned to the borrow area footprint. Approximately 1.8 ha of test pitting trails were identified outside the planned footprint in several areas, including near kms 10 and 13 of the access road, borrow area G-1 and at the northwest edge of the main work area footprint.

The borrow area footprint, including trails mapped from field surveys and satellite imagery, shows that actual clearing and physical disturbance was 150.6 ha in 2014 (Table 3-1), which was considerably less (61%) than the planned amount.

3.1.4 MAIN CAMP AND WELL AREAS

Clearing had not begun in the main camp and well area when surveys were conducted in 2012. At the time of the 2013 survey, the main camp, helicopter pad, well road and a large area within Work Area A had been cleared and work was underway in these areas (Note: The bare areas in Figure 3-10 near the well road were created by the 2013 wildfire.) By the time of the 2014 survey, the well road, main camp and helicopter pad were built and in use (Figure 3-10). Work was also underway in Work Area A. All clearing in this area was within the approved KIP Footprint boundary.

South of Work Area A, a construction office and storage area (north of the access road) was complete and was being used in 2014. Several other areas had been cleared and were in use near the end of the access road at Gull Rapids (Figure 3-11). Clearing in the three work areas was within the planned KIP Footprint boundary with the exception of approximately 0.01 ha.

A cofferdam access road (not shown) was built slightly outside of the planned KIP footprint, creating approximately 0.5 ha of additional disturbance.

The main camp and generating station work area footprint, mapped from field surveys and satellite imagery, indicates that actual clearing and physical disturbance was 196.2 ha in 2014 (Table 3-1), which was considerably less (47%) than the planned amount. Approximately 0.9 ha of clearing and disturbance was outside of the planned footprint.

3.1.5 LINEAR FEATURES

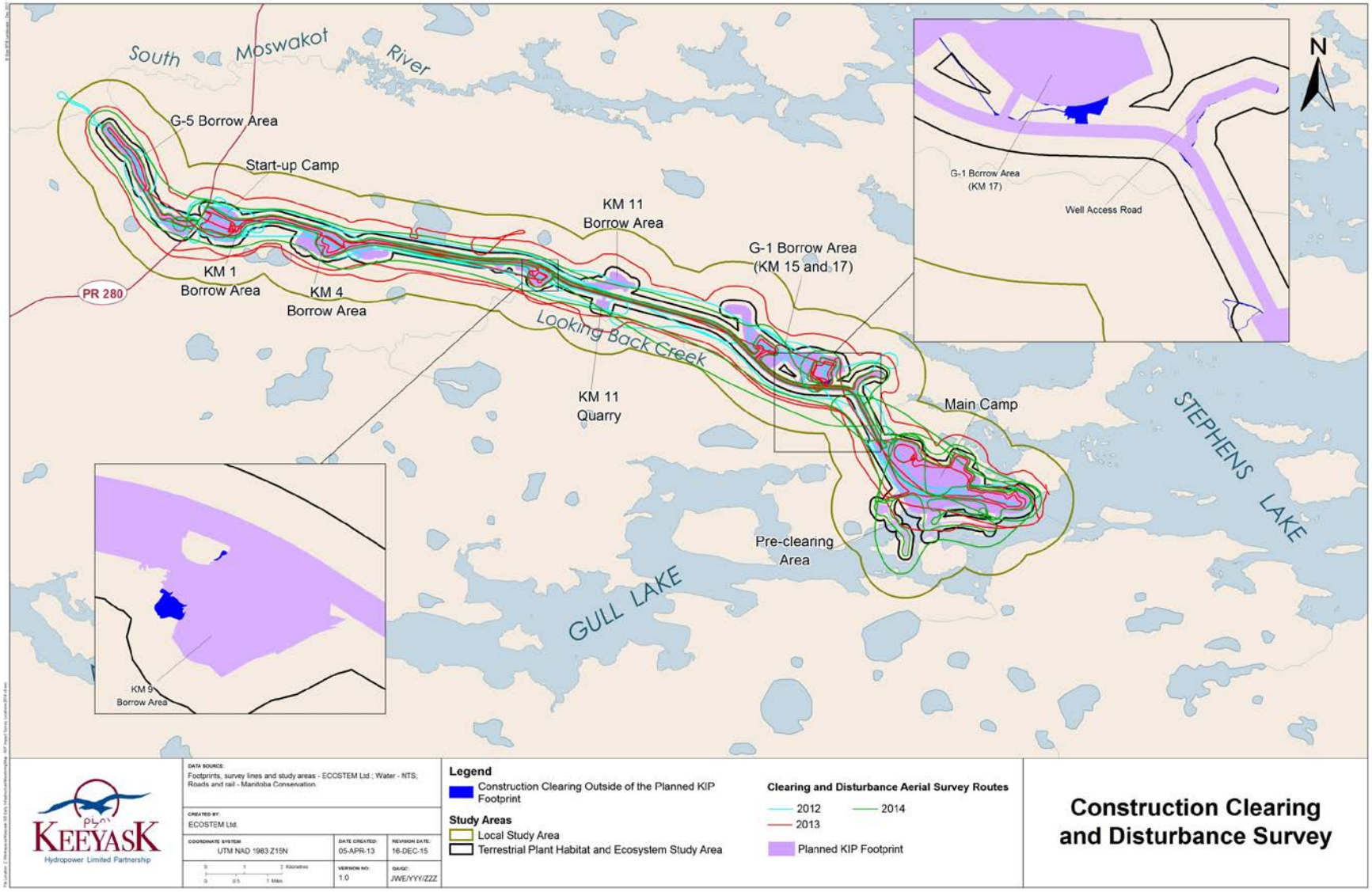
Table 3-3 shows that of the total 142.3 km of linear features (*e.g.*, cutlines and roads) present in the local study area before construction began, 118.7 km remained unchanged by KIP and 23.6 km of linear features were no longer linear because they coincided with other KIP footprint components (Table 3-1). The 60.2 km of linear features created or reused during the KIP were mostly all-weather roads (35.7 km) inside other cleared footprints and exploratory test-pitting trails (19 km) outside of other cleared footprints (Table 3-3). Cutlines were the sole type of linear feature that coincided with the KIP footprint (Table 3-3). The access road, main camp/work areas and other components created the largest net additions of linear features, mostly in the form of all-weather roads (Map 3-3).

On a net basis, KIP increased total linear feature length by 36.6 km, which was considerably less than the 51.9 km increase assumed in the EA Report.

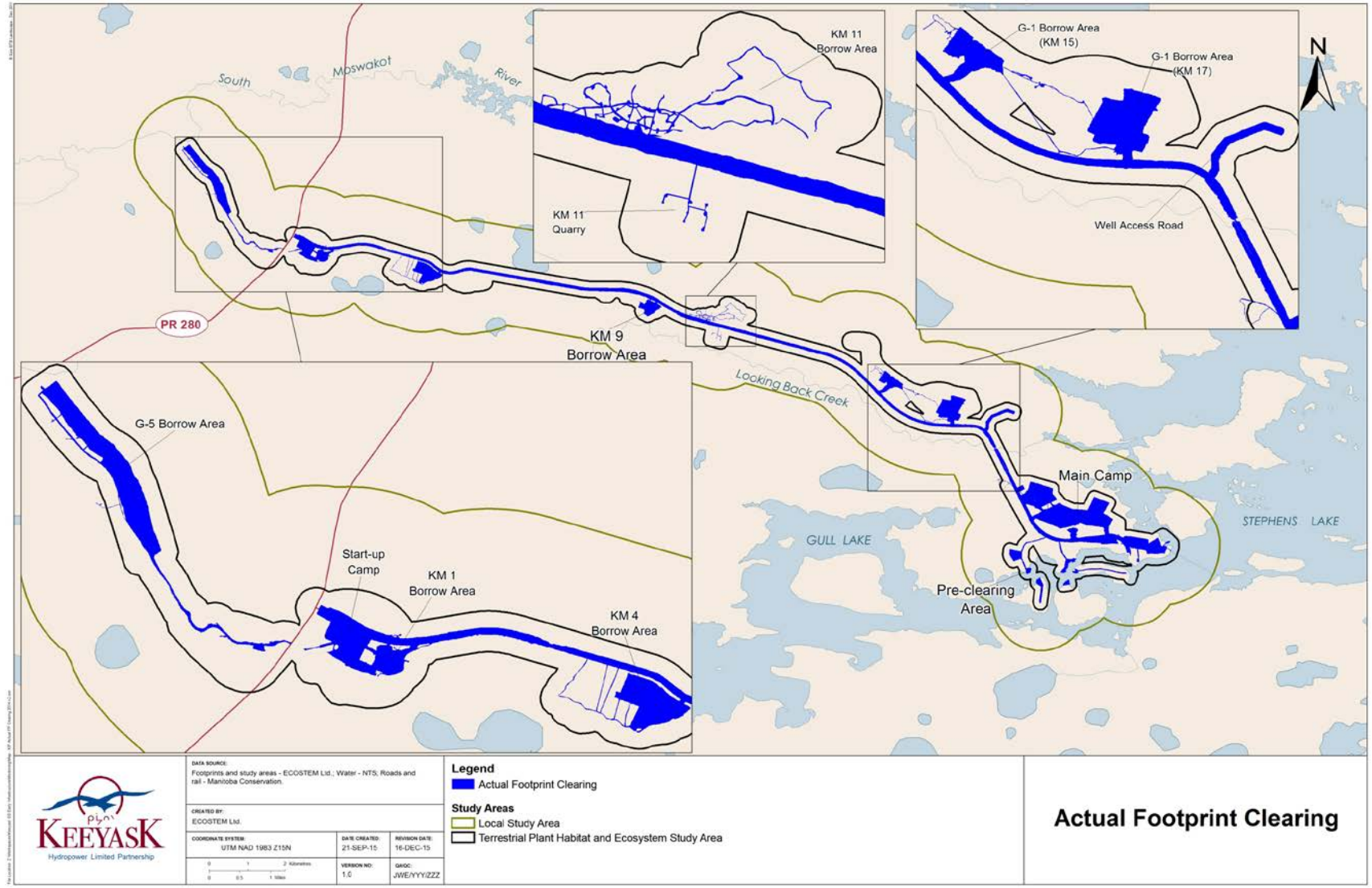
Table 3-3: Linear feature change (km) by main project component

Footprint Component	Linear Feature Type	Pre-KIP[1] Total (km)	KIP Added (km)	KIP Removed (km)	Post-KIP[2] Total (km)
Access Road	Cutline	2.2	-	2.2	**0.0**
	Road	0.0	23.4	-	**23.4**
Sub-Total		**2.2**	**23.4**	**2.2**	**23.4**
Borrow Areas	Cutline	11.3	8.3	11.0	**8.6**
	Path	-	0.4	-	**0.4**
	Road	0.3	2.4	-	**2.7**
Sub-Total		**11.6**	**11.1**	**11.0**	**11.7**
Main Camp, Work and Well Areas	Cutline	11.8	0.1	9.4	**2.5**
	Road	-	9.9	-	**9.9**
Sub-Total		**11.8**	**10.0**	**9.4**	**12.4**
Start-up Camp	Cutline	0.7	-	0.6	**0.1**
	Road	1.1	0.3	-	**1.4**
Sub-Total		**1.8**	**0.3**	**0.6**	**1.5**
Other	Test Pitting Trails	-	12.5	-	**12.5**
	Cutline	106.9	2.7	0.4	**109.2**
	Ditch	0.5	-	-	**0.5**
	Highway	3.4	-	-	**3.4**
	Path	3.9	0.2	-	**4.2**
	Road	0.2	-	-	**0.2**
Sub-Total		**114.9**	**15.4**	**0.4**	**130.0**
Total		**142.3**	**60.2**	**23.6**	**178.9**

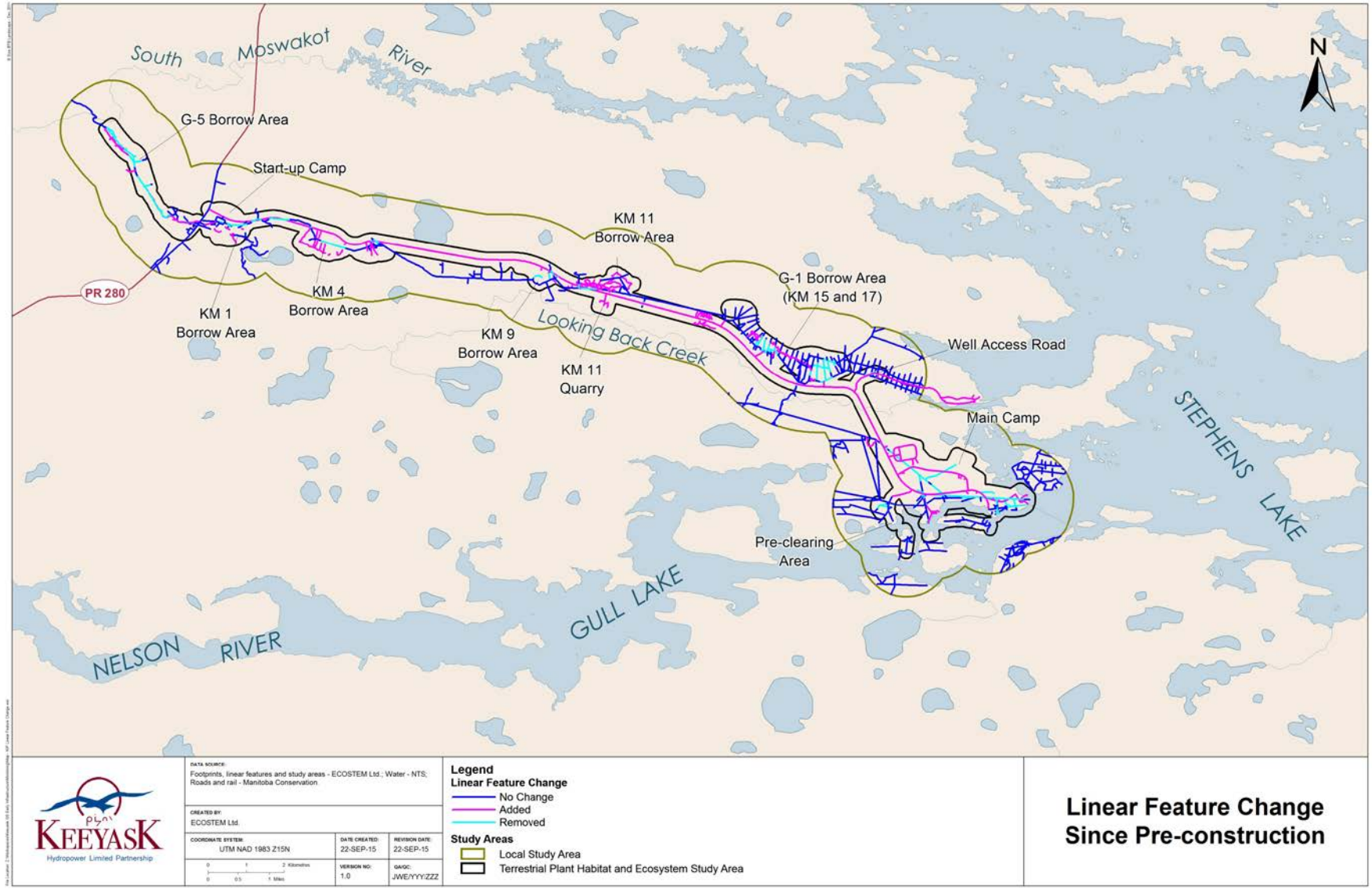
Notes: [1] Pre-KIP is existing clearing prior to KIP. [2] Pre-KIP + KIP Added – KIP Removed.
"0.0" indicates a length that rounds to this value; "-" indicates the feature is absent.



Map 3-1: KIP Footprint clearing and physical disturbance - aerial survey locations in 2012, 2013 and 2014



Map 3-2: Actual KIP Footprint clearing and physical disturbance



Map 3-3: Linear feature changes since pre-construction

Access road at the PR280 junction

Bridge at Looking Back Creek

Access road ditch work

End of the access road at survey time

Figure 3-1: Construction areas along the main access road (September 9, 2014).

Figure 3-2: Start-up camp and work area near PR 280 (September 9, 2014).

Figure 3-3: G-5 borrow area north of PR280 (June 25, 2014).

Figure 3-4: Borrow area showing grass growth and ponding (September 9, 2014).

Figure 3-5: Clearing and ponding in KM-4 borrow area (September 9, 2014).

Figure 3-6: Clearing and ponding in KM-9 borrow area (September 9, 2014).

Figure 3-7: Clearing and excavation in KM-15 borrow area, west side of G-1 (September 9, 2014).

Note: The bare areas surrounding the borrow area were created by the 2013 wildfire.

Figure 3-8: Clearing and excavation in KM-17 borrow area, east side (September 9, 2014).

Figure 3-9: Semi-aquatic vegetation growing in the margins of the KM-4 borrow area pond (August 26, 2014).

Main Camp

Helicopter Pad

Work Area A

Well Road

Note: The bare areas near the well road were created by the 2013 wildfire.

Figure 3-10: Clearing and construction in the main camp and well road areas (September 9, 2014).

Figure 3-11: GS construction office and other work areas near Gull Rapids (September 9, 2014).

3.2 S1 AND S2 RARE PLANT SPECIES

Pre-clearing rare plant surveys were conducted on July 12, 13 and 14 in 2011, on June 26 and 27 in 2012 and on July 20 in 2013 at the locations shown in Map 3-4. Additional pre-construction field surveys were not conducted during the 2014 growing season since further KIP clearing was not planned.

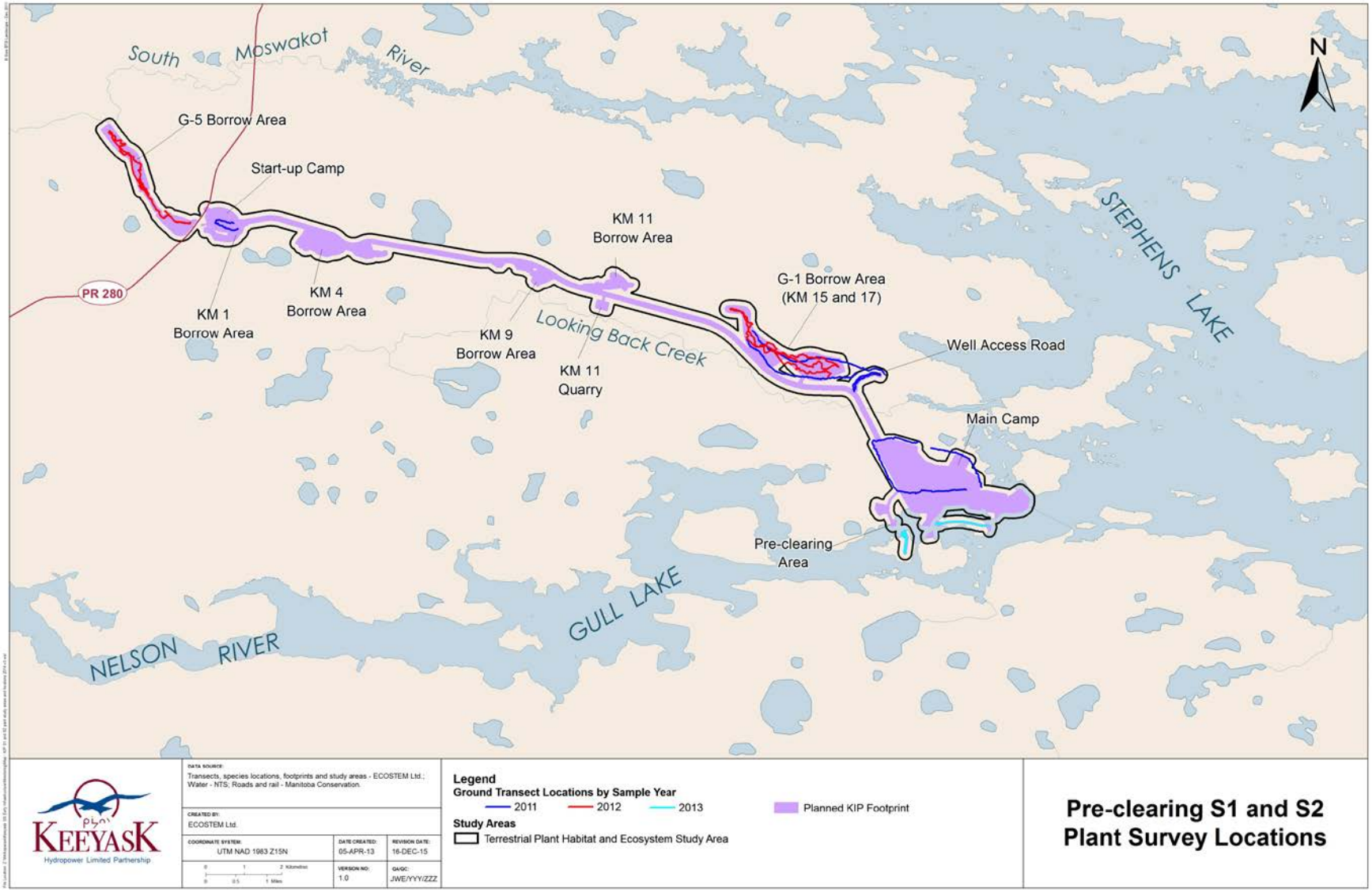
The KIP Footprint components surveyed in 2011 included the start-up camp, the G-1 borrow area and the first phase of the main camp area, with additional surveys in the G-1 and G-5 borrow areas in 2012. The 2013 surveys were conducted in breeding bird mitigation areas, which were located on islands in the Nelson River. The total length of survey transects was 20.7 km in 2011, 22.8 km in 2012 and 3.8 km in 2013.

Partial vegetation clearing and surface organic matter removal crossed some of the survey transects in 2012. No other vegetation clearing was evident in the surveyed areas in 2011 or 2013, except for pre-existing cutlines and clearings.

No S1 or S2 species were observed along any of the transects surveyed in 2011, 2012 and 2013, or incidentally in the Terrestrial Plant, Habitat and Ecosystem Study Area during fieldwork.

Ground surveys during 2011 recorded two S3 species, shrubby willow (*Salix arbusculoides*) and rock willow (*Salix vestita*), at seven locations. Additional S3 species were not found in 2012 or 2013.

No rare plant species were identified incidentally in the Project area in 2014.



Map 3-4: S1 and S2 rare plant pre-clearing survey locations in 2011, 2012 and 2013.

3.3 INTRODUCTION AND SPREAD OF INVASIVE AND NON-NATIVE PLANTS

Vehicle and foot-based surveys took place in 2013 and 2014 but, were not possible in 2012 due to safety concerns related to the condition of the access road and the amount of construction traffic and activity on the road. Therefore, a low altitude aerial survey was conducted in 2012 to visually search for invasive plant patches. Spot ground checks were completed in a few cleared areas where helicopter landing was feasible. Map 3-5 shows the helicopter and ground survey locations.

No invasive species were recorded in 2012, either during invasive plant aerial surveys, or incidentally while doing other aerial or ground surveys. Four invasive plant species were observed during 2013 ground surveys, all in the start-up camp area (Map 3-5).

In 2014, six invasive plant species were observed during spring ground surveys and were mainly found in the start-up camp, the G-5 borrow area (note that the G-5 borrow area was not sampled in 2013, because of construction activity), the KM-17 borrow area, the well road and at two locations along the road. During the fall surveys, 12 species were observed, a two-fold increase in the number of species over the spring survey although the spring and fall surveys in 2014 covered the same general areas with the exception of a portion of the KM-9 borrow area that was not sampled in the spring. Invasive species were found in all of the borrow areas, the start up camp and several of the work areas in the fall.

Several factors likely contributed to the increased number of of invasive species detected in the fall compared with the spring surveys. First, many of the invasive/non-native species are known to develop later in the growing season, so some likely went undetected in the spring survey. Second, increased construction activity in 2013 may have led to the introduction of more invasive/non-native species that developed in the KIP Footprint in 2014. Third, lamb's quarters may have been introduced by the hydroseeding since it appeared to be associated with these areas.

Lamb's quarters (*Chenopodium album*), sweet clover (*Melilotus* spp), alfalfa (*Medicago sativa*), common plantain (*Plantago major*), perennial sow thistle (*Sonchus arvensis*) and common dandelion (*Taraxacum officinale*) were observed during the spring 2014 survey. In addition, wild

barley (*Hordeum jubatum*), black medic (*Medicago lupulina*), white and yellow sweet clover (*Melilotus albus* and *M. officinalis*) and alsike, red and white clover (*Trifolium hybridum*, *T. pratense* and *T. repens*) were observed during the fall 2014 survey. Figure 3-12 and Figure 3-13 provide example photos of invasive plants found during the surveys.

In the spring 2014 survey, common dandelion was observed in 45 locations, including the perimeter of the startup camp, the startup camp well, the entrance to borrow area G5 (and one location at the north end of this borrow area), two locations in the KM-17 borrow area, two locations along the well road, two locations in the ditch of the access road at approximately km 16 and one at the end of the road in a cleared area (Map 3-5). The remaining invasive species observed during the spring 2014 survey were all located in the startup camp area, with one sweet clover location in the startup camp well area and one in the entrance to the G-5 borrow area. The sweet clover, perennial sow thistle and alfalfa were primarily located in the older portion of the startup camp (Map 3-5). Lamb's quarters was observed in the aggregate area surrounding the sewage field.

Spring surveys found that common dandelion was the most common invasive species, followed by sweet clover (14 locations). It is believed that the sweet clover identified in the spring was white sweet clover that had not yet flowered. Lamb's quarters, alfalfa and common plantain had the fewest locations, with two each.

Invasive species were not recorded in the main camp, helicopter pad, field office or work area A areas, nor were any recorded in the borrow areas KM-4, KM-9 or KM-15 during the spring surveys. It should be noted that a portion of the KM-9 borrow area, the work area south of the main camp and the south portion of the access road were being used in the spring and were unsafe to survey.

In the fall 2014 surveys, common dandelion was observed in the same areas as in the spring, except for the main well road (Map 3-5). It was recorded in more locations in most of these areas, and was also observed in the ditch at km 4 of the access road, in the KM-9 borrow area and the cleared area south of the access road east of the construction offices. The remaining invasive species were more spread out around the KIP Footprint than in the spring. Invasives were observed in the main camp area, the helicopter pad, the borrow areas at KM-4, KM-9 and

KM-15, where none had been observed in the spring. Invasives were also observed at the end of the access road, which had not been surveyed in the spring.

Fall surveys found that common dandelion was the most common invasive species (98 locations), followed by white sweet clover (65-81 locations) and lamb's quarters (64 locations). White sweet clover was recorded in the startup camp, the KM-1 borrow area and the entrance to the G5 borrow area, the well road and borrow areas at KM-4 and 15. Lamb's quarters was observed in the startup camp, the aggregate area, the well road and the borrow areas at KM-4, 9 and 15. Black medic, yellow sweet clover, alsike and white clover were the least common invasives, with two or fewer recorded locations each.

Lamb's quarters

Common dandelion

Common plantain

Perennial sow thistle

White sweet clover

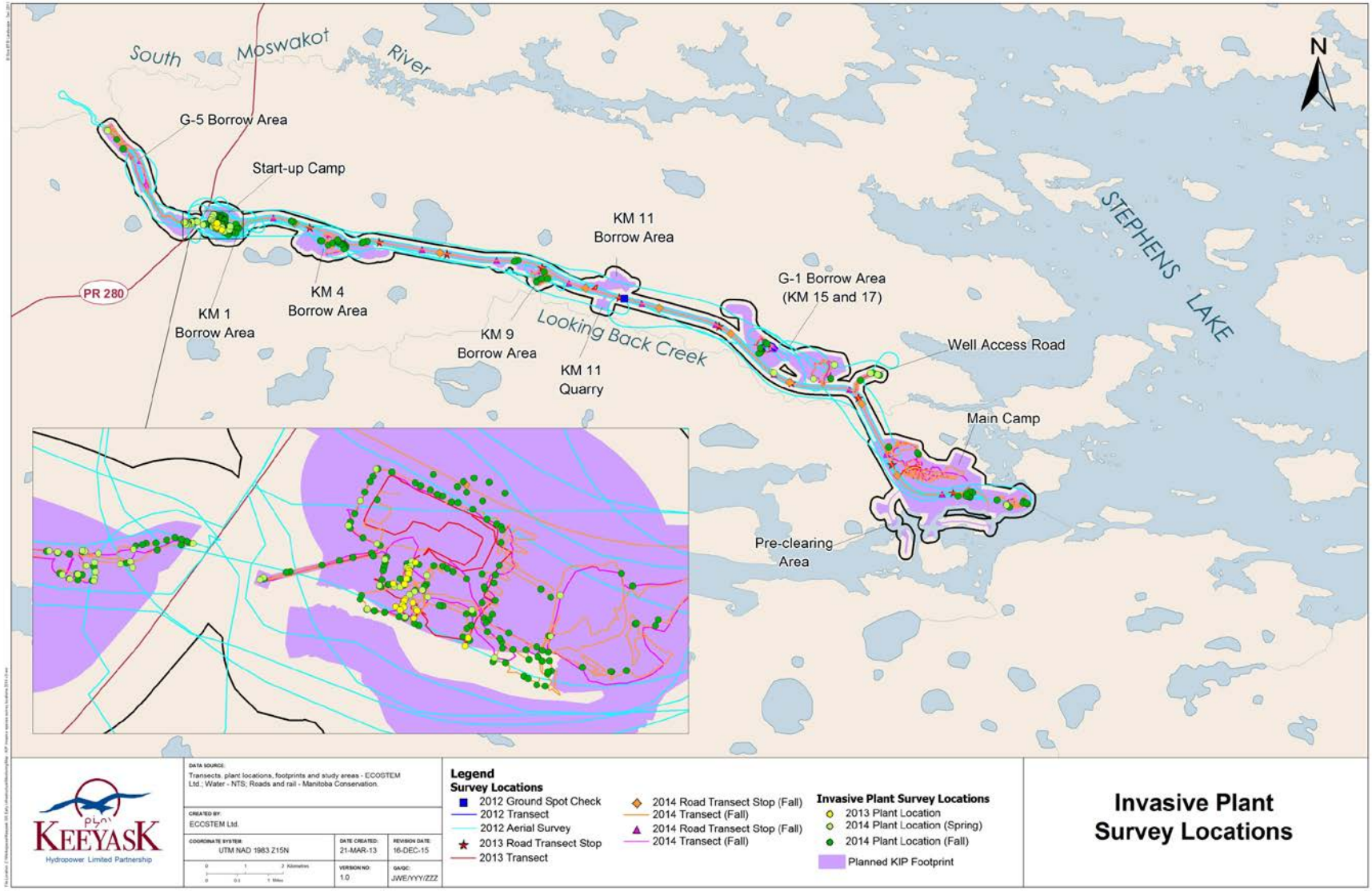
Figure 3-12: Invasive species observed during spring and fall surveys (June 25-27, 2014).

Yellow sweet clover

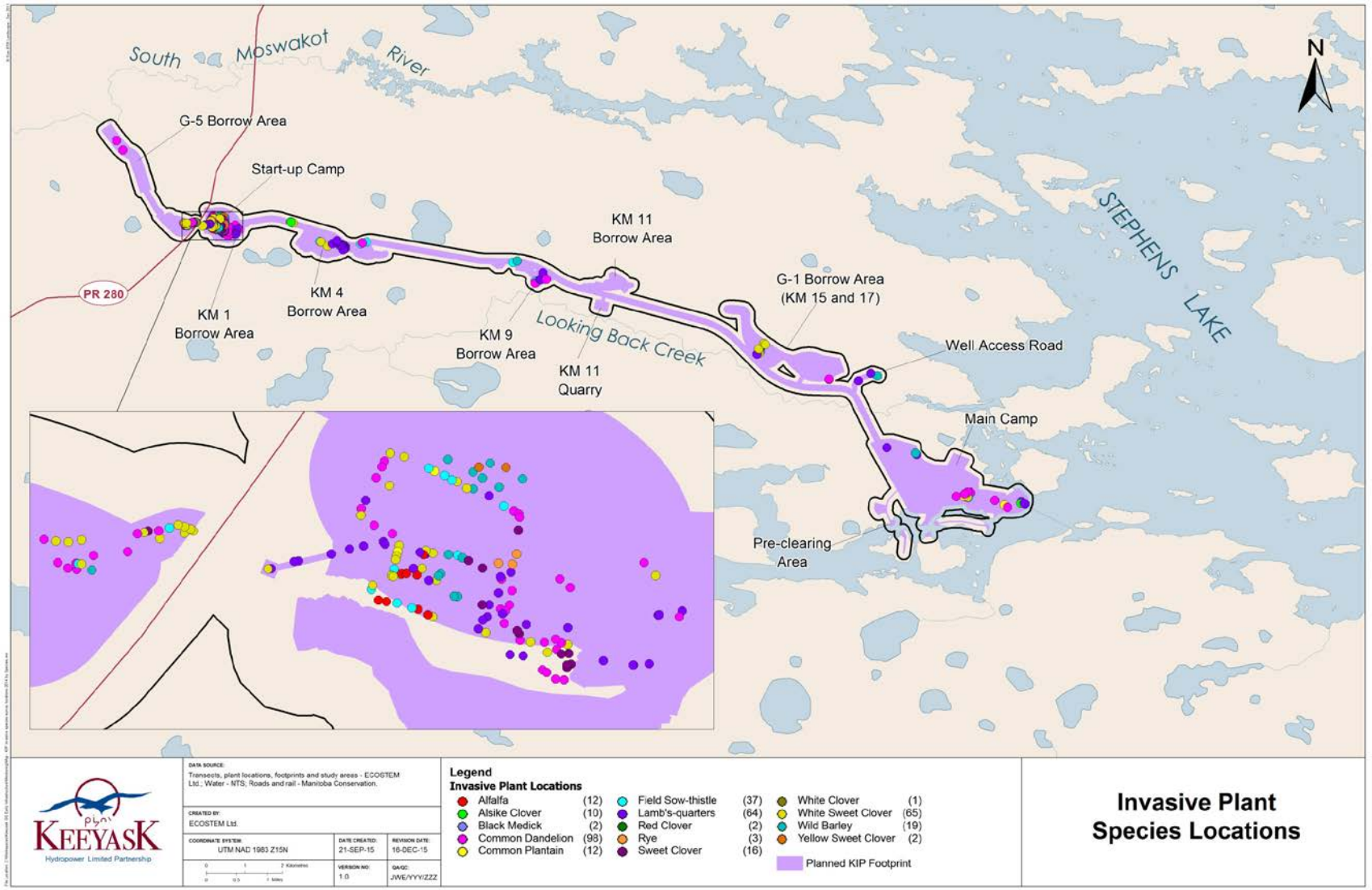
Alsike clover

Wild barley

Figure 3-13: Invasive species observed for the first time during the fall survey (August 24-26, 2014).



Map 3-5: KIP invasive plant survey locations and invasive/non-native species observations in 2012, 2013 and 2014.



Map 3-6: KIP invasive plant species locations and number of locations by species in fall 2014.

3.4 FIRE REGIME

Several large fires started by sources other than the KIP occurred in 2013. Map 3-7 shows the approximate locations of burned areas, as mapped from Landsat imagery acquired in summer 2014. These burned areas were consistent with those observed during aerial surveys on September 2, 2013, and June 25, 2014, when aerial surveys photographed the extent of burned area in the Local Study Area. The fire that swept through the Local Study Area burned right into the KIP Footprint in multiple areas (Map 3-7; see Figure 3-14 for example photos).

Landsat 8 and Worldview 2 satellite imagery collected in 2014 was used to map the extent and the severity of the burns in the Local Study Area (Map 3-7). Four areas of interest were selected for aerial survey, including two areas where it appeared that the access road and/or cleared areas acted as a fire break and two areas where it appeared that there was an unusually intense burn adjacent to the Footprint.

The wide clearing at the north end of the Footprint (north of PR280) appeared to halt the progress of the fire (Figure 3-15), as the burn appears to have stopped at the eastern edge of the clearing. Portions of a skipped area on the south side of the access road were partially burned between the road and the treeline (Figure 3-16), indicating that the fire had begun to cross the road. The areas that appeared to be severely burned, adjacent to the access road, had burned down to the sand substrate (appeared white in the photos) (Figure 3-17). However, other areas also had severe burns down to darker mineral substrates (Figure 3-17). The sandier locations happened to be located on the esker where the access road is located, making it appear in the mapping that the burn had been more intense adjacent to the access road.

Visual examination of the regeneration in different burned ecosite types did not suggest that there was a difference in regeneration at sites adjacent to, or away from the KIP Footprint (Figure 3-18). In general, regeneration was sparse to absent on burned peatlands, but was denser on thinner peatlands and mineral sites. Clayey bare mineral sites tended to have denser regeneration than sandy sites, and regeneration appeared to be denser under burned broadleaf (aspen) and jack pine stands than under burned black spruce stands.

Figure 3-14: An area burned and skipped by the 2013 fire, as seen in from a helicopter in September 2013 (left) and September 2014 (right).

Figure 3-15: View of the borrow area G-5 north of PR280, from the north looking south, with burned forest on the east (left) side and unburned forest on the west (right) side (June 25, 2014).

Figure 3-16: View of a section of the road with burn evidence between the road and a skipped area (June 25, 2014).

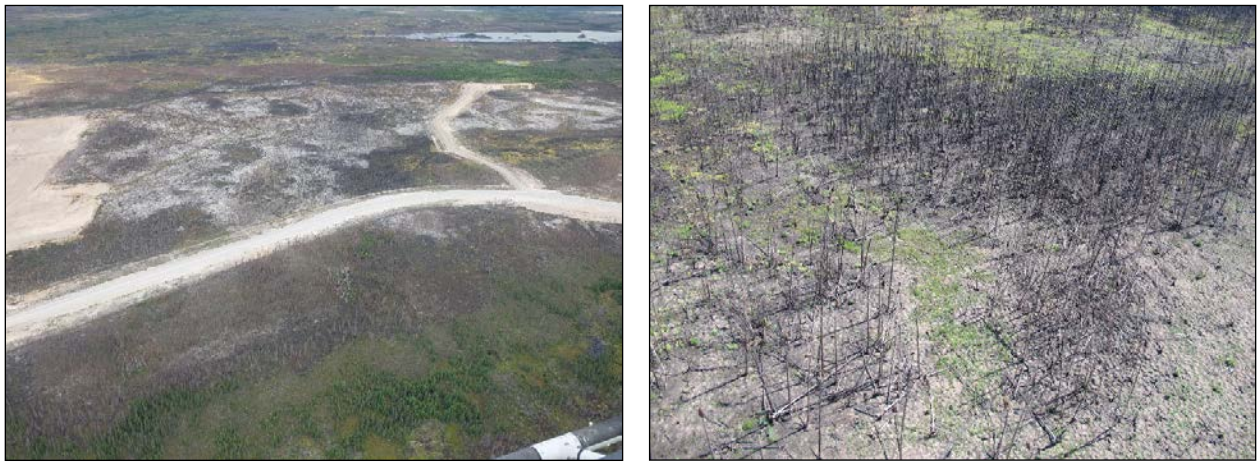
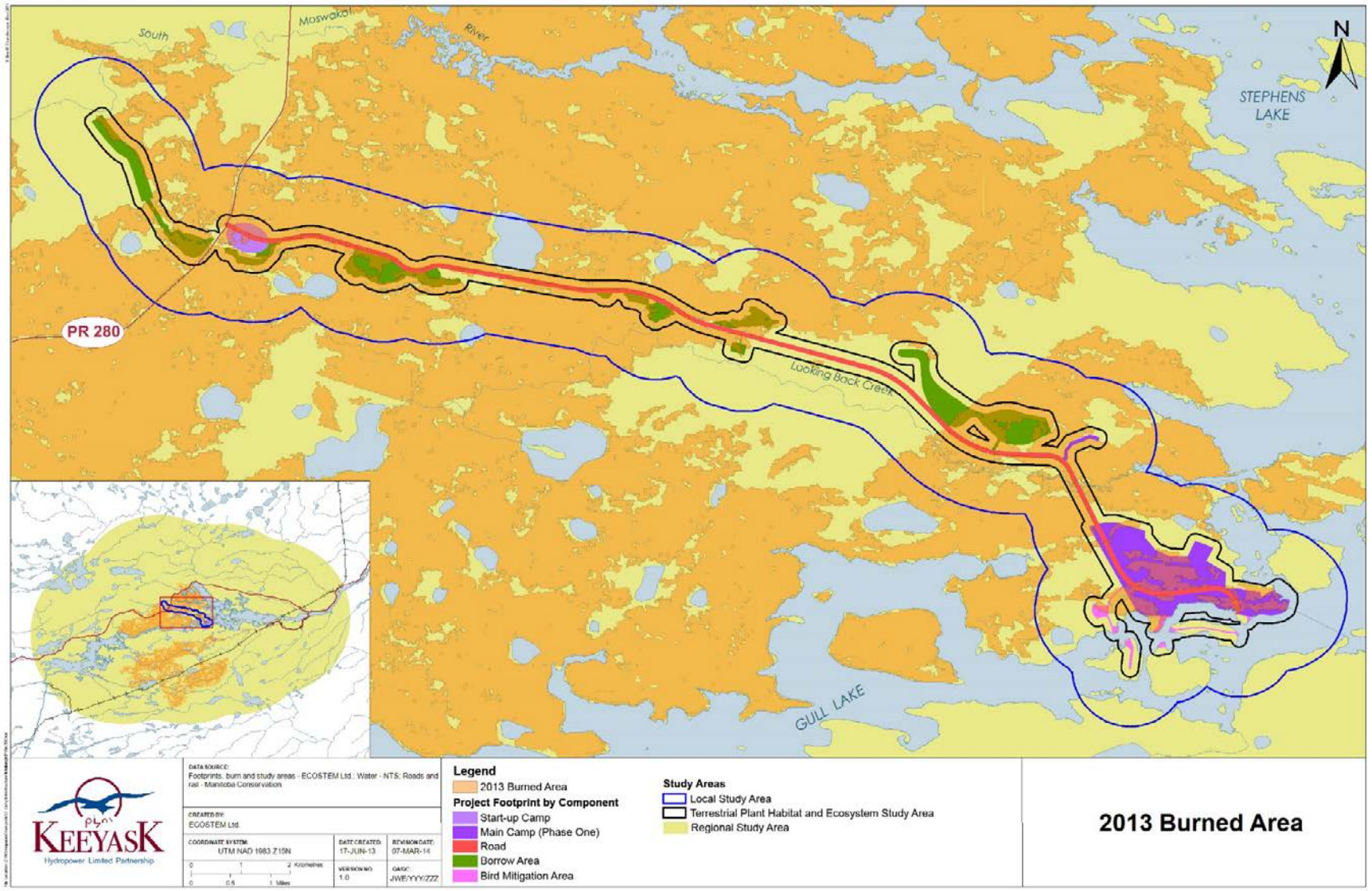


Figure 3-17: View of a sandy substrate adjacent to the Footprint (left) and a darker mineral substrate away from the Footprint (right), both showing severe burn intensity (June 25, 2014)

Figure 3-18: Regeneration on sandy sites adjacent to (left) and away from (right) the Project Footprint (June 25, 2014).



Map 3-7: Preliminary map of areas burned in the KIP Study Areas in 2013.

4.0 DISCUSSION

4.1 CONSTRUCTION CLEARING AND DISTURBANCE

As described in the Terrestrial Plant, Habitat, and Ecosystem Monitoring 2012 – 2013 Annual Report (ECOSTEM 2013), Manitoba Conservation and Water Stewardship approved a number of alterations to the planned KIP Footprint since 2009. The potential effects of these footprint alterations on terrestrial habitat and plants were evaluated prior to them being proposed to Manitoba Conservation and Water Stewardship, and were expected to be insignificant given the planned mitigation measures. Additionally, a cumulative effects assessment for the Keeyask Generation Project (KHLP 2012) assumed that all of the native terrestrial habitat included in the alterations to the planned KIP Footprint would be removed. That cumulative effects assessment concluded that significant effects on terrestrial ecosystems, habitat and plants were not expected based on the mitigation measures outlined in the Keeyask Generation Project effects assessment and the KIP EA Report (KHLP 2009). On this basis, and in combination with the environmentally sensitive sites review completed prior to approval of the KIP licence alterations, significant KIP effects on terrestrial habitat, ecosystems and plants were not anticipated. Monitoring verified that significant effects did not occur.

Field surveys in 2014 documented 537 ha of actual KIP clearing and physical disturbance, which was 47% less than the 1,025 ha planned footprint.

All clearing and physical disturbance documented up to 2014 were within the planned KIP Footprint with the exception of a number of small areas totalling 10.1 ha. Most of the exceptions were small slivers along planned footprint edges or small extensions of the borrow areas located at G-5, KM-4, KM-9, KM-17. Additionally, there were several unplanned trails that were outside of the planned footprint, representing approximately 1.8 ha of trails. The magnitude of effects on the terrestrial habitat included in this small additional area is within the total that was assessed in the KIP EA Report. Given that some small excursions outside of the planned footprint were to be expected due to unavoidable uncertainties, and that the total amount of actual clearing and disturbance was considerably lower than planned, implementation of environmental protection plan measures intended to minimize clearing and disturbance were effective.

KIP created 60.2 km of new linear features and removed 23.6 km of existing linear features. All-weather roads associated with the access road and main camp/work areas contributed the majority of the new linear features. Cutlines were the only feature removed by KIP. On a net basis, KIP increased total linear feature length by 36.6 km, which was 15.3 km less than the 51.9 km increase assumed in the EA Report.

4.2 S1 AND S2 RARE PLANT SPECIES

More than 47 km of transects were searched prior to clearing between 2011 and 2013 to further verify the absence of S1 or S2 plants in the KIP Footprint. Surveys were not conducted in 2014 as there was no future planned clearing.

No S1 or S2 species were observed during the rare plant surveys, or incidentally during other surveys.

Two S3 species, shrubby and rock willow (*Salix arbusculoides* and *S. vestita*), were recorded at seven locations in the Project Footprint. Studies conducted in the area (KHLP 2012) found that both of these species are more abundant in the Regional Study Area than their provincial S-rank suggest, and no substantial negative effects are expected from development of the Project.

As predicted in the KIP EA (KHLP 2009), KIP effects on S1 and S2 plants were not observed during construction as no S1 or S2 species have been detected in the Terrestrial Plant, Habitat and Ecosystem Study Area.

4.3 INTRODUCTION AND SPREAD OF INVASIVE AND NON-NATIVE PLANTS

Observations of invasive and non-native plants had been limited up to the 2014 season because the extent of ground surveys were limited by safety concerns due to the ongoing construction activities. In 2014, ground surveys were not as limited by safety concerns, with all areas except for portions of the work areas being visited. By 2014, activity in many of the cleared areas had ceased or been greatly reduced.

During the 2012 and 2013 surveys, vegetation was generally underdeveloped or absent in much of the newly cleared areas, and invasive and/or non-native species were more or less confined to the older portion of the start-up camp.

In 2014, invasive and non-native species were recorded in a fairly limited area in the spring, with most of the observations confined to the older portion of the start-up camp, the entrance to the G-5 borrow area and some scattered common dandelion in a few other locations. Two new species (lamb's quarters and common plantain) were recorded during the spring survey, in addition to the species recorded in 2013. By fall, invasive and/or non-native species were much more widespread and six new species were found. Nearly all of the cleared areas were affected by at least one invasive and/or non-native species location in the fall (except for the construction office area and the large work area south of the main camp). A number of invasive and/or non-native species were also observed in the access road ditches, mainly in scattered locations up to km 9. The ditches past km 9 remained largely underdeveloped in 2014 and invasive species were not observed. Invasive species were not observed spreading into the undisturbed areas adjacent to the cleared locations where they were growing.

The increase in the number of invasive species and their recorded locations between the spring and fall of 2014 was attributed to several factors. First, some of the invasives likely went undetected earlier in the spring simply because their stems and leaves were not sufficiently developed. Second, the increased construction activity in 2013 may have spread many of these species. Third, it appears that lamb's quarters may have been spread via the hydroseeding through contamination of the equipment or the seed mixture.

Four of the invasive species observed during field studies (lamb's quarters, wild barley, perennial sow thistle and common dandelion) are considered noxious species (Government of Manitoba 1988, Government of Canada, 2005), while four (alfalfa, white and yellow sweet clover and perennial sow thistle) are considered to be minor to moderate risk invasive species (White et al. 1993, ISCM 2015). To prevent further spread of these species within the project footprint, it is recommended that they be removed from the site by hand pulling, preferably earlier in the season, before the plants have gone to seed or the roots of young plants become well established.

One of these species, lamb's quarters, was associated with areas that appeared to have been seeded prior to the 2014 field surveys (Figure 4-1). It is recommended that this possibility be investigated further and, if determined likely to have occurred, measures be developed to prevent future occurrences.

It is also recommended that site staff be trained to recognize the noxious weed species occurring in the area so they can initiate hand pulling between the monitoring surveys, so as to minimize further spread of these species. Hand pulling will generally be easier if it is undertaken early in the growing season before the roots of young plants become well established. Alternative control measures may be needed in locations where large patches have established.

Figure 4-1: Lamb's quarters growing in the aggregate area and possibly associated with rehabilitation hydroseeding (August 24-26, 2014).

4.4 FIRE REGIME

Several large fires started by sources other than the KIP swept through the Local Study Area during the summer of 2013. The fires burned areas within the KIP Footprint at multiple locations. Satellite imagery of the burned areas was collected and used to plan and conduct ground and aerial surveys in 2014.

Aerial photos were taken of the entire footprint, and several areas of interest were visited by helicopter to determine if the Project had any effect on the fire's behaviour or intensity. Some potential effects caused by the Project on the fire were noted, such as the fire stopping along the east edge of the borrow area north of PR280 and skips that appeared to have been potentially

caused when the access road acted as a fire break. Additionally, based on LANDSAT composites and the 2013 still photography, some areas adjacent to the footprint appeared to be more severely burned compared to areas further away.

Helicopter surveys confirmed that the wide clearing at the northwest extent of the footprint appeared to halt the progress of the fire, with the burning stopping at the eastern edge of the clearing. At the other location of interest, ground surveys indicated that the fire did in fact begin to cross the access road, evidenced by burned vegetation between the road and the skip. This suggests that the road may only have served as a fire break when the burn was already dying out or changing direction.

KIP did not appear to affect burn severity. Ground color differences in the remote sensing (white versus black) adjacent to the footprint suggested that KIP may have increased burn severity. However, ground surveys indicated that color differences reflected substrates rather than amount of burned off organic layer (white areas were sand while black areas were usually a clayey substrate). Most of the burned sand substrate happened to be concentrated along the esker where the road was being constructed. Additionally, visual examination of the regeneration in different burned ecosite types (shallow peatland, permafrost peatland, thin peatland and mineral) did not suggest that there were any differences in fire behaviour in areas surrounding the KIP footprint compared with areas away from the footprint.

Overall, the aerial survey indicated that KIP had some small, localized effects on the spread of the fire, acting as a fire break in places where the fire was dying out or changing direction, but there was no obvious effect on fire intensity or behaviour.

5.0 CONCLUSIONS

Terrestrial plant, habitat, and ecosystem monitoring results to March 2015 determined that actual KIP effects on habitat, ecosystems and plants were generally less than predicted in the EA Report. Actual Project Footprint clearing covered an area 47% smaller than was anticipated before construction started. All clearing was within the planned Project Footprint boundaries, with the exception of a few small areas and trails, which represented a total of 10.1 ha. In 47 km of rare plant surveys, no S1 or S2 species were observed and no Project effects were observed on rare plants. While the KIP project was not responsible for starting any fires, the Project had some small, localized effects on the spread of a large wildfire in 2013, acting as a fire break in places where the fire was dying out or changing direction, but there was no obvious effect on fire intensity or behaviour.

The one effect that was larger than predicted in the EA Report was the spreading of invasive plants. Recommendations for potential modifications to monitoring programs, mitigation measures or EnvPP guidelines relating to invasive plants will be developed for use by other initiatives since this project is complete.

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