APPENDIX 17A

Fish and Fish Habitat Technical Data Report

Mackenzie Valley Highway Project
Technical Data Report—Fish and Fish Habitat

Prepared for:

Government of the Northwest Territories

Prepared by:

K'alo-Stantec Limited

December 2022

Project No.: 144903025

K'alo-Stantec

Limitations and Sign-off

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Executive Summary

The Government of the Northwest Territories (GNWT), Department of Infrastructure (INF) is proposing the Mackenzie Valley Highway Project (the "Project") that will extend the Mackenzie Valley Highway (Northwest Territories Highway #1) from Wrigley to Norman Wells to replace the Mackenzie Valley Winter Road (MVWR) along this portion. The Project includes construction of approximately 281 kilometres (km) of new all-season highway, and the construction and operation of temporary and permanent quarry and borrow sources. The project highway alignment passes through the Dehcho Region and a portion of the Tulita District of the Sahtu Region within the Northwest Territories (NT).

This technical data report (TDR) presents technical data and analysis of watercourses to be crossed by the highway alignment as well as wetlands and waterbodies immediately adjacent to the highway that may require culvert installations. Watercourses with existing crossing structures (e.g., bridges and culverts) that will become part of the highway are not included in this report. The Great Bear River is also not included because the bridge crossing of this watercourse is undergoing a separate regulatory approvals process.

All watercourses to be crossed by the project highway alignment drain into the Mackenzie River. There are 33 species of fish within the Regional Study Area (RSA); however, not all species found within the RSA would be expected to utilize watercourses to be crossed by the highway (e.g., chum salmon [*Oncorhynchus keta*]). There is a known spawning population of chum salmon in the Liard River, which is a tributary to the Mackenzie River; however, this species is unlikely to use the watercourses expected to be crossed by the highway. Two species, the Western Arctic populations of Bull trout (*Salvelinus confluentus*) and Dolly Varden (*Salvelinus malma*), are listed under Schedule 1 of the *Species at Risk Act* as species of "special concern" and ranked sensitive under the Northwest Territories Species Ranking; however, no additional regulatory restrictions currently apply to these populations.

A desktop assessment was conducted on the 43 watercourses that cross the project highway alignment in the Sahtu Region. This desktop assessment was augmented by 28 field site-assessments within the Sahtu Region portion of the Project. Field assessments were conducted in September and October of 2021. Results indicated that all but 4 of the 43 watercourses assessed provide fish habitat or have the potential to provide fish habitat; most of the watercourses that have the potential to provide fish habitat would likely only support forage fish species.

In the Dehcho Region of the Project, desktop assessments of 49 watercourses or wetlands were augmented by field assessments conducted in September 2020. Field assessments focused on locations where there was not an existing crossing structure. There were 25 watercourses assessed in the field. Of the 49 watercourses and wetlands, 18 were unlikely to provide fish habitat and another 5 are unknown if they provide fish habitat (there was no previous data and could not be assessed in the field at the time). All other watercourses are known to provide fish habitat or have the potential to provide fish habitat. Most of the watercourses that have the potential to provide fish habitat would likely only support forage fish species.

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Abbreviations

%	percent
AT	Alberta Transportation
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DAR	Developer's Assessment Report
DFO	Fisheries and Oceans Canada
GNWT	Government of the Northwest Territories
INF	Department of Infrastructure
IORVL	Imperial Oil Resources Ventures Limited
km	kilometre
KM	kilometre marker
LSA	local study area
m	metre
mg/L	milligrams per litre
MGP	Mackenzie Gas Project
mm	millimetre
MVRMA	*Mackenzie Valley Resource Management Act*
MVWR	Mackenzie Valley Winter Road
NT	Northwest Territories
NTCMA	Northwest Territories Conference of Management Authorities
PDR	Project Description Report
RSA	regional study area
SARA	*Species at Risk Act*
TDR	Technical Data Report
the Project	Mackenzie Valley Highway Project
TK	traditional knowledge
TLRU	traditional land and resource use

Glossary

Centreline	The location where the watercourse crosses the project highway alignment centreline, as currently defined by preliminary-level routing)
Coarse fish	Fish species that are not used for subsistence or recreational fishing such as suckers and Arctic lamprey
Drainage	Ephemeral feature that does not have a defined bed and banks
Feeding habitat	Habitat used by fish primarily for feeding purposes
Forage fish	Minnow-like species which are important food items for larger fish
Migration habitat	Features used by fish to migrate through a watercourse or waterbody to access different habitats to carry out additional life stages
Overwintering habitat	Habitat used by fish during the winter, typically when watercourses and waterbodies are ice-covered
Rearing habitat	Habitat used by larval and juvenile fish for feeding and shelter
Spawning habitat	Habitat used by adult fish to carry out spawning activities
Sport fish	Fish used for subsistence or recreational fishing such as whitefish

1 Introduction

The Government of the Northwest Territories (GNWT), Department of Infrastructure (INF) is proposing the Mackenzie Valley Highway Project (the Project) that will extend the Mackenzie Highway (Northwest Territories Highway #1) from Wrigley to Norman Wells to replace the Mackenzie Valley Winter Road (MVWR) along this portion. The Project includes construction of approximately 281 kilometres (km) of new all-season highway, and the construction and operation of temporary and permanent quarry and borrow sources. The project highway alignment will pass through the Dehcho Region and a portion of the Tulita District of the Sahtu Region within the Northwest Territories (NT; Figure 1.1). Watercourse crossing locations are provided in Appendix A.

The Project is subject to an environmental assessment and the requirements of Part 5 of the *Mackenzie Valley Resource Management Act* (MVRMA). This technical data report (TDR) presents the existing conditions for fish and fish habitat in watercourses, waterbodies, and wetlands crossed by, or adjacent to, the project highway alignment, as based on a preliminary design intended to support development of the Developer's Assessment Report (DAR) as required by the Terms of Reference (Mackenzie Valley Environmental Impact Review Board [MVEIRB], 2015). As per the Terms of Reference (MVEIRB, 2015), a description of existing fish habitat is provided (Table 1.1). As part of the environmental assessment, the DAR will present the GNWT's perspective of how the Project could affect the biophysical and socio-economic environment.

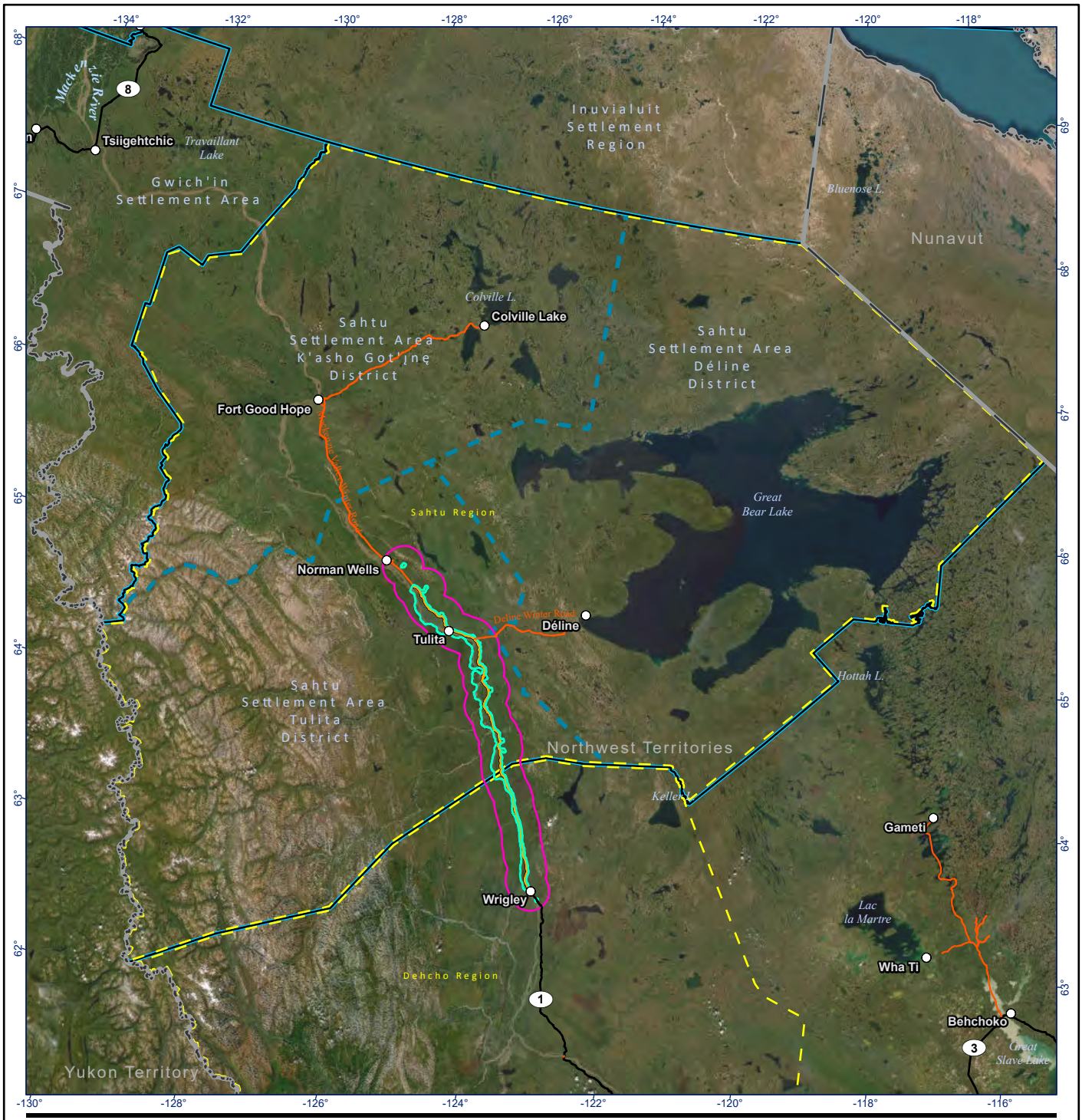
Table 1.1 Fish and Fish Habitat Topics in Terms of Reference and Corresponding Sections in this Technical Data Report

Terms of Reference[a]	Sections in This TDR
Description of fish habitat present at each of the planned water crossings including references	Section 3.2.2 Appendix A Appendix B
Fish species including forage fish (non-harvested) and any other aquatic resources of value present	Table 4.1
Seasonal and life cycle movements and sensitive periods	Section 4.2.1
Habitat requirements for each life stage	Section 4.2.1
Local and regional abundance, distribution and use of habitat types, including aquatic and riparian vegetation	Section 4.2.1
Known sensitive or important areas in terms of habitat type (e.g., spawning, overwintering, refugia, feeding), species and timing of use	Section 4.1
For species at risk or of concern, also describe specific location, population status, limits and size, sensitivity and limiting factors	Section 4.2.1.5 Section 4.2.1.6
Baseline contaminant concentrations in harvested species, that may change as a result of the highway and as available	Section 4.2
Any known issues with respect to health of harvested species (e.g., parasites, disease, condition)	Section 4.2
Species of particular importance to subsistence harvesters	Section 4.1

Terms of Reference[a]	Sections in This TDR
Species subject to exclusive or preferential rights granted by land claims	Section 4.1
species of particular importance to the guiding or outfitting industries	Section 4.1 Section 4.2.1
areas subject to exclusive harvesting rights granted to land claim beneficiaries	Section 4.1
harvest pressures (subsistence, sport fishing, and commercial harvesting) by species, season and geographic area	Section 4.1 Section 4.2.1
Listing of existing non-native species	Section 4.2

Note:

[a] Section 5.1.4 of MVEIRB, 2015 Terms of Reference was referred to in order to develop this TDR



- Proposed Mackenzie Valley Highway Alignment - Issued for EA 2022
- Granular Borrow / Rock Quarry Site and Access
- Local Study Area
- Regional Study Area
- Community
- All-Season Road
- Winter Road
- District Boundary
- Region Boundary
- Settlement Area Boundary
- Territorial Boundary

0 40 80 Kilometres

(At original document size of 8.5x11)
1:4,500,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 2023-03-07
TR by AJ on 2023-03-07

Client/Project
144903025-0066 REVB

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.
1.1

Title
Dehcho Region and Sahtu Region - Proposed Mackenzie Valley Highway Alignment – Issued for EA 2022

Notes
1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS

2 Study Areas

The Project is in the Mackenzie Valley region of the NT between Hodgson Creek (located approximately 1 km north of Wrigley) and Prohibition Creek (located approximately 28 km southeast of Norman Wells). The project highway alignment parallels the Mackenzie River to the east.

The Project is located within the Taiga Plains Low Subarctic, Taiga Cordillera Low Subarctic and Boreal Cordillera Level III ecoregions. Each of these ecoregions is distinguished by different climatic factors.

2.1 Local Study Area

The Local Study Area (LSA) for fish and fish habitat is defined as the collective area 300 metres (m) downstream and 100 m upstream of each watercourse crossing structure proposed to be constructed as part of the Project. The centreline reference point is defined as the mid-point where the highway preliminary routing corridor developed to support the DAR crosses a watercourse. This area provides local context for determining significance of Project specific and potential effects to be assessed in the DAR and to inform engineering design.

2.2 Regional Study Area

The Regional Study Area (RSA) is defined by a 15 km buffer on either side of the Project. The RSA includes the Mackenzie River and associated tributaries and drainages. A 15 km buffer provides regional context for determining significance of Project specific effects and potential cumulative effects to be assessed in the DAR.

3 Methods

3.1 Traditional Knowledge and Traditional Land and Resource Use

Traditional knowledge (TK) and traditional land and resource use (TLRU) were obtained through a review of existing published literature from past TK studies. For example, the Tulita Renewable Resources Council (TRRC) completed a TLRU study for the Tulita District relating to the Project (TRRC, 2022). In addition, the following published literature was reviewed:

- Auld and Kershaw (ed.), 2005
- Desseau, 2012
- Golder, 2015
- IMG-Golder Corporation, 2006
- TRRC, 2019

3.2 Fish and Fish Habitat Assessments

3.2.1 Desktop Assessment

Potential watercourses crossed by the project highway alignment were determined based on information included in the Project Description Report (PDR) for Construction of the Mackenzie Valley Highway Tulita District, Sahtu Settlement Area (5658 NWT Ltd. and GNWT, 2011), the PDR for the Mackenzie Valley Highway Extension Pehdzeh Ki Ndeh – Dehcho Region (Dessau, 2012), and the fish and fish habitat baseline report from the Mackenzie Gas Project (MGP) (Imperial Oil Resources Ventures Limited [IORVL], 2004), which follows a similar route to that of the Project. In 2011, fish habitat assessments were completed from a helicopter to identify potential watercourse crossings along the project highway alignment (5658 NWT Ltd. and GNWT, 2011; Dessau, 2012). Watercourse crossings were identified as either watercourses or drainages. Watercourses were identified as active channels with defined bed and banks, while drainages were vegetated and/or had no defined bed and banks (IORVL, 2004; 5658 NWT Ltd. and GNWT, 2011; Dessau, 2012).

During aerial surveys, (5658 NWT Ltd. and GNWT, 2011; Dessau, 2012) identified fish habitat potential based on the type of watercourse to be crossed and did not qualify the quality of habitat available. (5658 NWT and GNWT, 2011; Dessau, 2012) identified fish habitat potential as follows:

- non-fish bearing; features are not used by fish during any life stage.
- migratory channels; ephemeral features used by fish for migration only or contribute to downstream habitat quality.
- spawning, rearing, and feeding habitats; watercourses and drainages that are used by fish for at least one life stage as well as migration.

Reconnaissance and detailed and seasonal surveys at each crossing along the MGP route completed by IORVL (IORVL, 2004). Fish inventories were completed to determine species and life stages in the watercourses crossed by the MGP route, but the report does not provide a comprehensive inventory of fish species in each watercourse. Habitat suitability was evaluated for the potential of large-bodied species harvested for commercial, recreation, or subsistence purposes (e.g., northern pike, Arctic grayling, or groups of fish such as whitefish species) and assumed that all channels provided suitable habitat for some species while vegetated channels did not (IORVL, 2004); it did not describe quality of habitat; instead, it evaluated habitat potential for large-bodied species at each crossing location for

- overwintering
- spawning and incubating
- rearing
- adult feeding and holding

In addition to reviewing existing reports, information on crossings was found using publicly available aerial imagery. Existing watercourses with existing crossing structures that have been established for the MVWR will be utilized by the Project and have been previously assessed.

Primary sources for information on fish species presence was gathered from existing literature and Fisheries and Oceans Canada's (DFO) aquatic species at risk map (DFO, 2022). The resulting historical fish capture data was reviewed for the presence of fish species at risk listed under Schedule 1 of the *Species at Risk Act* (SARA) and the Northwest Territories Conference of Management Authorities (NTCMA) Species at Risk List. Other species designations and status reports were also considered: the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (GOC, 2022b) and the General Status of Ranks of Wild Species in the Northwest Territories (GNWT, 2016).

Life history strategies of the fish species with historical presence within the RSA were summarized based on published literature. Life history strategies were provided for species that are expected to be of value for subsistence or recreational fishing and are predominantly sport fish (e.g., Arctic grayling, northern pike, lake whitefish). Forage fish (e.g., cyprinids) and coarse fish (e.g., suckers) are expected to occur within the RSA; however, life history strategies were not provided because they are less valued for subsistence or recreational fishing although they are ecologically important to the aquatic system. Watercourse crossings identifiers were cross-referenced between the MGP (IORVL, 2004) and PDR (5658 NWT Ltd. and GNWT, 2011) reports and summarized based on both data sources.

3.2.2 Field Assessment

Field assessments were conducted in the Dehcho Region portion of the Project between September 16 and 24, 2020. Field assessments in the Sahtu Region were conducted between September 30 and October 11, 2021. Field assessments in the Sahtu settlement Area were conducted later than originally proposed due to delays in obtaining community and research study approvals due to COVID-19. This delay resulted in some watercourses not being assessed in the field or fish capture not being conducted at all watercourses due to freezing conditions, which could result in injury to fish. For potential stream crossings where field assessments were not conducted, information relies on the desktop assessment.

Field assessments were not conducted at watercourse crossings where there are existing watercourse crossing structures. The Great Bear River is also not included in this report because a proposed bridge over the river at Tulita is undergoing a separate regulatory process.

Features crossed by the Project were grouped into the following categories:

- drainage; ephemeral feature that does not have a defined bed and banks.
- watercourse; has defined bed and banks with flowing surface water that may be active year-round or seasonally.
- wetland; a waterbody with defined bed and banks but does not have flowing water. A wetland may have an inlet and/or an outlet, which connects it to another watercourse or waterbody.

The fish habitat assessment used procedures based on standard protocols outlined in Alberta Transportation's (AT) Fish Habitat Manual (AT, 2009) and R.L. & L. Environmental Services Ltd. (1992). Alberta protocols are used as there are no fish habitat assessment protocols established for the NT and are the Alberta protocols are accepted by regulators in the NT. At each crossing location, six transects were established to document channel characteristics along a 400 m reach. Transects were established at 100 m and 50 m upstream of the centreline and 100 m, 200 m, and 300 m downstream of the centreline. Where possible, the following information and observations were recorded at each transect:

- date and time
- photographs
- habitat-type (e.g., pool riffle, run) and area
- channel characteristics (e.g., channel and wetted widths, depths, gradient)
- bed material (substrate size distribution)
- obstructions to fish passage
- vegetation (instream and riparian)
- flood signs
- stage of stream

Bank materials, bank stability, bank slopes, cover, vegetation, and fish habitat were estimated visually. Channel width, wetted width, water depth, and bank heights were measured quantitively. Instream substrate composition was estimated visually at each transect.

Habitat characteristics were incorporated into a physical habitat classification system, which rated the quality of each macro-habitat type, based on physical characteristics (e.g., depth, cover, substrate) and life history requirements (e.g., rearing, spawning, migration, overwintering) of different fish species known or likely to occur in the vicinity of the Project. Fish habitat suitability for migration, spawning, rearing, and overwintering for waterbodies adjacent to the project highway alignment was rated (i.e., good, moderate, poor, or none) according to its suitability to support migration, spawning, rearing, and overwintering by fish species known or likely to be present within the waterbody.

Generally, sport fish spawning habitat was rated of higher quality (i.e., good) where there was abundant large gravel (suitable for redd construction) and coarse substrate, such as cobble (suitable for broadcast spawning). Proximity to cover was considered because it is important for some species, such as bull trout. For northern pike, flooded riparian vegetation is required for spawning. Consistent flow and suitable depth for the various species were considered in determination of quality. For coarse fish, similar attributes to sport fish were considered because the substrate utilized is similar overall. Forage fish exhibit a variety of spawning behaviours, and good spawning habitat typically includes instream woody debris, instream vegetation, or flooded riparian vegetation as well as the variety of substrates. In addition, forage fish are typically tolerant of lower flows and shallower depths. Ratings of moderate and poor were based on lower amounts of preferred spawning habitat at an area.

Rearing habitat was rated as good quality where flows were suitable for larval and juvenile fish and where there was abundant overhead and/or instream cover. Rearing habitat was rated as better quality where substrate was coarser and complex because it is more likely to support colonization of benthic invertebrate communities as a food source for fish. Ratings of moderate and poor were based on lower amounts of potential rearing habitat at an area.

Overwintering habitat was rated as good for sport and coarse fish where the watercourse does not freeze to bottom and consistent flows were maintained. Deep, high-quality pools were also considered as good overwintering habitat. These areas are likely to maintain sufficient dissolved oxygen concentrations for fish during the winter. Forage fish are generally small bodied, and many are more resilient to lower dissolved oxygen concentrations (e.g., brook stickleback, fathead minnow). These fish are able to successfully overwinter in wetlands (depth greater than 1.5 m), watercourses that do not freeze to the bottom, or that freeze near to bottom. Ratings of moderate and poor were based on lower amounts of potential overwintering habitat at an area.

Migration was rated as good where no barriers to migration were observed. Barriers such as cascades or rapids may not be passed by small-bodied forage fish but could be successfully jumped by an adult salmonid. Other barriers, such as beaver dams, may serve as partial barriers to larger-bodied fish, such as sport and coarse fish, while forage fish are able to migrate past them. Ratings of moderate and poor were based on increasing potential for blockages to fish passage due to flow levels or other natural potential barriers at an area.

4 Results

4.1 Traditional Knowledge and Traditional Land and Resource Use

4.1.1 Sahtu Region

Fishing is an important cultural and social activity in the Sahtu Region (Auld and Kershaw, 2005). The Mackenzie River is an important area for fish harvesting but lakes are also fished (Sahtu Heritage Places and Sites Working Group, 2000). When wildlife were not available at different times of year, some fish species were always available (Auld and Kershaw, 2005). Streams in the Sahtu area are all fish bearing though fish may be only found at certain times of year (Golder, 2015).

Important fish species harvested include Lake whitefish (humpbacks), Lake trout, Northern pike (jackfish), Arctic grayling and Inconnu (coney) (Auld and Kershaw, 2005; Golder, 2015). Arctic grayling are commonly present in the Great Bear River (5658 NWT Ltd. and GNWT, 2011). Broad whitefish are also harvested (Tallman and Reist, 1997). There are no exclusive harvesting rights for fish; however, individuals wishing to fish in Sahtu or Métis private lands or special harvesting areas should contact the local Renewable Resource Council for permission to access the area.

4.1.2 Dehcho Region

Fish, especially whitefish (Dessau, 2012), are an important food source and of cultural significance for people in the Dehcho Region, although other fish species are also harvested. The Mackenzie River is an important fishing area (Dehcho Land Use Planning Committee, 2006). Subsistence fishing is a commonly practiced activity, with the Mackenzie River, Wrigley River, Willowlake River, the River Between Two Mountains, Blackwater Lake, Greasy Lake and Highland Lake being important waterbodies for subsistence harvesting. The primary species caught are lake whitefish, lake trout, inconnu and northern pike (IMG-Golder, 2006). Fish spawning sites are located near the mouths of the Ochre River and Blackwater River (Dessau, 2012). as well as other watercourses crossed by the project highway alignment. Fishing is in important in Trout Lake for TLRU (TRRC, 2022). There are lakes within the RSA which are important spawning areas and fish harvesting within the RSA is reported to occur in the summer and wintertime (TRRC, 2022). There are no exclusive harvesting rights for fish and permission to access lands is not required.

4.2 Fish Species

Previously, 28 fish species were documented within the RSA, based on existing data from 5658 NWT and GNWT (2011) and IORVL (2004). Field assessments in the Dehcho Region by K'alo-Stantec in 2020 included capture of an additional two species: brook stickleback (*Cluea inconstans*) and fathead minnow (*Pimephales promelas*). The 2021 field assessments in the Sahtu Region identified three additional species: finescale dace (*Chrosomus neogaeus*), pearl dace (*Margariscus margarita*) and northern redbelly dace (*Chrosomus eos*). These additional five species raise the total number of fish species documented in the RSA to 33. The capture of pearl dace and northern redbelly dace indicates northern range extensions for both these species in the NT. Table 4.1 provides the status for each species identified in the desktop assessment and field assessments.

Previous studies (IORVL, 2004) conducted in the LSA captured lake chub (*Couesius plumbeus),* slimy sculpin (*Cottus cognatus*), northern pike (*Esox lucius*), longnose sucker (*Catostomus catostomus)* and Arctic grayling (*Thymallus arcticus)*

There are no resident non-native fish within the LSA. Three Pacific salmon species (sockeye [*Oncorhyncus nerka*], chinook [*O. tshawytscha*], and coho [*O. kisutch*]) have been captured and are non-native and occasionally occur in the Mackenzie River system but are considered vagrant in the RSA. Chum salmon [*O. keta*] also occurs within the RSA; however, this species is unlikely to migrate up watercourses into the LSA due to the lack of adequate spawning habitat for this species. Only one spawning population of chum salmon has been reported in the Mackenzie River system, in the Liard River (R.L. & L. Environmental Services Ltd., 1980) a tributary to the Mackenzie River.

The western Arctic population of bull trout (*Salvelinus confluentus*) and Dolly Varden (*Salvelinus malma*) are considered populations of Special Concern under SARA (GOC, 2022a) and COSEWIC (GOC, 2022b). Both species are listed as "sensitive" in the NT by the Species at Risk Committee (GNWT, 2020). Inconnu (*Stenodus leucichthys*) and Arctic cisco (*Coregonus autumnalis*) are also listed as "sensitive" (GNWT, 2016). Species listed as "special concern" or "sensitive" have no additional regulatory requirements associated with them.

There are no fish consumption advisories for watercourses crossed by the project highway alignment identified by the GNWT Department of Health and Social Services (GNWT, 2021) and no baseline contaminant studies have been conducted for those watercourses. No concerns over parasites in fish have been reported.

Table 4.1 Potential Fish Species Within the RSA

Species Information			Legislated Protection	Scientific Review or Recommendation	
Family	**Common Name**	**Scientific Name**	***SARA*[a] (Federal)**	**COSEWIC[a] (Federal)**	**General Status[b] (Northwest Territories)**
Catostomidae	longnose sucker	*Catostomus*	No status	Not assessed	Secure
	white sucker	*Catostomus commersonii*	No status	Not assessed	Secure
Cottidae	slimy sculpin	*Cottus cognatus*	No status	Not assessed	Secure
	spoonhead sculpin	*Cottus ricei*	No status	Not at risk	Secure
Cyprinidae	emerald shiner	*Notropis atherinoides*	No status	Not assessed	Secure
	fathead minnow	*Pimephales promelas*	No status	Not assessed	Undetermined
	finescale dace	*Chrosomus neogaeus*	No status	Not assessed	Secure
	flathead chub	*Platygobio gracilis*	No status	Not assessed	Secure
	lake chub	*Couesius plumbeus*	No status	Not assessed	Secure
	longnose dace	*Rhinichthys cataractae*	No status	Not assessed	Secure
	northern redbelly dace	*Chrosomus eos*	No status	Not assessed	Secure
	pearl dace	*Semotilus margarita*	No status	Not assessed	Secure
	spottail shiner	*Notropis hudsonius*	No status	Not assessed	Secure
Esocidae	northern pike	*Esox lucius*	No status	Not assessed	Secure
Gadidae	burbot	*Lota lota*	No status	Not assessed	Secure
Gasterosteidae	brook stickleback	*Cluea inconstans*	No status	Not assessed	Secure
	ninespine stickleback	*Pungitius pungitius*	No status	Not assessed	Secure
Hiodontidae	goldeye	*Hiodon alosoides*	No status	Not assessed	Secure
Percidae	walleye	*Sander vitreus*	No status	Not assessed	Secure
Percopsidae	trout-perch	*Percopsis omiscomaycus*	No status	Not assessed	Secure
Peteromyzontidae	Arctic lamprey	*Lampetra arcticus*	No status	Not assessed	Undetermined

Species Information			Legislated Protection	Scientific Review or Recommendation	
Family	**Common Name**	**Scientific Name**	***SARA*[a] (Federal)**	**COSEWIC[a] (Federal)**	**General Status[b] (Northwest Territories)**
Salmonidae	Arctic cisco	*Coregonus autumnalis*	No status	Not assessed	Sensitive
	Arctic grayling	*Thymallus arcticus*	No status	Not assessed	Secure
	broad whitefish	*Coregonus nasus*	No status	Not assessed	Secure
	bull trout	*Salvelinus confluentus*	Special Concern	Special Concern	Sensitive
Salmonidae (cont'd)	Dolly Varden	*Salvelinus malma*	Special Concern	Special Concern	Sensitive
	Inconnu	*Stenodus leucichthys*	No status	Not assessed	Sensitive
	lake trout	*Salvelinus namaycush*	No status	Not assessed	Secure
	lake whitefish	*Coregonus clupeaformis*	No status	Not assessed	Secure
	least cisco	*Coregonus sardinella*	No status	Not assessed	Secure
	mountain whitefish	*Prosopium williamsoni*	No status	Not assessed	Secure
	round whitefish	*Prosopium cylindraceum*	No status	Not assessed	Secure
	Chum salmon	*Oncorhynchus keta*	No status	Not assessed	Undetermined

Notes:

[a] *Species at Risk Act* and COSEWIC (GOC, 2022b)

[b] General Status Ranks of Wild Species in the Northwest Territories (GNWT, 2016)

4.2.1 Life History Strategies

4.2.1.1 Lake Whitefish

Lake whitefish or humpback is a common species harvested by communities throughout the Mackenzie River system, including in the RSA. Spawning occurs in the fall in lakes and larger rivers (Scott and Crossman, 1998). There are no records of lake whitefish spawning in smaller streams, but they may utilize these streams to move between lakes and larger river systems for rearing. Lake whitefish are known to spawn in the Mackenzie River (Jessop and Lilly, 1975) and in larger tributaries of the Mackenzie River.

Spawning typically occurs between late September and early October (Reist and Bond, 1988) and eggs hatch in spring. Lake whitefish do not make redds but instead broadcast their eggs over cobble and gravel substrate (Scott and Crossman, 1998). In rivers, larval lake whitefish are swept downstream and move into backwaters of rivers as nursery areas (Sawatzky et al., 2007) and then move into lakes until they reach maturity (Evans et al., 2001). It is unknown if there are lake whitefish that reside in major rivers for their entire life history (Evans et al., 2001).

Adult lake whitefish diet consists mainly of aquatic insect larvae (e.g., chironomids), snails, clams, amphipods, and other bottom organisms (Scott and Crossman, 1998). Lake whitefish have also been known to feed on small fish and fish eggs (Scott and Crossman, 1998).

Lake whitefish would not be expected to occur in watercourses assessed in the LSA due to the lack of suitable habitat.

4.2.1.2 Least Cisco

The majority of information known about least cisco, a member of the whitefish family, in the Western Arctic is from the lower Mackenzie River and delta. Although they are known to occur throughout most of the Mackenzie River, least cisco is not known to occur in Great Slave Lake (Stewart and Low, 2000). Least cisco can be found in both lakes and rivers with some populations being only lake dwelling (Scott and Crossman, 1998).

Spawning occurs in late September to early October with eggs broadcast over sand or gravel. Hatching typically occurs in May (Sawatzky et al., 2007). Least cisco feed on aquatic and terrestrial insects (Scott and Crossman, 1998).

Least cisco would not be expected to occur in the streams assessed during this study due to the lack of suitable habitat.

4.2.1.3 Inconnu

Inconnu or coney is the only truly piscivorous (fish eating) whitefish and the largest member of the whitefish family. They may undertake long migrations; two tagged inconnu migrated almost 1,800 km from the Liard River to the Mackenzie River delta and Tuktoyaktuk (Stephenson et al., 2005). Inconnu have been grouped into three migratory types: fully anadromous, partially anadromous, and freshwater (Howland et al., 2001). All three migratory types may be found in the RSA.

Inconnu spawning occurs in October over coarse cobble substrate and some sand (Alt, 1969) in the Mackenzie River and larger tributary rivers (e.g., Peel River). After spawning, they migrate downstream to overwintering areas. Spawning of mature inconnu is believed to occur only every two to four years (Scott and Crossman, 1998). Inconnu are not known to migrate up streams into the LSA although may be found at the mouths of streams that enter the Mackenzie River.

4.2.1.4 Lake Trout

Lake trout are mainly found in deep, cold-water lakes but may also be found in some shallower lakes and larger rivers in the NT (Scott and Crossman, 1998). They spawn in the fall over cobble substrate along exposed shorelines and shoals of lakes (Callaghan et al., 2015). Lake trout spawning is not expected in the watercourses within the LSA due to the lack of spawning habitat potential in these systems.

Lake trout feed on zooplankton, other fish, and occasionally small mammals (Scott and Crossman, 1998). The presence of lake trout within the LSA is expected to be restricted to larger watercourses and used mainly for movement between lakes.

4.2.1.5 Bull Trout

Two types of bull trout have been identified in the Mackenzie Valley: migratory and non-migratory (Mochnacz et al., 2013). Bull trout have been reported in the Great Bear River (Mochnacz et al., 2013; IORVL, 2004; Reist et al., 2002). However, they are not thought to spawn in the Great Bear River system because they usually spawn in smaller, steeper gradient streams (Mochnacz et al., 2013; IORVL, 2004). It has been suggested bull trout in the eastern tributaries of the Mackenzie River, such as those within the RSA are individuals from tributaries on the west side of the Mackenzie River in search of feeding or overwintering areas (Mochnacz et al., 2013).

Bull trout are fall spawners, making redds in gravel substrate (COSEWIC, 2012). In the NT, bull trout spawn in alternate years (Mochnacz et al., 2013). Incubation can range from 35 days to four months, depending on water temperatures (COSEWIC, 2012). As bull trout age, their diet transitions from aquatic and terrestrial invertebrates to fish (Stewart et al., 2007).

The Western Arctic population of bull trout is considered “of special concern” under SARA (GOC, 2022a) and COSEWIC (GOC, 2022b) and is considered “sensitive” under the General Status Ranks of Wild Species in the NT (GNWT, 2016). The population is widely distributed throughout the Western Arctic drainage; however, populations are not abundant (COSEWIC, 2012). There are no population estimates for the NT, but there is evidence of decline within the Western Arctic Population in some locations

(COSEWIC, 2012). This species is particularly vulnerable to habitat degradation and fragmentation as a result of industrial development (e.g., oil, gas, and mining development, commercial forestry, road and urban development, , displacement and hybridization with introduced species (i.e., brook trout [*Salvelinus fontinalis*]), and overexploitation, which is exacerbated with misidentification (COSEWIC, 2012).

Bull trout are not expected to occur in the watercourses assessed during this study due to the lack of suitable habitat.

4.2.1.6 Dolly Varden

Dolly Varden are unlikely to occur within tributaries of the Mackenzie River in the RSA. This is because the southern range of the northern population of Dolly Varden is the Gayna River, which is downstream of Norman Wells and outside the RSA. Dolly Varden have been reported in previous studies conducted within the RSA; however, these fish were likely misidentified bull trout (Reist et al., 2002).

There are two forms of Dolly Varden: a riverine form and an anadromous form, which migrates to the Beaufort Sea to feed during the open water season (Stewart at al., 2010). Both forms construct redds in clear, groundwater-fed streams that do not freeze to the bottom in winter (Stewart et al., 2010). The age before migrations to the Beaufort Sea can vary depending on the population but typically occurs between two to four years (Stewart et al., 2010).

The Western Arctic population of Dolly Varden is considered “of special concern” under SARA (GOC, 2022a) and COSEWIC (GOC, 2022b) and is considered “sensitive” under the General Status Ranks of Wild Species in the Northwest Territories (GNWT, 2016). The population within the NT is not well understood, and the extent of its decline is not known but serious declines have been observed in some populations (COSEWIC, 2010). The known threats to the species include climate change, habitat loss through freshwater river desiccation, overharvesting, and changes to groundwater recharging at overwintering sites (COSEWIC, 2010). Additional potential threats include offshore infrastructure (which can disrupt anadromous forms), resource extraction that may alter habitat and increasing fishing pressure driven by development of transportation corridors (COSEWIC, 2010).

Dolly Varden are not expected to occur in the watercourses assessed in the LSA due to the lack of suitable habitat.

4.2.1.7 Arctic Grayling

Arctic grayling is found in clear, cold streams, rivers, and lakes (Scott and Crossman, 1998; Ford et al., 1995) and are present in numerous streams along the project highway corridor. Male Arctic grayling reach maturity at three to four years of age; females mature later at four to five years (Low and Read, 1987).

Arctic grayling spawn in the spring as ice-cover begins to break-up over gravel or cobble bottoms (Scott and Crossman, 1998). No redd is built; instead, eggs are broadcast over the substrates. Young-of-the-year remain in their natal streams for up to 15 months (Ford et al., 1995). Adults may move into larger

systems to overwinter (Scott and Crossman, 1998). Juveniles feed mainly on zooplankton and gradually shift to larger aquatic and terrestrial invertebrates as they mature (Scott and Crossman, 1998).

Arctic grayling have the potential to occur in the larger watercourses assessed in the LSA.

4.2.1.8 Northern Pike

Northern pike occur in rivers, streams, and lakes throughout the Mackenzie River Valley (Scott and Crossman, 1998). Spawning occurs just after ice-out in weedy areas on flooded terrestrial vegetation with eggs hatching 12 to 14 days later (Scott and Crossman, 1998). Spawning adults may remain in the stream or lake where they spawned or move downstream to associated systems (Evans et al., 2002). Pike fry move into slower waters in tributaries or into the mainstem Mackenzie River in late July (Jessop and Lilly, 1975).

Adult northern pike prefer shallow portions of rivers, with no velocity or slow water and areas with aquatic vegetation (Casselman and Lewis, 1996; Ford et al., 1995; Jessop and Lilly, 1975). In mid-August and September, pike will move from shallower areas to deeper overwintering areas before freeze-up (Jessop and Lilly, 1975).

Northern pike have the potential to occur in most watercourses along the project highway alignment.

4.2.1.9 Burbot

Burbot or loche is a freshwater cod and is the only freshwater fish that spawns in the winter in the Northwest Territories. Burbot spawn in lakes over sand, gravel, or cobble substrate. In rivers and streams, burbot typically spawn in low-velocity areas within main channels or in side-channels behind depositional bars over fine gravel, sand, or fine silt substrate (McPhail and Paragamian, 2000). It is expected that suitable spawning habitat for burbot does not exist in most watercourses in the LSA highway corridor due to their shallow water depth and high likelihood of being frozen to or near the bottom.

Juvenile burbot may use smaller streams during the open water season. Young burbot feed on mainly aquatic invertebrates moving to a diet of fish as they become adults (McPhail and Paragamian, 2000; Scott and Crossman, 1998).

Burbot have the potential to occur in larger watercourses in the LSA along the project highway alignment.

4.2.1.10 Forage Fish

A variety of forage fish are found in watercourses in the LSA with Slimy sculpin, ninespine stickleback and brook stickleback being three of the more common and abundant forage species captured during fisheries surveys conducted for the Mackenzie Gas Project (IORVL, 2004). Forage fish species found in watercourses in the LSA are identified in Table 4.2 and Table 4.3, spawn in late spring or summer in flowing or stagnant water over a wide range of substrate types depending on species preferences.

4.3 Watercourse Crossing Assessments

A summary of watercourse crossings in the Sahtu Region are provided in Table 4.2 and Figure A.1 to Figure A.4 in Appendix A. Based on the desktop assessment and literature review (i.e., IORVL, 2004; 5658 NWT Ltd. and GNWT, 2011), 27 watercourses are crossed by the Project. In addition, four drainages are crossed by the project highway corridor. Table 4.2 indicates where the MGP route and the project highway alignment cross the same watercourses and drainages.

A summary of watercourse crossings in the Dehcho Region are provided in Table 4.3 and Figure A.4 to Figure A.6 in Appendix A. Table 4.3 indicates where the MGP route crosses the same watercourses and drainages as the project highway alignment. K'alo-Stantec's field assessment data is included in Table 4.3. The determination of the type of water feature crossed by the project highway corridor (i.e., watercourse, drainage, wetland) shown in Table 4.3 is based on K'alo-Stantec's field assessments because they were completed most recently compared to 5658 NWT Ltd. and GNWT (2011) and IORVL (2004). K'alo-Stantec was not able to assess all the crossings due to weather and access conditions at the time of the survey.

Existing data is summarized for each crossing in the Sahtu Region and Dehcho Region in Sections 4..1 and 4.3.2, respectively. Station summary data sheets from the field assessments in the Dehcho Region are located provided in Appendix C.

Restricted Activity Timing Windows have been developed by DFO for periods when instream works are to be avoided in order to protect sensitive life stages of fish species. Because species presence is not known at all crossing locations, the restricted activity timing windows for Zone 2 recommended by DFO (2013) within the LSA permit instream work between July 15 and August 15. This was not refined further as comprehensive fish inventories were not completed at each watercourse in the LSA and so a conservative approach was adopted. Works in or near water which cannot avoid the Restricted Activity Timing Windows require a Request for Review to be submitted to DFO for those works.

Table 4.2 Watercourses Crossed by the Mackenzie Valley Highway Project Corridor and the MGP Route—in the Sahtu Region

Watercourses	Mackenzie Valley Highway Project Corridor				MGP Route				Known and Potential Fish Presence[a]
	KM Reference	Centreline UTM			MGP Crossing ID	UTM			
		Zone (W)	Easting	Northing		Zone (W)	Easting	Northing	
Unnamed watercourse	797.9	10	437740	7101829	RPR-375	10	437768	7101905	Brook stickleback, Finescale dace, Pearl dace, unidentified cyprinid[b]
Unnamed watercourse	805.5	10	435589	7108255	RPR-374	10	435644	7108244	Brook stickleback. Pearl dace[b]
Unnamed watercourse	812.7	10	434329	7115337	RPR-372	10	434385	7115279	Potential
Unnamed watercourse	815	10	432721	7117031	-	-	-	-	Unlikely
Unnamed watercourse	820.7	10	433131	7121799	RPR-370	10	433494	7121478	Potential
Unnamed watercourse	821.9	10	432580	7123103	-	-	-	-	Potential
Unnamed watercourse	823	10	431979	7123968	-	-	-	-	Potential
Unnamed watercourse	824.5	10	431072	7126467	-	-	-	-	Potential
Unnamed watercourse	826	10	431007	7126834	-	-	-	-	Potential
Unnamed watercourse	826.3	10	430947	7126834	-	-	-	-	Potential
Unnamed watercourse	828.6	10	429991	7129070	-	-	-	-	Potential
Unnamed watercourse	834.1	10	425724	7132189	-	-	-	-	Potential
Unnamed watercourse	835	10	425405	7132988	-	-	-	-	Potential
Unnamed watercourse	837.1	10	424624	7135022	RPR-355	10	424006	7133065	Potential
Unnamed watercourse	843.3	10	422310	7140408	-	-	-	-	Unlikely
Unnamed watercourse	846.4	10	419947	7142715	-	-	-	-	Potential
Unnamed watercourse	857.4	10	415860	7151196	RPR-350	10	415585	7151326	Potential
Unnamed watercourse	872.9	10	412679	7164554	-	-	-	-	Unlikely
Drainage	874	10	410998	7166150	-	-	-	-	Potential

Watercourses	Mackenzie Valley Highway Project Corridor				MGP Route				Known and Potential Fish Presence[a]
	KM Reference	Centreline UTM			MGP Crossing ID	UTM			
		Zone (W)	Easting	Northing		Zone (W)	Easting	Northing	
Drainage	875.5	10	410938	7167644	RPR-347	10	413223	7168155	Potential
Unnamed watercourse	876.6	10	410947	7168766	-	-	-	-	Potential
Unnamed watercourse	877.8	10	411245	7169818	-	-	-	-	Potential
Unnamed watercourse	879.1	10	411064	7169505	-	-	-	-	Potential
Unnamed watercourse	878.8	10	411627	7170638					Potential
Unnamed watercourse	879.4	10	411209	7168580	-	-	-	-	Potential
Unnamed watercourse	880.2	10	411595	7170626	RPR-346	10	412160	7171394	Potential
Unnamed watercourse	880.6	10	411800	7171054	-	-	-	-	Brook stickleback, Finescale dace, Pearl dace[b]
Unnamed watercourse	881	10	411798	7171042	RPR-346	10	412160	7171394	Potential
Unnamed watercourse	883.6	10	411615	7173282	-	-	-	-	Unlikely
Unnamed watercourse	884.3	10	411435	7174830					Potential
Unnamed watercourse	884.8	10	411300	7174635	RPR-344	10	411510	7174746	Potential
Unnamed watercourse	889	10	408491	7178378					Potential
Unnamed watercourse	891.4	10	406839	7178354	-	-	-	-	Potential
Unnamed watercourse	891.7	10	406854	7178332	-	-	-	-	Potential
Unnamed watercourse	892	10	407102	7180445	-	-	-	-	Potential
Unnamed watercourse	915.6	10	397368	7198303	-	-	-	-	Potential
Unnamed watercourse	918	10	394969	7198798					Potential
Unnamed watercourse	919.9	10	394956	7198775	RPR-333	10	394959	7198712	Potential
Twelve Mile Creek	922	10	392020	7198797	RPR-332	10	393165	7200177	Arctic grayling, burbot, northern pike, emerald shiner, spottail shiner, lake chub[c]

Watercourses	Mackenzie Valley Highway Project Corridor				MGP Route				Known and Potential Fish Presence[a]
	KM Reference	Centreline UTM			MGP Crossing ID	UTM			
		Zone (W)	Easting	Northing		Zone (W)	Easting	Northing	
Four Mile Creek	931	10	382776	7200651	-	-	-	-	Arctic grayling, burbot, northern pike, emerald shiner, lake chub[d]
Unnamed watercourse	940.1	10	375325	7203625	-	-	-	-	Potential
Unnamed watercourse	980.3	9	629551	7227955	RPR-314	9	627399	7227382	Potential
Unnamed watercourse	981.2	10	629352	7227768	-	-	-	-	Potential
Prohibition Creek	983	9	626464	7228215	RPR-313	9	626292	7227921	Arctic grayling, broad whitefish, cisco, longnose sucker, mountain whitefish, northern pike, round whitefish, trout-perch, lake chub, emerald shiner, spottail shiner, spoonhead sculpin, slimy sculpin[c]
Unnamed watercourse	987.2	9	623577	7230276	RPR-312	9	623642	7230364	Potential

Notes:

- Watercourse/waterbody was not crossed or assessed by IORVL (2004)

[a] Where fish presence was recorded, the species are listed. Description of fish habitat potential are provided in Section 3.2.2. No recorded fish presence does not necessarily indicate the absence of fish or that the area does not afford fish habitat. Unlikely is related to lack of connectivity or no defined channel.

[b] This report

[c] IORVL, 2004

[d] 5658 NWT Ltd. and GNWT, 2011

KM = kilometre marker

Table 4.3 Waterbodies Crossed by the Mackenzie Valley Highway Project Corridor and the MGP Route—in the Dehcho Region

Watercourses	Mackenzie Valley Highway Project Corridor				MGP Route				Known and Potential Fish Presence[a]
	KM Reference	Centerline UTM			MGP Crossing ID	UTM			
		Zone (W)	Easting	Northing		Zone (W)	Easting	Northing	
Unnamed Watercourse	696.8	10	473317	7015384	-	-	-	-	Unknown
Drainage	699.1	10	473070	7015812	-	-	-	-	Unlikely
Wetland Area	699.3	10	472880	7015938	-	-	-	-	Unlikely
Wetland Area	700.3	10	472322	7016741	-	-	-	-	Potential
Wetland Area	701.7	10	471421	7017918	-	-	-	-	Potential
Wetland Area	702.2	10	471183	7018318	-	-	-	-	Potential
Wetland Area	702.9	10	470932	7019008	-	-	-	-	Potential
Wetland Area	704.7	10	470653	7020732	-	-	-	-	Potential
Unnamed Watercourse	705.4	10	470824	7023125	-	-	-	-	Unknown
Wetland Area	710.4	10	471528	7027742	-	-	-	-	Unlikely
Wetland Area	715.6	10	469827	7031105	-	-	-	-	Unlikely
Drainage	718.8	10	467959	7035544	-	-	-	-	Unlikely
Wetland Area	719.9	10	468244	7035072	-	-	-	-	Potential
Unnamed watercourse	721.6	10	465977	7037399	-	-	-	-	Potential
Unnamed Watercourse	724.5	10	465535	7039921	-	-	-	-	Unknown
Unnamed Watercourse	727.4	10	465248	7042571	-	-	-	-	Potential
Unnamed Watercourse	732.7	10	463008	7047414	-	-	-	-	Potential
Bonnie Creek	733.7	10	462586	7048307	-	-	-	-	Potential
Unnamed Watercourse	736.5	10	462082	7050913	-	-	-	-	Potential
Unnamed Watercourse	738.7	10	462013	7051561	-	-	-	-	Potential
Unnamed Watercourse	737.4	10	461944	7051827	-	-	-	-	Unknown
Unnamed Watercourse	739.6	10	461404	7053882	-	-	-	-	Potential

Watercourses	Mackenzie Valley Highway Project Corridor				MGP Route				Known and Potential Fish Presence[a]
	KM Reference	Centerline UTM			MGP Crossing ID	UTM			
		Zone (W)	Easting	Northing		Zone (W)	Easting	Northing	
Unnamed Watercourse	740.8	10	461135	7055011	-	-	-	-	Potential
Unnamed Watercourse	741.7	10	460915	7055927	-	-	-	-	Potential
Unnamed Watercourse	742.7	10	460641	7057047	-	-	-	-	Potential
Strawberry Creek	745.7	10	459359	7059422	RPR-385	10	465200	7060223	Potential
Unnamed Watercourse	747.6	10	458952	7061042	-	-	-	-	Potential
Unnamed Watercourse	748.0	10	458839	7061453	-	-	-	-	Potential
Bobs Canyon Creek	752.6	10	456554	7065466	-	-	-	-	Potential
Drainage	752.8	10	456629	7065715	-	-	-	-	Unlikely
Unnamed Watercourse	765.5	10	451513	7076541	-	-	-	-	Potential
Unnamed Watercourse	767.2	10	451279	7078183	-	-	-	-	Unknown
Unnamed Watercourse	767.8	10	451423	7076769	-	-	-	-	Potential
Wetland Area	768.2	10	451373	7077141	-	-	-	-	Potential
Drainage	768.9	10	451297	7077881	-	-	-	-	Unlikely
Drainage	769.7	10	450566	7080565	-	-	-	-	Unlikely
Wetland Area	769.7	10	451333	7078638	-	-	-	-	Unlikely
Wetland Area	770.0	10	451254	7079001	-	-	-	-	Unlikely
Wetland Area	770.6	10	451104	7079480	-	-	-	-	Potential
Drainage	772.8	10	449199	7083419	RPR-380	10	450932	7083773	Unlikely
Unnamed Watercourse	774.1	10	448523	7084338	RPR-379	10	448927	7086017	Arctic grayling, longnose sucker[c]
Drainage	780.9	10	444236	7089533	REV3-AK	10	444426	7089450	Unlikely
Drainage	785.3	10	-	-	-	-	-	-	Unlikely
Drainage	787.3	10	-	-	-	-	-	-	Unlikely

Watercourses	Mackenzie Valley Highway Project Corridor				MGP Route				Known and Potential Fish Presence[a]
	KM Reference	Centerline UTM			MGP Crossing ID	UTM			
		Zone (W)	Easting	Northing		Zone (W)	Easting	Northing	
Wetland Area	789.0	10	441775	7094706	-	-	-	-	Unlikely
Wetland Area	789.4	10	441568	7095152	-	-	-	-	Unlikely
Wetland Area	791.2	10	440409	7096395	-	-	-	-	Unlikely
Wetland Area	791.8	10	439719	7096318	-	-	-	-	Unlikely
Wetland Area	793.1	10	438820	7097394	RPR-376	10	440272	7097726	Brook stickleback, fathead minnow[b]

Notes:

- Watercourse/waterbody was not crossed or assessed by the MGP project

[a] Where fish presence was recorded, the species are listed. Description of fish habitat potential are provided in Section 3.2.2. No recorded fish presence does not necessarily indicate the absence of fish or that the area does not afford fish habitat. Unlikely is related to lack of connectivity or no defined channel.

[b] This report

[c] IORVL 200

4.3.1 Sahtu Settlement Area

Station location maps and summary sheets for the 2021 field assessment are provided in Appendix B.

4.3.1.1 Crossing KM 797.9 – Unnamed Watercourse

Changes to the project highway alignment in 2021 moved the kilometre posting from kilometre marker (KM) 796.4 to KM 797.9 for this watercourse. At KM 796.4 site, which was assessed from the air (5658 NWT Ltd. and GNWT, 2011), the channel was approximately 15 m wide at high flow conditions. Habitat was run and pool habitat and a deep pool was observed near the existing winter road crossing. Substrate was comprised entirely of sand. There was small woody debris observed (15% cover) and beaver activity was noted in the upstream reaches of the watercourse. Riparian vegetation was deciduous trees (45%), coniferous trees (40%), grasses (10%) and forbs (5%). Live trees were observed growing within the active channel (5658 NWT Ltd. and GNWT, 2011).

The watercourse is crossed by the MGP route (RPR-375 [IORVL, 2004]). A previous assessment (5658 NWT Ltd. and GNWT, 2011) reported that it may provide rearing and migration habitat for forage fish as well as potential migration habitat for sportfish.

At the centreline of the KM 797.9 crossing site, the channel width and depth were 4.3 m and 0.9 m, respectively, and the banks stable . In the assessed area, the maximum channel width was 16.8 m with a maximum water depth of 1.2 m. Substrate was a mixture of organics and fines. Grasses were observed in the stream bed, and logjams were present upstream and downstream of the proposed crossing site. An old beaver dam was present 300 m downstream of the proposed crossing site before a downstream wetland area. Overhead cover was estimated at 10% consisting mostly of grasses. Instream cover was mostly comprised of woody debris and afforded 30% coverage within the area.

Fishing was conducted using minnow traps. Four species were captured: brook stickleback, finescale dace, pearl dace and one unidentified Cyprinid (minnow). Spawning is rated as moderate for forage fish, and none to poor for coarse and sportfish. Overwintering is rated as poor to moderate for all three fish categories. Rearing is rated as good for forage and coarse fish species and moderate for sportfish. Fish passage is rated as good to moderate for all three categories of fish.

4.3.1.2 Crossing KM 805.5 – Unnamed Watercourse

Changes to the project highway alignment in 2021 moved the kilometre posting from KM 803.4 to KM 805.5 for this watercourse. The proposed crossing location at KM 805.5 was assessed in the field in 2021. The location was a wetland with no defined channel with the exception of the centreline. The channel width at the centreline at KM 805.5 is 0.3 m. Average depth at the centreline was 0.45 m (0.36 m to 0.62 m) at the time of the assessment. Substrate composition was estimated at 20% organics and 80% fines. Dominant riparian vegetation is grasses and shrubs. The watercourse is connected to a lake upstream (5658 NWT Ltd. and GNWT, 2011).

Fishing was conducted using minnow traps. Two fish species were captured: brook stickleback and pearl dace. Spawning habitat is rated as good for forage fish and none for coarse and sport fish. Overwintering potential is rated as poor to moderate for forage fish and poor for coarse and sportfish. Rearing habitat is rated as good for forage fish and poor to moderate for coarse and sportfish. Fish passage is rated as moderate for forage fish and poor to moderate for coarse and sportfish.

4.3.1.3 Crossing KM 812.7 – Unnamed Watercourse

Changes to the project highway alignment in 2021 moved the kilometre posting from KM 811 to KM 812.7 for this watercourse. At the former KM 811 site, the channel was between 8 m and 15 m wide. Habitat was runs and pools. Substrate was entirely of sand. Some small woody debris and a beaver dam were observed on the west side of the winter road crossing. This debris was disrupting flow at the time of assessment, resulting in pooling. Log jams and sediment wedges were also observed. Riparian vegetation was primarily grass (40%) with shrubs (25%), deciduous trees (25%), and coniferous trees (10%) (5658 NWT Ltd. and GNWT, 2011). The watercourse has potential rearing habitat for forage fish and migration potential for all three categories of fish (5658 NWT Ltd. and GNWT, 2011).

At the proposed KM 812.7 crossing site, the channel width at the centreline was 1.37 m with an average depth of 0.14 m during the time of assessment. The maximum channel width in the assessed area was 1.8 m and a maximum depth was 0.57 m. There was woody debris throughout the assessed area and some minor logjams, which may result in partial barriers to fish passage. Centreline substrate composition was estimated to be 50% organics and 50% fines. Downstream substrate composition was more diverse with fines, small gravel, larger gravel, and cobble. There was some minor undercutting of the banks upstream of the centreline, with the channel becoming poorly defined and with low-water depths. The banks were stable at the centreline. Three beaver dams were present in the area: one at the downstream side of the centerline, one at a tributary to the watercourse 50 m upstream and one abandoned farther up the tributary where the channel is dry. The tributary flows parallel to the winter road and goes subsurface near the abandoned beaver dam.

Fishing was conducted using a backpack electrofisher but no fish were captured. Spawning habitat was rated as good for forage fish but poor for coarse and sportfish. Overwintering was rated as none to poor for all three categories of fish. Rearing was rated as good for forage and coarse fish and moderate for sport fish. Fish passage was rated as moderate to good for forage fish and moderate for coarse and sportfish.

4.3.1.4 Crossing KM 815 – Unnamed Watercourse

At the time of the assessment in 2021, the channel width at the centreline was 1.9 m with a water depth of 0.1 m at the time of the assessment. The maximum channel width was 2.5 m and maximum depth was 0.1 m in the assessed area. The watercourse drains into a wetland. Logjams were present upstream. At the centreline, the substrate was mainly fines (60%) with small gravel (20%) cobble (10%) and organic matter (10%). Overhead cover was 80%, mostly from deciduous trees. Instream cover was 30% consisting of woody debris. Banks were moderately stable consisting of organic material at the centreline.

Due to the shallow water depths, no fishing was conducted. Overall fish habitat is rated as poor.

4.3.1.5 Crossing KM 820.7 – Unnamed Watercourse

Changes to the project highway alignment moved the kilometre posting from KM 819.2 to KM 820.7 for this watercourse. At the former KM 819.2 crossing site, the channel was approximately 100 m wide. At the time of the assessment, the crossing was flooded. Substrate was entirely sand. Riparian vegetation was dominated by coniferous trees (90%) with grass (10%) and shrubs (10%). There appeared to be flooded riparian vegetation within the channel comprised of grass (5658 NWT Ltd. and GNWT, 2011). The watercourse is crossed by the MGP route (RPR-370 [IORVL, 2004]) approximately 600 m upstream of the alignment crossing. A previous assessment (5658 NWT Ltd. and GNWT, 2011) reported that the watercourse may provide seasonal rearing habitat for forage fish. No barriers to fish migration were observed (5658 NWT Ltd. and GNWT, 2011).

At KM 820.7, the channel was poorly defined within a floodplain. At the centreline, the channel width was 15.5 m and the water depth was 0.2 m. The maximum channel width was 95 m within a flooded area 100 m upstream from the centreline. The maximum depth in the assessed area was 0.5 m during the time of the assessment. The substrate at the centreline was 100% organics. The banks were moderately stable on the left bank and stable on the right bank. Overhead cover was 5% with instream cover estimated at 10%, which was contributed from grasses growing in the streambed. A beaver dam was present 300 m downstream of the centreline. An exposed culvert was present that had been installed at the winter road crossing.

Fishing was conducted using minnow traps and no fish were captured. Spawning is rated as poor to moderate for forage fish and none for coarse and sportfish. Overwintering potential is rated as poor for forage and coarse fish and none to poor for sportfish. Rearing is rated as moderate for forage fish, poor for coarse fish and none to poor for sport fish. Fish passage is rated as moderate for forage fish and poor to moderate for coarse and sportfish.

4.3.1.6 Crossing KM 821.9 – Unnamed Watercourse

The proposed crossing location was assessed from the air in 2010 (5658 NWT Ltd. and GNWT, 2011). It was observed that the channel was confined with cobble substrate and shallow flow. Fish habitat was run with some step pool. The channel width was approximately 2 m (5658 NWT Ltd. and GNWT, 2011). Riparian habitat consisted mostly of conifers with some deciduous trees, shrubs, and grasses. The watercourse is crossed by the MGP route (RPR-370 [IORVL, 2004]), approximately 1.2 km upstream of the project highway alignment crossing.

The proposed crossing location was assessed in the field in 2021. The channel width at the centreline was 1.3 m and the water depth at the time of assessment was 0.4 m. The maximum channel width in the assessed area was 2.4 m and maximum water depth at the time of assessment was 0.4 m. The channel was frozen to the stream bed between 100 m and 200 m downstream. At the centreline, the substrate was 50% fines, 30% small gravel and 20% large gravel. At the time of the assessment, the substrate was covered in leaves and woody debris. Both banks at the centreline were moderately stable.

Overhead cover was estimated at 30% consisting mainly of deciduous trees with conifers farther back. Instream cover consisted mainly of woody debris.

No fishing was conducted due to freezing conditions. Potential spawning habitat was rated as moderate and overwintering potential as poor for all three fish categories. Rearing habitat was rated as good for forage and coarse fish and moderate for sportfish. Fish passage was rated as moderate to good for all three fish categories.

4.3.1.7 Crossing KM 823 – Unnamed Watercourse

At the time of the assessment in October 2021, the watercourse was mostly frozen. Channel width at the centreline was 0.2 m with an average depth of approximately 0.2 m. Maximum channel width was 1.9 m, which was 100 m upstream of the centreline. Maximum water depth at the time of the assessment was 3.0 m. The substrate at the centreline and through most of the assessed portion of the watercourse was a mixture of large gravel, cobble and boulders. Overhead cover was estimated at 60%, consisting mainly of shrubs and deciduous trees. Instream cover was estimated at 40%, which consisted of woody debris and boulders. Woody debris and logjams were observed throughout the assessed reach. The banks at the centreline were moderately stable.

No fishing was conducted because the watercourse was mostly frozen. Fish habitat for rearing is rated at moderate to good for forage fish, moderate for coarse fish, and poor for sport fish. Overwintering potential is rated as none to poor for all three categories of fish. Rearing habitat is rated as good for forage and coarse fish species and rated moderate for sportfish. Fish passage is rated as moderate to good for all three categories of fish.

4.3.1.8 Crossing KM 824.5 – Unnamed Watercourse

At the proposed crossing location, the channel was approximately 10 m wide and the water depth was 0.1 m at the time of assessment. The watercourse is an outflow from a small lake with water flowing through a wetland area. There was no flow at the time of assessment and water appeared to be an impounded area (5658 NWT Ltd. and GNWT, 2011). A beaver lodge was noted on the lake upstream of the crossing location. The substrate was entirely sand. Riparian vegetation was shrubs (40%), grass (40%), deciduous trees (15%), and coniferous trees (5%). Grasses and flooded trees were observed within the partially confined channel (5658 NWT Ltd. and GNWT, 2011).

Habitat conditions suggests there is rearing potential for forage fish and spawning potential for northern pike (5658 NWT Ltd. and GNWT, 2011). Barriers to migration were not observed; however, migration is likely limited to small-bodied forage fish (5658 NWT Ltd. and GNWT, 2011).

A field assessment was not conducted at this crossing site in 2021.

4.3.1.9 Crossing KM 826 – Unnamed Watercourse

The channel was irregular with poor connectivity upstream of the centreline. Channel width at the centreline was1.8 m and the water depth was approximately 0.3 m at the time of the assessment. The maximum channel width was 3.0 m at 100 m upstream of the centreline. The maximum water depth was 0.3 m. Substrate at the centreline was estimated at 60% organics and 40% fines. Upstream of the centreline, the substrate was 100% fines, and downstream of the centreline, the substrate was 100%

organics. Overhead cover was estimated at 80%, consisting mainly of trees and shrubs. Instream cover was estimated at 80%, consisting mainly of woody debris. The banks at the centreline were moderately stable; however, 100 m downstream, the banks become unstable with signs of erosion. Evidence of a previous fire was observed in the assessed area.

Fishing was conducted using minnow traps, but no fish were captured. Spawning habitat is rated as moderate to good for forage fish and none for coarse and sportfish. Overwintering potential is rated as moderate to good for forage fish, moderate for coarse fish, and poor to moderate for sportfish. A ponded area upstream of the centreline may provide overwintering habitat. Rearing habitat is rated as moderate to good for all three categories of fish. Fish passage is rated as moderate for all three categories of fish.

4.3.1.10 Crossing KM 826.3 – Unnamed Watercourse

The watercourse was braided with debris jams and shrub islands. Channel width at the centreline was 1.1 m with an average depth of 0.1 m. The maximum channel width was 4.0 m upstream of the centreline. The maximum water depth was 0.3 m at the time of the assessment. The substrate consisted of 100% organics throughout the assessed reach. Overhead cover was estimated at 50% from shrubs and trees. Instream cover was estimated to be 40% provided by woody debris in the watercourse. The banks at the centreline were unstable. There was evidence of bank erosion on the left bank, 100 m downstream of the centreline. Signs of a previous fire in the upland area was observed.

Fishing was conducted using a backpack electrofisher but no fish were captured. Potential spawning habitat is rated as poor to moderate for forage fish and none for coarse or sportfish. Overwintering potential is rated as poor for forage fish and none for coarse and sportfish. Rearing habitat is rated as moderate for forage and coarse fish and poor to moderate for sportfish. Fish passage is rated as moderate for forage fish and poor for coarse and sportfish.

4.3.1.11 Crossing KM 828.6 – Unnamed Watercourse

The channel width at the centreline was 0.8 m and the water depth averaged 0.4 m at the time of the assessment. The maximum channel width in the assessed area was 1.9 m, with a maximum depth of 0.5 m at the time of the assessment. The substrate at the centreline was 60% fines, 30% small gravel and 10% large gravel. Fines and small gavel were the dominant substrate types in the assessed area. Overhead cover was estimated at 70%, dominated by overhanging trees. Instream cover was estimated at 40%, mainly contributed by woody debris. The banks were stable at the centreline. New plant growth resulting from a previous fire was observed in the upland area of the LSA.

No fishing was conducted due to freezing conditions. Spawning habitat is rated as moderate for forage fish and poor for coarse and sportfish. Overwintering potential is rated as poor for forage fish and none for coarse and sportfish. Rearing habitat is rated as poor to moderate for all three categories of fish. Fish passage is rated as moderate for forage fish and poor to moderate for coarse and sportfish.

4.3.1.12 Crossing KM 834.1 – Unnamed Watercourse

The channel width at the centreline was 1.1 m and the water depth was 0.1 m at the time of the assessment. The maximum channel width was 1.3 m and the maximum water depth was 0.6 m at the time of the assessment. Upstream of the centreline, there was low flow with some pooling. The substrate at the centreline was 100% fines. Downstream of the centreline, small and large gravel was present in addition to fines. Overhead cover was estimated at 70%, composed mainly of shrubs and deciduous trees. Instream cover was estimated at 40%, with undercut banks and woody debris. Logjams were present throughout the assessed reach. Unstable banks were present throughout the assessment area.

No fishing was conducted due to freezing conditions. Spawning habitat is rated as moderate for forage fish and poor for coarse and sportfish. Overwintering potential is rated as none to poor for all three categories of fish. Rearing habitat is rated as moderate for forage and coarse fish and poor to moderate for sportfish. Fish passage is rated as poor to moderate for all three categories of fish.

4.3.1.13 Crossing KM 835 – Unnamed Watercourse

At the time of the assessment, the area was covered in snow and the watercourse was mostly frozen over. Channel width at the centreline was 1.9 m and it was the maximum channel width of the assessed reach. The average water depth at the centreline was approximately 0.1 m. The maximum water depth of the assessed reach at the time of the assessment was 0.8 m. Substrate composition at the centreline and upstream was estimated to be 10% fines, 40% small gravel, 40% large gravel and 10 % cobble. Downstream, 200 m and 300 m from the centreline, the substrate was primarily organics. Overhead cover was estimated to be 70%, consisting of shrubs and deciduous trees. Instream cover was estimated to be 50%, consisting mainly of woody debris and undercut banks. At the centreline, the banks were unstable but most of the assessed reach had moderately stable banks.

No fishing was conducted due to freezing conditions. Spawning habitat is rated as moderate for forage fish and poor for coarse and sportfish. Overwintering potential is rated as none to poor for all three categories of fish. Rearing habitat is rated as moderate for forage fish and poor to moderate for coarse and sportfish. Fish passage is rated as poor to moderate for all three categories of fish.

4.3.1.14 Crossing KM 837.1 – Unnamed Watercourse

Changes to the project highway alignment moved the kilometre posting from KM 836.2 to KM 837.1. The watercourse was assessed from the air in 2010 and, at that time, the channel was dry. The channel width was estimated to be less than 2 m (5658 NWT Ltd. and GNWT, 2011). The watercourse is crossed by the MGP route (RPR-355 [IORVL, 2004]) downstream of the Project crossing. At the MGP route crossing location, instream habitat consisted of shallow run and riffle with coarse substrate (boulder, cobble and gravel) with few fines. Instream cover was provided by overhanging vegetation and woody debris. Riparian habitat was mainly shrubs, grasses, and forbes with some deciduous frees. There was evidence of a past fire (IORVL, 2004).

The new proposed crossing location was assessed in the field in 2021. The channel width at the centreline was 1.2 m and the average water depth was 0.1 m at the time of the assessment. The maximum channel width was 2.7 m and the maximum water depth in the assessed reach was 0.2 m at the time of the assessment. Step pools were created by downed woody debris in the upstream reach of the assessed area. Substrate composition at the centreline was a mixture of small gravel (20%), large gravel (35%), cobble (10%), and boulders (25%). The substrate composition was similar throughout the assessed reach. Overhead cover was estimated at 10%, dominated by shrubs. Instream cover was estimated at 30%, provided by cobble. The banks at the centreline were unstable but becoming moderately stable downstream of the centreline, although some undercutting of the banks was observed. Evidence of previous fire history was observed.

No fishing was conducted due to freezing conditions. Fishing conducted in 2002 for the MGP Project using a backpack electrofisher captured no fish (IORVL, 2004). Spawning habitat is rated as moderate to good for forage fish and moderate for coarse and sport fish. Overwintering potential is rated as none to poor for all three fish categories. Rearing habitat is rated as moderate for all three categories of fish. Fish passage is rated as moderate for forage fish and poor to moderate for coarse and sportfish.

4.3.1.15 Crossing KM 843.3 – Unnamed Watercourse

The site was snow covered at the time of the assessment in the fall of 2021. Most of the downstream assessed reach was a flooded area within the trees with no defined channel. Maximum depth was 0.39 m. Substrate was 30% fines, 30% small gravel, 30% large gravel and 10% cobble. Overhead cover was estimated at 60% created by deciduous trees. Instream cover was estimated at 80% provided by grasses and woody debris. The watercourse is not considered fish habitat and no fishing was conducted.

4.3.1.16 Crossing KM 846.4 – Unnamed Watercourse

The upstream section and centreline of the assessed reach was flooded with no defined channel, water was frozen and snow covered at the time of the assessment in the fall of 2021 and, therefore, no data could be collected for the centerline and upstream reach. From the centreline to 100 m downstream, the watercourse was also flooded with the channel banks becoming defined. Sinuous meanders develop downstream but could not be accessed for additional data collection because flooded portions upstream preventing downstream access to the downstream reach. At 100 m downstream, the channel width 1 was 2.5 m with an average depth of 0.7 m. The maximum water depth was 0.8 m at the time of the assessment. The substrate consisted of 40% organics and 60% fines. Overhead cover was estimated as 30%, consisting mostly of leaning branches from trees. Instream cover was estimated at 30%, provided by woody debris. Banks downstream were moderately stable.

No fishing was conducted due to freezing conditions. Spawning habitat for all three categories of fish is rated as poor as well as the potential for overwintering and fish passage. Rearing habitat is rated as moderate to good for forage fish, poor to moderate for coarse fish and poor for sportfish. The proposed crossing location is unlikely to allow fish passage.

4.3.1.17 Crossing KM 857.4 – Unnamed Watercourse

Changes to the project highway alignment in 2021 moved the kilometre posting from KM 855.9 to KM 857.4. The watercourse at KM 855.9 was assessed from the air in 2010. The area is an unconfined drainage/wetland approximately 100 m wide with no defined bed or banks. At the time of the assessment, water at the crossing location was impounded. The drainage is connected to a large lake to the northeast. Substrate was comprised of entirely of sand. Riparian vegetation was comprised of grass (50%), shrubs (30%), forbs (10%), and coniferous trees (10%). The drainage may provide spawning habitat for forage fish (5658 NWT Ltd. and GNWT, 2011). The watercourse is crossed by the MGP route (RPR-350 [IORVL, 2004]).

The upstream section of the assessed reach was flooded through low shrubs and grasses when assessed in October 2021. Flooding is likely related to beaver dams impounding water. Beaver dams were present upstream and downstream as well as one dam at the centreline. Approximately 130 m downstream, the channel converged with a larger channel. This second channel was flooded and meandered around debris dams. The channel width at the centreline was 2.3 m with an average depth of approximately 0.3 m. The maximum water depth was 0.6 m at the time of the assessment. Overhead cover was estimated at 10% with some small shrubs. Instream cover was estimated at 40% consisting mostly of woody debris and some grasses in the channel. The substrate at the centreline was approximately 60% organics and 40% fines. The substrate throughout the assessed reach was either organics or fines or a mixture of both.

No fishing was conducted due to freezing conditions. Spawning habitat is rated as moderate for forage fish and none for coarse and sportfish. Overwintering potential is rated as moderate for forage fish and poor for coarse and sportfish. Rearing habitat is rated as moderate to good for forage fish, poor to moderate for coarse fish, and poor for sportfish. Fish passage is rated poor for all three categories of fish. The downstream section of the assessed reach provides better fish habitat than at the centreline.

4.3.1.18 Crossing KM 872.9 – Unnamed Watercourse (Drainage)

Changes to the project highway alignment moved the kilometre posting from KM 871.6 to KM 872.9. The watercourse at KM 855.9 was assessed from the air in 2010. The drainage was approximately 12 m wide with a wetted area of approximately 2 m at the time of assessment. There were no defined bed or banks observed. Substrate was comprised entirely of sand. Small woody debris was abundant within the drainage. Riparian vegetation was grass (40%), shrubs (30%), and coniferous trees (30%). There is potential for rearing, spawning, and migration for forage provided by back-flooding from Big Smith Creek (5658 NWT Ltd. and GNWT, 2011).

At the time of the 2021 field assessment, the downstream was a flooded wetland area with submerged aquatic vegetation. The substrate was fines and organics throughout the assessed reach. Overhead cover was estimated at 10%; the area was mostly clear. Instream cover was estimated at 60%, dominated by aquatic vegetation. A rig mat was present over the crossing location. An exposed pipe from a pipeline was noted in the channel.

One minnow trap was set for one hour, but no fish were captured. It is unlikely the proposed crossing location provides fish habitat.

4.3.1.19 Crossing KM 874 – Drainage

At the proposed crossing location, the drainage was approximately 11 m wide with defined bed and banks. The crossing is at the downstream confluence of a series of lakes. Substrate is sand. There were trace small woody debris observed throughout the assessed area. Riparian vegetation was grass (40%), shrubs (30%), and coniferous trees (30%). Grass and dead trees were observed within the drainage (5658 NWT Ltd. and GNWT, 2011).

The upstream lakes likely provide habitat for northern pike and whitefish (5658 NWT Ltd. and GNWT, 2011). Based on observed conditions, the drainage has the potential to provide rearing habitat for forage fish and spawning habitat for sportfish (5658 NWT Ltd. and GNWT, 2011). There are no barriers to fish migration (5658 NWT Ltd. and GNWT, 2011).

The site was not assessed in the field in 2021.

4.3.1.20 Crossing KM 875.5 – Drainage

At the proposed crossing location, the drainage was approximately 50 m wide and there was an unconfined low area between two lakes. The substrate was entirely sand. Riparian vegetation was grass (40%), shrubs (30%), and coniferous trees (30%). Grasses and live coniferous trees were observed within the drainage area (5658 NWT Ltd. and GNWT, 2011).

The nearby lakes likely provide suitable habitat for northern pike and forage fish (5658 NWT Ltd. and GNWT, 2011). Based on observed conditions, the drainage may provide rearing and spawning habitat for forage fish and spawning habitat for northern pike (5658 NWT Ltd. and GNWT, 2011). No barriers to fish migration were observed. However, fish passage is likely limited to small-bodied forage fish at high flows (5658 NWT Ltd. and GNWT, 2011).

The site was not assessed in the field in 2021.

4.3.1.21 Crossing KM 876.6 – Unnamed Watercourse

At the proposed crossing location, the watercourse was approximately 11 m wide and the wetted width was 0.5 m at the winter road crossing and 1 m wide downstream of the winter road crossing. The substrate was entirely sand. Riparian vegetation was shrubs (40%), coniferous trees (40%), and grass (20%). Grasses and live coniferous trees were observed within the channel (5658 NWT Ltd. and GNWT, 2011).

Based on observed features, it is expected that this watercourse provides spawning and rearing habitat for forage fish and spawning habitat for sportfish (5658 NWT Ltd. and GNWT, 2011). No barriers to fish migration were observed but fish passage would be limited to high flows due to shallow water depths at other times of the year (5658 NWT Ltd. and GNWT, 2011).

The site was not assessed in the field in 2021.

4.3.1.22 Crossing KM 877.8 – Unnamed Watercourse

At the proposed crossing location, the channel was up to 20 m wide with a wetted width of 0.5 m (5658 NWT Ltd. and GNWT, 2011). The drainage was between a series of small lakes and was crossed by the existing winter road (5658 NWT Ltd. and GNWT, 2011). The substrate was entirely sand. Riparian vegetation was grass (40%), shrubs (30%), and coniferous trees (30%). Vegetation observed within the channel included shrubs and grass (5658 NWT Ltd. and GNWT, 2011).

Based on observed features, it is expected that this watercourse provides spawning and rearing habitat for forage fish (5658 NWT Ltd. and GNWT, 2011). No barriers to fish passage were observed but fish passage would be limited to periods of high flows due to shallow water depths at other times of the year (5658 NWT Ltd. and GNWT, 2011).

The site was not assessed in the field in 2021.

4.3.1.23 Crossing KM 878.8 – Unnamed Watercourse

At the proposed crossing location, the channel was approximately 2 m wide with a wetted width of 0.5 m (5658 NWT Ltd. and GNWT, 2011). The watercourse is a drainage from a series of small lakes. Habitat observed was predominately run. Substrate was cobble (50%) and boulder (50%). Riparian vegetation was coniferous trees (90%), shrubs (5%), and deciduous trees (5%) (5658 NWT Ltd. and GNWT, 2011).

Based on observed features, it is anticipated that this watercourse provides spawning habitat for forage fish (5658 NWT Ltd. and GNWT, 2011). No barriers to fish passage were observed but fish passage would be limited to periods of high flows due to shallow water depths at other times of the year (5658 NWT Ltd. and GNWT, 2011).

The site was not assessed in the field in 2021.

4.3.1.24 Crossing KM 879.1 – Unnamed Watercourse

The crossing location appears to be a wetland area and was frozen over at the time of the assessment in October 2021. The wetland is connected to the proposed crossing location at KM 879.4. Beaver activity was observed upstream of the centreline and there was a beaver lodge and impoundment downstream. Overhead cover was estimated at 30%, mainly provided by grasses. Instream cover could not be estimated because the watercourse was frozen. There are ponds located both upstream and downstream of the centreline.

No fishing was conducted due to frozen conditions. There is potential good habitat for forage fish during the open water season but likely poor for coarse and sportfish. Low oxygen levels (0.68 milligrams per litre [mg/L]) likely limits overwintering potential for fish.

4.3.1.25 Crossing KM 879.4 – Unnamed Watercourse

The watercourse was assessed in the fall of 2021. The channel width at the centreline was 5.2 m with an average water depth of approximately 0.4 m. The upstream portions of the assessment area were flooded. Maximum water depth in the assessed reach was 0.5 m at the time of the assessment. The substrate at the centreline was organics as well as upstream of the centreline; downstream was predominantly fines. Overhead cover was estimated at 60%, provided mainly by shrubs, while instream cover was estimated at 50%, mainly through woody debris in the water column. Grasses and aquatic vegetation were observed in the channel upstream of the centreline. The banks at the centreline were stable. Undercutting of the banks were observed 300 m downstream of the centreline. Aerial imagery of the area shows it is connected to the crossing at KM 879.1 on the upstream side and appears to have wetland characteristics upstream of T1 (100 m upstream), based on the aerial imagery, but it was snow covered at time of assessment.

No fishing was conducted due to unsafe conditions for electrofishing and freezing conditions. Spawning habitat is rated as poor to moderate for forage fish and none for coarse and sportfish. Overwintering potential is rated as poor to moderate for forage fish and poor for coarse and sportfish. Rearing habitat is rated as moderate for forage fish and poor to moderate for coarse and sport fish. Fish passage is rated as moderate to good for forage fish and moderate for coarse and sport fish.

4.3.1.26 Crossing KM 880.2 – Unnamed Watercourse

The channel width at the centreline was 2.7 m with an average water depth of 0.2 m at the time of the assessment. The maximum water depth in the assessed reach was 0.2 m at the time of the assessment. Upstream (at 100 m) of the centreline, the area was flooded with no defined channel. There is poor connectivity until 100 m downstream of the centreline where connectivity improves. The channel narrows 300 m downstream and has a steep grade with several logjams. Overhead cover was estimated at 30%, provided by shrubs and trees, while instream cover was estimated at 20%, mainly provided by woody debris. At the centreline, the left bank was stable while the right bank was moderately stable.

No fishing was conducted due to shallow water depths. The watercourse is unlikely to provide fish habitat.

4.3.1.27 Crossing KM 880.6 – Unnamed Watercourse

At the proposed crossing location, the watercourse was a large drainage channel from a lake. The watercourse is crossed by the MGP route (RPR-346 [IORVL, 2004]), approximately 830 m upstream of the project highway alignment crossing.

The channel width at the centreline was 1.8 m with an average water depth of 0.4 m at the time of the assessment in October 2021. Maximum water depth in the assessed reach was 0.6 m. A pipeline crossing exists 100 m downstream from the centreline. At this location there was some large boulders from rip-rap for a wooden banks support structure that was in place. Substrate at the centreline is 30% organics and 70% fines. Fines were the dominant substrate throughout the assessed reach. Overhead cover was estimated at 80%, provided mostly by shrubs. Instream cover was estimated at 40%, provided

mainly through woody debris. Banks at the centreline were stable; upstream and downstream of the centreline banks, were predominantly moderately stable.

Fishing was conducted using a backpack electrofisher. Three forage fish species were captured: brook stickleback, finescale dace, and pearl dace. Spawning habitat is rated as moderate for forage fish and none to poor for coarse and sport fish. Overwintering potential is rated as poor for all three categories of fish. Rearing habitat and fish passage is rated as good for all three categories of fish.

4.3.1.28 Crossing KM 883.6 – Unnamed Watercourse

The channel width at the centreline was 1.3 m with an average water depth of 0.3 m. The maximum water depth in the assessed reach was 0.3 m at the time of the assessment. The channel became undefined 50 m upstream from the centreline. Water was tinted an orange, copper colour. The substrate at the centreline was organics (100%). Organics was the dominant substrate type with some fines downstream. Overhead cover was estimated at 70%, provided mainly by shrubs. Instream cover was estimated at 10%, provided by woody debris. At the centreline and upstream, the banks were moderately stable transitioning to unstable 200 m downstream from the centreline.

No fishing was conducted due to freezing conditions. Fish habitat is rated as poor for all fish categories. The watercourse likely does not provide fish habitat.

4.3.1.29 Crossing KM 884.3 – Unnamed Watercourse

The proposed crossing location was assessed from the air in 2010 (5658 NWT Ltd. and GNWT, 2011). The watercourse is a drainage from a series of lakes. Channel width was estimated as 15 m, and it was ponded due to a beaver dam several metres downstream. Overhead cover was estimated at 1% to 25%, predominately consisting of a mix of conifer and deciduous trees. Substrate was sand (5658 NWT Ltd. and GNWT, 2011).

The site was not assessed in the field in 2021.

4.3.1.30 Crossing KM 889 – Unnamed Watercourse

The proposed crossing location was assessed from the air in 2010 (5658 NWT Ltd. and GNWT, 2011). The watercourse is connected to several lakes. The channel at the crossing was estimated to be approximately 15 m wide with a water depth of approximately 3 m. Overhead cover was estimated to be between 1% to 25%, consisting primarily of conifer trees with smaller amounts of deciduous trees and grasses. The substrate was sand. Water colour at the time of the survey was brown. The watercourse may provide habitat for forage and sport fish (5658 NWT and GNWT, 2011).

The site was not assessed in the field in 2021.

4.3.1.31 Crossing KM 884.8 – Unnamed Watercourse

The channel width at the centreline was 2.5 m with an average water depth of 0.3 m. The maximum water depth in the assessed reach was 0.6 m. Substrate at the centreline was 90% fines and 10% small gravel. Fines was the dominant substrate throughout the assessed reach. Overhead cover was estimated as 30%, provided mainly from shrubs. However, at the centreline, overhead cover was estimated as 60%. Instream cover was estimated at 60%, provided mainly through woody debris. Banks at the centreline and downstream were moderately stable; upstream they were unstable. According to a local wildlife monitor, a beaver dam 50 m upstream of the centreline collapsed the year before. This may have resulted in the unstable banks upstream.

Fishing was conducted using a backpack electrofisher. Two forage fish species were captured: brook stickleback and pearl dace. Spawning habitat is rated as moderate for forage fish and poor for coarse and sportfish. Overwintering potential is rated as poor for all three categories of fish. Rearing habitat is rated as moderate to good for forage fish, poor to moderate for coarse fish, and poor for sportfish. Fish passage was rated as moderate for forage fish and poor to moderate for coarse and sportfish.

4.3.1.32 Crossing KM 891.4 – Unnamed Watercourse

The channel width at the centreline was 12.5 m. A beaver dam at the centreline was impounding water upstream. Downstream from the centreline, channel width decreased to between 6.0 and 5.5 m. Water depth at the centreline could only be taken at one location due to safety concerns and was recorded as 1.3 m at the time of the assessment. The maximum water depth was estimated as greater than 1 m. Downstream of the centreline, water depths decreased to approximately 0.5 m. The substrate at the centreline was 100% fines. Downstream, the substrate was organics and fines. No substrate composition estimates were made for the upstream portion of the assessed reach. Overhead cover was estimated at 10%, provided mainly from conifer trees. Instream cover was estimated at 10%, largely provided by woody debris. Banks at the centreline were unstable, as well as downstream, but moderately stable upstream. Erosion of the banks were observed near the centreline and downstream.

No fishing was conducted due to freezing conditions and conditions were unsafe for electrofishing due to high flows and water depth. Spawning habitat is rated as moderate to good for forage fish and poor for coarse and sport fish. Overwintering potential is rated as moderate for all fish categories. Rearing habitat was rated as good and fish passage as moderate to good for all three fish categories.

4.3.1.33 Crossing KM 891.7 – Unnamed Watercourse

At the proposed crossing location, the channel was approximately 20 m wide and up to 2 m deep (5658 NWT Ltd. and GNWT, 2011). The watercourse drains a series of small upstream lakes. Substrate was entirely sand. There were trace amounts of large woody debris and a moderate amount of small woody debris observed throughout the assessed area. A beaver dam and small log jams were observed downstream from the proposed crossing location. Riparian vegetation was coniferous trees (85%), deciduous trees (5%), grass (5%), and shrubs (5%). Given the observed habitat conditions, the crossing likely provides rearing, spawning, and migration habitat for forage fish and sportfish (5658 NWT Ltd. and GNWT, 2011).

The site was not assessed in the field in 2021.

4.3.1.34 Crossing KM 915.6 – Unnamed Drainage

At the proposed crossing location, the drainage was between 3 m and 8 m wide and up to 0.2 m deep. The watercourse is a drainage from a series of upstream lakes. The substrate was entirely sand. Riparian vegetation was coniferous trees (75%), deciduous trees (15%), grass (5%), and shrubs (5%) and the drainage likely provides spawning and migration habitat for forage fish (5658 NWT Ltd. and GNWT, 2011).

The watercourse is crossed by the MGP route (RPR-333 [IORVL, 2004]) 87 m upstream of the proposed crossing location.

The site was not assessed in the field in 2021.

4.3.1.35 Crossing KM 918 – Unnamed Watercourse

The proposed crossing location was assessed from the air in 2010 (5658 NWT Ltd. and GNWT, 2011). The watercourse channel at the crossing site is approximately 8 m to 15 m wide with a water depth of approximately 0.2 m. The watercourse connects a series of lakes. Crown closure was estimated at 1% to 25% consisting of primarily conifer trees, with smaller amounts of deciduous trees, shrubs and grasses. Instream cover consisted of large woody debris. The substrate was sand. Water colour at the time of the assessment was brown. The watercourse may provide habitat for forage and sport fish (5658 NWT and GNWT, 2011).

The site was not assessed in the field in 2021.

4.3.1.36 Crossing KM 919.9 – Unnamed Watercourse

The channel width at the centreline was 37 m with a water depth of 0.2 m at the time of the assessment. The maximum water depth in the assessed reach was estimated to be greater than 2 m. Upstream, 100 m of the centreline, there was an entrance to a deep pool. Upstream 50 m, the area is flooded which extends downstream of the centreline. Downstream of the centreline, the channel becomes narrower and, by 300 m downstream, was only 1.3 m wide. Substrate at the centreline was estimated to be 30% organics, 60% fines, and 10% boulders. The boulders appear to be from rip-rap used for the winter road and not naturally occurring. Upstream, the substrate composition was 100% organics; downstream was a mixture of organics and fines. Overhead cover was estimated at 10% with overhanging grasses. Instream cover was also estimated at 10%, provided by vegetation. Banks at the centreline were stable.

Fishing was conducted using minnow traps but no fish were captured. Spawning habitat is rated as good for forage fish and none for coarse and sportfish. Overwintering potential is rated poor to moderate for forage fish and poor for coarse and sportfish. Rearing habitat is rated as good for forage fish, moderate for coarse fish, and poor to moderate for sportfish. Fish passage is rated as poor to moderate for all three categories of fish.

4.3.1.37 Crossing KM 922 – Twelve Mile Creek

At the proposed crossing location, the channel was approximately 1 m wide with a depth of 0.2 m at the time of assessment. The watercourse receives water from a series of small upstream lakes. Habitat was predominately run. Substrate was dominated by sand (90%) with limited gravel (10%). Small woody debris was observed throughout the watercourse, Riparian vegetation consisted of forbs (30%), grasses (20%), conifers (20%), deciduous trees (15%), and shrubs (15%) (5658 NWT Ltd. and GNWT, 2011).

Given the observed habitat conditions, Twelve Mile Creek likely provides spawning and rearing habitat for sportfish, forage fish, and coarse fish. There were no barriers to migration observed and no overwintering habitat present (5658 NWT Ltd. and GNWT, 2011). Arctic grayling, burbot, northern pike, emerald shiner, spottail shiner and lake chub were the most frequently captured species in Twelve Mile Creek (IORVL, 2004).

Twelve Mile Creek was assessed for the MGP route (crossing RPR-332 [IORVL, 2004]) approximately 1.7 km upstream of the project crossing.

The site was not assessed in the field in 2021.

4.3.1.38 Crossing KM 931 – Four Mile Creek

At the proposed crossing location, the channel was approximately 3 m wide and 0.5 m deep. Habitat was predominately run. A moderate amount of small woody debris was observed throughout the assessed area. The substrate was sand (90%) and gravel (10%). Riparian vegetation was forbs (30%), grass (20%), coniferous trees (20%), shrubs (15%), and deciduous trees (15%) (5658 NWT Ltd. and GNWT, 2011).

Juvenile Arctic grayling, burbot, northern pike, emerald shiner, spottail shiner, and lake chub have been captured at the confluence of Four Mile Creek and the Mackenzie River (5658 NWT Ltd. and GNWT, 2011). The upstream lakes provide suitable habitat for northern pike and whitefish (5658 NWT Ltd. and GNWT, 2011). Based on observed habitat conditions, Four Mile Creek provides suitable spawning, rearing, and migration habitat for species captured as well as bull trout and whitefish (5658 NWT Ltd. and GNWT, 2011).

The site was not assessed in the field in 2021.

4.3.1.39 Crossing KM 940.1 – Unnamed Watercourse

Channel width at the centreline was 1.5 m with an average water depth of 0.4 m at the time of the assessment. The maximum water depth in the assessed reach was 0.6 m. Substrate composition at the centreline was 60% organics and 40% fines. The substrate throughout the assessed reach was organics and fines. Overhead cover was 90%, provided by overhanging shrubs. Instream cover was 10%, provided by undercut banks. Banks at the centreline were moderately stable. A series of cascades with 0.25 m drops were present 200 to 300 m downstream from the centreline. These cascades may be barriers to fish passage.

No fishing was conducted due to snow and ice conditions. Spawning habitat is rated as moderate for forage fish and none for coarse and sportfish. Overwintering potential is rated as none to poor for all three categories of fish. Rearing habitat is rated as moderate to good for forage fish and poor to moderate for coarse and sportfish. Fish passage is rate as poor to moderate for all three categories of fish.

4.3.1.40 Crossing KM 980.3 – Unnamed Watercourse

At the proposed crossing location, the channel was approximately 1 m wide with a maximum depth of 0.2 m; it was dry in some locations. Habitat was predominately run. Substrate was predominantly boulders (70%) and cobble (30%). A moderate amount of small woody debris was observed throughout the assessed area. Riparian vegetation was coniferous trees (75%), shrubs (20%), and deciduous trees (5%). It is unknown whether this watercourse provides fish habitat.

The watercourse is crossed by the MGP route (RPR-314 [IORVL, 2004]) approximately 2.4 km downstream of the project crossing.

4.3.1.41 Crossing KM 981.2 – Unnamed Watercourse

The assessment was conducted in snow and 50% ice cover. The channel width at the centreline was 2.6 m with an average water depth of 0.1 m at the time of the assessment. The maximum water depth at the time of the assessment was 0.8 m. The substrate composition at the centreline was estimated to be 20% small gravel, 40% large gravel, 30% cobble and 10% boulders. The substrate upstream of the centreline was similar to the centreline. Downstream, 200 m and 300 m from the centreline, substrate composition changed to a mixture of fines and organics. Overhead cover was estimated at 40%, provided mainly by shrubs; instream cover was estimated at 25% cobble and boulders. Banks were moderately stable throughout the assessed reach except 300 m downstream of the centreline where the banks become unstable. Riffle and chutes occur throughout the assessed reach.

Fishing was conducted using a backpack electrofisher and no fish were captured. Spawning habitat is rated as moderate to good for all three categories of fish. Overwintering potential is ranked none to poor for all three categories of fish. Rearing habitat is rated as good for forage and coarse fish and moderate for sportfish. Fish passage is rated as moderate for all three categories of fish.

4.3.1.42 Crossing KM 983 – Prohibition Creek

At the proposed crossing location, Prohibition Creek was approximately 20 m wide with a depth of 0.2 m at the time of assessment. Habitat was predominately run (98%) with limited riffle habitat (2%). Substrate was cobble (60%), sand (20%), gravel (15%), and boulders (5%). Riparian vegetation was predominantly coniferous trees (70%) with some shrubs (20%) and grasses (10%) (5658 NWT Ltd. and GNWT, 2011).

Arctic grayling, broad whitefish, cisco, longnose sucker, mountain whitefish, northern pike, round whitefish, trout-perch, lake chub, emerald shiner, spottail shiner, spoonhead sculpin, and slimy sculpin have been previously captured in Prohibition Creek (IORVL, 2004). Given the observed habitat conditions, it is likely that spawning, rearing, and overwintering habitat for sportfish, forage fish, and

coarse fish exist in Prohibition Creek (IORVL, 2004; 5658 NWT Ltd. and GNWT, 2011). No barriers to migration were observed (5658 NWT Ltd. and GNWT, 2011).

Prohibition Creek is crossed by the MGP route (RPR-313 [IORVL, 2004]) approximately 470 m downstream from the proposed Project crossing.

The site was not assessed in the field in 2021.

4.3.1.43 Crossing KM 987.2 – Unnamed Watercourse

At the proposed crossing location, the channel was approximately 2.5 m wide and 0.1 m deep at the time of assessment. Habitat was predominately run habitat. Substrate was cobble (50%) and gravel (50%). Moderate small woody debris was observed at the crossing location. Riparian vegetation was predominately conifers (60%) with shrubs (25%), limited grass (10%), and deciduous trees (5%) (5658 NWT Ltd. and GNWT, 2011).

Fish sampling was conducted in 2002 and 2003 but no fish were captured (IORVL, 2004). Given the observed habitat conditions, it is anticipated that spawning and rearing habitat exists for sportfish, forage fish, and coarse fish in this unnamed watercourse (5658 NWT Ltd. and GNWT, 2011). At the MGP route crossing, it was reported that there was potential rearing habitat for Arctic grayling and juvenile suckers, but the lack of deep-water habitat could restrict adult feeding by large-bodied fish species (IORVL, 2004).

The unnamed watercourse is crossed by the MGP route (RPR-312 [IORVL, 2004]) approximately 100 m upstream of the project crossing.

The site was not assessed in the field in 2021.

4.3.2 Dehcho Region

Field Assessments were completed by K'alo-Stantec between September 16 and September 24, 2020. Station location maps for crossings assessed in the field and site summary sheets are provided in Appendix C.

4.3.2.1 Crossing KM 696.8 – Unnamed Watercourse

There is no existing data at the proposed crossing location The proposed crossing location was not assessed by K'alo-Stantec in 2020 due to difficulties accessing the site and time constraints related to weather.

4.3.2.2 Crossing KM 699.1 - Drainage

At the proposed crossing location, there is an ephemeral drainage which is oriented from east to west across the existing winter road. Ponded water was present on both sides of the winter road. However, there were no continuously defined channels on either side of the road and this drainage is unlikely to support fish. This drainage was not assessed by previous studies.

4.3.2.3 Crossing KM 699.3 - Wetland Area

A suspected wetland area with several small waterbodies is located adjacent to the project highway alignment at this crossing location. The inlet to the wetland area was accessed as an ephemeral drainage (WX-028). Neither the wetland nor inlet were not considered fish habitat due to the lack of connectivity to a fish-bearing waterbody and lack of overwintering potential. This wetland area was not assessed in previous studies.

4.3.2.4 Crossing KM 700.3 - Wetland Area

At the proposed crossing location, there is a wetland which has an outlet connecting it to the Mackenzie River. Substrate in the wetland was entirely organics. Wetland riparian vegetation was also observed. The maximum depth was approximately 3 m. An active beaver lodge was observed in the wetland.

Minnow trapping was conducted for approximately 45 hours; no fish were captured. However, this waterbody likely provides fish habitat because of its connectivity to the Mackenzie River as well as its depth. The outlet to the waterbody is on the downstream side of the project highway corridor. It does not appear that the wetland crosses the existing winter road. This crossing was not assessed in previous studies.

4.3.2.5 Crossing KM 701.7 - Wetland Area

At the proposed crossing location, there is a wetland with an outlet connecting it to the Mackenzie River. The substrate was entirely organics. Wetland riparian vegetation was observed. The maximum depth of the waterbody was 2 m.

Minnow trapping was completed for 46 hours; no fish were captured. However, it is expected to provide fish habitat due to its connectivity with the Mackenzie River. This crossing was not assessed in previous studies.

4.3.2.6 Crossing KM 702.2 - Wetland Area

A wetland area with numerous small ponds was located adjacent to the project highway alignment. Substrates in the ponds was entirely organic material. Wetland vegetation exists around each pond. The outlet of this wetland connects to the Mackenzie River across the alignment.

Minnow trapping was conducted for approximately 40 hours; no fish were captured. This wetland likely provides habitat for forage fish due to its connectivity with the Mackenzie River. This crossing was not assessed in previous studies.

4.3.2.7 Crossing KM 702.9 - Wetland Area

At the crossing location, there is a wetland with an ephemeral drainage connected to a larger waterbody to the west, located adjacent to the project highway alignment. Substrates were entirely organic matter. Wetland riparian vegetation surrounded the waterbody on all sides. The maximum measured depth was approximately 1 m.

Minnow trapping was conducted for approximately 45 hours; no fish were captured. However, the wetland may provide seasonal fish habitat for forage fish due to its connectivity with a larger waterbody. This wetland was not assessed in previous studies.

4.3.2.8 Crossing KM 704.7 – Wetland Area

At the proposed crossing location, there was a wetland area which was connected to a larger waterbody to the west. Substrate was organic material and wetland riparian vegetation was present. The maximum measured depth was approximately 1 m.

Minnow trapping was conducted for 46 hours; no fish were captured. This wetland likely provides seasonal fish habitat for forage fish because of its connectivity with a larger waterbody to the west. This wetland was not assessed in previous studies.

4.3.2.9 Crossing KM 705.4 – Unnamed Watercourse

There is no existing data for the watercourse at this proposed crossing location. The proposed crossing location was not assessed by K'alo-Stantec in 2020 due to difficulties accessing the site or time constraints related to weather.

4.3.2.10 Crossing KM 710.4 - Wetland Area

A wetland area was located adjacent to the project highway alignment. An outlet from the wetland was assessed as an ephemeral drainage (WX-006) and this outlet crosses the alignment. No inlet to the wetland was observed. The wetland and outlet are not considered to provide fish habitat because of lack of connectivity to larger waterbodies or watercourses. K'alo-Stantec only assessed the crossing 200 m to the southeast because of a nearby moose pasture and concerns of entering the pasture raised by the community of Wrigley. There is no previous data for the suspected wetland area.

4.3.2.11 Crossing KM 715.6 - Wetland Area

A small wetland with no inlets or outlets was located adjacent to the project highway alignment. This waterbody is not considered fish habitat due to its lack of connectivity with other waterbodies. This wetland was not assessed in previous studies.

4.3.2.12 Crossing KM 718.8 - Drainage

This is an ephemeral drainage, oriented east to west, at the proposed crossing location, which is at the existing winter road. This drainage did not have a defined channel bed or banks and there was no channelization for approximately 50 m upslope of the existing winter road; standing water was present only downslope of the proposed crossing. The drainage is unlikely to provide fish habitat because it does not have sufficient depth nor connectivity to fish-bearing waterbodies. The crossing was previously assessed (Dessau, 2012) approximately 36 m southeast of the proposed crossing location and no fish habitat potential was found.

4.3.2.13 Crossing KM 719.9 - Wetland Area

A wetland area with an outlet visible to the northwest was located adjacent to the project highway alignment. Substrate was organic material and the waterbody was surrounded by wetland riparian vegetation. The maximum depth was greater than 2 m.

Minnow trapping was conducted for 35 hours; no fish were captured. However, this wetland likely provides fish habitat for forage fish because of its suitable depth and an outlet with connectivity to other waterbodies in the area. This waterbody was not assessed in previous studies.

4.3.2.14 Crossing KM 721.6 – Unnamed Watercourse

At the proposed crossing location, the watercourse was approximately 1.9 m wide with a wetted width of 2.6 m. The wetted width was longer than the channel width due to undercut banks. The maximum depth was 0.6 m at the time of the assessment. Substrate was fines (50%), organics (25%), cobble (10%), boulder (10%), and large gravel (5%). Riparian vegetation was dominated by shrubs and grasses on both banks. Cover for fish was provided by trees and shrubs as well as boulders and woody debris instream. Riffles was the dominant habitat type observed and a small cascade was observed at the proposed crossing location. However, approximately 300 m downstream of the crossing location, shallow runs dominated.

Backpack electrofishing was completed for 450 seconds of effort; no fish were captured. Spawning habitat potential is rated as poor for all species due to unsuitable substrate and limited instream woody debris. Downstream of the proposed crossing location, there is more suitable habitat that includes riffles and flat habitat with abundant cover and woody debris that may afford spawning habitat for forage fish. Overwintering habitat potential is rated as poor to nil for all fish species because it is expected that the watercourse will freeze to the bottom in winter. Rearing habitat potential is rated as moderate for coarse and forage fish and poor-moderate for sportfish because it is likely limited by high water velocity in the riffle habitat. Fish passage potential for all fish species is rated as good with no obstructions observed.

The watercourse was not assessed in previous studies.

4.3.2.15 Crossing KM 724.5 – Unnamed Watercourse

There is no existing data at the proposed crossing location; it was not assessed by K'alo-Stantec in 2020 due to difficulties accessing the site or time constraints related to weather.

4.3.2.16 Crossing KM 727.4 – Unnamed Watercourse

At the proposed crossing location, the watercourse was 1.5 m wide with a wetted width of 1.1 m. The maximum dept was 0.5 m at the time of the assessment. The substrate was fines (50%), organics (30%), cobble (10%), large gravel (5%), and small gravel (5%). Riparian vegetation was shrubs. There was little instream or overhead cover within the assessed area. Cover for fish was provided by undercut banks, trees and shrubs, and woody debris.

Backpack electrofishing was completed for 432 seconds; no fish were captured. Spawning habitat potential is as rated poor for all fish species due to the lack of appropriate substrate, instream woody debris, and vegetation. Overwintering habitat is rated as poor to nil for all fish species as the watercourse is expected to freeze to bottom in winter. There is limited overhead cover, limited instream cover, and lack of substrate complexity for invertebrate populations. Therefore, habitat is rated as moderate for forage fish and coarse fish and poor to moderate for sportfish. Migration habitat for all fish species is rated as moderate because there were no obstructions observed. During periods of low flow, fish passage for large-bodied fish species may be restricted

The watercourse was not assessed in previous studies.

4.3.2.17 Crossing KM 732.7 – Unnamed Watercourse

At the proposed crossing location, the channel width was 0.66 m with a wetted width of 0.74 m (Dessau, 2012). The substrate was fines (80%), gravel (10%), and cobble (10%). Riparian vegetation was dominated by coniferous trees (Dessau, 2012). Overhead cover was estimated to be 90% for the entire site (Dessau, 2012).

This crossing was assessed by K'alo-Stantec in 2020. The channel was found to have a width of 0.9 m with a wetted width of 0.8 m at the time of the assessment. The maximum depth was 0.6 m. The substrate was fines (40%), boulder (35%), cobble (15%), and organics (10%). Riparian vegetation was predominantly shrubs and grasses. Overhead cover was provided by trees and shrubs and undercut banks. The dominant habitat type was riffle.

Spawning habitat was rated as poor for all fish species. Overwintering habitat was rated as poor because the watercourse is likely to freeze to the bottom in winter. Rearing habitat potential was rated as poor for all fish species because overhead cover is limited and instream cover was provided primarily by boulders. The amount of overhead cover may have changed since the previous assessment (Dessau, 2012) due to local changes in vegetation. Fish passage was rated as poor for forage fish because of high water velocity and steeper gradients at the confluence with the Mackenzie River (14% gradient) and downstream of the crossing location (16% gradient). Sport and coarse fish are more likely to migrate past the gradient barriers; however, water depth was shallow with abundant boulders and migration could be

limited by depth. Therefore, passage was rated as poor to moderate for sport and coarse fish. In a previous assessment fish habitat potential was rated as poor due to low flow and fine substrate In addition, to debris jams which likely impede fish migration (Dessau, 2012).

4.3.2.18 Crossing KM 733.7 - Bonnie Creek

At the proposed crossing location, the channel was 2.9 m wide with a wetted width of 2.4 m (Dessau, 2012). Substrate was boulder (60%), cobble (15%), fines (15%), and gravel (10%) with riparian vegetation comprised of deciduous trees (Dessau, 2012). Available instream cover to fish was estimated to be 65% (Dessau, 2012). Spawning fish habitat potential was rated as low, overwintering habitat potential was rated as low, and rearing habitat potential was rated as moderate (Dessau, 2012). It is suspected that Arctic grayling may be present within Bonnie Creek (Dessau, 2012).

Bonnie Creek was assessed by K'alo-Stantec in 2020. The confluence of Bonnie Creek with the Mackenzie River is located approximately 240 m downstream of the proposed crossing location. At the proposed crossing location, Bonnie Creek was 2.0 m wide with a wetted width of 2.2 m with a maximum depth of 0.5 m. Substrate was boulder (40%), cobble (20%), fines (20%), small gravel (15%), and organics (5%). Riparian vegetation was shrubs and grasses with some coniferous trees. The dominant habitat type was riffle with a shallow pool located approximately 100 m upstream and shallow run approximately 200 m downstream of the proposed crossing. No electrofishing was completed but the presence of Arctic grayling was suspected (Dessau, 2012).

Spawning habitat potential was rated as poor for all fish species due to the very coarse substrate with limited instream vegetation and woody debris. Overwintering habitat potential was rated as nil because the watercourse likely freezes to bottom in winter due to maximum water depth of 0.5 m. Rearing habitat was rated as moderate for forage fish and coarse fish and moderate for sport fish. The coarse substrate likely supports benthic invertebrate production and provides instream cover for fish, but otherwise there is limited overhead cover. Fish passage was rated as moderate for all fish species because no barriers were observed during the survey. However, fish passage during lower flows may be more difficult for fish due to the boulder substrate.

4.3.2.19 Crossing KM 736.5 – Unnamed Watercourse

At the proposed crossing location, the channel was 0.79 m wide with a wetted width of 0.77 m (Dessau, 2012). Substrate was entirely fines. Riparian vegetation was deciduous trees (Dessau, 2012). Instream cover for fish was estimated to be 80% (Dessau, 2012). Fish habitat potential was rated as low due to poor substrate and shallow depths (Dessau, 2012).

Crossing KM 736.48 was assessed by K'alo-Stantec in 2020. The watercourse was 0.9 m wide with a wetted width of 1.0 m at the proposed crossing location. The maximum depth was 0.7 m at the time of the assessment. Substrate was fines (30%), organics (20%), small gravel (20%), boulder (15%), cobble (10%), and large gravel (5%). Riparian vegetation was grass and shrubs with some deciduous trees. There was limited cover provided by woody debris and undercut banks. The dominant habitat type was riffles with some shallow runs approximately 100 m and 50 m upstream of the proposed crossing location.

No electrofishing was completed. Overall, fish habitat was rated as poor. Spawning habitat potential was rated as poor for all fish species because of the lack of coarse substrate and instream vegetation. Overwintering habitat potential was rated as poor because the watercourse is expected to freeze to the bottom in winter. Rearing habitat potential was rated as moderate for forage fish and coarse fish and poor to moderate for sportfish. There was some substrate complexity that may support benthic invertebrate production, and there was some cover for fish provided by woody debris and undercut banks. Migration was rated as moderate for all fish species due to instream large woody debris, which may affect passage. However, there were no barriers between the proposed crossing location and the Mackenzie River.

4.3.2.20 Crossing KM 738.7 – Unnamed Watercourse

At the proposed crossing location, the watercourse was 1.8 m wide with a wetted width of 1.1 m. Maximum measured depth was 0.7 m at the time of the assessment. The substrate was fines (40%), small gravel (20%), cobble (20%), organics (10%), large gravel (5%), and bedrock (5%). Riparian vegetation was grass and shrubs with some deciduous and coniferous trees. Limited cover was provided by undercut banks, woody debris, and boulders. The dominant habitat type at the crossing location was shallow run with riffles observed upstream and downstream.

Backpack electrofishing was completed for 573 seconds of effort; no fish were captured (K'alo-Stantec, 2021). Overall, fish habitat potential was rated as poor. Spawning habitat potential was rated as poor for all fish species. There are limited gravel substrates for species that construct redds and limited instream vegetation and woody debris for other fish species. Overwintering habitat potential was rated as poor for all fish species because the watercourse is likely to freeze to the bottom in winter. Rearing habitat was rated as moderate for forage fish and coarse fish and poor to moderate for sportfish. There is some substrate complexity to support benthic invertebrate production; however, fine substrates would likely limit this production to a smaller diversity of taxa. Migration potential was rated as good for all fish species because there were no known barriers between the crossing and the Mackenzie River. This crossing was not assessed by previous studies.

4.3.2.21 Crossing KM 737.4 – Unnamed Watercourse

There was no previous existing data at the proposed crossing location. The proposed crossing location was not assessed by K'alo-Stantec in 2020 due to difficulties accessing the site or time constraints related to weather.

4.3.2.22 Crossing KM 739.6 – Unnamed Watercourse

At the crossing location, this watercourse was 1.3 m wide with a wetted width of 1.3 m at the time of the assessment (Dessau, 2012). The substrate was gravel (50%), fines (45%), and cobble (5%). Riparian vegetation was dominated by alder trees (Dessau, 2012). Fish habitat potential was rated as moderate to low for rearing and spawning and low for overwintering (Dessau, 2012).

K'alo-Stantec assessed the proposed crossing location in 2020. At the proposed crossing location, the watercourse was 1.6 m wide with a wetted width of 1.18 m. The maximum measured depth was 0.5 m at the time of the assessment. The substrate was fines (40%), organics (20%), cobble (20%), small gravel (10%), and large gravel (10%). Riparian vegetation was shrubs and grass with some deciduous trees. There was limited overhead cover provided by undercut banks and limited instream cover provided by woody debris. The dominant habitat type was shallow run. Riffles were the dominant habitat type downstream of the proposed crossing location.

No electrofishing was completed; fish presence was assumed. Overall, fish habitat potential is poor. Spawning habitat potential for all fish species was rated as poor due to the limited depth, presence of predominantly fine substrates, and lack of instream vegetation and woody debris. Overwintering habitat potential for all fish species was rated as poor because the watercourse is likely to freeze to the bottom in winter. Rearing habitat potential was rated as good for all fish species because there was some substrate complexity to support benthic invertebrate production, and there was cover for juvenile fish from overhanging riparian vegetation and woody debris

Fish passage was rated as good for all fish species because no barriers were identified between the proposed crossing location downstream to the Mackenzie River. A logjam was observed approximately 50 m upstream of the proposed crossing that may partially impede fish passage upstream of the crossing, particularly for large bodied species.

4.3.2.23 Crossing KM 740.8 – Unnamed Watercourse

K'alo-Stantec assessed the proposed crossing location in 2020; there was no previous existing data at the proposed crossing location (Dessau, 2012). At the proposed crossing location, the channel was 1.3 m wide with a wetted width of 1.4 m. Wetted width was wider than the channel width due to the presence of undercut banks. The maximum depth was 0.4 m at the time of the assessment. The substrate was fines (70%), organics (20%), large gravel (5%), and cobble (5%). Riparian vegetation was grasses, shrubs, and coniferous trees. Cover was provided by woody debris and overhanging riparian vegetation. The dominant habitat type at the proposed and upstream of the crossing location consisted of shallow run habitat while riffles were present downstream of the proposed crossing location.

Backpack electrofishing was completed for 359 seconds of effort; no fish were captured. Overall, fish habitat was rated as poor. Spawning habitat potential was rated as poor for all fish species due to the fine substrate, limited instream vegetation and woody debris, and shallow depth. Overwintering habitat potential was rated as poor for all species because the watercourse is likely to freeze to the bottom in winter. Rearing habitat potential was rated as moderate to good for forage fish and coarse fish and moderate for sportfish. Fine substrate composition may limit benthic invertebrate production. However, there was overhead and instream cover and suitable flows for rearing fish. Passage potential was rated as moderate because there were no known barriers to migration downstream of the proposed crossing location to the Mackenzie River.

4.3.2.24 Crossing KM 741.7 - Unnamed Watercourse

There was no previous existing data at the proposed crossing location (Dessau, 2012). K'alo-Stantec assessed the proposed crossing location in 2020. At the proposed crossing location, the channel was 1.3 m wide with a wetted width of 1.0 m. Maximum depth was measured at 0.9 m depth at the time of the assessment. The substrate was entirely fines. Riparian vegetation was grasses and shrubs with deciduous and coniferous trees. Cover was provided by trees, shrubs, and woody debris. The dominant habitat type at the crossing location was shallow run with step pools upstream and riffles and shallow run habitat downstream of the proposed crossing location.

Backpack electrofishing was completed for 331 seconds; no fish were captured. Overall, fish habitat potential was rated as poor at the proposed crossing location. Spawning habitat potential was rated as nil for all fish species due to the fine substrates. Overwintering habitat was rated as poor for all fish species because the watercourse is likely to freeze to the bottom. Rearing habitat potential was rated as poor to moderate for forage fish and coarse fish and poor for sportfish because of the limited cover and lack of complex substrate to support benthic invertebrates and likely limited by depth. Passage was rated as moderate for all fish species as there are no barriers between the proposed crossing location.

4.3.2.25 Crossing KM 742.7 – Unnamed Watercourse

There was no previous existing data at the proposed crossing location (Dessau, 2012). K'alo-Stantec assessed the proposed crossing location in 2020. At the proposed crossing location, the channel was 1.0 m wide with a wetted width of 1.4 m. Wetted width was wider than channel width due to the presence of undercut banks. Maximum depth was 0.3 m at the time of the assessment. The substrate was fines (90%) with small gravel (10%). Riparian vegetation was shrubs with deciduous and coniferous trees. Overhead cover was limited and provided by trees and shrubs. The dominant habitat type was shallow run.

Backpack electrofishing was not completed due to safety concerns of walking over unstable banks. Overall, fish habitat potential was rated as poor. Spawning habitat potential was rated as poor for all fish species due to the fine substrates and shallow depths. Overwintering habitat potential was rated as poor for all fish species because the watercourse is likely to freeze to the bottom. Rearing habitat potential was rated as poor for all fish species due to the lack of substrate complexity for benthic invertebrates and limited cover. Passage was rated as poor for all fish species due to the shallow depth which likely limits fish passage to high flow periods.

4.3.2.26 Crossing KM 745.7 – Strawberry Creek

At the proposed crossing location, Strawberry Creek had a channel width of 8 m with a wetted width of 8 m (Dessau, 2012). Substrates were boulder (70%), fines (10%), gravel (10%), and cobble (10%) (Dessau, 2012). Riparian vegetation was willows and grasses (Dessau, 2012). Instream cover was provided in approximately 80% of the channel (Dessau, 2012). Fish habitat potential was rated as moderate for rearing and spawning with low overwintering habitat potential (Dessau, 2012).

Strawberry Creek is crossed by the MGP route (RPR-385 [IORVL, 2004]). The proposed crossing location was not assessed by K'alo-Stantec in 2020 due to access or time constraints related to weather.

4.3.2.27 Crossing KM 747.6 – Unnamed Watercourse

There is no previous existing data at the proposed crossing location (Dessau, 2012). K'alo-Stantec assessed the proposed crossing location in 2020. The confluence with the Mackenzie River is located approximately 110 m downstream from the proposed crossing location. The gradient between the proposed crossing and the river was approximately 30%. An existing culvert at the proposed crossing location was damaged at the outlet.

At the proposed crossing location, the channel was 1.3 m wide with a wetted width of 0.9 m. Maximum depth was measured at 0.1 m at the time of assessment. Substrate was boulder (30%), fines (25%), small gravel (20%), cobble (20%), and large gravel (5%). Riparian vegetation was grasses and shrubs with deciduous and coniferous trees. Cover was limited and provided by trees and shrubs and undercut banks. The dominant habitat type at the proposed crossing location was riffle with step pools upstream and downstream of the proposed crossing location.

Backpack electrofishing was completed for 213 seconds; no fish were captured. Overall, fish habitat was rated as poor. Spawning habitat potential was rated as poor for all fish species due to insufficient depth and unsuitable substrate. Overwintering habitat potential was rated as poor for all fish species as the watercourse likely freezes to bottom in winter. Rearing habitat potential was rated as poor for all fish species due lack of instream cover and insufficient depth. Passage was rated as poor for all species because the culvert had resulted in sloughing, which temporarily obstructed fish passage and because of the steep gradient (30%) upstream from the confluence with the Mackenzie River. In addition, there is a potential velocity barrier 100 m upstream from the proposed crossing location associated with the step pools.

4.3.2.28 Crossing KM 748.0 – Unnamed Watercourse

There is no previous existing data at the proposed crossing location (Dessau, 2012). K'alo-Stantec assessed the proposed crossing location in 2020. At the proposed crossing location, the channel was approximately 1.6 m wide with a wetted width of 1.0 m. Maximum depth was 0.6 m at the time of the assessment. The substrate was cobble (40%), fines (20%), boulder (15%), large gravel (15%), and small gravel (10%). Riparian vegetation was shrubs and grasses. Cover for fish was also provided by undercut banks, overhanging trees and shrubs, and boulders.

Backpack electrofishing was completed for 335 seconds of effort; no fish were captured. Overall, fish habitat potential was rated as poor. Spawning habitat was rated as poor for all species due to the coarse substrate and lack of instream vegetation. Overwintering habitat was rated as poor for all species because the watercourse is expected to freeze to the bottom in winter. Rearing habitat potential was rated as poor for all species due to limited cover. Passage was rated as poor for all species because of a gradient barrier (24% gradient over 20 m length) approximately 50 m upstream of the confluence of the Mackenzie River.

There is a culvert at this site associated with the winter road which is partially collapsed..

4.3.2.29 Crossing KM 752.6 – Bob's Canyon Creek

Bob's Canyon Creek is a tributary of the Mackenzie River. At the proposed crossing location, the channel width was 5.8 m and the wetted width was 4.8 m (Dessau, 2012). Substrate was boulder (40%), cobble (40%), and gravel (20%). Instream cover for fish was determined to be 70% (Dessau, 2012). Rearing habitat was rated as moderate, overwintering habitat was rated as low, and spawning habitat was rated as low (Dessau, 2012). The creek has been reported to freeze to the bottom (GNWT, 2010).

K'alo-Stantec assessed the proposed crossing location in 2020 approximately 50 m to the south from the location described in GNWT (2012). The proposed crossing is located approximately 200 m upstream from the confluence with the Mackenzie River. A large (7 m diameter) culvert is present at the existing winter road crossing location and was in good condition at the time of the assessment.

The channel at the road crossing location was 2.0 m wide with a wetted width of 1.8 m. Maximum depth was measured to be 0.48 m at the time of the assessment. The substrate was boulder (40%), fines (25%), small gravel (20%), and cobble (15%). Riparian vegetation was shrubs and grasses with deciduous trees. Cover was limited and provided by trees, shrubs, undercut banks, and instream woody debris.

Backpack electrofishing was not completed because it had been reported the creek was unlikely to provide fish habitat (GNWT, 2010). Overall, fish habitat potential was rated as poor due to the overall steep gradient (15% and 17% slopes near confluence with Mackenzie River). Spawning habitat was rated as poor for all fish species due to lack of suitable spawning substrate and surfaces (e.g., woody debris, instream vegetation). Overwintering habitat was rated a poor for all fish species because it is expected the watercourse freezes to the bottom in winter. Rearing habitat was rated as poor for forage fish and poor to moderate for coarse fish and sportfish. This was because, although there is cover for juvenile fish and substrates suitable for diverse benthic invertebrate production, the channel gradient is likely too steep for juvenile fish of most species. Passage was rated as poor for all fish species because of the two gradient impediments (15% and 17%) near the confluence with the Mackenzie River; also, there are some smaller cascades, which may be challenging for some smaller bodied fish to migrate past.

4.3.2.30 Crossing KM 752.8 – Drainage

This is an ephemeral drainage that does not provide fish habitat (Dessau, 2012). The drainage was a dry, vegetated gully during the assessment (Dessau, 2012). K'alo-Stantec did not assess the drainage in 2020 due to access or time constraints related to weather.

4.3.2.31 Crossing KM 765.5 – Unnamed Watercourse

There is no previous existing data at the proposed crossing location (Dessau, 2012). K'alo-Stantec assessed the proposed crossing location in 2020. At the proposed crossing location, the channel measured 1.5 m wide with a wetted width of 1.6 m. Wetted width was wider than channel width due to the presence of undercut banks. Maximum depth was 0.6 m at the time of the assessment. The substrate

was boulder (40%), cobble (20), fines (20%), organics (10%), and small gravel (10%). Riparian vegetation was grasses and shrubs with deciduous and coniferous trees. Cover was provided by overhanging trees, shrubs, woody debris, and instream boulders.

Backpack electrofishing was completed for 651 seconds; no fish were captured. Overall, fish habitat potential was rated as moderate. Spawning habitat was rated as poor to moderate for forage fish and coarse fish and poor for sportfish because of inappropriate substrate size (i.e., few gravels). Overwintering habitat was rated as poor for all fish species because the watercourse is likely to freeze to the bottom in winter. Rearing habitat was rated as good for all fish species due to the substrate complexity, which likely supports benthic invertebrate production, and cover is provided to juvenile fish from woody debris, undercut banks, instream boulders, and overhanging vegetation. Fish passage was rated as good for all fish species because there were no barriers to migration between the Mackenzie River and the proposed crossing location.

4.3.2.32 Crossing KM 767.2 – Unnamed Watercourse

There is no previous existing data at the proposed crossing location. The proposed crossing location was not assessed by K'alo-Stantec in 2020 due to difficulties accessing the site or time constraints related to weather.

4.3.2.33 Crossing KM 767.8 – Unnamed Watercourse

This watercourse, not previously reported, was identified during K'alo-Stantec's 2020 field program. The confluence of this unnamed tributary with the Mackenzie River is approximately 400 m downstream of the proposed crossing location. No formal fish and fish habitat assessment was completed because the crossing has similar morphology to the crossing at KM 765.51 (WX-045) and has connectivity with the Mackenzie River; the tributary was assumed to be fish-bearing.

4.3.2.34 Crossing KM 768.2 – Wetland Area

This wetland, not previously reported, was identified during K'alo-Stantec's 2020 field program. A beaver impoundment was observed, which extended onto the existing winter road. However, no inlet was observed. The beaver dam appears to be active. The substrate was organics. Riparian vegetation was wetland species. Maximum depth was greater than 2 m at the time of the assessment and, therefore, may not freeze to the bottom in winter. The wetland may afford fish habitat potential because it is close to the Mackenzie River and is unlikely to freeze to the bottom. Small-bodied fish may be able to migrate past the beaver dam to access the wetland.

4.3.2.35 Crossing KM 768.9 - Drainage

There is no previous existing data at the proposed crossing location (Dessau, 2012). At the proposed crossing location, an ephemeral drainage flows from west to east across the existing winter road. There were no defined banks approximately 25 m downslope of the existing winter road and water was flowing through grasses and sedges approximately 70 m downslope. There was intermittent channelization approximately 50 m upslope of the existing winter road crossing. This drainage is unlikely to support fish because it does not have connectivity to any other waterbodies that may be fish-bearing.

4.3.2.36 Crossing KM 769.7 - Drainage

There is no previous existing data at the proposed crossing location (Dessau, 2012). At the proposed crossing location is an ephemeral drainage oriented along the winter road. Standing water was present both upslope and downslope of the existing winter road. However, no defined channel or banks were observed. This drainage is unlikely to support fish due to its lack of connectivity with fish-bearing waterbodies.

4.3.2.37 Crossing KM 769.7 –Wetland Area

There is no previous existing data at the proposed crossing location (Dessau, 2012). A wetland area with a shallow pond was present adjacent to the project highway alignment. However, no outlet or inlet were observed. This wetland area is not considered fish habitat because of its lack of connectivity to any fish-bearing waterbodies.

4.3.2.38 Crossing KM 770.0 – Wetland Area

There is no previous existing data at the proposed crossing location (Dessau, 2012). A small pond and wetland area were present adjacent to the project highway alignment. However, no outlet or inlet were observed. The pond intrudes into the project highway corridor. The pond and wetland were not considered fish habitat because there was no observed connectivity with any fish-bearing waterbodies.

4.3.2.39 Crossing KM 770.6 – Wetland Area

This wetland, not previously reported, was identified during K'alo-Stantec's 2020 field program. The inlet to this wetland is an ephemeral drainage. The outlet drained the wetland to the west. The substrate in the wetland was organic material. Riparian vegetation was wetland species. Maximum depth was measured to be greater than 2 m. Minnow trapping was completed within the unclassified waterbody for 40 hours; no fish were captured. The wetland was assumed to provide fish habitat because it has an inlet and outlet and depth greater than 2 m, so is unlikely to freeze to the bottom in winter.

4.3.2.40 Crossing KM 772.8 - Drainage

At the proposed crossing location, an ephemeral drainage flows along and across the winter road Standing water was present on both sides of the road. However, there was no defined channel bed or stream banks on either side of the road. For this reason, this drainage is unlikely to support fish and was not considered fish habitat. The drainage is crossed by the MGP route (RPR-380 [IORVL, 2004]). Like the K'alo-Stantec assessment, no fish habitat was identified (IORVL, 2004).

4.3.2.41 Crossing KM 774.1 – Unnamed Watercourse

At the proposed crossing location, this unnamed tributary did not have a defined channel, and a beaver dam was present (Dessau, 2012). Overall fish habitat quality was determined to be low and unlikely to provide overwintering habitat due to shallow water depths (Dessau, 2012). Potential rearing and feeding habitat were observed approximately 50 m downstream of the proposed crossing location (Dessau, 2012).

The watercourse is crossed by the MGP route (RPR-379 [IORVL, 2004]). The report described the channel width as ranging between 1.2 m and 4.2 m with a wetted width of 3 m and a maximum depth of 0.4 m. However, most of the watercourse was less than 0.3 m deep (IORVL, 2004). Habitat was shallow runs with riffles and pools accounting for approximately 20% of the total available habitat. Substrate was coarse gravel and cobble but was moderately embedded with fine material. Cover was provided by woody debris, overhanging vegetation, and boulders in riffles. Riparian vegetation was grass, forbs, and shrubs within a deciduous forest. A fish inventory was completed in the spring and summer; one Arctic grayling was captured in the spring and one juvenile longnose sucker was captured in the summer (IORVL, 2004).

K'alo-Stantec assessed the proposed crossing location in 2020. At the proposed crossing location, the channel was 4.1 m wide with a wetted width of 4.3 m. Wetted width was wider than channel width due the presence of undercut banks. Maximum depth at the proposed crossing was 0.6 m at the time of the assessment. The substrate was boulder (40%), cobble (30%), fines (15%), organics (10%), and large gravel (5%). Riparian vegetation was shrubs and grass with deciduous and coniferous trees. Cover was limited and provided by woody debris and instream boulders. The dominant habitat throughout the assessed area was run habitat . No fish inventory was conducted because fish presence was known.

Overall, fish habitat was rated as moderate. Spawning habitat was rated as poor for all fish species due to a lack of suitable substrates and limited instream vegetation and woody debris. Overwintering habitat was rated as poor for all species. Although pools were observed throughout the assessed area, their depths were shallow and the watercourse likely freezes to or near the bottom. Rearing habitat was rated as moderate for all fish species because the substrate is suitable for benthic invertebrate production and there is instream and overhead cover for juvenile fish. Passage was rated as good for all fish species with no barriers to fish passage observed between the Mackenzie River and the proposed crossing location.

4.3.2.42 Crossing KM 780.9 – Drainage

At the proposed crossing location, there were no defined stream banks, and the crossing is located on an ephemeral drainage (Dessau, 2012; IORVL, 2004). Flow is expected to occur only during the spring run-off and be dry for the rest of the year (Dessau, 2012). There is no fish habitat potential at this location (Dessau, 2012; IORVL, 2004). K'alo-Stantec did not assess this crossing in 2020 due to access or time constraints related to weather.

4.3.2.43 Crossing KM 785.3 – Drainage

At the proposed crossing location, there was no defined channel and there were no channel substrates or surface flow (Dessau, 2012). A barrier to fish passage, a 2 m vertical drop near the crossing location, was observed (Dessau, 2012). The drainage does not provide fish habitat (Dessau, 2012). K'alo-Stantec did not assess this crossing in 2020 due to access or time constraints related to weather.

4.3.2.44 Crossing KM 787.3 – Drainage

There is no suitable fish habitat present at this site and the crossing is a dry, vegetated gully at the proposed crossing location (Dessau, 2012). K'alo-Stantec did not assess the crossing in 2020.

4.3.2.45 Crossing KM 789.0 (SWA-5) - Wetland Area

There is no previous existing data at the proposed crossing location (Dessau, 2012). A wetland area was present adjacent to the project highway alignment. No outlet or inlet were observed connecting the wetland to another waterbody. This wetland area is not considered fish habitat because it does not have connectivity to a fish-bearing waterbody.

4.3.2.46 Crossing KM 789.4 - Wetland Area

There is no previous existing data at the proposed crossing location (Dessau, 2012). A wetland area with a small waterbody was present adjacent to the project highway alignment. No outlet or inlet were observed connecting the wetland to another waterbody. This wetland is not considered fish habitat because there is no connectivity to a fish-bearing waterbody.

4.3.2.47 Crossing KM 791.2 - Wetland Area

There is no previous existing data at the proposed crossing location (Dessau, 2012). A wetland area with a small shallow waterbody is present adjacent to the project highway alignment. No outlet or inlet were observed connecting the wetland to another waterbody. This wetland is not considered fish habitat because there is no connectivity to a fish-bearing waterbody.

4.3.2.48 Crossing KM 791.8 - Wetland Area

There is no previous existing data at the proposed crossing location (Dessau, 2012). A wetland area with a small shallow waterbody and several smaller ponds were present adjacent to the project highway alignment. No outlet or inlet were observed. This wetland area is not considered fish habitat because there is no connectivity to a fish-bearing waterbody.

4.3.2.49 Crossing KM 793.1 - Wetland Area

There is no previous existing data at the proposed crossing location (Dessau, 2012). The area is crossed by the MGP route (RPR-376 [IORVL, 2004]). The crossing to be vegetated and did not provide fish habitat.

A wetland area was present adjacent to the project highway alignment in 2020. An outlet draining to the Mackenzie River was difficult to identify. Instead, large shallow ponded areas surrounded by wetland vegetation were visible. The Substrate was entirely organic material. A culvert (900 millimetres [mm] diameter) was placed across the existing winter road between two wetland areas. Some flow was observed in the culvert during the site visit. Minnow trapping (87 hours of effort) captured 120 brook stickleback and 60 fathead minnows. Therefore, this wetland area does provide fish habitat, at least for forage fish species.

5 Summary

All permanent watercourses that are proposed to be crossed by the Project drain into the Mackenzie River. There are 33 fish species within the RSA, which includes the Mackenzie River. However, not all species are expected to utilize every watercourse that would be crossed by the project highway alignment (e.g., chum salmon). Two species, Bull trout and Dolly Varden, are listed under Schedule 1 of the *Species at Risk Act* as a species of "special concern" and are also ranked as "sensitive" under the Northwest Territories Species Ranking. Inconnu and Arctic cisco are also considered "sensitive" under the NT Species Ranking; however, no additional regulatory restrictions apply to this species because of these listings.

Two species of fish, finescale dace and pearl dace captured in field assessments in the Sahtu Settlement Area represent northern range extensions for these two species.

Based on a desktop review of existing information and field assessments, 39 of the 43 potential watercourse and wetland crossings within the Sahtu Region were found to provide fish habitat or have the potential to provide fish habitat. It is unlikely four other unnamed watercourses to be crossed by the project highway alignment could provide fish habitat. Most of the watercourses that have the potential to provide fish habitat would likely only support forage fish species.

In the Dehcho Region, desktop assessments of 49 watercourses or wetlands were conducted and augmented by field assessments conducted in September 2020. Field assessments focused on locations where there was not an existing crossing structure. There were 25 watercourses assessed in the field. Of the 49 watercourses and wetlands 18 were unlikely to provide fish habitat and another 5 are unknown whether they provide fish habitat as there is no previous data on these watercourses and field assessments have not been conducted at this time. All other watercourses are known to provide fish habitat or have the potential to provide fish habitat. Most of the watercourses that have the potential to provide fish habitat would likely only support forage fish species.

6 Closure

This TDR was prepared for the sole benefit of GNWT to describe existing conditions related to fish and fish habitat within the Project LSA and RSA. If you have any questions, please do not hesitate to contact the undersigned.

Respectfully submitted,

K’alo-Stantec Limited

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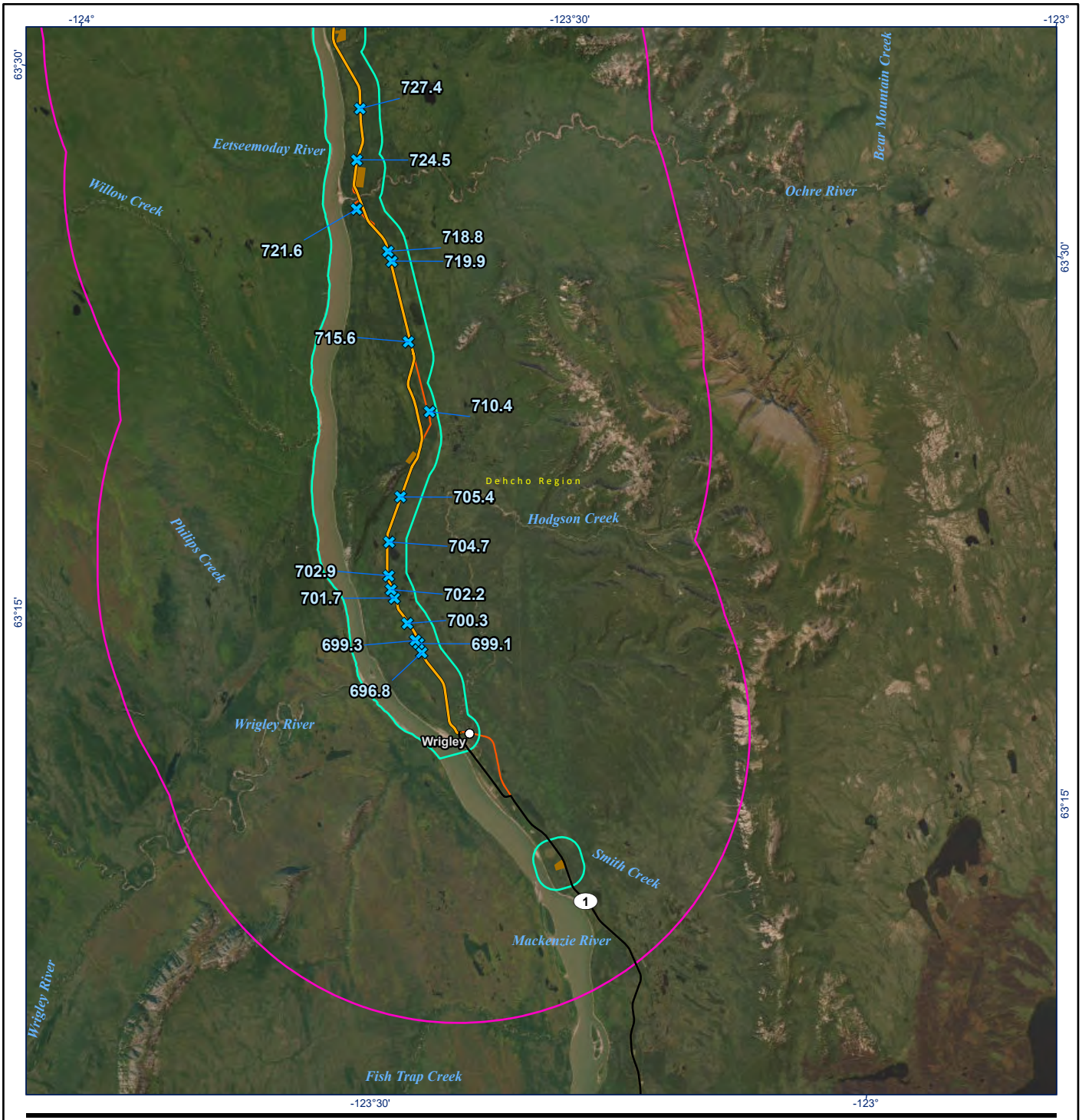
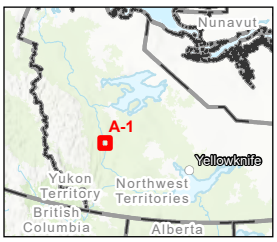
Appendix A Watercourse Crossing Locations





- Assessed Proposed Watercourse Crossing
- Proposed Mackenzie Valley Highway Alignment - Issued for EA 2022
- Granular Borrow / Rock Quarry Site and Access
- Local Study Area
- Regional Study Area
- Community
- Prohibition Creek Access Road
- Proposed Great Bear River Bridge Project
- All-Season Road
- Winter Road
- District Boundary
- Region Boundary
- Settlement Area Boundary

0 2.5 5 Kilometres

(At original document size of 8.5x11)
1:300,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 2023-03-07
TR by AJ on 2023-03-07

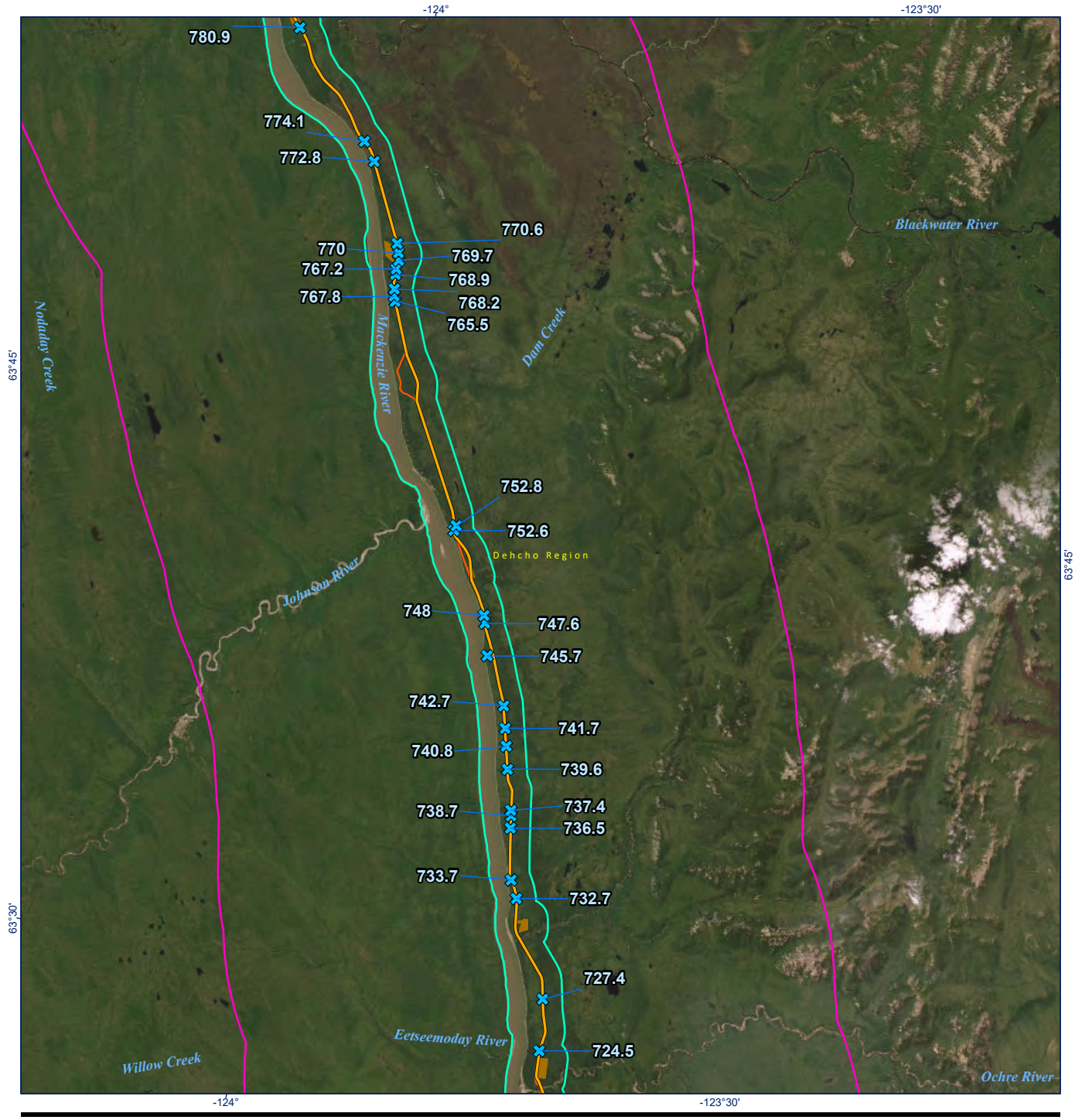
Client/Project
144903025-0067-REVC

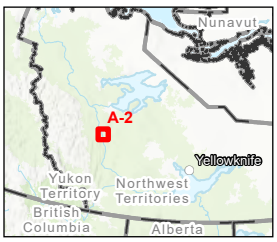
Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.
A.1

Title
Assessed Proposed Watercourse Crossings
Sites Km 727.4 to Km 699.1

Notes
1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS





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0 2.5 5 Kilometres

(At original document size of 8.5x11)
1:300,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 2023-03-07
TR by AJ on 2023-03-07

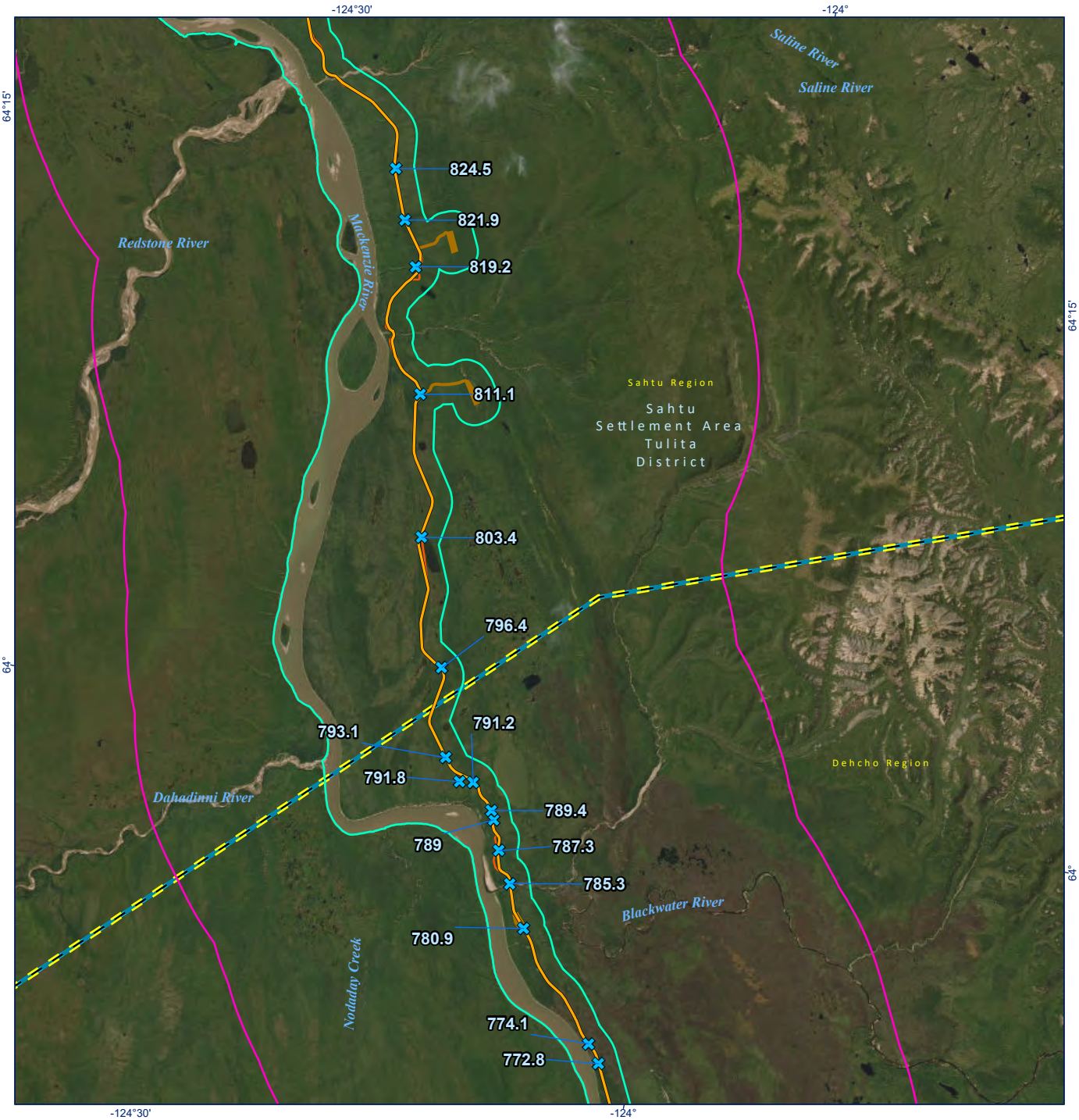
Client/Project
144903025-0067-REVC

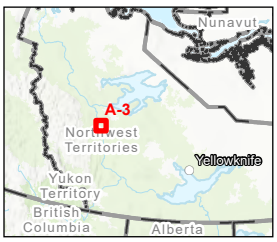
Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.
A.2

Title
Assessed Proposed Watercourse Crossings
Sites Km 780.9 to Km 724.5

Notes
1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS





- Assessed Proposed Watercourse Crossing
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- Regional Study Area
- Community
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- All-Season Road
- Winter Road
- District Boundary
- Region Boundary
- Settlement Area Boundary

0 2.5 5 Kilometres

(At original document size of 8.5x11)
1:300,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 2023-03-07
TR by AJ on 2023-03-07

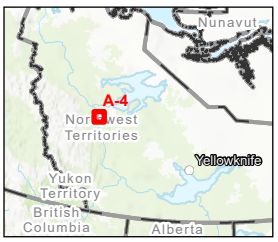
Client/Project
144903025-0067-REVC

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.
A.3

Title
Assessed Proposed Watercourse Crossings
Sites Km 824.5 to Km 774.1

Notes
1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS



- Assessed Proposed Watercourse Crossing
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- Granular Borrow / Rock Quarry Site and Access
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- Regional Study Area
- Community
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- All-Season Road
- Winter Road
- District Boundary
- Region Boundary
- Settlement Area Boundary

0 2.5 5 Kilometres

(At original document size of 8.5x11)
1:300,000

N

Kálo-Stantec

Notes

1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS

Project Location
Wrigley to Norman Wells, NWT

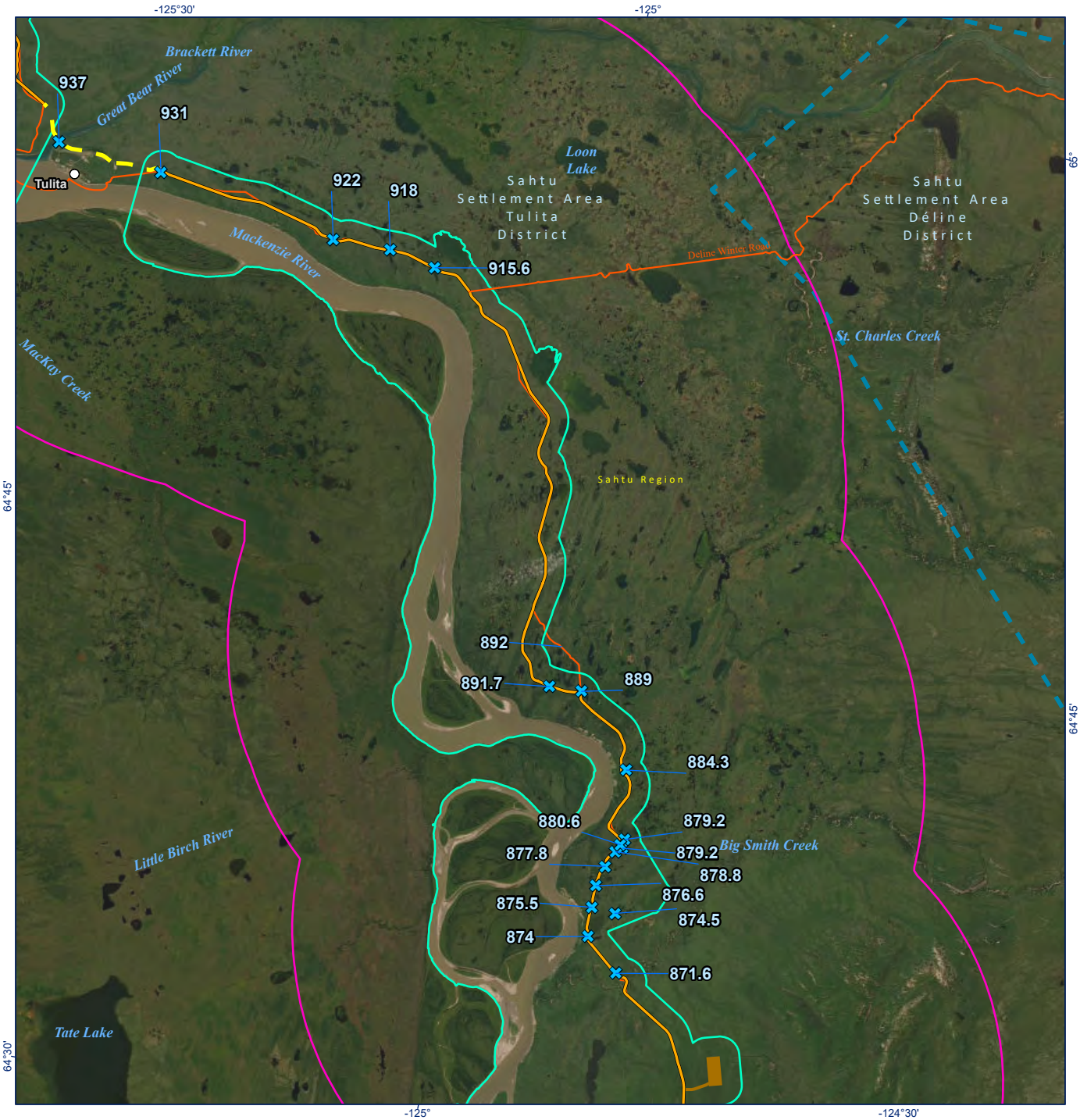
Prepared by AT on 2023-03-07
TR by AJ on 2023-03-07

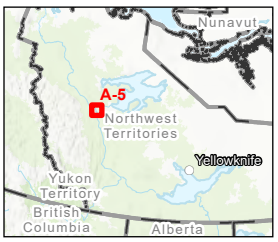
Client/Project
144903025-0067-REVC

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.
A.4

Title
Assessed Proposed Watercourse Crossings
Sites Km 884.3 to Km 824.5





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- All-Season Road
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- Region Boundary
- Settlement Area Boundary

0 2.5 5 Kilometres

(At original document size of 8.5x11)
1:300,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 2023-03-07
TR by AJ on 2023-03-07

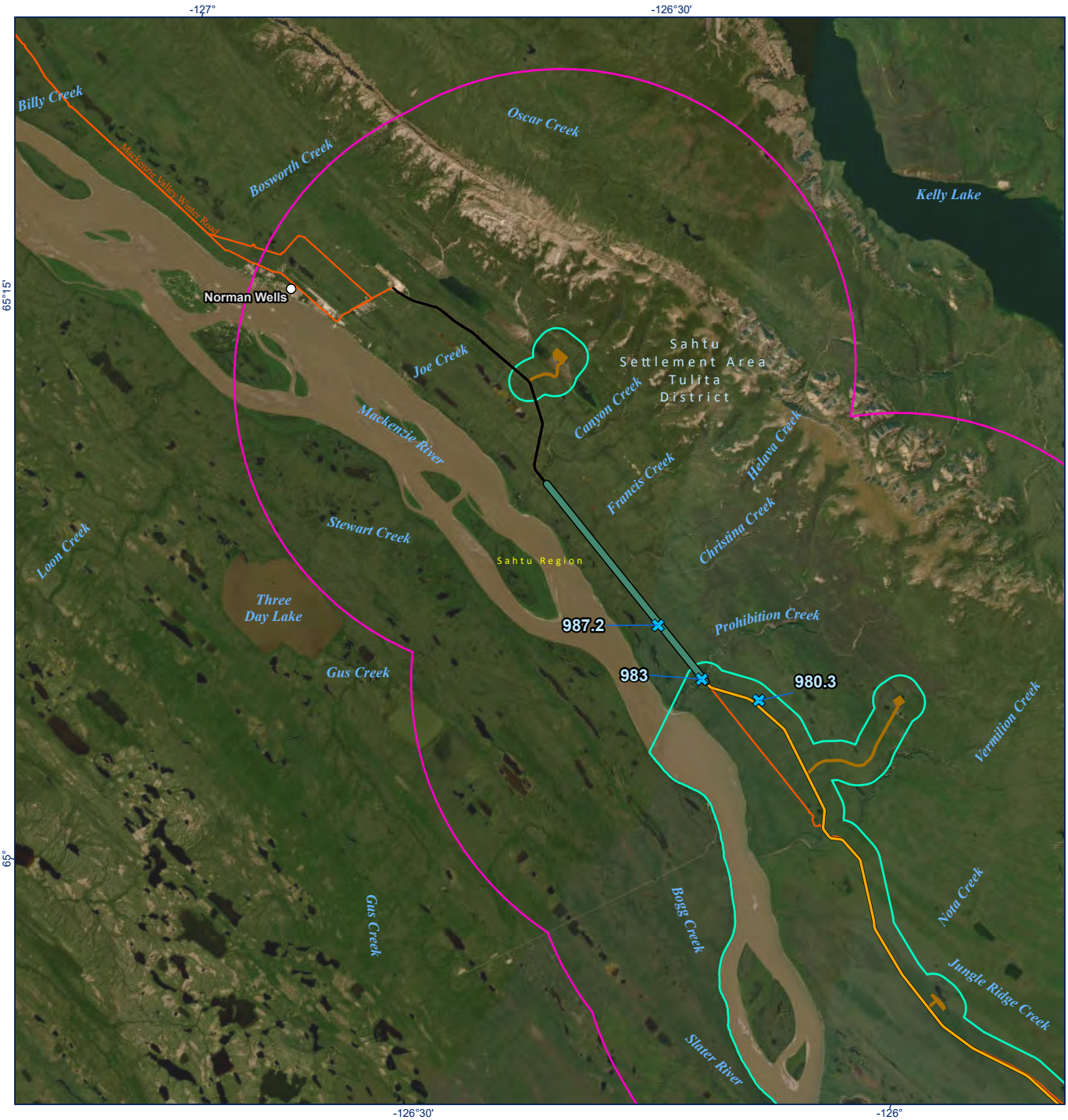
Client/Project
144903025-0067-REVC

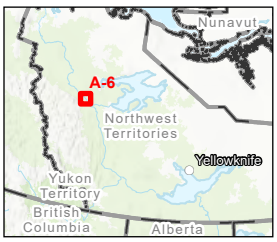
Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.
A.5

Title
Assessed Proposed Watercourse Crossings
Sites Km 937 to Km 871.6

Notes
1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS





- Assessed Proposed Watercourse Crossing
- Proposed Mackenzie Valley Highway Alignment - Issued for EA 2022
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- Local Study Area
- Regional Study Area
- Community
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- All-Season Road
- Winter Road
- District Boundary
- Region Boundary
- Settlement Area Boundary

0 2.5 5 Kilometres

(At original document size of 8.5x11)
1:300,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 2023-03-07
TR by AJ on 2023-03-07

Client/Project
144903025-0067-REVC

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.
A.6

Title
Assessed Proposed Watercourse Crossings
Sites Km 987.2 to Km 980.3

Notes
1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS

Appendix B Station Location Maps and Summary Sheets – Sahtu Settlement Area

Mackenzie Valley Highway

Site 797.9 Unnamed Watercourse

UTM Location: 10W 437740 7101829 **Survey Date:** 10/1/2021; 10:55

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)	
Channel Width (m)	4.1		5.8		4.3		13.0		16.8		-	
Wetted Width (m)	2.7		3.7		3.7		7.1		5.6		-	
Depth at LDB + 25% (m)	0.4		0.3		0.9		0.9		0.2		-	
Depth at LDB + 50% (m)	0.3		0.6		0.9		1.2		0.4		-	
Depth at LDB + 75% (m)	0.3		0.6		0.5		0.8		0.4		-	
Max.BankfullDepth (m)	1.3		1.0		1.2		0.90		0.72		-	
Gradient (%)	1		1		1		1		1		-	
Dominant Habitat Unit	DD		FL		FL		FL		DD		WL	
Stream Bed												
Substrate (% of Transect Area) Organics	50		20		40		30		60		100	
Fines	50		80		60		70		30		0	
Small Gravel	0		0		0		0		0		0	
Large Gravel	0		0		0		0		0		0	
Cobble	0		0		0		0		0		0	
Boulder	0		0		0		0		0		0	
Bedrock	0		0		0		0		0		0	
Embeddedness	N		N		N		N		N		N	
Bank Measurements	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**
Bank Height (m)	0.9	1.0	1.0	0.6	0.2	0.2	0.3	0.3	0.4	0.3	-	-
Bank Slope (°)	90	60	50	50	90	60	30	30	80	50	-	-
Bank Stability	US	US	MS	MS	S	S	S	S	MS	MS	-	-
Dom. Bank Material	F	F	F	F	F	F	O	F	O	F	-	-
Subdom. Bank Material	O	O	O	O	O	O	F	O	F	BL	-	-
Dom. Riparian Veg.	G	G	G	G	G	G	G	G	C	M	G	G
Subdom. Riparian Veg.	S	S	G	D	G	G	M	C	G	G	G	G

Habitat Inventory / Reach Data

Instream Cover (%):	30	Overhead Cover (%):	10
Dom. Instream Cover:	WD	Dom. Overhead Cover:	C
Subdom. Instream Cover:	G	Subdom. Overhead Cover:	S
Maximum Depth (m)	1.2	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	10:55
Water Temperature (°C):	4.5
Dissolved Oxygen (mg/L):	10.49
Sp. Conductivity (µs/cm):	339
pH:	7.50
Turbidity (NTU):	Lightly Turbid

Channel Characteristics

Pattern:	IR
Islands:	O
Bars:	N
Coupling:	PC
Confinement:	OC
Flow Stage:	Flood

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate	None-Poor	None-Poor
Overwintering:	Poor-Moderate	Poor-Moderate	Poor-Moderate
Rearing:	Good	Good	Moderate
Passage:	Moderate-Good	Moderate-Good	Moderate-Good

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
Minnow Trap (MT)	72.0	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
BROOK STICKLEBACK	-	13	-	0.18	2.5%
PEARL DACE	-	20	-	0.28	3.9%
-	-	1	-	0.01	0.2%
FINESCALE DACE	-	477	-	6.63	93.3%

General Comments

Grasses in stream, slight undercutting and exposed roots on left bank 100 m upstream. Logjams upstream and downstream of crossing. Occasional vegetation bars. Crossing was cleared for winter road, abundant grasses instream. Old beaver dam 300m downstream prior to wetland area. Could not measure some aspects due to flooding. The one fish not identified in the table is tentatively as Northern redbelly dace.

TETRA TECH

Mackenzie Valley Highway

Site 812.7 Unnamed Watercourse

UTM Location: 10W 434329 7115337 **Survey Date:** 10/1/2021; 16:17

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	-	1.3	1.37	1.18	1.6	1.8
Wetted Width (m)	-	0.76	1.12	0.75	0.75	1
Depth at LDB + 25% (m)	-	0.13	0.18	0.38	0.13	0.09
Depth at LDB + 50% (m)	-	0.21	0.14	0.51	0.17	0.09
Depth at LDB + 75% (m)	-	0.25	0.11	0.57	0.19	0.09
Max.BankfullDepth (m)	-	0.55	0.7	0.95	0.75	0.56
Gradient (%)	1	1	1	1	2	3
Dominant Habitat Unit	R2	R3	FL	FL	R2	RF
Stream Bed						
Substrate (% of Transect Area) – Organics	100	30	50	0	0	0
Substrate (% of Transect Area) – Fines	0	20	50	30	10	20
Substrate (% of Transect Area) – Small Gravel	0	50	0	40	30	30
Substrate (% of Transect Area) – Large Gravel	0	0	0	0	10	40
Substrate (% of Transect Area) – Cobble	0	0	0	10	50	10
Substrate (% of Transect Area) – Boulder	0	0	0	0	0	0
Substrate (% of Transect Area) – Bedrock	0	0	0	20	0	0
Embeddedness	N	M	N	L	N	L

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	-	-	0.3	0.3	0.5	0.6	0.5	0.4	0.6	0.6	0.43	0.52
Bank Slope (°)	-	-	90	70	80	80	80	80	70	75	50	45
Bank Stability	-	-	S	S	S	S	MS	MS	MS	MS	S	S
Dom. Bank Material	O	O	SG	SG	O	O	F	F	SG	SG	F	F
Subdom. Bank Material	F	F	O	O	F	F	O	O	F	F	O	O
Dom. Riparian Veg.	D	D	D	D	S	S	D	D	D	D	D	D
Subdom. Riparian Veg.	S	S	S	S	D	D	S	S	S	S	S	S

Habitat Inventory / Reach Data

Instream Cover (%):	30	Overhead Cover (%):	70
Dom. Instream Cover:	Co	Dom. Overhead Cover:	M
Subdom. Instream Cover:	UCB	Subdom. Overhead Cover:	S
Maximum Depth (m)	0.6	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	16:17
Water Temperature (°C):	0.1
Dissolved Oxygen (mg/L):	12.53
Sp. Conductivity (µs/cm):	435
pH:	7.74
Turbidity (NTU):	CLEAR

Channel Characteristics

Pattern:	IR
Islands:	N
Bars:	N
Coupling:	DC
Confinement:	FC
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Good	Poor	Poor
Overwintering:	None-Poor	None-Poor	None-Poor
Rearing:	Good	Good	Moderate
Passage:	Moderate-Good	Moderate	Moderate

Fish Sampling Data

Method	Effort	
Backpack Electrofisher (EB)	263	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
225	30	12	150

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED	-	-	-	-	-
	-	-	-	-	
	-	-	-	-	
	-	-	-	-	
	-	-	-	-	

General Comments

This channel had excellent spawning potential, and consisted of good fish habitat. There is a small change in grade near 300 m downstream but this would not affect fish passage. There is woody debris throughout and some minor logjam which may creat partial barriers to fish passage. There is trace undercut banks upstream, and channel becomes poorly defined with low water depths at 100 m upstream. There were several beaver dams at this site. One at the crossing on the downstream side of centerline, one at a tributary to the channel approximately 50 m upstream, and one further upstream the tributary watercourse (however, this channel was dry). The second channel goes runs parallel to the winter road and goes subsurface near an abandoned and dry beaver dam.

TETRA TECH

Mackenzie Valley Highway

Site 815 Unnamed Watercourse

UTM Location: 10W 432721E 7117031N **Survey Date:** 10/2/2021; 13:05

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	1.8	2.4	1.9	1.8	2.5	-
Wetted Width (m)	1.3	1.0	1.4	1.0	0.6	-
Depth at LDB + 25% (m)	0.1	0.1	0.1	0.0	0.0	-
Depth at LDB + 50% (m)	0.1	0.1	0.1	0.0	0.1	-
Depth at LDB + 75% (m)	0.1	0.0	0.1	0.0	0.0	-
Max.BankfullDepth (m)	0.5	0.6	0.4	0.4	0.1	-
Gradient (%)	-	-	-	-	-	-
Dominant Habitat Unit	R2	DD	R2	IP1	WL	-
Stream Bed						
Substrate (% of Transect Area) – Organics	0	0	10	10	90	-
Substrate (% of Transect Area) – Fines	30	0	60	10	10	-
Substrate (% of Transect Area) – Small Gravel	30	20	20	40	0	-
Substrate (% of Transect Area) – Large Gravel	20	40	0	20	0	-
Substrate (% of Transect Area) – Cobble	20	40	10	20	0	-
Substrate (% of Transect Area) – Boulder	0	0	0	0	0	-
Substrate (% of Transect Area) – Bedrock	0	0	0	0	0	-
Embeddedness	L	N	L	M	H	-

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.3	-	-	-	-
Bank Slope (°)	70	60	30	80	50	30	90	90	-	-	-	-
Bank Stability	MS	MS	MS	MS	MS	MS	MS	MS	-	-	-	-
Dom. Bank Material	O	O	F	F	O	F	SG	F	SG	F	-	-
Subdom. Bank Material	F	F	O	O	SG	SG	O	O	O	O	-	-
Dom. Riparian Veg.	S	S	S	S	S	S	D	D	D	D	-	-
Subdom. Riparian Veg.	C	D	G	G	G	G	S	S	S	S	-	-

Habitat Inventory / Reach Data

Instream Cover (%):	30	Overhead Cover (%):	80
Dom. Instream Cover:	WD	Dom. Overhead Cover:	S
Subdom. Instream Cover:	-	Subdom. Overhead Cover:	G
Maximum Depth (m)	-	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	13:05
Water Temperature (°C):	2.3
Dissolved Oxygen (mg/L):	12.13
Sp. Conductivity (µs/cm):	760
pH:	8.37
Turbidity (NTU):	Clear

Channel Characteristics

Pattern:	ME
Islands:	N
Bars:	N
Coupling:	PC
Confinement:	FC
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor-Moderate	Poor	None-Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Poor-Moderate	Poor-Moderate	None-Poor
Passage:	Poor-Moderate	Poor	Poor

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings			
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)

Fish habitat is poor, unlikely to hold fish due to lack of outlet downstream (converts to wetland) and logjams upstream. Crossing is eroded with two culverts that are not in line with watercourse. Not deep enough for minnow traps and too much woody debris/ too narrow for electrofishing. Not suitable for fish due to woody debris barriers throughout crossing section and poor connectivity. Minor undercutting of banks upstream.

TETRA TECH

Mackenzie Valley Highway

Site 820.7 Unnamed Watercourse

UTM Location: 10W 433131 7121700 **Survey Date:** 10/6/2021; 14:00

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)	
Channel Width (m)	3.4		13.5		15.5		95.0		7.1		3.2	
Wetted Width (m)	3.4		4.9		11.6		25.0		4.9		1.2	
Depth at LDB + 25% (m)	0.1		0.1		0.2		0.2		0.4		0.1	
Depth at LDB + 50% (m)	0.2		0.1		0.2		0.2		0.5		0.1	
Depth at LDB + 75% (m)	0.1		0.1		0.3		0.3		0.4		0.1	
Max.BankfullDepth (m)	0.0		1.3		0.7		2.0		1.0		0.5	
Gradient (%)	2		2		1		1		1		2	
Dominant Habitat Unit	FL		FL		IP1		IP1		IP1		BD	
Stream Bed												
Substrate (% of Transect Area) Organics	100		30		100		60		100		0	
Fines	0		0		0		40		0		25	
Small Gravel	0		30		0		0		0		20	
Large Gravel	0		20		0		0		0		25	
Cobble	0		10		0		0		0		10	
Boulder	0		10		0		0		0		20	
Bedrock	0		0		0		0		0		0	
Embeddedness	N		H		N		N		N		H	
Bank Measurements	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**
Bank Height (m)	0.0	0.2	0.4	1.3	0.2	0.4	0.3	0.3	0.2	0.5	0.20	0.20
Bank Slope (°)	10	10	15	3	10	40	10	30	30	40	30	70
Bank Stability	US	US	MS	US	MS	S	MS	MS	MS	MS	US	US
Dom. Bank Material	O	O	O	O	O	O	O	O	F	F	F	SG
Subdom. Bank Material	F	F	F	F	F	F	F	F	O	O	O	LG
Dom. Riparian Veg.	S	S	G	G	G	G	G	G	G	G	G	G
Subdom. Riparian Veg.	G	G	S	S	S	C	M	M	D	G	G	G

Instream Cover (%):	10	Overhead Cover (%):	5
Dom. Instream Cover:	G	Dom. Overhead Cover:	C
Subdom. Instream Cover:	EV	Subdom. Overhead Cover:	-
Maximum Depth (m)	0.6	Dom. Aquatic Veg. Type:	-

Quality Data		Channel Characteristics	
Time of Day (HH:MM):	14:01	Pattern:	ME
Water Temperature (°C):	2.3	Islands:	O
Dissolved Oxygen (mg/L):	10.47	Bars:	N
Sp. Conductivity (µs/cm):	731	Coupling:	DC
pH:	7.72	Confinement:	OC
Turbidity (NTU):	Clear	Flow Stage:	Pooled

Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor-Moderate	None	None
Overwintering:	Poor	Poor	None-Poor
Rearing:	Moderate	Poor	None-Poor
Passage:	Moderate	Poor-Moderate	Poor-Moderate

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
Minnow Trap (MT)	50.0	(hr)

Electrofisher Settings			
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED					

General Comments

Poorly defined channel within floodplain with pockets of grasses throughout. Upstream of 300 m downstream is a beaver dam. There was limited crown cover due to flooded region, which likely fills during freshet. Aquatic vegetation growing throughout. Exposed culvert along winter road.

Mackenzie Valley Highway

Site 821.9 Unnamed Watercourse

UTM Location: 10W 432580 7123103 **Survey Date:** 10/9/2021; 11:13

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	1.2	1.5	1.3	1.4	1.2	2.1
Wetted Width (m)	1.3	1.3	0.9	1.0	0.2	0.9
Depth at LDB + 25% (m)	0.1	0.2	0.4	0.0	0.0	0.1
Depth at LDB + 50% (m)	0.3	0.3	0.4	0.2	0.0	0.1
Depth at LDB + 75% (m)	0.3	0.2	0.4	0.1	0.0	0.1
Max.BankfullDepth (m)	0.57	0.49	0.71	0.70	0.23	0.68
Gradient (%)	2	2	1	2	2	1
Dominant Habitat Unit	P3	IP3	R2	R2	DR	FL
Stream Bed						
Substrate (% of Transect Area) Organics	20	40	0	0	40	30
Fines	30	0	50	0	30	40
Small Gravel	50	60	30	100	30	30
Large Gravel	0	0	20	0	0	0
Cobble	0	0	0	0	0	0
Boulder	0	0	0	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	N	N	N	N	N	N

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.3	0.2	0.2	0.2	0.3	0.3	0.5	0.5	0.1	0.2	0.6	0.6
Bank Slope (°)	40	60	90	90	30	20	90	100	45	45	30	30
Bank Stability	US	US	US	US	MS	MS	US	US	MS	MS	MS	MS
Dom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	O
Subdom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	S	S	S	M	S	S	D	D	S	S	C	S
Subdom. Riparian Veg.	D	D	M	S	G	G	D	D	D	D	S	C

Habitat Inventory / Reach Data

Instream Cover (%):	-	Overhead Cover (%):	30
Dom. Instream Cover:	-	Dom. Overhead Cover:	WD
Subdom. Instream Cover:	-	Subdom. Overhead Cover:	S
Maximum Depth (m)	0.4	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	11:13
Water Temperature (°C):	1.4
Dissolved Oxygen (mg/L):	7.52
Sp. Conductivity (µs/cm):	1,097
pH:	7.78
Turbidity (NTU):	Lightly Turbid

Channel Characteristics

Pattern:	ST
Islands:	N
Bars:	N
Coupling:	PC
Confinement:	OC
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate	Moderate	Moderate
Overwintering:	Poor	Poor	Poor
Rearing:	Good	Good	Moderate
Passage:	Moderate-Good	Moderate-Good	Moderate-Good

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)

General Comments

Some sign of grasses under snow as well. Undercut on left bank occasionally in upstream reach. Abundant woody debris and leaves resting on top of sediment throughout, Dry channel between 100 m and 200 m downstream, frozen to bed and not enough flow. Debris buildup occasionally thoughout,the watercourse creating potential barriers to fish. Woody debris overhanging throughout. No fishing conducted due to freezing conditions..

TETRA TECH

Km 823

Mackenzie Valley Highway

Site 823 Unnamed Watercourse

UTM Location: 10W 431979 7123968 **Survey Date:** 10/6/2021; 16:00

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	1.9	1.3	0.2	0.2	0.1	0.0
Wetted Width (m)	2.5	1.0	0.1	0.0	0.1	0.0
Depth at LDB + 25% (m)	2.2	1.7	0.2	0.2	0.3	0.0
Depth at LDB + 50% (m)	3.0	1.0	0.1	0.2	0.1	0.0
Depth at LDB + 75% (m)	1.7	1.4	0.4	0.4	0.3	0.0
Max.BankfullDepth (m)	4.1	2.3	0.97	0.84	0.77	0.43
Gradient (%)	3	2	2	2	1	1
Dominant Habitat Unit	R1	RF	R1	R1	R1	R1
Stream Bed						
Substrate (% of Transect Area) — Organics	0	0	0	0	0	0
Substrate (% of Transect Area) — Fines	0	0	0	10	40	0
Substrate (% of Transect Area) — Small Gravel	0	0	0	30	20	10
Substrate (% of Transect Area) — Large Gravel	20	30	30	40	30	20
Substrate (% of Transect Area) — Cobble	30	30	30	20	0	60
Substrate (% of Transect Area) — Boulder	45	39	30	0	10	10
Substrate (% of Transect Area) — Bedrock	5	1	20	0	0	0
Embeddedness	L	L	N	L	L	L

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.8	1.1	0.6	0.4	0.6	0.4	0.4	0.4	0.5	0.4	0.4	0.4
Bank Slope (°)	90.0	80.0	65.0	40.0	80.0	80.0	30.0	60.0	80.0	60.0	30.0	70.0
Bank Stability	MS	MS	MS	MS	MS	MS	MS	MS	US	US	MS	MS
Dom. Bank Material	F	F	O	O	F	F	F	F	O	O	O	O
Subdom. Bank Material	O	O	F	F	O	O	O	O	F	F	F	F
Dom. Riparian Veg.	D	C	S	S	S	S	S	S	S	S	S	S
Subdom. Riparian Veg.	S	S	C	C	C	C	M	M	C	C	C	C

Habitat Inventory / Reach Data

Instream Cover (%):	40	Overhead Cover (%):	60
Dom. Instream Cover:	Co	Dom. Overhead Cover:	S
Subdom. Instream Cover:	UCB	Subdom. Overhead Cove	C
Maximum Depth (m)	3.0	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	16:00
Water Temperature (°C):	0.3
Dissolved Oxygen (mg/L):	11.60
Sp. Conductivity (µs/cm):	1,123
pH:	8.14
Turbidity (NTU):	Clear

Channel Characteristics

Pattern:	ST
Islands:	I
Bars:	N
Coupling:	CO
Confinement:	OC
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate-Good	Poor-Moderate	Poor
Overwintering:	None-Poor	None-Poor	None-Poor
Rearing:	Good	Good	Moderate
Passage:	Moderate-Good	Moderate-Good	Moderate-Goo

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundanc (% of total)

General Comments

Low water levels at time of assessment and was mostly frozen. Abundant woody debris and logjams throughout reach, some bank erosion and some undercut banks. No fishing was conducted due to freezing and frozen conditions.

TETRA TECH

Mackenzie Valley Highway

Site 826 Unnamed Watercourse

UTM Location: 10W 431007 7126445 **Survey Date:** 10/8/2021; 13:37

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	3.0	0.8	1.8	1.3	1.0	1.0
Wetted Width (m)	2.1	0.6	1.1	0.6	0.8	0.6
Depth at LDB + 25% (m)	0.2	0.3	0.3	0.0	0.2	0.1
Depth at LDB + 50% (m)	0.2	0.3	0.3	0.1	0.2	0.1
Depth at LDB + 75% (m)	0.2	0.2	0.2	0.2	0.2	0.1
Max.BankfullDepth (m)	0.54	0.51	0.69	0.34	0.46	0.48
Gradient (%)	2	2	2	3	4	4
Dominant Habitat Unit	FL	R3	R3	DD	DD	DD
Stream Bed						
Substrate (% of Transect Area) — Organics	0	0	60	100	100	100
Fines	100	100	40	0	0	0
Small Gravel	0	0	0	0	0	0
Large Gravel	0	0	0	0	0	0
Cobble	0	0	0	0	0	0
Boulder	0	0	0	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	N	N	N	N	N	N

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.3	0.4	0.2	0.2	0.4	0.4	0.2	0.2	0.2	0.2	0.2	0.4
Bank Slope (°)	45	60	45	45	80	90	10	10	80	50	50	50
Bank Stability	MS	US	MS	MS	MS	MS	US	US	US	US	US	US
Dom. Bank Material	O	O	O	O	F	F	O	O	O	O	F	O
Subdom. Bank Material	F	F	F	F	O	O	F	F	F	F	O	F
Dom. Riparian Veg.	G	G	G	G	G	G	S	S	S	S	S	S
Subdom. Riparian Veg.	S	S	S	S	S	S	G	G	G	G	G	G

Habitat Inventory / Reach Data

Instream Cover (%):	80	Overhead Cover (%):	80
Dom. Instream Cover:	WD	Dom. Overhead Cover:	WD
Subdom. Instream Cover:	DP	Subdom. Overhead Cove	-
Maximum Depth (m)	0.3	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	13:40
Water Temperature (°C):	2.0
Dissolved Oxygen (mg/L):	11.82
Sp. Conductivity (µs/cm):	439
pH:	7.82
Turbidity (NTU):	..ightly Turbi

Channel Characteristics

Pattern:	ME
Islands:	N
Bars:	N
Coupling:	PC
Confinement:	OC
Flow Stage:	Pooled

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate-Good	None	None
Overwintering:	Moderate-Good	Moderate	Poor-Moderate
Rearing:	Moderate-Good	Moderate-Good	Moderate-Goo
Passage:	Moderate	Moderate	Moderate

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
Minnow Trap (MT)	44.7	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundanc (% of total)
NO FISH CAPTURED					

General Comments

Upstream has a ponded area that may provide good overwintering habitat. The channel is irregular with poor connectivity upstream of centerline with limited overhanging vegetation and subsurface flow around historic beaver dam.

Downstream has abundant woody debris over channel and good cover from shrubs. There is evidence that there was a fire previously here. Approximately 200 m downstream, banks are unstable with occasional erosion throughout stretch. Most of the overhanging vegetation is shrubs.

Mackenzie Valley Highway

Site 826.3 Unnamed Watercourse

UTM Location: 10W 430947 7126834 **Survey Date:** 10/8/2021; 15:17

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	4.0	2.7	1.1	1.6	2.9	1.1
Wetted Width (m)	4.0	2.3	0.9	1.1	1.8	0.8
Depth at LDB + 25% (m)	0.1	0.2	0.1	0.1	0.1	0.1
Depth at LDB + 50% (m)	0.2	0.3	0.1	0.2	0.2	0.2
Depth at LDB + 75% (m)	0.1	0.3	0.1	0.1	0.2	0.2
Max.BankfullDepth (m)	1.6	0.52	0.34	0.41	0.70	0.40
Gradient (%)	2	2	2	2	2	2
Dominant Habitat Unit	DD	R3	R3	R3	R3	R3
Stream Bed						
Substrate (% of Transect Area) Organics	100	90	100	100	70	100
Fines	0	10	0	0	30	0
Small Gravel	0	0	0	0	0	0
Large Gravel	0	0	0	0	0	0
Cobble	0	0	0	0	0	0
Boulder	0	0	0	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	N	N	N	N	N	N

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	1.4	0.3	0.2	0.2	0.2	0.1	0.3	0.1	0.5	0.4	0.2	0.2
Bank Slope (°)	85.0	20.0	30.0	30.0	70.0	40.0	50.0	50.0	60.0	60.0	40.0	20.0
Bank Stability	US	MS	MS	MS	US	US	US	MS	US	US	MS	MS
Dom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	O
Subdom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	S	S	G	G	S	S	S	S	S	S	S	S
Subdom. Riparian Veg.	C	C	S	S	C	C	C	C	D	D	D	D

Habitat Inventory / Reach Data

Instream Cover (%):	40	Overhead Cover (%):	50
Dom. Instream Cover:	WD	Dom. Overhead Cover:	S
Subdom. Instream Cover:	-	Subdom. Overhead Cover:	M
Maximum Depth (m)	0.3	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	15:17
Water Temperature (°C):	1.2
Dissolved Oxygen (mg/L):	10.08
Sp. Conductivity (µs/cm):	663
pH:	7.81
Turbidity (NTU):	Clear

Channel Characteristics

Pattern:	ME
Islands:	O
Bars:	BR
Coupling:	CO
Confinement:	FC
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor-Moderate	None	None
Overwintering:	Poor	None	None
Rearing:	Moderate	Moderate	Poor-Moderate
Passage:	Moderate	Poor	Poor

Fish Sampling Data

Method	Effort	
Backpack Electrofisher (EB)	164	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
225	30	12	280

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED					-

General Comments

Braided with debris jams throughout. Inconsistent wetted width due to channel interrupted by shrub islands. Poor connectivity despite defined channels. Natural debris jam throughout. Signs of historic fire in upland area. Some erosion on left bank 100 m downtream that could couple the channel. The crossing has coupling potential as well. Upstream pond may provide limited overwintering potential for forage fish but shallow water depth and organic substrate would make it unlikely coarse or sportfish could overwinter..

TETRA TECH

Mackenzie Valley Highway

828.6 Unnamed Watercourse

UTM Location: 10W 429991 7129070 **Survey Date:** 10/9/2021; 13:30

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	0.9	0.6	0.8	1.8	1.9	1.6
Wetted Width (m)	0.3	0.6	0.7	0.8	1.3	0.6
Depth at LDB + 25% (m)	0.1	0.5	0.4	0.3	0.4	0.3
Depth at LDB + 50% (m)	0.2	0.5	0.4	0.4	0.5	0.3
Depth at LDB + 75% (m)	0.2	0.5	0.3	0.4	0.3	0.3
Max.BankfullDepth (m)	0.76	0.81	0.49	0.98	0.83	0.88
Gradient (%)	1	1	3	1	1	1
Dominant Habitat Unit	R2	R2	R2	R2	R2	R2
Stream Bed						
Substrate (% of Transect Area) – Organics	0	0	0	0	10	0
Substrate (% of Transect Area) – Fines	60	0	60	40	40	40
Substrate (% of Transect Area) – Small Gravel	40	30	30	40	40	60
Substrate (% of Transect Area) – Large Gravel	0	40	10	20	10	0
Substrate (% of Transect Area) – Cobble	0	30	0	0	0	0
Substrate (% of Transect Area) – Boulder	0	0	0	0	0	0
Substrate (% of Transect Area) – Bedrock	0	0	0	0	0	0
Embeddedness	L	L	L	L	M	L

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.6	0.3	0.3	0.3	0.1	0.1	0.47	0.54	0.4	0.3	0.6	0.5
Bank Slope (°)	80	20	45	45	20	10	65	65	30	70	50	80
Bank Stability	MS	MS	S	S	S	S	MS	MS	MS	MS	S	MS
Dom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	O
Subdom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	C	S	M	M	S	S	S	S	D	D	D	D
Subdom. Riparian Veg.	S	G	G	G	C	C	G	M	S	S	S	S

Habitat Inventory / Reach Data

Instream Cover (%):	40	Overhead Cover (%):	70
Dom. Instream Cover:	WD	Dom. Overhead Cover:	WD
Subdom. Instream Cover:	UCB	Subdom. Overhead Cover:	S
Maximum Depth (m)	0.5	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	13:37
Water Temperature (°C):	0.3
Dissolved Oxygen (mg/L):	11.31
Sp. Conductivity (µs/cm):	733
pH:	7.92
Turbidity (NTU):	Lightly Turbid

Channel Characteristics

Pattern:	ST
Islands:	N
Bars:	N
Coupling:	PC
Confinement:	FC
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate	Poor	Poor
Overwintering:	Poor	None	None
Rearing:	Poor-Moderate	Poor-Moderate	Poor-Moderate
Passage:	Moderate	Poor-Moderate	Poor-Moderate

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)

General Comments

Some instream grasses in upstream reach. Woody debris overhanging throughout. Crossing is cleared, coupled area with grasses and same channel width. Downstream has moderate riffles over woody debris and trace undercut banks. New growth in upland due to historic fire. No fishing was conducted due to freezing conditions.

TETRA TECH

Mackenzie Valley Highway

Site 834.1 Unnamed Watercourse

UTM Location: 10W 425724 7132189 **Survey Date:** 10/10/2021; 13:51

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	0.9	1.1	1.1	1.3	0.9	0.9
Wetted Width (m)	0.9	0.9	0.6	0.7	0.7	0.9
Depth at LDB + 25% (m)	0.1	0.1	0.1	0.1	0.1	0.1
Depth at LDB + 50% (m)	0.1	0.1	0.1	0.1	0.1	0.1
Depth at LDB + 75% (m)	0.1	0.1	0.1	0.1	0.6	0.2
Max.BankfullDepth (m)	0.20	0.30	0.49	0.87	0.76	0.50
Gradient (%)	1	1	1	1	1	1
Dominant Habitat Unit	R1	R1	R2	R1	R1	R1
Stream Bed						
Substrate (% of Transect Area) Organics	20	20	0	0	0	0
Fines	80	80	100	20	60	10
Small Gravel	0	0	0	30	30	40
Large Gravel	0	0	0	10	10	30
Cobble	0	0	0	40	0	20
Boulder	0	0	0	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	N	N	N	L	N	N

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.1	0.1	0.2	0.1	0.4	0.4	0.8	0.5	0.2	0.1	0.34	0.24
Bank Slope (°)	20	20	20	20	90	90	70	70	30	30	80	80
Bank Stability	US	US	US	US	US	US	US	US	MS	MS	US	US
Dom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	O
Subdom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	G	G	S	S	D	D	S	S	S	S	S	S
Subdom. Riparian Veg.	S	S	D	D	G	G	D	D	D	D	D	D

Habitat Inventory / Reach Data

Instream Cover (%):	40	Overhead Cover (%):	70
Dom. Instream Cover:	UCB	Dom. Overhead Cover:	S
Subdom. Instream Cover:	C	Subdom. Overhead Cover:	M
Maximum Depth (m)	0.6	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	13:50
Water Temperature (°C):	1.1
Dissolved Oxygen (mg/L):	9.42
Sp. Conductivity (µs/cm):	736
pH:	7.44
Turbidity (NTU):	Clear

Channel Characteristics

Pattern:	IR
Islands:	N
Bars:	N
Coupling:	PC
Confinement:	OC
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate	Poor	Poor
Overwintering:	None-Poor	None-Poor	None
Rearing:	Moderate	Moderate	Poor-Moderate
Passage:	Poor-Moderate	Poor-Moderate	Poor-Moderate

Fish Sampling Data

Method	Effort
No Electrofishing	- (s)
No Trapping	- (hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)

General Comments

Upstream has low flow with some pooling. Thick deciduous forest throughout. Mostly overhanging vegetation and shrubs for cover. Minor undercutting downstream on both banks. Downed woody debris throughout, signs of bank erosion and logjams throughout. No fishing conducted due to freezing conditions.

Mackenzie Valley Highway

Site 835 Unnamed Watercourse

UTM Location: 10W 425405 7132988 **Survey Date:** 10/10/2021; 14:56

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	1.1	1.4	1.9	1.0	1.0	1.0
Wetted Width (m)	0.3	0.3	1.1	1.0	0.5	0.8
Depth at LDB + 25% (m)	0.1	0.1	0.1	0.2	0.1	0.1
Depth at LDB + 50% (m)	0.1	0.1	0.1	0.2	0.1	0.1
Depth at LDB + 75% (m)	0.1	0.1	0.2	0.1	0.1	0.1
Max.BankfullDepth (m)	0.39	0.48	0.58	0.58	0.37	0.42
Gradient (%)	3	2	1	1	2	1
Dominant Habitat Unit	R2	R2	R1	R1	DD	R2
Stream Bed						
Substrate (% of Transect Area) — Organics	0	0	0	0	100	80
Fines	10	10	10	40	0	20
Small Gravel	30	30	40	20	0	0
Large Gravel	40	40	40	10	0	0
Cobble	20	20	10	30	0	0
Boulder	0	0	0	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	L	N	L	M	L	N

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.3	0.3	0.4	0.3	0.4	0.4	0.3	0.2	0.3	0.3	0.34	0.31
Bank Slope (°)	45	45	90	70	90	90	70	70	40	80	45	50
Bank Stability	MS	MS	MS	MS	US	US	MS	MS	US	US	MS	MS
Dom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	O
Subdom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	S	S	S	S	S	D	D	D	D	D	D	M
Subdom. Riparian Veg.	G	G	G	G	G	G	S	S	S	S	S	S

Habitat Inventory / Reach Data

Instream Cover (%):	50	Overhead Cover (%):	70
Dom. Instream Cover:	WD	Dom. Overhead Cover:	S
Subdom. Instream Cover:	UCB	Subdom. Overhead Cove	D
Maximum Depth (m)	0.8	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	15:00
Water Temperature (°C):	0.1
Dissolved Oxygen (mg/L):	11.78
Sp. Conductivity (µs/cm):	1,001
pH:	8.07
Turbidity (NTU):	Clear

Channel Characteristics

Pattern:	ST
Islands:	N
Bars:	N
Coupling:	PC
Confinement:	CO
Flow Stage:	High

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate	Poor	Poor
Overwintering:	None-Poor	None-Poor	None-Poor
Rearing:	Moderate	Poor-Moderate	Poor-moderate
Passage:	Poor-moderate	Poor-moderate	Poor-Moderate

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundanc (% of total)

General Comments

Fire evidence in upland. Abundant woody debris throughout. Shallow water with unstable banks at the centerline. Some undercut banks in downstream reach. Snow covering site at time of visit and mostly frozen over. No fishing conducted due to freezing conditions.

Mackenzie Valley Highway

Site 837.1 Unnamed Watercourse

UTM Location: 10W 424624 7135022 **Survey Date:** 10/11/2021; 12:34

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	1.5	1.7	1.2	2.7	2.1	1.9
Wetted Width (m)	1.3	1.3	0.9	1.3	1.0	1.4
Depth at LDB + 25% (m)	0.2	0.2	0.1	0.0	0.1	0.2
Depth at LDB + 50% (m)	0.2	0.2	0.2	0.1	0.1	0.2
Depth at LDB + 75% (m)	0.0	0.2	0.1	0.1	0.1	0.1
Max.BankfullDepth (m)	0.65	0.59	0.45	0.45	0.41	0.62
Gradient (%)	2	3	3	5	3	3
Dominant Habitat Unit	R2	R2	R2	RF	R2	R2
Stream Bed						
Substrate (% of Transect Area) — Organics	0	0	0	0	0	0
Substrate (% of Transect Area) — Fines	0	0	0	0	0	10
Substrate (% of Transect Area) — Small Gravel	10	25	20	10	20	30
Substrate (% of Transect Area) — Large Gravel	30	30	35	45	30	45
Substrate (% of Transect Area) — Cobble	30	30	10	30	40	5
Substrate (% of Transect Area) — Boulder	30	10	25	20	10	0
Substrate (% of Transect Area) — Bedrock	0	0	0	0	0	0
Embeddedness	N	N	N	N	N	N

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.4	0.4	0.2	0.4	0.2	0.3	0.4	0.3	0.2	0.3	0.4	0.3
Bank Slope (°)	90	90	70	70	70	70	10	10	30	20	60	55
Bank Stability	MS	US	US	US	US	US	MS	MS	MS	MS	MS	MS
Dom. Bank Material	O	O	O	O	O	O	O	O	LG	O	O	O
Subdom. Bank Material	F	F	F	F	F	F	F	SG	SG	F	F	F
Dom. Riparian Veg.	C	S	S	S	S	C	S	S	S	S	S	S
Subdom. Riparian Veg.	S	C	D	D	C	S	G	G	G	G	G	G

Habitat Inventory / Reach Data

Instream Cover (%):	30	Overhead Cover (%):	10
Dom. Instream Cover:	C	Dom. Overhead Cover:	S
Subdom. Instream Cover:	-	Subdom. Overhead Cover:	-
Maximum Depth (m)	0.2	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	12:34
Water Temperature (°C):	1.1
Dissolved Oxygen (mg/L):	12.27
Sp. Conductivity (µs/cm):	482
pH:	8.20
Turbidity (NTU):	Clear

Channel Characteristics

Pattern:	ME
Islands:	N
Bars:	SD
Coupling:	DC
Confinement:	OC
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate-Good	Moderate	Moderate
Overwintering:	None-Poor	None-Poor	None-Poor
Rearing:	Moderate	Moderate	Moderate
Passage:	Moderate	Poor-moderate	Poor-moderate

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)

General Comments

Step pools created naturally from downed woody debris in upstream reach. Downstream has emergent boulders and cobbles instream. Minor undercutting of bank in downstream. Fire history in upland. Gravel bar on left bank 200 m downstream. Limited overhanging vegetation in downstream reach. Downed trees created step pools. Challenging for forage fish but good habitat. No fishing conducted due to freezing conditions.

Mackenzie Valley Highway

Site 843.3 Unnamed Watercourse

UTM Location: 10W 422310 7140408 **Survey Date:** 10/11/2021; 14:20

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Water Quality Data

Time of Day (HH:MM):	14:20
Water Temperature (°C):	0.5
Dissolved Oxygen (mg/L):	11.83
Sp. Conductivity (µs/cm):	577
pH:	8.07
Turbidity (NTU):	Clear

Habitat Inventory / Reach Data

Instream Cover (%):	80	Overhead Cover (%):	60
Dom. Instream Cover:	G	Dom. Overhead Cover:	D
Subdom. Instream Cover:	WD	Subdom. Overhead Cover:	S
Maximum Depth (m)	-	Dom. Aquatic Veg. Type:	0

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)

General Comments

Maximum depth was 0.39 m. Substrate was 30% fines, 30% small gravel, 30% large gravel and 10% cobble. Snow cover at the site at time of visit, most of the downstream reach was a flooded area within the trees and no defined channel. No suitable fish habitat for any fish.

TETRA TECH

Mackenzie Valley Highway

Site 846.4 Unnamed Watercourse

UTM Location: 10W 419947 7142715 **Survey Date:** 10/11/2021; 15:00

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)	
Channel Width (m)	-		-		-		2.5		2.3		2.1	
Wetted Width (m)	-		-		-		2.3		1.9		1.7	
Depth at LDB + 25% (m)	-		-		-		0.5		0.2		0.1	
Depth at LDB + 50% (m)	-		-		-		0.7		0.5		0.5	
Depth at LDB + 75% (m)	-		-		-		0.8		0.2		0.4	
Max.BankfullDepth (m)	-		-		-		1.5		0.84		0.63	
Gradient (%)	-		-		-		1		1		1	
Dominant Habitat Unit	P1		P1		P1		P1		R1		R1	
Stream Bed												
Substrate (% of Transect Area) Organics	-		-		-		40		40		40	
Fines	-		-		-		60		60		60	
Small Gravel	-		-		-		0		0		0	
Large Gravel	-		-		-		0		0		0	
Cobble	-		-		-		0		0		0	
Boulder	-		-		-		0		0		0	
Bedrock	-		-		-		0		0		0	
Embeddedness	-		-		-		0		0		0	
Bank Measurements	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**
Bank Height (m)	-	-	-	-	-	-	0.7	0.3	0.3	0.2	0.1	0.1
Bank Slope (°)	-	-	-	-	-	-	90	90	70	20	5	40
Bank Stability	-	-	-	-	-	-	MS	MS	MS	MS	MS	MS
Dom. Bank Material	-	-	-	-	-	-	O	O	O	O	O	O
Subdom. Bank Material	-	-	-	-	-	-	F	F	F	F	F	F
Dom. Riparian Veg.	-	-	-	-	-	-	S	S	S	S	S	S
Subdom. Riparian Veg.	-	-	-	-	-	-	G	G	D	D	D	D

Habitat Inventory / Reach Data

Instream Cover (%):	30	Overhead Cover (%):	30
Dom. Instream Cover:	WD	Dom. Overhead Cover:	-
Subdom. Instream Cover:	-	Subdom. Overhead Cover:	-
Maximum Depth (m)	0.8	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	14:00
Water Temperature (°C):	0.1
Dissolved Oxygen (mg/L):	12.21
Sp. Conductivity (µs/cm):	264
pH:	7.97
Turbidity (NTU):	Lightly Turbid

Channel Characteristics

Pattern:	SI
Islands:	S
Bars:	N
Coupling:	PC
Confinement:	OC
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Moderate-Good	Poor-moderate	Poor
Passage:	Poor	Poor	Poor

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)

General Comments

The upstream area was flooded with no defined channel and frozen over with snow cover at time of assessment. Most of the downstream reach was flooded as well until approximately 100 m downstream, where the channel banks became more defined. The channel developed sinuous meanders downstream. Current crossing is not suitable for fish passage. No fishing conducted due to freezing conditions.

TETRA TECH

Mackenzie Valley Highway

Site 857.4 Unnamed Watercourse

UTM Location: 10W 415860 7151196 **Survey Date:** 10/11/2021; 16:28

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)	
Channel Width (m)	1.5		10.0		2.3		0.6		2.3		-	
Wetted Width (m)	1.4		10.0		1.4		0.5		2.0		-	
Depth at LDB + 25% (m)	0.2		0.5		0.2		0.2		0.5		-	
Depth at LDB + 50% (m)	0.2		-		0.4		0.3		0.6		-	
Depth at LDB + 75% (m)	0.1		-		0.2		0.2		0.4		-	
Max.BankfullDepth (m)	0.28		0.50		0.56		0.40		0.73		0.00	
Gradient (%)	1		1		2		2		1		1	
Dominant Habitat Unit	R1		IP1		BD		R3		DD		FL	
Stream Bed												
Substrate (% of Transect Area) Organics	80		0		60		80		60		0	
Fines	20		100		40		20		40		100	
Small Gravel	0		0		0		0		0		0	
Large Gravel	0		0		0		0		0		0	
Cobble	0		0		0		0		0		0	
Boulder	0		0		0		0		0		0	
Bedrock	0		0		0		0		0		0	
Embeddedness	N		N		N		N		N		N	
Bank Measurements	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**
Bank Height (m)	0.1	0.1	-	-	0.2	0.2	0.2	0.2	0.2	0.1	-	-
Bank Slope (°)	10	10	30	30	25	10	5	5	10	10	30	30
Bank Stability	MS	MS	US	US	MS	MS	US	MS	MS	MS	MS	MS
Dom. Bank Material	O	O	-	-	O	O	O	O	O	O	-	-
Subdom. Bank Material	F	F	-	-	F	F	F	F	F	F	-	-
Dom. Riparian Veg.	S	S	S	S	S	S	S	S	S	S	M	M
Subdom. Riparian Veg.	G	G	G	G	G	G	G	C	G	G	C	C

Habitat Inventory / Reach Data

Instream Cover (%):	40	Overhead Cover (%):	10
Dom. Instream Cover:	WD	Dom. Overhead Cover:	C
Subdom. Instream Cover:	G	Subdom. Overhead Cover:	S
Maximum Depth (m)	0.6	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	16:28
Water Temperature (°C):	0.5
Dissolved Oxygen (mg/L):	9.45
Sp. Conductivity (µs/cm):	163
pH:	7.92
Turbidity (NTU):	Lightly Turbid

Channel Characteristics

Pattern:	IR
Islands:	I
Bars:	N
Coupling:	PC
Confinement:	FC
Flow Stage:	Pooled

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate	None	None
Overwintering:	Moderate	Poor	Poor
Rearing:	Moderate-Good	Poor-moderate	Poor
Passage:	Poor	Poor	Poor

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)

General Comments

The upstream reach was mostly low shrubs and grasses as it was likely flooded in past due to downstream beaver dam, poorly defined channel. Some grasses instream at the crossing. There were two beaver dams, just upstream of the centerline crossing over the winter road. There was a smaller beaver dam at the winter road. Watercourse converged with larger channel approximately 130 m downstream. There were multiple beaver dams downstream as well. Could not assess parts of T2 and T6 locations because the water was frozen over and was unsafe to assess. Channel width for T6 was measured from aerial imagery. At 200 m downstream, the second channel was flooded and meandered around debris dams (likely from previous backflooding from impoundment). The downstream area would be more suitable fish habitat than in the channel that crosses the proposed highway alignment. No fishing conducted due to freezing conditions.

TETRA TECH

Mackenzie Valley Highway

Site 872.9 Unnamed Watercourse

UTM Location: 10W 412679 7164554 **Survey Date:** 10/2/2021; 15:17

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Water Quality Data

Time of Day (HH:MM):	15:17
Water Temperature (°C):	0.1
Dissolved Oxygen (mg/L):	12.53
Sp. Conductivity (µs/cm):	435
pH:	7.74
Turbidity (NTU):	Clear

Habitat Inventory / Reach Data

Instream Cover (%):	60	Overhead Cover (%):	10
Dom. Instream Cover:	AQ	Dom. Overhead Cover:	-
Subdom. Instream Cover:	G	Subdom. Overhead Cover:	-
Maximum Depth (m)	0.6	Dom. Aquatic Veg. Type:	-

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
Minnow Trap (MT)	1.0	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED					

General Comments

Wetland habitat, poor connectivity with rigmat over the crossing. Exposed pipe from a pipeline in the channel. One minnow trap was set but pulled after 1 hr when it was noted that there was no connectivity and no defined channel. The downstream area is flooded wetland with submerged aquatic vegetation. Substrate was all fines and organics. Not fish habitat.

TETRA TECH

Mackenzie Valley Highway

Site 879.1 Unnamed Watercourse

UTM Location: 10W 411064 7169505 **Survey Date:** 10/9/2021; 16:16

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Water Quality Data

Time of Day (HH:MM):	16:16
Water Temperature (°C):	0.6
Dissolved Oxygen (mg/L):	0.68
Sp. Conductivity (µs/cm):	151
pH:	6.44
Turbidity (NTU):	Lightly Turbid

Habitat Inventory / Reach Data

Instream Cover (%):	0	Overhead Cover (%):	30
Dom. Instream Cover:	-	Dom. Overhead Cover:	G
Subdom. Instream Cover:	-	Subdom. Overhead Cover:	C
Maximum Depth (m)	0.6	Dom. Aquatic Veg. Type:	-

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
Minnow Trap (MT)	36.5	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED					

General Comments

Very low dissolved oxygen - was measured multiple times in multiple locations and got same result. Frozen cover throughout, generally a marshy bog. This wetland was connected to the watercourse crossing at Site 879.4. Beaver activity in the upstream and a beaver lodge and impoundment downstream. Potential good habitat for forage fish but low DO levels may not make it suitable for larger bodied fish. No fishing conducted due to frozen conditions.

Mackenzie Valley Highway

Site 879.4 Unnamed Watercourse

UTM Location: 10W 411209 716858 **Survey Date:** 10/9/2021; 16:34

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	1.5	2.9	5.2	1.2	1.9	1.0
Wetted Width (m)	1.3	2.5	5.2	0.9	1.9	1.0
Depth at LDB + 25% (m)	0.3	0.5	0.2	0.2	0.1	0.0
Depth at LDB + 50% (m)	0.3	0.5	0.4	0.2	0.2	0.1
Depth at LDB + 75% (m)	0.3	0.4	0.5	0.2	0.1	0.2
Max.BankfullDepth (m)	0.31	0.54	0.46	0.39	0.56	0.59
Gradient (%)	1	1	2	3	1	1
Dominant Habitat Unit	IP1	IP1	IP1	R2	R1	R1
Stream Bed						
Substrate (% of Transect Area) Organics	100	100	100	0	0	0
Fines	0	0	0	90	100	100
Small Gravel	0	0	0	10	0	0
Large Gravel	0	0	0	0	0	0
Cobble	0	0	0	0	0	0
Boulder	0	0	0	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	0	0	0	0	0	0

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.4	0.2	0.4	0.4
Bank Slope (°)	0	0	0	0	10	10	40	40	20	40	75	40
Bank Stability	S	S	S	S	S	S	US	US	MS	US	MS	MS
Dom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	O
Subdom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	G	G	G	G	G	G	S	S	S	S	S	M
Subdom. Riparian Veg.	S	S	S	S	S	S	M	M	C	C	M	S

Habitat Inventory / Reach Data

Instream Cover (%):	50	Overhead Cover (%):	60
Dom. Instream Cover:	WD	Dom. Overhead Cover:	S
Subdom. Instream Cover:	UC	Subdom. Overhead Cover:	M
Maximum Depth (m)	0.5	Dom. Aquatic Veg. Type:	G

Water Quality Data

Time of Day (HH:MM):	16:36
Water Temperature (°C):	0.6
Dissolved Oxygen (mg/L):	10.81
Sp. Conductivity (µs/cm):	193
pH:	7.37
Turbidity (NTU):	Clear

Channel Characteristics

Pattern:	ME
Islands:	N
Bars:	N
Coupling:	CO
Confinement:	FC
Flow Stage:	Flood

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor-Moderate	None	None
Overwintering:	Poor-moderate	Poor	Poor
Rearing:	Moderate	Poor-Moderate	Poor-Moderate
Passage:	Moderate-Good	Moderate	Moderate

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)

General Comments

Some instream aquatic vegetation and grasses instream in upstream reach, within the flooded area. The upstream area is flooded throughout trees and downstream is confined to valley. Some undercut banks 300 m downstream. Aerial imagery of the area shows the watercourse is connected to Site 879.1 on the upstream side, and appears to have wetland characteristics upstream of T1 (100 m upstream) based on the aerial imagery. The area was snow covered at the time of the assessment. No fishing was conducted due to unsafe conditions for electrofishing and freezing conditions.

Mackenzie Valley Highway

Site 880.2 Unnamed Watercourse

UTM Location: 10W 411595 7170626 **Survey Date:** 10/1/2021; 16:23

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	-	1.2	2.7	2.6	3.2	0.9
Wetted Width (m)	-	0.8	0.7	1.0	0.7	0.5
Depth at LDB + 25% (m)	-	0.1	0.1	0.1	0.1	0.1
Depth at LDB + 50% (m)	-	0.2	0.2	0.1	0.1	0.1
Depth at LDB + 75% (m)	-	0.1	0.2	0.1	0.1	0.1
Max.BankfullDepth (m)	-	0.4	1.0	0.5	0.5	0.6
Gradient (%)	-	1.0	2.0	2.0	8.0	8.0
Dominant Habitat Unit	WL	R2	R2	R2	R2	R2
Stream Bed						
Substrate (% of Transect Area) — Organics	-	90	0	60	10	10
Substrate (% of Transect Area) — Fines	-	10	100	40	80	90
Substrate (% of Transect Area) — Small Gravel	-	0	0	0	10	0
Substrate (% of Transect Area) — Large Gravel	-	0	0	0	0	0
Substrate (% of Transect Area) — Cobble	-	0	0	0	0	0
Substrate (% of Transect Area) — Boulder	-	0	0	0	0	0
Substrate (% of Transect Area) — Bedrock	-	0	0	0	0	0
Embeddedness	-	N	N	N	L	N

Bank Measurements	1 (↑100) Left	1 (↑100) Right	2 (↑50) Left	2 (↑50) Right	3 (CL) Left	3 (CL) Right	4 (↓100) Left	4 (↓100) Right	5 (↓200) Left	5 (↓200) Right	6 (↓300) Left	6 (↓300) Right
Bank Height (m)	-	-	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Bank Slope (°)	-	-	20	20	45	80	45	50	10	80	45	45
Bank Stability	-	-	MS	MS	S	MS	US	MS	US	US	MS	MS
Dom. Bank Material	-	-	O	O	O	O	O	O	F	F	O	O
Subdom. Bank Material	-	-	F	F	F	F	F	F	O	O	F	F
Dom. Riparian Veg.	-	-	S	S	S	S	S	S	S	S	C	C
Subdom. Riparian Veg.	-	-	C	C	C	C	C	C	C	C	S	S

Habitat Inventory / Reach Data

Instream Cover (%):	20	Overhead Cover (%):	30
Dom. Instream Cover:	-	Dom. Overhead Cover:	-
Subdom. Instream Cover:	-	Subdom. Overhead Cover:	-
Maximum Depth (m)	0.2	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	16:23
Water Temperature (°C):	2.5
Dissolved Oxygen (mg/L):	9.47
Sp. Conductivity (µs/cm):	195
pH:	7.87
Turbidity (NTU):	Clear

Channel Characteristics

Pattern:	IR
Islands:	N
Bars:	N
Coupling:	DC
Confinement:	OC
Flow Stage:	Low

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	None	None	None
Overwintering:	None	None	None
Rearing:	None	Poor	None
Passage:	None-Poor	None-Poor	None-Poor

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED					

General Comments

100 m upstream is a flooded area and no defined channel. Poor connectivity all the way to 100 m downstream of crossing. Abundant grasses instream and woody debris blocking channel. 100 m downstream of proposed alignment is just upstream of existing winter road. There is a soft organic bottom with minor undercuts. Some underground flow where banks have coupled previously. 200 m downstream looks like it was flooded a few years ago but has since had new growth. 300 m downstream is a narrow channel with steep grade and several logjams. Woody debris throughout. No fishing conducted due to shallow water depths.

Mackenzie Valley Highway

Site 880.6 Unnamed Watercourse

UTM Location: 10W411800 7171054 | **Survey Date:** 10/5/2021; 16:30

Legal Location: - | **Zone:**

Crew Initials: TM & MAN | **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	2.5	2.2	1.8	2.8	2.7	1.9
Wetted Width (m)	2.3	1.6	1.5	1.9	2.0	1.1
Depth at LDB + 25% (m)	0.2	0.3	0.2	0.3	0.3	0.5
Depth at LDB + 50% (m)	0.3	0.3	0.4	0.4	0.5	0.5
Depth at LDB + 75% (m)	0.4	0.2	0.6	0.3	0.2	0.4
Max.BankfullDepth (m)	0.67	0.65	0.78	0.66	0.83	1.1
Gradient (%)	1	1	2	4	5	5
Dominant Habitat Unit	FL	FL	R1	CA	R1	R1
Stream Bed						
Substrate (% of Transect Area) – Organics	0	10	30	10	10	10
Substrate (% of Transect Area) – Fines	100	90	70	80	70	90
Substrate (% of Transect Area) – Small Gravel	0	0	0	0	20	0
Substrate (% of Transect Area) – Large Gravel	0	0	0	0	0	0
Substrate (% of Transect Area) – Cobble	0	0	0	0	0	0
Substrate (% of Transect Area) – Boulder	0	0	0	10	0	0
Substrate (% of Transect Area) – Bedrock	0	0	0	0	0	0
Embeddedness	0	0	0	0	0	0

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.3	0.2	0.3	0.2	0.2	0.2	0.3	0.2	0.4	0.2	0.3	0.5
Bank Slope (°)	25	70	10	20	30	10	10	25	60	10	60	80
Bank Stability	MS	US	MS	MS	S	S	MS	MS	MS	MS	S	MS
Dom. Bank Material	O	F	F	O	O	O	F	F	F	F	F	O
Subdom. Bank Material	F	O	O	F	F	F	O	O	SG	O	O	F
Dom. Riparian Veg.	S	S	S	S	S	S	S	S	S	S	S	S
Subdom. Riparian Veg.	C	C	G	G	D	G	S	S	M	M	D	C

Habitat Inventory / Reach Data

Instream Cover (%):	40	Overhead Cover (%):	80
Dom. Instream Cover:	WD	Dom. Overhead Cover:	S
Subdom. Instream Cover:	-	Subdom. Overhead Cover:	C
Maximum Depth (m)	0.6	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	16:30
Water Temperature (°C):	1.6
Dissolved Oxygen (mg/L):	13.61
Sp. Conductivity (µs/cm):	240
pH:	7.66
Turbidity (NTU):	Moderately Turbid

Channel Characteristics

Pattern:	ST
Islands:	N
Bars:	N
Coupling:	PC
Confinement:	CO
Flow Stage:	High

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate	None-poor	None-Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Good	Good	Good
Passage:	Good	Good	Good

Fish Sampling Data

Method	Effort	
Backpack Electrofisher (EB)	246	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
200	30	12	200

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundanc (% of total)
BROOK STICKLEBACK	2	-	2.86	-	40.0%
FINESCALE DACE	1	-	1.43	-	20.0%
PEARL DACE	2	-	2.86	-	40.0%

General Comments

100 m downstream is located along pipeline, some large boulders in transect from riprap for wooden bank support that was in place. Some in stream grass throughout. Lots of woody debris in water. High flow rate wth occasional riffle sections. Occasional natural small debris dams.

TETRA TECH

Mackenzie Valley Highway

Site 883.6 Unnamed Watercourse

UTM Location: 10W 411615 7173282 **Survey Date:** 10/5/2021; 11:53

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	2.4	-	1.3	2.1	3.1	3.4
Wetted Width (m)	2.0	-	1.3	1.3	0.5	1.1
Depth at LDB + 25% (m)	0.0	-	0.3	0.2	0.1	0.1
Depth at LDB + 50% (m)	0.1	-	0.3	0.1	0.1	0.1
Depth at LDB + 75% (m)	0.2	-	0.2	0.1	0.1	0.0
Max.BankfullDepth (m)	0.46	-	0.41	0.44	1.1	2.0
Gradient (%)	1	-	2	2	6	8
Dominant Habitat Unit	WL	-	R1	R1	RF	RF
Stream Bed						
Substrate (% of Transect Area) — Organics	100	100	100	90	0	60
Substrate (% of Transect Area) — Fines	0	0	0	10	0	40
Substrate (% of Transect Area) — Small Gravel	0	0	0	0	0	0
Substrate (% of Transect Area) — Large Gravel	0	0	0	0	0	0
Substrate (% of Transect Area) — Cobble	0	0	0	0	0	0
Substrate (% of Transect Area) — Boulder	0	0	0	0	0	0
Substrate (% of Transect Area) — Bedrock	0	0	0	0	0	0
Embeddedness	N	N	N	N	N	N

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.2	0.3	-	-	0.1	0.1	0.3	0.2	0.9	1.1	0.7	1.9
Bank Slope (°)	5	45	-	-	5	5	20	25	60	70	80	90
Bank Stability	MS	MS	-	-	MS	MS	MS	MS	US	US	US	US
Dom. Bank Material	O	O	-	-	O	O	O	O	O	O	O	O
Subdom. Bank Material	F	F	-	-	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	G	D	-	-	S	S	S	S	S	S	C	C
Subdom. Riparian Veg.	S	S	-	-	C	D	M	M	C	D	S	S

Instream Cover (%):	10	Overhead Cover (%):	70
Dom. Instream Cover:	WD	Dom. Overhead Cover:	S
Subdom. Instream Cover:	-	Subdom. Overhead Cover:	M
Maximum Depth (m)	0.3	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	11:56
Water Temperature (°C):	2.8
Dissolved Oxygen (mg/L):	2.54
Sp. Conductivity (µs/cm):	355
pH:	7.16
Turbidity (NTU):	Lightly Turbid

Channel Characteristics

Pattern:	IR
Islands:	O
Bars:	N
Coupling:	PC
Confinement:	OC
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Poor	Poor	Poor
Passage:	Poor	Poor	Poor

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)

General Comments

50 m upstream was the winter road and no defined channel was present (depths recorded at deep pools). The water was snow covered and had low flow upstream. Some overhanging vegetation and abundant downed woody debris. Orange copper look to water, flow is low with occasional pool pockets to the side, dominated by organic debris (leaves and sticks).Slope increased at 300 m downstrea, with steep slopes, riffles with minor cascades and organic islands. Abundant moss throughout. Flowing water, 250 m downstream there was erosion on the left bank. No fishing conducted due to freezing conditions.

TETRA TECH

Mackenzie Valley Highway

Site 884.8 Unnamed Watercourse

UTM Location: 10W 411300 7174635 **Survey Date:** 09/30/2021; 14:24

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	10.5	8.4	2.5	2.3	3.1	2.0
Wetted Width (m)	3.0	2.2	1.0	0.8	1.3	1.3
Depth at LDB + 25% (m)	0.5	0.1	0.3	0.3	0.2	0.2
Depth at LDB + 50% (m)	0.6	0.1	0.4	0.2	0.2	0.3
Depth at LDB + 75% (m)	0.3	0.1	0.2	0.2	0.2	0.3
Max.BankfullDepth (m)	2.0	2.1	0.82	0.97	0.72	1.0
Gradient (%)	-	-	-	-	-	-
Dominant Habitat Unit	IP1	FL	R2	R2	R1	R1
Stream Bed						
Substrate (% of Transect Area) — Organics	0	0	0	20	20	60
Substrate (% of Transect Area) — Fines	0	90	90	80	80	40
Substrate (% of Transect Area) — Small Gravel	0	10	10	0	0	0
Substrate (% of Transect Area) — Large Gravel	0	0	0	0	0	0
Substrate (% of Transect Area) — Cobble	0	0	0	0	0	0
Substrate (% of Transect Area) — Boulder	0	0	0	0	0	0
Substrate (% of Transect Area) — Bedrock	0	0	0	0	0	0
Embeddedness	VH	M	H	N	N	N

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.5	1.4	0.5	2.0	0.4	0.4	0.5	0.7	0.5	0.3	0.60	0.70
Bank Slope (°)	45	45	60	60	90	90	80	80	70	70	60	60
Bank Stability	US	US	US	US	MS	MS	MS	MS	MS	US	MS	MS
Dom. Bank Material	F	F	F	F	F	F	O	O	F	F	F	F
Subdom. Bank Material	O	O	O	O	O	O	F	F	O	O	O	O
Dom. Riparian Veg.	G	G	G	G	D	D	G	G	S	C	G	G
Subdom. Riparian Veg.	S	S	C	C	S	S	S	C	G	S	D	D

Habitat Inventory / Reach Data

Instream Cover (%):	60	Overhead Cover (%):	30
Dom. Instream Cover:	WD	Dom. Overhead Cover:	S
Subdom. Instream Cover:	-	Subdom. Overhead Cover:	G
Maximum Depth (m)	0.6	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	14:22
Water Temperature (°C):	3.2
Dissolved Oxygen (mg/L):	-
Sp. Conductivity (µs/cm):	338
pH:	7.70
Turbidity (NTU):	ightly Turbi

Channel Characteristics

Pattern:	IR
Islands:	O
Bars:	BR
Coupling:	CO
Confinement:	CO
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Moderate-Good	Poor-Moderate	Poor
Passage:	Moderate	Poor-Moderate	Poor-Moderate

Fish Sampling Data

Method	Effort	
Backpack Electrofisher (EB)	471	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
190	30	12	300

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
BROOK STICKLEBACK	3	-	0.64	-	9.4%
PEARL DACE	29	-	6.16	-	90.6%

General Comments

No crown cover from crossing to 100 m upstream, and no overhanging vegetation. Significant erosion on banks. Partially coupled. The wildlife monitor mentioned that a beaver dam approximately 50 m upstream of centerline was blown out a year ago. A lot of bank instability at that location. Ice scarring is 2 m high at 50 m upstream and at the crossing. Crown cover is 60% at crossing. In downstream reach, there are woody debris throughout.

Mackenzie Valley Highway

Site 891.4 Unnamed Watercourse

UTM Location: 10W 406839 7178354 **Survey Date:** 10/11/2021; 11:00

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	17.0	15.0	12.5	5.5	5.8	6.0
Wetted Width (m)	-	-	-	5.0	5.0	-
Depth at LDB + 25% (m)	-	-	1.3	0.5	0.5	-
Depth at LDB + 50% (m)	-	-	-	0.5	0.5	-
Depth at LDB + 75% (m)	-	-	-	0.3	0.7	-
Max.BankfullDepth (m)	-	-		0.52	0.65	-
Gradient (%)	3	3	3	3	3	3
Dominant Habitat Unit	R1	RF	BD	R1	R1	FL
Stream Bed						
Substrate (% of Transect Area) Organics	-	-	0	30	30	-
Fines	-	-	100	40	70	-
Small Gravel	-	-	0	-	-	-
Large Gravel	-	-	0	-	-	-
Cobble	-	-	0	30	-	-
Boulder	-	-	0	-	-	-
Bedrock	-	-	0	-	-	-
Embeddedness	-	-	N	M	M	-

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	-	-	-	-	1.3	-	-	-	-	-	-	-
Bank Slope (°)	80	80	70	70	65	65	50	50	50	50	50	50
Bank Stability	MS	MS	MS	US	US	US	US	US	US	US	US	US
Dom. Bank Material	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG
Subdom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	C	C	C	C	C	C	C	C	C	C	C	C
Subdom. Riparian Veg.	G	G	G	G	G	G	G	G	G	G	G	G

Habitat Inventory / Reach Data

Instream Cover (%):	10	Overhead Cover (%):	10
Dom. Instream Cover:	WD	Dom. Overhead Cover:	C
Subdom. Instream Cover:	C	Subdom. Overhead Cover:	S
Maximum Depth (m)	>1	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	11:00
Water Temperature (°C):	3.3
Dissolved Oxygen (mg/L):	10.25
Sp. Conductivity (µs/cm):	340
pH:	8.04
Turbidity (NTU):	Lightly Turbid

Channel Characteristics

Pattern:	ST
Islands:	N
Bars:	N
Coupling:	CO
Confinement:	CO
Flow Stage:	High

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate-Good	Poor	Poor
Overwintering:	Moderate	Moderate	Moderate
Rearing:	Good	Good	Good
Passage:	Moderate-Good	Moderate-Good	Moderate-Good

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)

General Comments

Upstream of the centerline was a slightly impounded area as a result of the beaver dam at the centerline. The channel was wide providing moderate to good fish habitat. Steep banks on either side made access not possible for assessment of 100 m and 50 m upstream as well as 300 m downstream, therefore aerial assessments were completed instead. No barriers were observed with the exception of the beaver dam. Erosion of bank was more significant near the centerline and downstream, with increasing bank stability upstream. No fishing conducted due to freezing conditions and unsafe conditions for electrofishing due to high flows and water depth

TETRA TECH

Mackenzie Valley Highway

Site 919.9 Unnamed Watercourse

UTM Location: 10W 394956 7198775 **Survey Date:** 9/30/2021; 10:27

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	43.0	44.0	37.0	18.0	3.1	1.3
Wetted Width (m)	27.0	44.0	37.0	18.0	1.8	0.6
Depth at LDB + 25% (m)	0.7	0.6	0.2	1.1	0.3	0.3
Depth at LDB + 50% (m)	1.1	1.4	0.2	1.2	0.3	0.4
Depth at LDB + 75% (m)	0.8	0.4	0.2	1.1	0.2	0.3
Max.BankfullDepth (m)	1.5	1.9	0.29	1.3	0.70	0.77
Gradient (%)	-	-	-	-	-	-
Dominant Habitat Unit	IP1	WL	WL	WL	WL	IP1
Stream Bed						
Substrate (% of Transect Area) Organics	100	100	30	30	60	60
Fines	0	0	60	70	40	40
Small Gravel	0	0	0	0	0	0
Large Gravel	0	0	0	0	0	0
Cobble	0	0	0	0	0	0
Boulder	0	0	10	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	VH	VH	L	H	H	H

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.3	0.5	0.6	0.6	0.1	0.1	0.1	0.1	0.2	0.4	0.37	0.23
Bank Slope (°)	0	0	0	0	0	0	10	10	10	10	70	70
Bank Stability	S	S	S	S	S	S	S	S	MS	MS	MS	MS
Dom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	O
Subdom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	C	C	G	C	G	S	G	S	S	C	D	D
Subdom. Riparian Veg.	S	S	C	S	S	G	S	G	S	G	G	G

Habitat Inventory / Reach Data

Instream Cover (%):	10	Overhead Cover (%):	10
Dom. Instream Cover:	OHV	Dom. Overhead Cover:	G
Subdom. Instream Cover:	G	Subdom. Overhead Cover:	S
Maximum Depth (m)	>2	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	10:27
Water Temperature (°C):	2.9
Dissolved Oxygen (mg/L):	5.96
Sp. Conductivity (µs/cm):	182
pH:	6.50
Turbidity (NTU):	Lightly Turbid

Channel Characteristics

Pattern:	ME
Islands:	O
Bars:	BR
Coupling:	DC
Confinement:	UN
Flow Stage:	Flood

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Good	None	None
Overwintering:	Poor-Moderate	Poor	Poor
Rearing:	Good	Moderate	Poor-Moderate
Passage:	Poor-Moderate	Poor-Moderate	Poor-Moderate

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
Minnow Trap (MT)	46.6	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED					

General Comments

100 m upstream is the entrance of a deep pool flooded in floodplain. at 50 m upstream is a flooded area that crosses downstream of centerline. Downstream is braided with organic islands in the middle throughout to 100 m downstream, where beaver dam is present. An existing culvert is present at crossing with pooling on either side with vegetation islands. Entire reach had poorly defined channel that was largely flooded.Two minnow traps were set on either side of the crossing.

Mackenzie Valley Highway

Site 940.1 Unnamed Watercourse

UTM Location: 10W 375325 7203625 **Survey Date:** 10/8/2021; 18:00

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)	
Channel Width (m)	1.9		2.2		1.5		1.4		1.0		1.3	
Wetted Width (m)	1.1		1.7		1.0		1.1		0.9		1.0	
Depth at LDB + 25% (m)	0.2		0.3		0.4		0.4		0.2		0.1	
Depth at LDB + 50% (m)	0.4		0.3		0.4		0.3		0.1		0.2	
Depth at LDB + 75% (m)	0.3		0.2		0.3		0.5		0.3		0.2	
Max.BankfullDepth (m)	0.51		0.47		0.93		0.68		0.40		0.32	
Gradient (%)	1		1		1		1		5		8	
Dominant Habitat Unit	R1		R1		R1		R1		P2		SP	
Stream Bed												
Substrate (% of Transect Area) Organics	40		40		60		100		30		60	
Fines	60		60		40		0		70		30	
Small Gravel	0		0		0		0				0	
Large Gravel	0		0		0		0		0		10	
Cobble	0		0		0		0		0		0	
Boulder	0		0		0		0		0		0	
Bedrock	0		0		0		0		0		0	
Embeddedness	N		N		N		N		N		N	
Bank Measurements	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**
Bank Height (m)	0.1	0.1	0.2	0.1	0.4	0.5	0.2	0.1	0.0	0.1	0.1	0.1
Bank Slope (°)	20	5	25	30	20	20	10	10	10	10	10	10
Bank Stability	MS	MS	MS	MS	MS	MS	US	MS	S	MS	MS	MS
Dom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	O
Subdom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	S	S	S	S	S	S	S	S	D	D	S	S
Subdom. Riparian Veg.	G	G	G	G	G	G	D	D	S	S	D	D

Habitat Inventory / Reach Data

Instream Cover (%):	10	Overhead Cover (%):	90
Dom. Instream Cover:	UC	Dom. Overhead Cover:	S
Subdom. Instream Cover:	-	Subdom. Overhead Cover:	G
Maximum Depth (m)	0.6	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	18:09
Water Temperature (°C):	0.2
Dissolved Oxygen (mg/L):	12.54
Sp. Conductivity (µs/cm):	597
pH:	8.29
Turbidity (NTU):	Lightly Turbid

Channel Characteristics

Pattern:	ME
Islands:	N
Bars:	N
Coupling:	PC
Confinement:	OC
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate	None	None
Overwintering:	None-Poor	None-Poor	None-Poor
Rearing:	Moderate-Good	Poor-Moderate	Poor-Moderate
Passage:	Poor-Moderate	Poor-Moderate	Poor-Moderate

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)

General Comments

Snow and ice cover throughout at time of assessment. Overhanging shrubs cover 90-100% of stream throughout. Grasses compressed by snow. Uplands show signs of fire in past, with abundant woody debris throughout. No instream vegetation. 200 DS: Significant flow with several cascades. Upstream passage, along with the increased gradient, would be difficult for all fish species.Step pools are present downstream 300 m and cascade drops 0.25m with 0.36m pool depth (i.e. natural barriers). No fishing conducted due to snow and ice conditions.

Mackenzie Valley Highway

Site 981.2 Unnamed Watercourse

UTM Location: 10W 629352 7227768 **Survey Date:** 10/7/2021; 15:30
Legal Location: - **Zone:**
Crew Initials: TM & MAN **Restricted Activity Period:** -

Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	1.4	2.2	2.6	2.0	4.0	1.4
Wetted Width (m)	0.9	1.1	1.4	1.5	1.4	0.7
Depth at LDB + 25% (m)	0.1	0.1	0.0	0.2	0.5	0.2
Depth at LDB + 50% (m)	0.1	0.1	0.1	0.1	0.4	0.2
Depth at LDB + 75% (m)	0.1	0.1	0.2	0.1	0.4	0.2
Max.BankfullDepth (m)	0.45	0.71	1.0	0.52	0.86	0.57
Gradient (%)	4	4	4	2	2	2
Dominant Habitat Unit	RF	RF	RF	R1	R1	R2
Stream Bed						
Substrate (% of Transect Area) Organics	0	0	0	0	0	0
Fines	10	10	0	0	30	20
Small Gravel	40	10	20	40	70	80
Large Gravel	30	25	40	50	0	0
Cobble	20	50	30	10	0	0
Boulder	0	5	10	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	N	N	N	N	N	N

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.3	0.3	0.6	0.5	0.9	0.7	0.3	0.3	0.3	0.4	0.3	0.4
Bank Slope (°)	70	90	50	90	90	90	35	50	20	30	90	70
Bank Stability	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	US	US
Dom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	O
Subdom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	S	S	S	S	S	S	S	S	S	S	S	S
Subdom. Riparian Veg.	G	G	S	C	G	G	C	C	G	G	C	C

Habitat Inventory / Reach Data

Instream Cover (%):	25	Overhead Cover (%):	40
Dom. Instream Cover:	Co	Dom. Overhead Cover:	S
Subdom. Instream Cover:	Bo	Subdom. Overhead Cover:	C
Maximum Depth (m)	0.8	Dom. Aquatic Veg. Type:	-

Water Quality Data

Time of Day (HH:MM):	15:30
Water Temperature (°C):	0.2
Dissolved Oxygen (mg/L):	12.77
Sp. Conductivity (µs/cm):	961
pH:	8.54
Turbidity (NTU):	Clear

Channel Characteristics

Pattern:	ME
Islands:	I
Bars:	N
Coupling:	CO
Confinement:	OC
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Moderate-Good	Moderate-Good	Moderate-Good
Overwintering:	None-Poor	None-Poor	None-Poor
Rearing:	Good	Good	Moderate
Passage:	Moderate	Moderate	Moderate

Fish Sampling Data

Method	Effort	
Backpack Electrofisher (EB)	485	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
235	30	12	100

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED					

General Comments

Assessment done in snow and 50% ice cover frozen. Upstream has some undercut banks and large cobbles present under banks. There are riffle sections throughout with chutes abundant. Some step pools upstream from woody debris. Some logjams downstream that may be fish passage barriers. Good flow 300 m downstream, some woody debris causing riffling with minor undercutting and exposed roots on bank. Grasses covered in snow on bank.

TETRA TECH

Mackenzie Valley Highway

Site 805.5 Unnamed Watercourse

UTM Location: 10W 435589 7108255 **Survey Date:** 10/1/2021; 13:13

Legal Location: - **Zone:**

Crew Initials: TM & MAN **Restricted Activity Period:** -

Water Quality Data

Time of Day (HH:MM):	13:13
Water Temperature (°C):	4.1
Dissolved Oxygen (mg/L):	9.10
Sp. Conductivity (µs/cm):	257
pH:	7.53
Turbidity (NTU):	Clear

Habitat Inventory / Reach Data

Instream Cover (%):		Overhead Cover (%):	30
Dom. Instream Cover:		Dom. Overhead Cover:	-
Subdom. Instream Cover:		Subdom. Overhead Cover:	-
Maximum Depth (m)		Dom. Aquatic Veg. Type:	-

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
Minnow Trap (MT)	44.4	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
BROOK STICKLEBACK	-	106	-	2.39	67.9%
PEARL DACE	-	50	-	1.13	32.1%

General Comments

The site was a flooded wetland and only had a defined channel at the crossing location. An assessment at the crossing identified the substrate to be 20% organics and 80% fines. Channel width as it crossed the winter road was 0.3 m but was undefined upstream and downstream of the crossing due to flooding. Wetted width at the crossing was 0.14m and the average depth was 0.45 m (0.36 m to 0.62m). Dominant riparian vegetation was grasses with shrubs.

Appendix C Station Location Maps and Summary Sheets – Dehcho Territory

Table B.1 Substrate Classifications for Stream Bed and Banks

Code	Substrate	Size Range
O	Organics	NA
F	Fines	<2mm
SG	Small gravel	2-16mm
LG	Large gravel	17-64mm
C	Cobble	65-256mm
BL	Boulder	>256mm
BD	Bedrock	NA

Table B.2 Embeddedness

Code	Class	Description
N	Non-embedded	All rock substrates (i.e., gravel, cobble, boulders)
L	Low embeddedness	<25% embedded
M	Medium embeddedness	25-50% embedded
H	High embeddedness	51-75% embedded
VH	Very high embeddedness	>75% embedded

Table B.3 Bank Stability

Code	Description
S	Stable
MS	Moderately stable
US	Unstable

Table B.4 Riparian Vegetation

Code	Description
N	None
G	Grass
S	Shrub
C	Coniferous
D	Deciduous forest
M	Mixed coniferous and deciduous forest
W	Wetland (e.g., muskeg, marsh, swamp, or bog)

Table B.5 Instream and Overhead Cover Types

Code	Description
AV	Aquatic vegetation
BL	Boulders
DC	Depth or clarity (turbid) of water
OV	Overhanging vegetation
TS	Trees and/or shrubs overhead
UC	Undercut bank
WD	Woody debris

Table B.6 Stream Channel Pattern

Code	Description
ST	Straight
SI	Sinuous
IR	Irregular, wandering
IM	Irregular, meandering
ME	Regular meanders
TM	Torturous meander

Table B.7 Channel Islands

Code	Type	Description
N	None	No islands in channel
O	Occasional	No overlapping islands, average spacing less than ten channel widths
I	Infrequent	Infrequent overlapping, average spacing less than ten channel widths
F	Frequent	Not overlapping, average spacing less than ten channel widths
S	Split	Islands overlap frequently or continuously, usually two or three flow branches
AN	Anatomizing	Continuously overlapped islands, with multiple flow branches

Table B.8 Sediment Bars

Code	Type	Description
N	None	No bars present
SD	Side bar/point bar	Sediment deposition intermittent along the sides of the stream
DG	Diagonal bar	Mid-stream sediment deposition diagonally aligned to stream axis
MD	Mid-channel bar	Mid-stream deposition aligned parallel to stream axis
SP	Span	Sediment deposition continuous along the sides of the stream
BR	Braided	Sediment deposition forms a number of small channels separated by bars

Table B.9 Coupling

Code	Type	Description
DC	Decoupled	Sediment mobilized on the hill slope by a land-slide normally would not enter the stream channel
PC	Partially coupled	A portion of the sediment mobilized on the hill slope by a landslide enters the stream channel
CO	Coupled	Sediment mobilized on the hillslope by landslide activity directly enters the stream channel

Table B.10 Confinement

Code	Type	Description
EN	Entrenched	Entrenched channels are confined by fluvial eroded gullies or valleys or bedrock walls
CO	Confined	Confined channels are prevented or restricted from lateral migration by the valley walls
FC	Frequently Confined	Frequently confined channels are restricted from lateral migration by the valley walls, but are able to store sediments on a valley flat (typically, < channel width)
OC	Occasionally Confined	Occasionally confined channels are able to store sediments on a valley flat (typically 1 to 10 channel widths)
UN	Unconfined	Unconfined channels are not restricted from lateral migration by the valley walls.
N/A	Not Applicable	Confinement is not always applicable to every stream reach, such as a channel flowing across a fan or cone onto a valley flat.

Table B.11 Channel and Flow Characterization

Code	Type	Description
NDC	No defined channel	Site lacks a defined bed and bank (i.e., no channel scour).
EPH	Ephemeral	Water only present during certain times of the year (e.g., spring freshet). Includes dry channels that exhibit a defined bed and bank (i.e., scour)
INT	Intermittent	Water is not continuous in space. Example: areas of sub-surface flow
PER	Permanent	Water is likely present at all times of the year

Table B.12 Flow Stage

Type	Description
Dry	Water not present
Pooled	Water only present as unconnected pools or standing in bottom depressions. No flow
Low	Water flowing as threads within the channel; most bed material is exposed and little of the lower banks are wet
Moderate	Water flowing throughout the normal bed and in contact with the lower portions of banks; some bars are exposed
High	Water fills most of the channel and is in contact with the middle and upper portions of banks
Flood	Water is bankfull or over banks and into the floodplain

Table B.13 Habitat Unit Classification for Small Streams

Habitat Unit	Class	Code	Description
Falls		FA	Highly turbulent whitewater caused by water free-falling over a vertical drop. Falls formed from a full spanning flow obstruction, often bedrock. Slope < 100%.
Cascade		CA	Series of small falls or steps and pools; stepped longitudinal profile. Substrate of bedrock or boulder accumulations. Highly turbulent, high velocity, > 7% slope, mainly whitewater.
Rapid		RA	Steps and pocket pools common, cobble/boulder substrate with some exposed boulders at lower flows. Considerable turbulence, some whitewater, fast velocity (> 0.5 m/s), 4-7% slope.
Chute		CH	Area of channel constriction, usually due to bedrock intrusions; associated with channel deepening and increased velocity.
Riffle		RF	Partially to totally submerged pebble to cobble substrate, causing moderate turbulence and ripples, little to no whitewater (some whitewater at points of constriction), moderate velocity (0.2 to 0.5 m/s), usually < 0.5 m depth, 1 - 4% slope.
Run			Runs are typically deep, slow to swift flowing sections (> 0.2 m/s), with gravel to boulder substrate. Defined thalweg, moderate slope and with no surface turbulence. Run units are differentiated into three classes, based on depth.
	1	R1	Deepest run (> 1 m), slow to fast water velocity, coarse substrate (cobble to boulder), high instream cover from substrate and depth.
	2	R2	Moderate depth (0.6 - 1.0 m), slow to fast water velocity, coarse substrate (cobble to boulder), moderate instream cover from substrate and depth.
	3	R3	Shallowest depth (0.3 - 0.6 m), slow to fast water velocity, coarse substrate (gravel to cobble), low instream cover.
Glide		GL	Glides are shallow (< 0.3 m deep), wide, slow flowing (< 0.2 m/s), non-turbulent and lack a defined thalweg. Substrate is usually silt/sand but may sometimes consist of gravel to small cobble. Featureless with low instream cover.
Flat		FL	Area characterized by low velocity and near-uniform flow; differentiated from pool habitat by high channel uniformity; more depositional than R3 habitat
Sheet		ST	Shallow water reach that flows uniformly over smooth bedrock. Non-turbulent.
Pool			Pools are deeper and wider than channel units immediately above or below it and are usually formed by the scouring or plunging action of water. Sub-surface velocities are slow (water surface may be fast and substrate usually composed of fines or small gravel.
	1	P1	High quality pool habitat based on depth and size. High instream cover from instream features (*i.e.*, logs/boulders) and depth (> 1.2 m deep), provides overwintering habitat.
	2	P2	Shallower than P1 (0.6 - 1.2 m deep), moderate to high instream cover, not suitable for overwintering but provides juvenile and adult fish rearing habitat during open water.
	3	P3	Shallow (< 0.6 m deep) and small, low instream cover. Not suitable for overwintering or adult holding habitat but may provide rearing habitat for juvenile fish during open water.
Step Pool		SP	Series of pools separated by short riffles or cascades. Generally found in high gradient, confined mountain streams dominated by boulder substrate. The length of the turbulent water cannot exceed the mean wetted width; otherwise, classify the pools and turbulent water separately.

Table B.14 Water Clarity/Turbidity Codes

Code	Definition
C	Turbid
L	Moderately turbid
M	Lightly turbid
T	Clear

Dehcho Territory Fish and Fish Habitat

030CF: Drainage

UTM Location: 10U 473070 7015812 **Survey Date:** September 16, 2020

km Marker: 699.1 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing south on existing winter road

Photo 2. Subsurface flows to east of existing winter road

Photo 3. Water with subsurface flow to west of existing winter road

Photo 4. Facing downslope at drainage crossing

General Comments

Chance find ephemeral drainage oriented from east to west across the existing winter road, does not have continuously defined bed or banks. Not fish habitat potential.

Dehcho Territory Fish and Fish Habitat

SWA: Wetland Area

UTM Location: 10U 472880 7015938 **Survey Date:** September 23, 2020

km Marker: 699.3 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing west from helicopter

Photo 2. Facing east toward existing winter road from helicopter

Photo 3. Facing south from helicopter

Photo 4. Aerial imagery of survey area

General Comments

Wetland area adjacent to proposed Project corridor. An inlet was observed and assessed (WX-028) as an ephemeral drainage. No outlet was observed. No fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

UWB: Wetland Area

UTM Location: 10U 472322 7016741 **Survey Date:** September 23, 2020

km Marker: 700.3 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing west toward beaver lodge

Photo 2. Riparian vegetation during minnow trapping

Photo 3. Aerial imagery showing survey area

Fish Sampling Data

Method	Effort		Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Electrofishing	-	(s)	NO FISH CAPTURED	-	0	-	0.00	-
Minnow Trap	44.8	(hr)						

Water Quality Data

Time of Day (HH:MM):	17:36
Water temperature (°C):	6.34
Dissolved Oxygen (mg/L):	6.63
Sp. Conductivity (µS/cm):	-
pH:	6.62
Turbidity (NTU):	-

General Comments

Wetland area with an outlet connected to the Mackenzie River. Organic substrate and wetland vegetation. Maximum depth approximately 3 m. Active beaver lodge. Wetland affords potential fish habtiat.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

UWB-7: Wetland Area

UTM Location: 10U 471421 7017918 **Survey Date:** September 16, 2020

km Marker: 701.7 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing west from existing winter road

Photo 2. Facing north along edge of wetland area

Photo 3. Facing west from existing winter road

Photo 4. Outlet to west of wetland area

Fish Sampling Data

Method	Effort		Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Electrofishing	-	(s)	NO FISH CAPTURED	-	0	-	0.00	-
Minnow Trap	46	(hr)						

Water Quality Data

Time of Day (HH:MM):	10:53
Water temperature (°C):	5.85
Dissolved Oxygen (mg/L):	17.1
Sp. Conductivity (µS/cm):	131
pH:	6.61
Turbidity (NTU):	-

General Comments

Outlet visible to Mackenzie River. Organic substrate with wetland vegetation. Maximum depth measured approximately 2 m. Active beaver impoundment observed. No fish captured in minnow traps. Fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

SWA-1: Wetland Area

UTM Location: 10U 471183 7018318 **Survey Date:** September 23, 2020

km Marker: 702.2 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing southeast showing outlet

Photo 2. Facing east, outlet in red circle

Photo 3. Facing west from existing winter road

Photo 4. Minnow trap location near existing winter road

Fish Sampling Data

Method	Effort		Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Electrofishing	-	(s)	NO FISH CAPTURED	-	0	-	0.00	-
Minnow Trap	39.6	(hr)						

Water Quality Data

Time of Day (HH:MM):	16:55
Water temperature (°C):	8.04
Dissolved Oxygen (mg/L):	4.62
Sp. Conductivity (µS/cm):	102.00
pH:	5.02
Turbidity (NTU):	-

General Comments

Outlet visible to Mackenzie River. Organic substrate with riparian wetland vegetation. No fish captured during minnow trapping. Fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

UWB-1: Wetland Area

UTM Location: 10U 470932 7019008 **Survey Date:** September 16, 2020

km Marker: 702.9 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing wet towards larger body of water

Photo 2. Facing west showing inlet as ephemeral drainage

Photo 3. Aerial imagery showing survey area

Fish Sampling Data

Method	Effort		Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Electrofishing	-	(s)	NO FISH CAPTURED	-	0	-	0.00	-
Minnow Trap	44.8	(hr)						

Water Quality Data

Time of Day (HH:MM):	14:22
Water temperature (°C):	7.86
Dissolved Oxygen (mg/L):	13.08
Sp. Conductivity (µS/cm):	109.00
pH:	6.77
Turbidity (NTU):	-

General Comments

Wetland area with an inlet assessed as an ephemeral drainage (WX-031). Inlet provides connectivity to a larger waterbody to the west. Organic substrate and wetland vegetation with a maximum depth of approximately 1 m. No fish captured in minnow traps. Larger waterbody to west may afford fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

UWB-2: Wetland Area

UTM Location: 10U 470653 7020732 **Survey Date:** September 23, 2020
km Marker: 704.7 **Zone:** 2
Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing north across wetland

Photo 2. Facing west showing connection to larger waterbody

Photo 3. Facing west showing larger waterbody

Photo 4. Facing south with UWB-2 and larger waterbody visible

Fish Sampling Data

Method	Effort		Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Electrofishing	-	(s)	NO FISH CAPTURED	-	0	-	0.00	-
Minnow Trap	46	(hr)						

Water Quality Data

Time of Day (HH:MM):	12:27
Water temperature (°C):	7.98
Dissolved Oxygen (mg/L):	7.05
Sp. Conductivity (µS/cm):	65.00
pH:	7.82
Turbidity (NTU):	-

General Comments

Wetland is connected to a larger waterbody to the west. Wetland area has organic substrate and wetland vegetation. Maximum depth measured approximately 1 m. Larger waterbody likely has fish habtiat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

SWA-3: Wetland Area

UTM Location: 10U 471528 7027742 **Survey Date:** September 16, 2020

km Marker: 710.35 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Showing outlet, an ephemeral drainage

Photo 2. Facing south down existing winter road, no visible outlet

Photo 3. Water with subsurface flow to west of existing winter road

General Comments

Wetland area adjacent to proposed construction corridor. The outlet was assessed as an ephemeral drainage. There was no inlet visible on the ground. A full survey could not be completed due to nearby moose pasture. No fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

UWB-3: Wetland Area

UTM Location: 10U 469827 7031105 **Survey Date:** September 20, 2020

km Marker: 715.6 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing north from helicopter

Photo 2. Facing northeast from helicopter

Photo 3. Facing east towards existing winter road from helicopter

General Comments

Wetland area adjacent to proposed Project. No inlet or outlet were observed. No fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-035: Drainage

UTM Location: 10U 467959 7035544 **Survey Date:** September 22, 2020

km Marker: 718.79 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing north across existing winter road

Photo 2. No channelization 40 m east of existing winter road

Photo 3. Standing water on west side of existing winter road

Photo 4. No channelization 50 m east of existing winter road

General Comments

Ephemeral drainage oriented east-west across the existing winter road. No defined bed or banks observed. Some standing, isolated water was observed and was discontinuous on the west side of the existing winter road. No connectivity to the Mackenzie River was observed. River is approximately 2 km to the west. No fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

UWB-4: Wetland Area

UTM Location: 10U 468244 7035072 **Survey Date:** September 22, 2020

km Marker: 719.9 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing south from helicopter

Photo 2. Facing north from helicopter showing outlet

Photo 3. Facing east showing minnow trap

Photo 4. Facing southeast along wetland edge

Fish Sampling Data

Method	Effort		Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Electrofishing	-	(s)	NO FISH CAPTURED	-	0	-	0.00	-
Minnow Trap	35	(hr)						

Water Quality Data

Time of Day (HH:MM):	12:27
Water temperature (°C):	7.98
Dissolved Oxygen (mg/L):	7.05
Sp. Conductivity (µS/cm):	65.00
pH:	7.82
Turbidity (NTU):	-

General Comments

Wetland area. Outlet visible at northwest end of wetland. Organic substrate and wetland vegetation observed. Maximum depth is greater than 2 m. Wetland affords fish habtiat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-036: Unnamed Watercourse

UTM Location: 10U 465977 7037399 **Survey Date:** Septemeber 22, 2020
km Maker: 721.61 **Zone:** 2
Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Physical Channel Transect Data

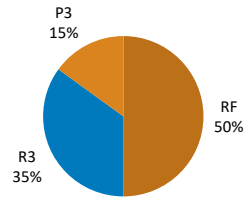
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	2.7	2.2	1.8	1.9	1.6	1.2
Wetted Width (m)	1.9	2.1	1.7	2.6	1.4	1.7
Depth at LDB + 25% (m)	0.1	0.2	0.2	0.2	0.1	0.2
Depth at LDB + 50% (m)	0.2	0.1	0.2	0.2	0.3	0.2
Depth at LDB + 75% (m)	0.3	0.1	0.4	0.2	0.3	0.2
Max.Bankfull Depth (m)	0.6	0.5	0.7	0.6	0.9	0.5
Gradient (%)	2	5	6	5	4	3
Dominant Habitat Unit	RF	RF	RF	RF	RF	R3
Stream Bed						
Substrate (% of Transect Area) Organics	25	25	25	25	25	25
Fines	50	50	50	50	50	50
Small Gravel	0	0	0	0	0	0
Large Gravel	5	5	5	5	5	5
Cobble	10	10	10	10	10	10
Boulder	10	10	10	10	10	10
Bedrock	0	0	0	0	0	0
Embeddedness	H	H	H	H	H	H

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.3	0.3	0.2	0.3	0.4	0.3	0.3	0.4	0.6	0.6	0.3	0.3
Bank Slope (°)	40	30	150	150	120	120	130	160	110	70	130	150
Bank Stability	MS	MS	S	S	MS	MS	S	S	S	MS	S	S
Dom. Bank Material	F	F	F	F	O	O	O	O	O	O	O	O
Subdom. Bank Material	F	O	O	O	F	LG	SG	C	F	F	F	F
Dom. Riparian Veg.	G	G	G	G	S	S	G	G	N	N	G	G
Subdom. Riparian Veg.	S	S	D	D	G	G	D	D	D	D	D	D

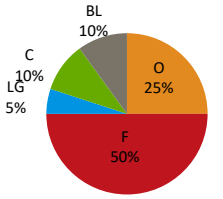
Habitat Inventory / Reach Data

Instream Cover (%):	11	Overhead Cover (%):	24
Dom. Instream Cover:	WD	Dom. Overhead Cover:	TS
Subdom. Instream Cover	DC	Subdom. Overhead Cove	UB
Maximum Depth (m)	0.4	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	14:03
Water Temperature (°C):	2.9
Dissolved Oxygen (mg/L)	8.59
Sp. Conductivity (µs/cm)	81.0
pH:	6.27
Turbidity (NTU):	-

Channel Characteristics

Pattern:	SI
Islands:	N
Bars:	SD
Coupling:	CO
Confinement:	FC
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Moderate	Moderate	Poor-Moderate
Passage:	Good	Good	Good

Photo 1: Facing upstream 200 m downstream of centerline.

Photo 2: Facing upstream at centerline.

Fish Sampling Data

Method	Effort	
Backpack Electrofisher (EB)	450	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
400	30	12	346

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED	0	-	0.00	-	-

General Comments

No fish captured or observed during fish assessment. Rearing habitat may be limited by velocity in riffle habitat throughout assessed reach. No known barrier between crossing location and Mackenzie River.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-038: Unnamed Watercourse

UTM Location: 10U 465248 7042571 **Survey Date:** September 22, 2020
km Marker 727.36 **Zone:** 2
Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Physical Channel Transect Data

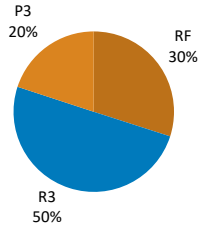
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	1.6	1.1	1.5	1.4	2.3	0.9
Wetted Width (m)	1.1	1.0	1.1	1.2	1.8	0.8
Depth at LDB + 25% (m)	0.1	0.2	0.3	0.3	0.2	0.3
Depth at LDB + 50% (m)	0.1	0.2	0.3	0.3	0.2	0.4
Depth at LDB + 75% (m)	0.1	0.2	0.2	0.1	0.1	0.4
Max.Bankfull Depth (m)	0.5	0.6	0.5	0.5	0.6	0.7
Gradient (%)	1	4	4	3	1.5	1.5
Dominant Habitat Unit	RF	RF	R3	R3	R3	R3
Stream Bed						
Substrate (% of Transect Area) Organics	30	30	30	30	30	30
Fines	50	50	50	50	50	50
Small Gravel	5	5	5	5	5	5
Large Gravel	5	5	5	5	5	5
Cobble	10	10	10	10	10	10
Boulder	0	0	0	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	H	H	H	H	H	H

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.3
Bank Slope (°)	80	60	100	90	45	50	80	30	50	40	90	90
Bank Stability	MS	MS	MS	MS	US	US	MS	MS	US	US	MS	MS
Dom. Bank Material	O	O	O	O	O	F	O	F	F	F	O	O
Subdom. Bank Material	F	F	F	F	F	F	F	O	O	O	F	F
Dom. Riparian Veg.	G	G	G	G	N	N	G	G	N	N	G	G
Subdom. Riparian Veg.	S	S	S	S	S	S	S	S	S	S	S	S

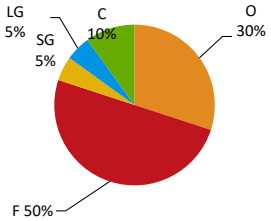
Habitat Inventory / Reach Data

Instream Cover (%):	9	Overhead Cover (%):	21
Dom. Instream Cover:	DC	Dom. Overhead Cover:	UB
Subdom. Instream Cover	-	Subdom. Overhead Cove	WD
Maximum Depth (m)	0.4	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	17:26
Water Temperature (°C):	2.5
Dissolved Oxygen (mg/L)	9.26
Sp. Conductivity (µs/cm)	74.0
pH:	7.53
Turbidity (NTU):	-

Channel Characteristics

Pattern:	ME
Islands:	N
Bars:	DG
Coupling:	CO
Confinement:	FC
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Moderate	Moderate	Poor-Moderate
Passage:	Moderate	Moderate	Moderate

Photo 1: Facing up at 50 m upstream from centerline

Photo 2: Facing upstream at centerline.

Fish Sampling Data

Method	Effort	
Backpack Electrofisher (EB)	432	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
400	30	12	317

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED	0	-	0.00	-	-

General Comments

High approach banks, fish habitat mostly limited by overall depth. No known barriers from Mackenzie River may provide seasonal fish habitat. No fish captured or observed during fish assessments.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

Drainage 1: Unnamed Watercourse

UTM Location: 10U 463008 7047414 **Survey Date:** September 24, 2020
km Marker: 732.74 **Zone:** 2
Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Physical Channel Transect Data

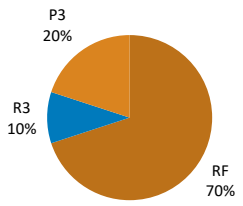
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6
Channel Width (m)	0.9	0.9	0.9	1.7	1.1	1.6
Wetted Width (m)	0.8	0.9	0.8	1.7	0.9	1.2
Depth at LDB + 25% (m)	0.2	0.2	0.2	0.3	0.0	0.1
Depth at LDB + 50% (m)	0.2	0.2	0.2	0.0	0.1	0.0
Depth at LDB + 75% (m)	0.1	0.1	0.3	0.1	0.1	0.2
Max.Bankfull Depth (m)	0.6	0.7	0.6	0.4	0.4	0.5
Gradient (%)	4	5	5	14	6	9
Dominant Habitat Unit	RF	RF	RF	RF	RF	RF
Stream Bed						
Substrate (% of Transect Area) – Organics	10	10	10	10	10	10
Substrate (% of Transect Area) – Fines	40	40	40	40	40	40
Substrate (% of Transect Area) – Small Gravel	0	0	0	0	0	0
Substrate (% of Transect Area) – Large Gravel	0	0	0	0	0	0
Substrate (% of Transect Area) – Cobble	15	15	15	15	15	15
Substrate (% of Transect Area) – Boulder	35	35	35	35	35	35
Substrate (% of Transect Area) – Bedrock	0	0	0	0	0	0
Embeddedness	M	M	M	M	M	M

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.4	0.4	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.2
Bank Slope (°)	90	90	100	80	90	90	90	90	100	90	50	90
Bank Stability	S	MS	MS	MS	S	S	S	S	S	S	MS	S
Dom. Bank Material	O	F	F	O	O	O	O	O	O	O	O	O
Subdom. Bank Material	F	O	O	O	F	F	F	F	O	O	F	O
Dom. Riparian Veg.	G	G	G	S	S	S	G	G	G	G	S	S
Subdom. Riparian Veg.	S	S	S	G	S	G	G	C	C	C	S	S

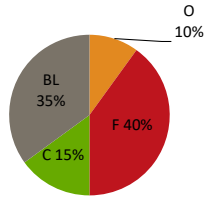
Habitat Inventory / Reach Data

Instream Cover (%):	5	Overhead Cover (%):	22
Dom. Instream Cover:	DC	Dom. Overhead Cover:	TS
Subdom. Instream Cover:	-	Subdom. Overhead Cover:	UB
Maximum Depth (m)	0.3	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	13:52
Water Temperature (°C):	3.3
Dissolved Oxygen (mg/L):	8.55
Sp. Conductivity (µs/cm):	88.0
pH:	6.47
Turbidity (NTU):	-

Channel Characteristics

Pattern:	ST
Islands:	N
Bars:	SD
Coupling:	CO
Confinement:	EN
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Poor	Poor	Poor
Passage:	Poor	Poor-Moderate	Poor-Moderate

Photo 1: Facing upstream 50 m downstream from centerline.

Photo 2: Facing downstream 100 m downtream of centerline.

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED					-

General Comments

Velocity and gradient barriers for fish at confluence with Mackenzie River and downstream of centerline (14% and 16% slope, respectively). Fish assessment not completed as fish presence was known.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

Bonnie Creek

UTM Location: 10U 462586 7048307 **Survey Date:** September 23, 2020
km Marker: 733.71 **Zone:** 2
Crew Initials: LD MAN **Restricted Activity Timing Window** August 15 to July 15

Physical Channel Transect Data

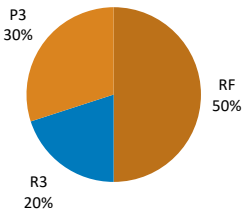
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	3.4	3.1	2.0	3.0	3.1	-
Wetted Width (m)	3.0	3.2	2.2	3.1	2.3	-
Depth at LDB + 25% (m)	0.1	0.2	0.2	0.2	0.3	-
Depth at LDB + 50% (m)	0.1	0.2	0.2	0.1	0.4	-
Depth at LDB + 75% (m)	0.1	0.3	0.2	0.2	0.3	-
Max.Bankfull Depth (m)	0.4	0.5	0.7	0.5	0.7	-
Gradient (%)	4	4	9	5	2	-
Dominant Habitat Unit	P3	RF	RF	RF	R3	-
Stream Bed						
Substrate (% of Transect Area) Organics	5	5	5	5	5	-
Fines	20	20	20	20	20	-
Small Gravel	15	15	15	15	15	-
Large Gravel	0	0	0	0	0	-
Cobble	20	20	20	20	20	-
Boulder	40	40	40	40	40	-
Bedrock	0	0	0	0	0	-
Embeddedness	M	M	M	M	M	-

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.2	0.2	0.2	0.2	0.5	0.6	0.3	0.3	0.2	0.3	-	-
Bank Slope (°)	90	90	110	90	90	100	120	110	90	40	-	-
Bank Stability	S	MS	MS	MS	S	S	S	S	MS	MS	-	-
Dom. Bank Material	O	O	O	O	O	O	O	O	O	F	-	-
Subdom. Bank Material	F	F	F	F	F	F	SG	SG	F	O	-	-
Dom. Riparian Veg.	G	S	S	S	S	S	G	G	G	G	-	-
Subdom. Riparian Veg.	C	G	G	G	C	G	S	S	S	S	-	-

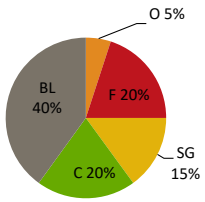
Habitat Inventory / Reach Data

Instream Cover (%):	15	Overhead Cover (%):	25
Dom. Instream Cover:	BL	Dom. Overhead Cover:	TS
Subdom. Instream Cover:	WD	Subdom. Overhead Cove	UB
Maximum Depth (m)	0.4	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	10:47
Water Temperature (°C):	0.8
Dissolved Oxygen (mg/L):	12.03
Sp. Conductivity (µs/cm):	80.0
pH:	6.61
Turbidity (NTU):	-

Channel Characteristics

Pattern:	SI
Islands:	N
Bars:	DG
Coupling:	CO
Confinement:	EN
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	None	None	None
Rearing:	Moderate	Moderate	Moderate-Good
Passage:	Moderate	Moderate	Moderate

Photo 1: Facing upstream from 100 meters up for centerline

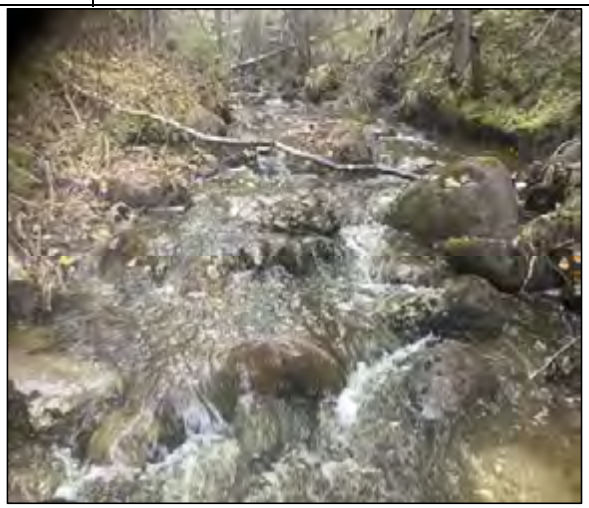


Photo 2: Facing upstream 100 meters down from Centerline.

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED					-

General Comments

Confluence with Mackenzie River approximately 240 meters downstream from centerline, no fish barriers observed. Fish assessment not completed as fish presence was known.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

Drainage 2 Unnamed Watercourse

UTM Location: 10U 462082 7050913 **Survey Date:** September 23, 2020

km Marker: 736.48 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

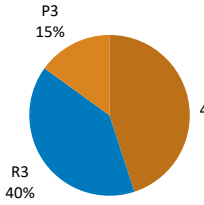
Physical Channel Transect Data

Transect # (Location)	1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)	
Channel Width (m)	0.8		1.1		0.9		1.2		1.3		1.2	
Wetted Width (m)	0.9		1.0		1.0		1.0		0.9		1.7	
Depth at LDB + 25% (	0.2		0.1		0.3		0.1		0.3		0.1	
Depth at LDB + 50% (	0.2		0.1		0.3		0.2		0.3		0.1	
Depth at LDB + 75% (	0.2		0.1		0.3		0.3		0.1		0.1	
Max.Bankfull Depth (	0.6		0.4		0.7		0.5		0.4		0.2	
Gradient (%)	6		4		4		10		7		6	
Dominant Habitat Un	R3		R3		RF		R3		RF		RF	
Stream Bed												
Substrate (% of Transect Area) Organics	20		20		20		20		20		20	
Fines	30		30		30		30		30		30	
Small Gravel	20		20		20		20		20		20	
Large Gravel	5		5		5		5		5		5	
Cobble	10		10		10		10		10		10	
Boulder	15		15		15		15		15		15	
Bedrock	0		0		0		0		0		0	
Embeddedness	M		M		M		M		M		M	
Bank Measurements	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**
Bank Height (m)	0.3	0.3	0.3	0.3	0.3	0.4	0.2	0.2	0.2	0.3	0.2	0.3
Bank Slope (°)	110	130	70	50	120	160	80	70	110	80	130	160
Bank Stability	S	S	MS	US	S	S	MS	MS	S	S	S	S
Dom. Bank Material	O	O	F	F	O	O	F	F	O	O	O	O
Subdom. Bank Mater	F	F	O	O	F	F	O	O	F	F	F	F
Dom. Riparian Veg.	N	N	G	G	G	G	G	G	G	G	G	G
Subdom. Riparian Ve	S	S	S	S	S	S	S	S	S	S	S	S

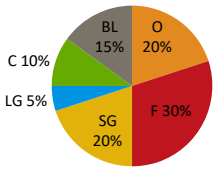
Habitat Inventory / Reach Data

Instream Cover (%):	7	Overhead Cover (%):	16
Dom. Instream Cover:	WD	Dom. Overhead Cover:	UB
Subdom. Instream Cover	DC	Subdom. Overhead Cove	TS
Maximum Depth (m)	0.3	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	10:27
Water Temperature (°C):	0.7
Dissolved Oxygen (mg/L)	8.88
Sp. Conductivity (µs/cm)	78.0
pH:	6.52
Turbidity (NTU):	-

Channel Characteristics

Pattern:	SI
Islands:	N
Bars:	N
Coupling:	CO
Confinement:	CO
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Moderate	Moderate	Poor-Moderate
Passage:	Moderate	Moderate	Moderate

Photo 1: Facing downstream 200 m downstream of centerline.

Photo 2: Facing upstream 100 m upstream of centerline.

Fish Sampling Data

Method	Effort		Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
No Electrofishing	-	(s)	NO FISH CAPTURED					-
No Trapping	-	(hr)						

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)

General Comments

No known barriers between Mackenzie River and proposed crossing location or within assessed reach. Fish assessment not completed as fish presence was known. Fish habitat was limited by depth at the time of assessment.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-039: Unnamed Watercourse

UTM Location: 10U 462013 7051561 **Survey Date:** Septemeber 23, 2020
km Marker: 738.7 **Zone:** 2
Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Physical Channel Transect Data

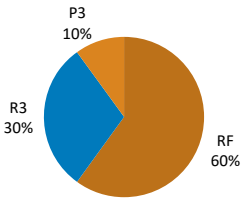
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	1.4	0.9	1.8	1.1	1.4	1.5
Wetted Width (m)	1.2	1.0	1.1	1.0	1.0	1.1
Depth at LDB + 25% (m)	0.2	0.1	0.2	0.3	0.2	0.1
Depth at LDB + 50% (m)	0.2	0.2	0.2	0.3	0.2	0.0
Depth at LDB + 75% (m)	0.2	0.2	0.1	0.2	0.1	0.1
Max.Bankfull Depth (m)	0.6	0.6	0.7	0.7	0.6	0.5
Gradient (%)	3	4	2	1	3	3
Dominant Habitat Unit	RF	RF	R3	R3	RF	RF
Stream Bed						
Substrate (% of Transect Area) Organics	10	10	10	10	10	10
Fines	40	40	40	40	40	40
Small Gravel	20	20	20	20	20	20
Large Gravel	5	5	5	5	5	5
Cobble	20	20	20	20	20	20
Boulder	0	0	0	0	0	0
Bedrock	5	5	5	5	5	5
Embeddedness	M	M	M	M	M	M

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.3	0.3	0.3	0.3	0.4	0.5	0.3	0.4	0.2	0.3	0.3	0.2
Bank Slope (°)	95	110	120	110	90	50	90	90	80	40	100	90
Bank Stability	MS	MS	MS	MS	MS	US	MS	MS	MS	US	US	MS
Dom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	F
Subdom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	O
Dom. Riparian Veg.	G	G	G	G	G	G	G	G	G	G	G	G
Subdom. Riparian Veg.	C	C	S	S	S	S	C	S	S	S	S	S

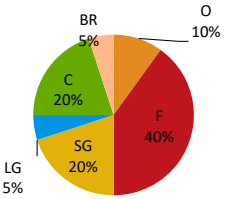
Habitat Inventory / Reach Data

Instream Cover (%):	9	Overhead Cover (%):	15
Dom. Instream Cover:	DC	Dom. Overhead Cover:	TS
Subdom. Instream Cover:	BL	Subdom. Overhead Co	UB
Maximum Depth (m)	0.3	Dom. Aquatic Veg. Typ	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	13:27
Water Temperature (°C):	0.4
Dissolved Oxygen (mg/L):	9.08
Sp. Conductivity (µs/cm):	67.0
pH:	6.99
Turbidity (NTU):	-

Channel Characteristics

Pattern:	IR
Islands:	N
Bars:	SD
Coupling:	CO
Confinement	FC
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Moderate	Moderate	Poor-Moderate
Passage:	Good	Good	Good

Photo 1: Facing down fom 50 m upstream from centerline.

Photo 2: Facing upstream at centerline.

Fish Sampling Data

Method	Effort	
Backpack Electrofisher (EB)	573	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
350	30	12	378

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED	0	-	0.00	-	-

General Comments

No fish captured or observed during fish assessment. No known barrier from Mackenzie River. Watercourse may provide seasonal fish habitat. Predominantly fines and organic substrate combined with low depth and cover limit fish habitat ratings.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

Drainage 3 Unnamed Watercourse

UTM Location: 10U 461404 7053822 **Survey Date:** September 21, 2020

km Marker: 739.55 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Physical Channel Transect Data

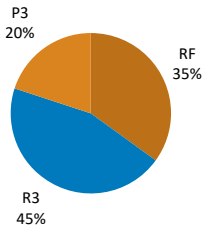
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	2.4	2.2	1.6	1.7	2.4	1.7
Wetted Width (m)	1.9	1.1	1.2	1.4	2.2	1.4
Depth at LDB + 25% (m)	0.1	0.2	0.2	0.2	0.1	0.1
Depth at LDB + 50% (m)	0.1	0.2	0.2	0.2	0.1	0.2
Depth at LDB + 75% (m)	0.2	0.2	0.2	0.1	0.1	0.3
Max.Bankfull Depth (m)	0.5	0.6	0.5	0.7	0.3	0.6
Gradient (%)	2	4	3	3	2	4
Dominant Habitat Unit	R3	R3	R3	RF	RF	R3
Stream Bed						
Substrate (% of Transect Area) Organics	20	20	20	20	20	20
Fines	40	40	40	40	40	40
Small Gravel	10	10	10	10	10	10
Large Gravel	10	10	10	10	10	10
Cobble	20	20	20	20	20	20
Boulder	0	0	0	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	H	H	H	H	H	H

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.2	0.4	0.3	0.3	0.2	0.2	0.3	0.3	0.3	0.2	0.3	0.2
Bank Slope (°)	80	90	30	70	40	80	50	80	90	100	30	150
Bank Stability	S	S	MS	MS	MS	MS	MS	MS	MS	S	US	S
Dom. Bank Material	O	O	F	F	F	F	O	O	O	O	F	O
Subdom. Bank Material	F	F	O	O	O	O	F	F	F	F	O	F
Dom. Riparian Veg.	S	S	C	S	S	S	S	S	C	S	S	S
Subdom. Riparian Veg.	G	G	S	G	G	G	G	G	G	G	G	G

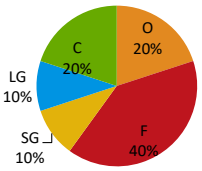
Habitat Inventory / Reach Data

Instream Cover (%):	13	Overhead Cover (%)	11
Dom. Instream Cover:	WD	Dom. Overhead Cov	TS
Subdom. Instream Cover:	DC	Subdom. Overhead	UB
Maximum Depth (m)	0.3	Dom. Aquatic Veg. T	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	17:23
Water Temperature (°C):	2.2
Dissolved Oxygen (mg/L):	9.29
Sp. Conductivity (µs/cm):	103
pH:	7.55
Turbidity (NTU):	-

Channel Characteristics

Pattern:	ME
Islands:	N
Bars:	DG
Coupling:	CO
Confinement	FC
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Good	Good	Good
Passage:	Good	Good	Good

Photo 1: Facing upstrea 200 m downstream from centerline.

Photo 2: Facing downstream 50 m upstream of centerline.

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts | Freq. (Hz) | Duty Cycle (%) | Dist. (m)

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED					-

General Comments

Potential for erosion concerns upstream of centerline, stream does a sharp "S" bend and parallels existing winter road for approximately 20 m. No know barriers between crossing and Mackenzie River. Fish assessment not completed as fish presence was known.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-040: Unnamed Watercourse

UTM Location: 10U 461135 7055011 **Survey Date:** Septemeber 21, 2020
km Marker: 740.75 **Zone:** 2
Crew Initials: LD MAN **Restricted Activity Timing Window** August 15 to July 15

Physical Channel Transect Data

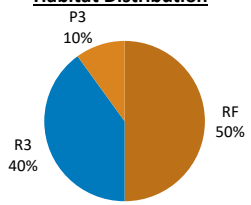
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	1.5	1.9	1.3	1.2	1.4	1.1
Wetted Width (m)	1.1	1.6	1.4	1.0	1.3	1.1
Depth at LDB + 25% (	0.3	0.1	0.3	0.3	0.2	0.3
Depth at LDB + 50% (	0.3	0.1	0.2	0.3	0.2	0.4
Depth at LDB + 75% (	0.1	0.1	0.1	0.2	0.3	0.3
Max.Bankfull Depth (	0.6	0.4	0.4	0.4	0.5	0.6
Gradient (%)	4	2	4	-	4	3
Dominant Habitat Un	RF	R3	R3	RF	RF	RF
Stream Bed						
Substrate (% of Transect Area) Organics	20	20	20	20	20	20
Fines	70	70	70	70	70	70
Small Gravel	0	0	0	0	0	0
Large Gravel	5	5	5	5	5	5
Cobble	5	5	5	5	5	5
Boulder	0	0	0	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	M	M	M	M	M	M

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.2	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.3	0.2	0.1	0.2
Bank Slope (°)	80	20	40	70	100	100	70	45	90	110	100	90
Bank Stability	MS	US	US	US	S	S	MS	MS	MS	MS	S	S
Dom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	O
Subdom. Bank Mater	F	F	F	F	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	G	G	G	G	G	G	G	G	G	G	S	S
Subdom. Riparian Ve	S	S	S	S	C	S	S	S	S	S	G	G

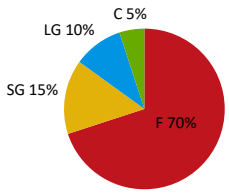
Habitat Inventory / Reach Data

Instream Cover (%):	8	Overhead Cover (%):	17
Dom. Instream Cover:	DC	Dom. Overhead Cover:	TS
Subdom. Instream Cover:	WD	Subdom. Overhead Cover:	WD
Maximum Depth (m)	0.4	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	16:25
Water Temperature (°C):	2.5
Dissolved Oxygen (mg/L):	17.83
Sp. Conductivity (µs/cm):	83.0
pH:	7.99
Turbidity (NTU):	-

Channel Characteristics

Pattern:	IR
Islands:	N
Bars:	DG
Coupling:	CO
Confinement:	CO
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Moderate-Good	Moderate-Good	Moderate
Passage:	Moderate	Moderate	Moderate

Photo 1: Facing downstream at centerline

Photo 2: Facing downstream 100 m upstream of centerline.

Fish Sampling Data

Method	Effort	
Backpack Electrofisher (EB	359	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
300	30	12	367

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED	0	-	0.00	-	-

General Comments

No fish captured or observed during fish assessment. No known barrier from Mackenzie River, likely provides seasonal fish habitat. Low depth and cover limit fish habitat, with potential for rearing in run habitat.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-041: Unnamed Watercourse

UTM Location: 10U 460915 7055927 **Survey Date:** Septemeber 20, 2020
km Marker: 741.74 **Zone:** 2
Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Physical Channel Transect Data

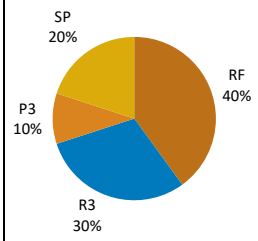
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	0.9	1.3	1.2	1.3	1.7	0.8
Wetted Width (m)	0.6	0.7	1.0	1.0	1.1	0.9
Depth at LDB + 25% (m)	0.3	0.1	0.5	0.1	0.1	0.2
Depth at LDB + 50% (m)	0.2	0.0	0.6	0.2	0.1	0.2
Depth at LDB + 75% (m)	0.2	0.2	0.5	0.3	0.2	0.3
Max.Bankfull Depth (m)	0.7	0.7	0.9	0.6	0.5	0.6
Gradient (%)	7	6	4	-	4	6
Dominant Habitat Unit	SP	SP	R3	RF	R3	RF
Stream Bed						
Substrate (% of Transect Area) Organics	0	0	0	0	0	0
Fines	100	100	100	100	100	100
Small Gravel	0	0	0	0	0	0
Large Gravel	0	0	0	0	0	0
Cobble	0	0	0	0	0	0
Boulder	0	0	0	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	VH	VH	VH	VH	VH	VH

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.3	0.3	0.3	0.4	0.3	0.4	0.2	0.3	0.4	0.3	0.3	0.3
Bank Slope (°)	80	80	90	50	45	70	80	90	80	80	100	120
Bank Stability	MS	MS	MS	US	MS	MS	MS	S	US	US	S	S
Dom. Bank Material	F	F	F	F	F	F	O	O	F	F	F	F
Subdom. Bank Material	O	O	O	O	O	O	F	F	O	O	O	O
Dom. Riparian Veg.	G	G	N	G	G	G	G	G	G	G	G	G
Subdom. Riparian Veg.	S	D	S	S	S	S	S	S	S	S	S	S

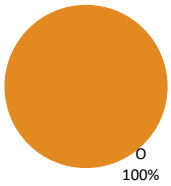
Habitat Inventory / Reach Data

Instream Cover (%):	2	Overhead Cover (%):	15
Dom. Instream Cover:	DC	Dom. Overhead Cover:	TS
Subdom. Instream Cover	-	Subdom. Overhead Cove	WD
Maximum Depth (m)	0.6	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	18:07
Water Temperature (°C):	4.0
Dissolved Oxygen (mg/L)	8.94
Sp. Conductivity (µs/cm):	62.0
pH:	7.24
Turbidity (NTU):	-

Channel Characteristics

Pattern:	IR
Islands:	N
Bars:	MD
Coupling:	CO
Confinement:	FC
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	None	None	None
Overwintering:	Poor	Poor	Poor
Rearing:	Poor-Moderate	Poor-Moderate	Poor
Passage:	Moderate	Moderate	Moderate

Photo 1: Facing down at 200 m downstream from centerline

Photo 2: Facing up at 100 m downstream of centerline.

Fish Sampling Data

Method	Effort	
Backpack Electrofisher (EB)	331	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
300	30	12	321

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED	0	-	0.00	-	-

General Comments

No suitable substrate for spawning. No known barriers between proposed crossing location and the Mackenzie River. Some rearing habitat present in runs throughout assessed reach but limited by depth and instream cover. No fish captured during fish assessments.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-042: Unnamed Watercourse

UTM Location: 10U 460641 7057047 **Survey Date:** Septemeber 20, 2020
km Marker: 742.74 **Zone:** 2
Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Physical Channel Transect Data

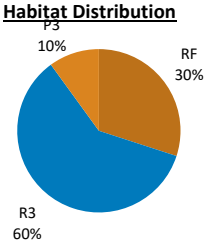
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	0.6	0.6	1.0	1.6	1.4	0.8
Wetted Width (m)	1.1	1.2	1.4	2.0	1.8	1.1
Depth at LDB + 25% (m)	0.1	0.1	0.1	0.1	0.1	0.1
Depth at LDB + 50% (m)	0.1	0.2	0.1	0.1	0.1	0.1
Depth at LDB + 75% (m)	0.1	0.1	0.0	0.0	0.2	0.1
Max.Bankfull Depth (m)	0.6	0.7	0.3	0.4	0.9	0.4
Gradient (%)	3	1	-	4	-	-
Dominant Habitat Unit	R3	R3	R3	RF	R3	R3
Stream Bed						
Substrate (% of Transect Area) Organics	0	0	0	0	0	0
Fines	90	90	90	90	90	90
Small Gravel	10	10	10	10	10	10
Large Gravel	0	0	0	0	0	0
Cobble	0	0	0	0	0	0
Boulder	0	0	0	0	0	0
Bedrock	0	0	0	0	0	0
Embeddedness	VH	VH	VH	VH	VH	VH

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.3	0.4	0.3	0.3	0.1	0.1	-	0.4	0.3	0.4	0.2	0.3
Bank Slope (°)	70	70	60	60	20	20	-	50	-	-	110	70
Bank Stability	US	US	US	US	US	US	US	US	US	US	US	US
Dom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	F
Subdom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	O
Dom. Riparian Veg.	N	N	S	S	N	N	S	S	S	S	S	S
Subdom. Riparian Veg.	G	G	G	G	S	S	N	N	N	N	N	N

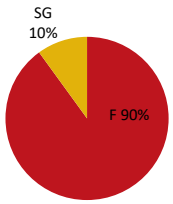
Habitat Inventory / Reach Data

Instream Cover (%):	0	Overhead Cover (%):	19
Dom. Instream Cover:	-	Dom. Overhead Cover:	TS
Subdom. Instream Cover	-	Subdom. Overhead Cove	OV
Maximum Depth (m)	0.2	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	14:15
Water Temperature (°C):	2.9
Dissolved Oxygen (mg/L)	10.00
Sp. Conductivity (µs/cm)	96.0
pH:	7.32
Turbidity (NTU):	-

Channel Characteristics

Pattern:	IR
Islands:	F
Bars:	BR
Coupling:	CO
Confinement:	FC
Flow Stage:	Low

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Poor	Poor	Poor
Passage:	Poor	Poor	Poor

Photo 1: Facing up 200 m downstream from centerline

Photo 2: Facing up 100 m downstream from centerline.

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts Freq. (Hz) Duty Cycle (%) Dist. (m)

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED	-	-	-	-	-

General Comments

Fish assessment not completed due to safety concerns from unstable banks. Fish habitat rated as poor due to low depth, predominantly fine and organic substrate and lack of instream cover.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-043: Unnamed Watercourse

UTM Location: 10U 458952 7061042 **Survey Date:** September 20, 2020
km Marker: 747.56 **Zone:** 2
Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

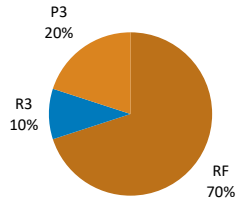
Physical Channel Transect Data

Transect # (Location)	1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)	
Channel Width (m)	0.9		-		1.3		1.3		-		-	
Wetted Width (m)	2.1		-		0.9		0.9		-		-	
Depth at LDB + 25% (	0.8		-		0.1		0.1		-		-	
Depth at LDB + 50% (	0.1		-		0.0		0.1		-		-	
Depth at LDB + 75% (	0.2		-		0.0		0.1		-		-	
Max.Bankfull Depth (	0.1		-		0.1		0.4		-		-	
Gradient (%)	16		-		2		14		-		-	
Dominant Habitat Un	SP		-		RF		SP		-		-	
Stream Bed												
Substrate (% of Transect Area) Organics	0		-		0		0		-		-	
Fines	25		-		25		25		-		-	
Small Gravel	20		-		20		20		-		-	
Large Gravel	5		-		5		5		-		-	
Cobble	20		-		20		20		-		-	
Boulder	30		-		30		30		-		-	
Bedrock	0		-		0		0		-		-	
Embeddedness	L		L		L		L		-		-	
Bank Measurements	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**
Bank Height (m)	-	-	-	-	0.2	0.1	0.2	0.2	-	-	-	-
Bank Slope (°)	-	-	-	-	70	60	90	60	-	-	-	-
Bank Stability	S	S	-	-	US	US	MS	MS	-	-	-	-
Dom. Bank Material	O	O	-	-	F	F	O	C	-	-	-	-
Subdom. Bank Mater	LG	SG	-	-	F	O	C	O	-	-	-	-
Dom. Riparian Veg.	G	G	-	-	G	G	G	G	-	-	-	-
Subdom. Riparian Ve	G	G	-	-	G	S	S	S	-	-	-	-

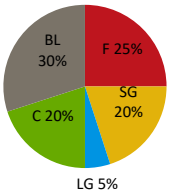
Habitat Inventory / Reach Data

Instream Cover (%):	6	Overhead Cover (%):	10
Dom. Instream Cover:	BL	Dom. Overhead Cover:	TS
Subdom. Instream Cover	DC	Subdom. Overhead Cove	UB
Maximum Depth (m)	0.8	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	10:45
Water Temperature (°C):	2.6
Dissolved Oxygen (mg/L)	113.20
Sp. Conductivity (µs/cm):	90.0
pH:	-
Turbidity (NTU):	-

Channel Characteristics

Pattern:	IR
Islands:	N
Bars:	N
Coupling:	CO
Confinement:	CO
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Poor	Poor	Poor
Passage:	Poor	Poor	Poor

Photo 1: Facing upstream 100 m upstream of centerline.

Photo 2: Facing downstream 50 m downstream of centerline.

Fish Sampling Data

Method	Effort	
Backpack Electrofisher (EB	213	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
355	30	12	131

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED	0	-	0.00	-	-

General Comments

Existing culvert at this site is broken on the inlet and bank is sloughing on the outlet causing a temporary barrier to fish (see crossing WX-043 Culvert). Confluence with Mackenzie River located approximately 110 m downstream. Potential gradient barrier (30% slope) with step pools 30 m upstream of confluence. Potential velocity barrier at step pools 100 m upstream from centerline. No transect completed at 50 m upstream as stream became inaccessible in root bridge complexes for approximately 50 m. No fish were captured or observed during the fish assessment.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-043: Culvert

UTM Location: 10U 458952 7061042 **Survey Date:** September 16, 2020

km Marker: - **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing right downstream bank towards inlet

Photo 2. Facing left downstream bank towards inlet

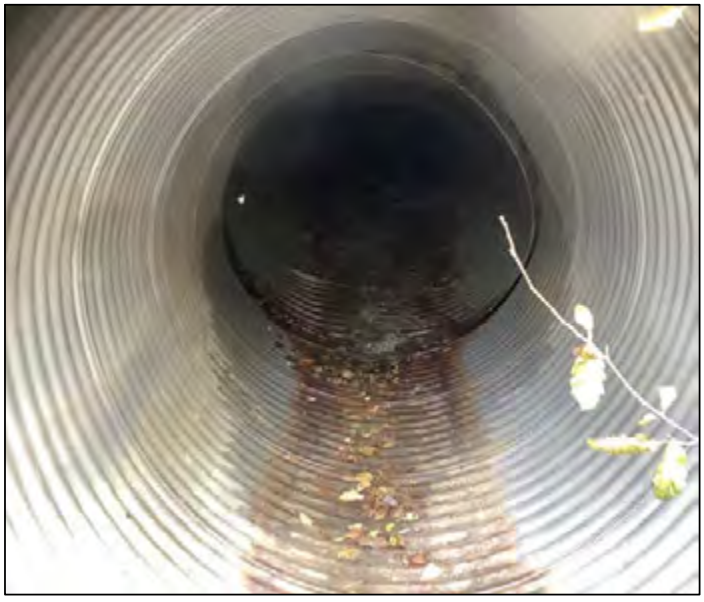


Photo 3. Facing upstream showing damaged culvert

Photo 4. Culvert outlet

General Comments

Culvert associated with watercourse crossed at WX-043. 1,500 mm diameter culvert. Culvert appears to be collapsed and broken, especially at inlet. Evidence of ice jams against existing winter road.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-044 Unnamed Watercourse

UTM Location: 10U 458839 7061453 **Survey Date:** September 20, 2020
km Marker: 748.02 **Zone:** 2
Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

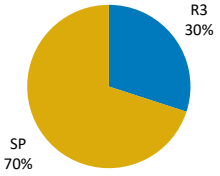
Physical Channel Transect Data

Transect # (Location)	1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)	
Channel Width (m)	1.2		1.6		1.6		0.8		1.7		-	
Wetted Width (m)	1.0		0.5		1.0		0.9		1.4		-	
Depth at LDB + 25% (m)	0.1		0.2		0.1		0.1		0.1		-	
Depth at LDB + 50% (m)	0.1		0.3		0.1		0.1		0.1		-	
Depth at LDB + 75% (m)	0.1		0.3		0.2		0.1		0.1		-	
Max.Bankfull Depth (m)	0.7		0.5		0.6		0.4		0.4		-	
Gradient (%)	15		16		-		2		11		-	
Dominant Habitat Unit	SP		SP		SP		R3		SP		-	
Stream Bed												
Substrate (% of Transect Area) Organics	0		0		0		0		0		-	
Fines	20		20		20		20		20		-	
Small Gravel	10		10		10		10		10		-	
Large Gravel	15		15		15		15		15		-	
Cobble	40		40		40		40		40		-	
Boulder	15		15		15		15		15		-	
Bedrock	0		0		0		0		0		-	
Embeddedness	L		L		L		L		L		-	
Bank Measurements	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**
Bank Height (m)	0.4	0.5	0.1	0.2	0.4	0.4	0.1	0.2	0.3	0.3	-	-
Bank Slope (°)	100	110	30	110	30	70	90	110	100	130	-	-
Bank Stability	S	S	MS	S	US	MS	S	S	S	S	-	-
Dom. Bank Material	O	O	F	F	F	F	O	O	O	O	-	-
Subdom. Bank Material	SG	C	O	O	O	O	F	F	LG	F	-	-
Dom. Riparian Veg.	G	G	G	G	S	S	S	S	S	S	-	-
Subdom. Riparian Veg.	S	S	S	S	G	G	G	G	G	G	-	-

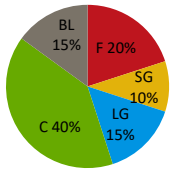
Habitat Inventory / Reach Data

Instream Cover (%):	8	Overhead Cover (%):	18
Dom. Instream Cover:	DC	Dom. Overhead Cover:	UB
Subdom. Instream Cover	BL	Subdom. Overhead Cove	TS
Maximum Depth (m)	0.3	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	12:13
Water Temperature (°C):	3.8
Dissolved Oxygen (mg/L)	12.09
Sp. Conductivity (µs/cm):	74.0
pH:	6.59
Turbidity (NTU):	-

Channel Characteristics

Pattern:	IR
Islands:	N
Bars:	N
Coupling:	CO
Confinement:	CO
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Poor	Poor	Poor
Passage:	Poor	Poor	Poor

Photo 1: Facing upstream 100 m downstream from centerline.

Photo 2: Facing upstream 50 m upstream of centerline.

Fish Sampling Data

Method	Effort	
No Electrofishing	335	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
375	30	12	251

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED	0	-	0.00	-	-

General Comments

No fish captured or observed during fish assessment. Gradient barrier identified 50 m upstream from confluence with Mackenzie River, 24 % gradient over 20 m of stream length. Culvert collapsed under existing road, see WX-044 Culvert summary data sheet.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-044: Culvert

UTM Location: 10U 458839 7061453 **Survey Date:** September 16, 2020

km Marker: - **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

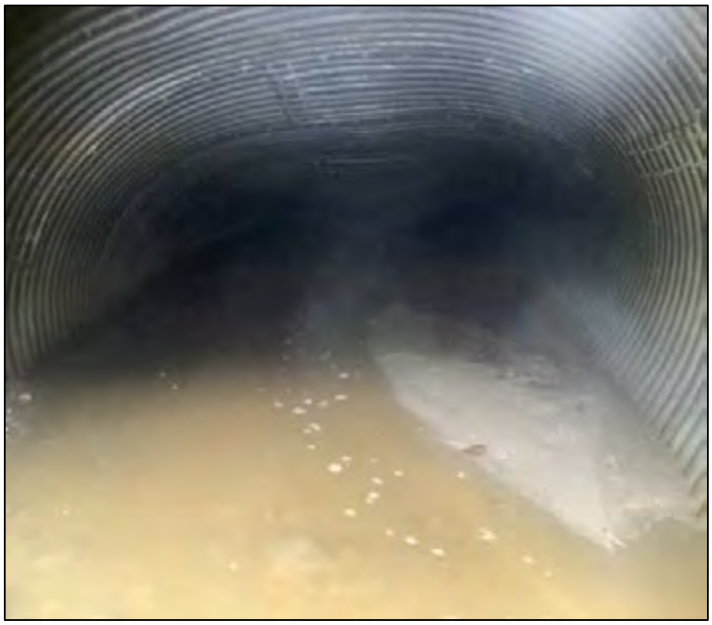


Photo 1.Facing outlet, culvert collapsed in centre

Photo 2. Facing outlet of culvert

Photo 3. Facing downstream towards culvert inlet

Photo 4. Facing downstream towards culvert inlet

General Comments

Culvert associated with watercourse crossed at WX-044. 1,500 mm diameter culvert. Culvert appears to be collapsed and sediment hase accumulated within the culvert near the outlet.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

Bob's Canyon Creek

UTM Location: 10U 456554 7065466 **Survey Date:** Septmeber 19, 2020

km Marker: 752.61 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Physical Channel Transect Data

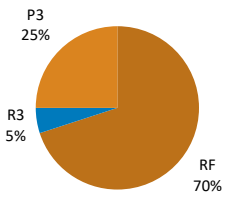
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓150)	6 (↓300)
Channel Width (m)	1.7	3.4	2.0	2.5	1.9	-
Wetted Width (m)	1.5	2.5	1.8	2.75	1.65	-
Depth at LDB + 25% (m)	0.2	0.2	0.2	0.1	0.3	-
Depth at LDB + 50% (m)	0.2	0.3	0.2	0.1	0.2	-
Depth at LDB + 75% (m)	0.2	0.1	0.4	0.1	0.1	-
Max.Bankfull Depth (m)	0.4	0.4	0.48	0.35	0.5	-
Gradient (%)	5	7	4	5	6	-
Dominant Habitat Unit	RF	RF	RF	RF	RF	-
Stream Bed						
Substrate (% of Transect Area) Organics	0	0	0	0	0	-
Fines	25	25	25	25	25	-
Small Gravel	20	20	20	20	20	-
Large Gravel	0	0	0	0	0	-
Cobble	15	15	15	15	15	-
Boulder	40	40	40	40	40	-
Bedrock	0	0	0	0	0	-
Embeddedness	L	L	L	L	L	

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.2	0.2	0.1	0.2	0.1	0.2	0.3	0.2	0.2	0.2	-	-
Bank Slope (°)	110	90	70	45	90	80	90	140	100	90	-	-
Bank Stability	MS	MS	US	US	MS	MS	MS	MS	S	S	-	-
Dom. Bank Material	O	O	F	F	O	O	F	F	O	O	-	-
Subdom. Bank Material	F	F	O	O	F	F	O	O	SG	F	-	-
Dom. Riparian Veg.	S	S	S	S	S	S	G	S	G	G	-	-
Subdom. Riparian Veg.	G	G	N	G	G	G	S	G	S	S	-	-

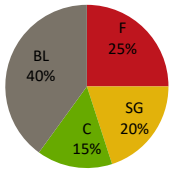
Habitat Inventory / Reach Data

Instream Cover (%):	4	Overhead Cover (%):	24
Dom. Instream Cover:	DC	Dom. Overhead Cover:	TS
Subdom. Instream Cover	-	Subdom. Overhead Cove	UB
Maximum Depth (m)	0.4	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	21:47
Water Temperature (°C):	5.1
Dissolved Oxygen (mg/L)	88.10
Sp. Conductivity (µs/cm):	52.0
pH:	8.01
Turbidity (NTU):	-

Channel Characteristics

Pattern:	IR
Islands:	N
Bars:	DG
Coupling:	CO
Confinement:	OC
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Poor	Poor-Moderate	Poor-Moderate
Passage:	Poor	Poor	Poor

Photo 1: Facing upstream at 50 m upstream from centerline.

Photo 2: Facing downstream at 150 m downstream from centerline.

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts Freq. (Hz) Duty Cycle (%) Dist. (m)

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED					-

General Comments

Overall poor fish habitat due to steep gradient. Two potential gradient barriers (15% and 17% slope) near confluence with Mackenzie River, approximately 200 m downstream from centerline. Large (7,000 mm diameter) culvert on Bob's Canyon Creek at existing winter road appears in good condition. Fish assessment not completed as fish presence was known.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-045: Unnamed Watercourse

UTM Location: 10U 451513 7076541 **Survey Date:** September 18, 2020
km Marker: 765.51 **Zone:** 2
Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Physical Channel Transect Data

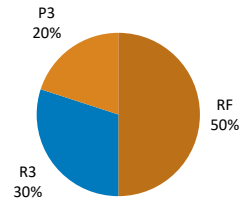
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)
Channel Width (m)	2.1	3.0	1.5	2.7	2.7	3.2
Wetted Width (m)	1.9	2.2	1.6	2.7	2.5	2.7
Depth at LDB + 25% (	0.2	0.1	0.2	0.3	0.3	0.2
Depth at LDB + 50% (	0.2	0.2	0.2	0.3	0.4	0.1
Depth at LDB + 75% (	0.3	0.2	0.3	0.2	0.4	0.1
Max.Bankfull Depth (	0.5	0.7	0.6	0.5	0.9	0.4
Gradient (%)	3	3	4	2	5	11
Dominant Habitat Un	RF	RF	R3	RF	RF	RF
Stream Bed						
Substrate (% of Transect Area) Organics	10	10	10	10	10	10
Fines	20	20	20	20	20	20
Small Gravel	10	10	10	10	10	10
Large Gravel	0	0	0	0	0	0
Cobble	20	20	20	20	20	20
Boulder	40	40	40	40	40	40
Bedrock	0	0	0	0	0	0
Embeddedness	M	M	H	M	M	M

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	0.2	0.2	0.3	0.3	0.4	0.3	0.2	0.2	0.3	0.4	0.2	0.2
Bank Slope (°)	100	90	100	90	90	90	110	90	110	90	150	90
Bank Stability	S	S	S	S	MS	MS	S	S	S	S	S	S
Dom. Bank Material	O	O	O	O	O	O	O	O	O	O	F	O
Subdom. Bank Mater	F	F	F	F	F	F	F	BL	F	SG	O	C
Dom. Riparian Veg.	S	S	S	S	G	G	G	G	S	S	G	G
Subdom. Riparian Ve	G	G	G	G	G	S	S	S	G	G	S	S

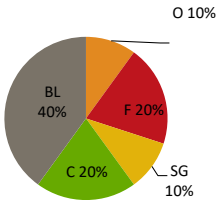
Habitat Inventory / Reach Data

Instream Cover (%):	10	Overhead Cover (%):	22
Dom. Instream Cover:	BL	Dom. Overhead Cover:	TS
Subdom. Instream Cover	DC	Subdom. Overhead Cove	WD
Maximum Depth (m)	0.4	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	17:04
Water Temperature (°C):	4.6
Dissolved Oxygen (mg/L)	19.25
Sp. Conductivity (µs/cm):	81.0
pH:	7.31
Turbidity (NTU):	-

Channel Characteristics

Pattern:	ST
Islands:	N
Bars:	N
Coupling:	PC
Confinement:	OC
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor-Moderate	Poor-Moderate	Poor
Overwintering:	Poor	Poor	Poor
Rearing:	Good	Good	Good
Passage:	Good	Good	Good

Photo 1: Facing upstream 100 m downstream of centerline.

Photo 2: Facing upstream at centerline.

Fish Sampling Data

Method	Effort	
Backpack Electrofisher (EB	651	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
405	30	12	377

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED	0	-	0.00	-	-

General Comments

No fish captured or observed during fish assessment. No known barriers between proposed crossing location and the Mackenzie River. Run habitat with cover could provide rearing habitat for sport, forage, and coarse fish.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

New 1: Unnamed Watercourse

UTM Location: 10U 451423 7076769 **Survey Date:** September 16, 2020

km Marker: 767.8 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing downstream at centreline

Photo 2. Facing upstream at centreline

Photo 3. Facing downstream at centreline

General Comments

Previously unreported watercourse. Fish and fish habtiat assessment not completed. Crossing location appears similar to WX-045 and therefore it is assumed it affords fish habitat potential. The confluence with the Mackenzie River is located approximately 400 m downstream from the proposed crossing location.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

New-3: Wetland Area

UTM Location: 10U 451373 7077141 **Survey Date:** September 16, 2020

km Marker: 770.6 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing east along impoundment

Photo 2. Facing southeast along impoundment

Photo 3. Facing northeast along impoundment

Photo 4. Aerial imagery showing wetland area

General Comments

Previously unreported wetland. Beaver impoundment observed within wetland. No inlet was visible from the aerial survey but the outlet appears to drain across the existing winter road. Substrate was organic and wetland vegetation observed. Maximum depth was greater than 2 m. A fish habtiat assessment was not completed. Fish habitat potential is assumed.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-046: Drainage

UTM Location: 10U 451297 7077881 **Survey Date:** September 16, 2020

km Marker: 768.9 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Flow through grasses and sedges 70 m west of winter road

Photo 2. No defined bed or banks 35 m west of winter raod

Photo 3. Section of intermittent channelization, 50 m east of winter road

Photo 4. Facing west at existing winter road

General Comments

Ephemeral drainage oriented east to west across the existing winter road. Drainage does not have continuously defined bed or banks. No known connectivity with the Mackenzie River located approximately 1 km to the west. No fish habitat potential.

Prepared by: LD Reviewed by: DC

Kálo-Stantec

Dehcho Territory Fish and Fish Habitat

WX-047: Drainage

UTM Location: 10U 450566 7080565 **Survey Date:** September 18, 2020

km Marker: 769.66 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing north, water along existing winter road

Photo 2. Facing downslope 50 m below existing winter road

Photo 3. Facing downslope 25 m down from existing winter road

Photo 4. Facing downslope 50 m down ffrom existing winter road

General Comments

Ephemeral drainage oriented east to west. Drainage runs along existing winter road for approximately 100 m. Discontinous to the west of existing winter road. No known connectivity with the Mackenzie River. No defined bed or banks. No fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

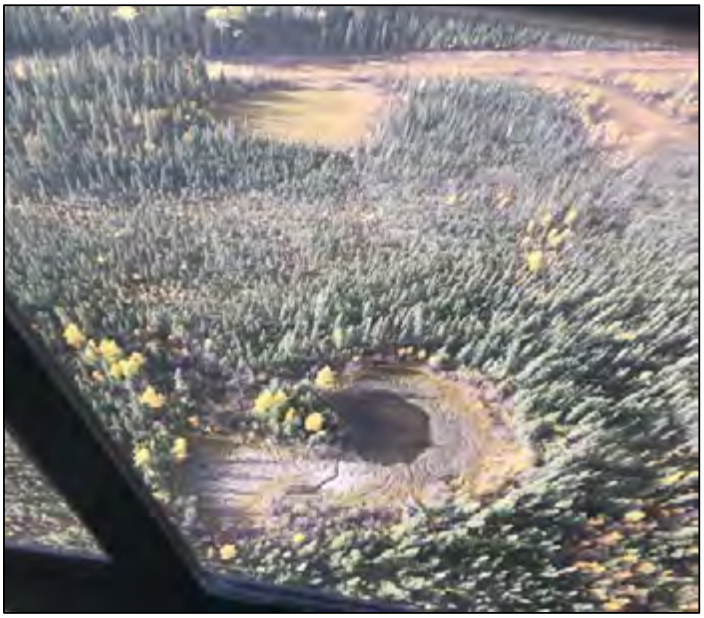
SWA-4: Wetland Area

UTM Location: 10U 451333 7078639 **Survey Date:** September 23, 2020

km Marker: 769.7 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs



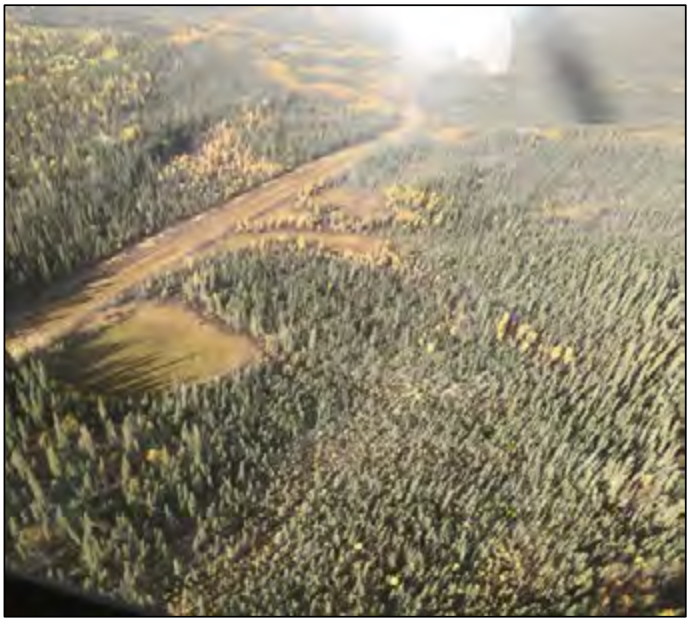


Photo 2. Facing northwest towards existing winter road from helicopter

Photo 3. Aerial imagery of Wetland area

General Comments

Wetland area adjacent to proposed construction corridor. No visible inlet or outlet. No fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

UWB-5: Wetland Area

UTM Location: 10U 451254 7079001 **Survey Date:** September 18, 2020

km Marker: 770 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing north from helicopter

Photo 2. Aerial imagery showing wetland location

General Comments

Wetland area adjacent to proposed construction corridor. No inlet or outlet visible. No fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

New-2: Wetland Area

UTM Location: 10U 451104 7079480 **Survey Date:** September 18, 2020

km Marker: 770.6 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing downslope showing inlet 50 m east of impoundment

Photo 2. Facing south along impoundment

Photo 3. Facing north along impoundment

Photo 4. Facing west along impoundment

Fish Sampling Data

Method	Effort		Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Electrofishing	-	(s)	NO FISH CAPTURED	-	0	-	0.00	-
Minnow Trap	40	(hr)						

Water Quality Data

Time of Day (HH:MM):	11:04
Water temperature (°C):	7.4
Dissolved Oxygen (mg/L):	8.33
Sp. Conductivity (µS/cm):	169.00
pH:	7.53
Turbidity (NTU):	-

General Comments

Previously unreported site. Impoundment as result of active beaver dam. Inlet is an ephemeral drainage and an outlet is visible to the west. Organic substrate and wetland vegetation in riparian area. Maximum measured depth greater than 2 m. No fish captured in minnow traps. Fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

WX-048: Drainage

UTM Location: 10U 449199 7083419 **Survey Date:** September 16, 2020

km Marker: 772.83 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing upslope 60 m upslope from winter road

Photo 2. Water visible on existing winter road

Photo 3. Facing upslope 25 m upslope of winter road

Photo 4. Now channelization visible

General Comments

Ephemeral drainage, oriented northeast to southwest across the existing winter road. No defined bed or banks. Does not afford fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

Drainage 4 Unnamed Watercourse

UTM Location: 10U 448523 7084338 **Survey Date:** September 18, 2020

km Marker: 774.04 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

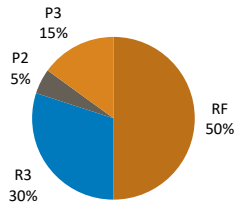
Physical Channel Transect Data

Transect # (Location)	1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)	
Channel Width (m)	4.2		5.1		4.1		4.1		6.0		6.5	
Wetted Width (m)	3.6		4.8		4.3		3.5		5.1		4.9	
Depth at LDB + 25% (	0.3		0.3		0.5		0.4		0.5		0.3	
Depth at LDB + 50% (	0.3		0.4		0.5		0.4		0.5		0.3	
Depth at LDB + 75% (	0.6		0.4		0.4		0.4		0.4		0.3	
Max.Bankfull Depth (	0.8		0.7		0.6		0.9		0.9		0.7	
Gradient (%)	1		-		-		5		5		4	
Dominant Habitat Un	R2		RF		R2		RF		RF		RF	
Stream Bed												
Substrate (% of Transect Area) Organics	10		10		10		10		10		10	
Fines	15		15		15		15		15		15	
Small Gravel	0		0		0		0		0		0	
Large Gravel	5		5		5		5		5		5	
Cobble	30		30		30		30		30		30	
Boulder	40		40		40		40		40		40	
Bedrock	0		0		0		0		0		0	
Embeddedness	H		H		H		H		H		H	
Bank Measurements	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**
Bank Height (m)	0.4	0.3	0.3	0.2	0.2	0.1	0.3	0.2	0.2	0.5	0.4	0.3
Bank Slope (°)	40	70	120	110	90	130	70	30	20	40	20	90
Bank Stability	MS	MS	S	S	MS	S	S	S	S	MS	S	S
Dom. Bank Material	F	O	O	O	O	F	O	O	O	O	O	O
Subdom. Bank Mater	O	F	F	F	O	O	F	F	F	F	F	F
Dom. Riparian Veg.	G	S	S	S	S	S	S	S	S	G	S	S
Subdom. Riparian Ve	S	G	C	G	G	G	G	G	G	S	S	S

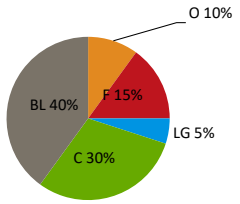
Habitat Inventory / Reach Data

Instream Cover (%):	18	Overhead Cover (%):	9
Dom. Instream Cover:	BL	Dom. Overhead Cover:	WD
Subdom. Instream Cover	DC	Subdom. Overhead Cover:	GF
Maximum Depth (m)	0.6	Dom. Aquatic Veg. Type:	-

Habitat Distribution



Substrate Composition



Water Quality Data

Time of Day (HH:MM):	09:04
Water Temperature (°C):	4.8
Dissolved Oxygen (mg/L)	11.29
Sp. Conductivity (µs/cm):	121
pH:	7.39
Turbidity (NTU):	-

Channel Characteristics

Pattern:	TM
Islands:	F
Bars:	BR
Coupling:	CO
Confinement:	FC
Flow Stage:	Moderate

Fish Habitat Assessment Ratings

	Forage Fish	Coarse Fish	Sport Fish
Spawning:	Poor	Poor	Poor
Overwintering:	Moderate	Moderate	Moderate
Rearing:	Moderate	Moderate	Moderate
Passage:	Good	Good	Good

Photo 1: Facing downstream 100 m upstream from centerline.

Photo 2: Facing upstream 100 m downstream of centerline.

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts Freq. (Hz) Duty Cycle (%) Dist. (m)

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
NO FISH CAPTURED					-

General Comments

No barrier observed at confluence with Mackenzie River. No spawning habitat present, overwintering potential in pools and cover sufficient for rearing habitat. Fish assessment not completed as fish presence was known.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

SWA-5: Wetland Area

UTM Location: 10U 441775 7094706 **Survey Date:** September 23, 2020

km Marker: 774.04 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing south over winter road from helicopter

Photo 2. Aerial imagery showing survey area

General Comments

Wetland adjacent to proposed Project corridor. No inlet or outlet were observed from aerial survey. No fish habitat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

SWA-6: Wetland Area

UTM Location: 10U 441568 7095152 **Survey Date:** September 18, 2020

km Marker: 789.4 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing north from helicopter

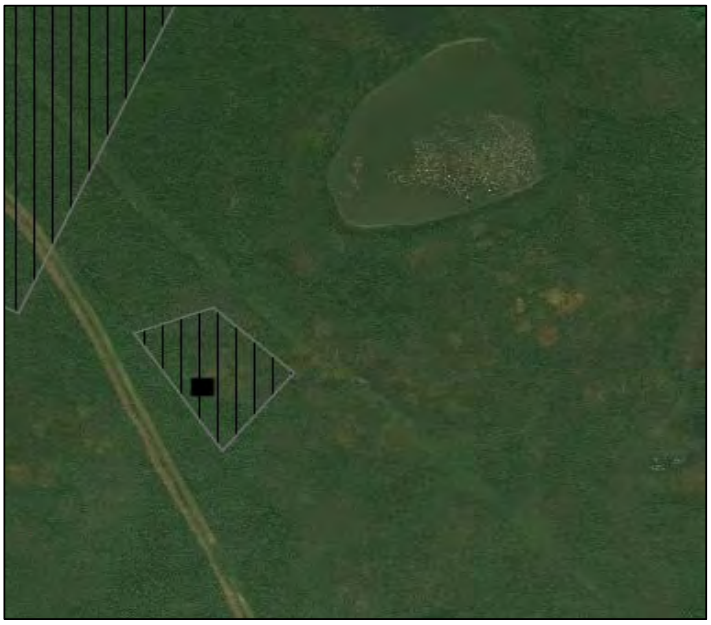


Photo 2. Aerial imagery showing survey area

General Comments

Wetland area adjacent to proposed construction corridor. No inlet our outlet visible from aerial survey. Does not afford fish habtiat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

SWA-8: Wetland Area

UTM Location: 10U 440409 7096395 **Survey Date:** September 21, 2020

km Marker: 791.2 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

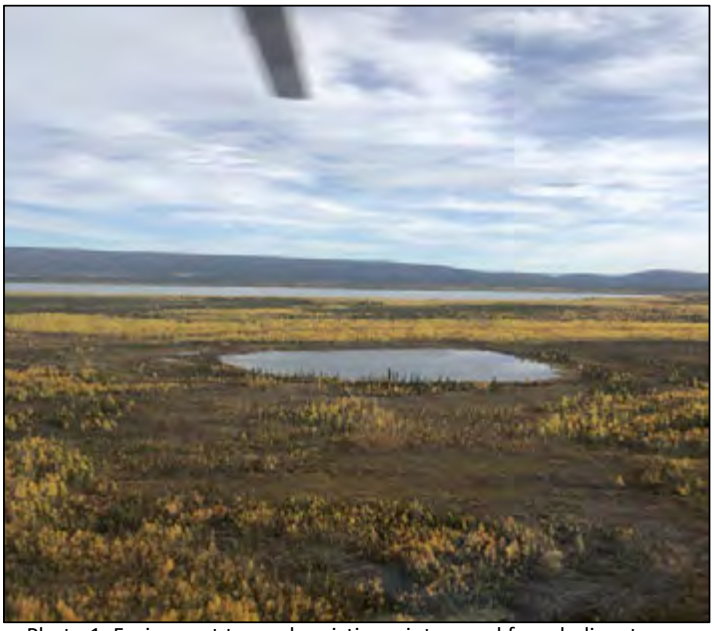


Photo 1. Facing east towards existing winter road from helicopter

Photo 2. Facing north from helicopter

General Comments

Wetland area adjacent to proposed Project. No inlet or outlet visible from aerial survey. No fish habtiat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

SWA-9: Wetland Area

UTM Location: 10U 439719 7096318 **Survey Date:** September 21, 2020

km Marker: 791.8 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

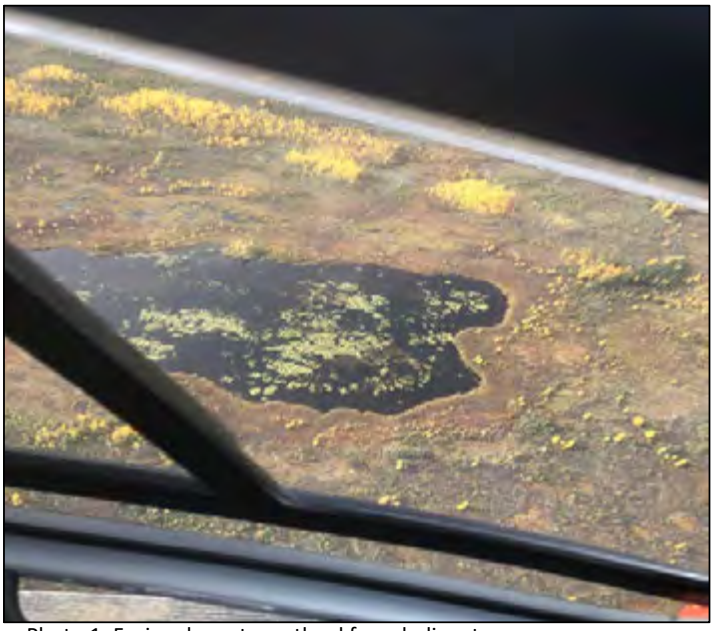


Photo 1. Facing down to wetland from helicopter

Photo 2. Aerial imagery showing survey location

General Comments

Wetland area adjacent to proposed Project. No inlet or outlet visible from aerial survey. No fish habtiat potential.

Prepared by: LD Reviewed by: DC

Dehcho Territory Fish and Fish Habitat

SWA-10: Wetland Area

UTM Location: 10U 438820 7097394 **Survey Date:** September 18, 2020

km Marker: 793.1 **Zone:** 2

Crew Initials: LD MAN **Restricted Activity Timing Window:** August 15 to July 15

Site Photographs

Photo 1. Facing northwest from helicopter

Photo 2. Facing south along existing winter road

Photo 3. Facing northwest from middle of beaver dam complex

Photo 4. Minnow trap location in wetland near existing winter road

Fish Sampling Data

Method	Effort		Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Electrofishing	-	(s)	Brook stickleback	-	120	-	14.93	66.7
Minnow Trap	87	(hr)	Fathead minnow	-	60	-	7.46	33.3

Water Quality Data

Time of Day (HH:MM):	16:55
Water temperature (°C):	8.04
Dissolved Oxygen (mg/L):	4.62
Sp. Conductivity (µS/cm):	102.00
pH:	6.21
Turbidity (NTU):	-

General Comments

Outlet with connection to Mackenzie River. Old beaver dam complex observed but does not appear to be active. A 900 mm diameter culvert is across the existing winter road between two wetland areas. Brook stickleback and fathead minnow captured so wetlands afford fish habitat.

Prepared by: LD Reviewed by: DC

APPENDIX 18A

Vegetation and Wetlands Technical Data Report

Mackenzie Valley Highway Project
Technical Data Report—Vegetation and Wetlands

Prepared for:

Government of the Northwest Territories

Prepared by:

K'alo-Stantec Limited

December 2022

Project No.: 144903025

K'alo-Stantec

Limitations and Sign-off

This document entitled Mackenzie Valley Highway Project Technical Data Report—Vegetation and Wetlands was prepared by K'alo-Stantec Limited ("K'alo-Stantec") for the account of Government of Northwest the Territories (the "Client") to support the regulatory review process for its Developers Assessment Report (DAR) (the "Application") for the Mackenzie Valley Highway Project (the "Project"). In connection therewith, this document may be reviewed and used by the Department of Infrastructure (INF) for the Government of the Northwest Territories participating in the review process in the normal course of its duties. Except as set forth in the previous sentence, any reliance on this document by any other party or use of it for any other purpose is strictly prohibited. The material in it reflects K'alo-Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between K'alo-Stantec and the Client. The information and conclusions in the document are based on the conditions existing at the time the document was published and does not take into account any subsequent changes. In preparing the document, K'alo-Stantec did not verify information supplied to it by the Client or others, unless expressly stated otherwise in the document. Any use which another party makes of this document is the responsibility and risk of such party. Such party agrees that K'alo-Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other party as a result of decisions made or actions taken based on this document.

Prepared by Borton, Adam Digitally signed by Borton, Adam _____
(signature)

Adam Borton, B.Env.St, P.Biol.
Biologist

Reviewed by De Carlo, Nick Digitally signed by De Carlo, Nick _____
(signature)

Nick De Carlo, B.Sc., P.Biol.
Senior Vegetation Ecologist

Approved by Digitally signed by Bonhomme, Erica _____
(signature)

Erica Bonhomme, M.Sc., P.Geo.
Principal, Environmental Services

K'alo-Stantec

Executive Summary

The Government of the Northwest Territories (GNWT), Department of Infrastructure (INF) is proposing the Mackenzie Valley Highway Project (the Project) that will extend the Mackenzie Highway (Northwest Territories Highway #1) from Wrigley to Norman Wells to replace the Mackenzie Valley Winter Road (MVWR) along this portion. The Project includes construction of approximately 281 kilometres (km) of new all-season highway, and the construction and operation of temporary and permanent quarry and borrow sources. The project highway alignment will pass through the Dehcho Region and a portion of the Tulita District of the Sahtu Region within the Northwest Territories (NT).

This technical data report (TDR) presents data and analysis of landcover/plant assemblages, forest characteristics (e.g., tree heights and timber volume), fire, plant species of conservation concern (SOCC), and weeds for the Dehcho and Sahtu regions intersected by the project highway alignment.

Coniferous forest is the most abundant landcover type/plant assemblage in upland areas within the Local Study Area (LSA) (44.8%) and the Regional Study Area (RSA) (32.5%) in the Dehcho Region. Wetlands occupy 19.6% of the LSA and 29.0% of the RSA in the Dehcho Region.

Large portions of the LSA and RSA have burned in the past; however, fires in the LSA are not common: a maximum of two fires have occurred per decade recorded (1990-1999).

No plant SOCC occurrences have been documented within the Dehcho Region of the LSA or RSA; however, several species reported by Dessau (2012) were previously considered plant SOCC but are no longer listed due to changes in territorial rankings. Nine alien and three invasive alien plant species have been documented in the RSA in the Dehcho Region. Appendix B provides a list of additional alien and invasive alien plant species in the RSA that have been documented, although specific distributions of these species are not known.

Upland areas in the Sahtu Region are similarly dominated by coniferous forest in both the LSA (28.3%) and RSA (31.3%). Wetlands occupy 25.5% of the LSA and 25.3% of the RSA.

Fires in the LSA and RSA have occurred in multiple areas with portions within the Sahtu Region burning at least once per decade. Less than 1% to 61.1% of the LSA burned each decade between 1960 and 2019.

In the RSA, seven vascular plant SOCC have been documented, six of which are considered *sensitive* and one considered *may be at risk*, territorially. Ten alien and three invasive alien plant species have been documented in the RSA in the Sahtu Region. Appendix B provides a list of additional alien and invasive alien plant species in the RSA that have been documented, although specific distributions of these species are not known.

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Abbreviations

%	percent
AKEPIC	Alaska Exotic Plants Information Clearinghouse
cm	centimetre
CNFDB	Canadian National Fire Database
COSEWIC	Committee on The Status of Endangered Wildlife in Canada
DAR	Developer's Assessment Report
EOSD	Earth Observation of Sustainable Development of Forests
GNWT	Government of the Northwest Territories
ha	hectare
INF	Department of Infrastructure
km	kilometre
LSA	Local Study Area
m	metre
m^3	cubic metre
m^3/ha	cubic metres per hectare
MVWR	Mackenzie Valley Winter Road
NT/NWT	Northwest Territories
PDA	Project Development Area
PDR	Project Description Report
ROW	right-of-way
RSA	Regional Study Area
SARA	*Species At Risk Act*
SD	standard deviation
SOCC	species of conservation concern
TDR	technical data report
the Project	Mackenzie Valley Highway Project
TK	traditional knowledge
TLRU	traditional land and resource use
ToR	Terms of Reference

Glossary

Alien plant species	Plants introduced to the Northwest Territories from Eurasia or other parts of North America as a result of human activities (Oldham and Delisle-Oldham, 2016).
Invasive alien plant species	Plants introduced to the Northwest Territories from Eurasia or other parts of North America as a result of human activities and with potential to cause significant ecological harm to native ecosystems, economy, or society (Carriere, 2008 and GNWT, 2015). Invasive alien plant species have the potential to be invasive due to high rates of dispersal and establishment (Snyder and Anions, 2008).
May be at Risk	Species that may be at risk of extinction or extirpation. NatureServe S-rank equaling S1 to S2 (Working Group on General Status of NWT Species, 2016).
Sensitive	Species that are not at high risk of extinction or extirpation but may require some special attention or protection to prevent them from becoming at risk. NatureServe S-rank equaling S3. May include species assessed as special concern by Committee on The Status of Endangered Wildlife in Canada (COSEWIC) or SARA (Working Group on General Status of NWT Species, 2016).
the Project	Mackenzie Valley Highway Project

1 Introduction

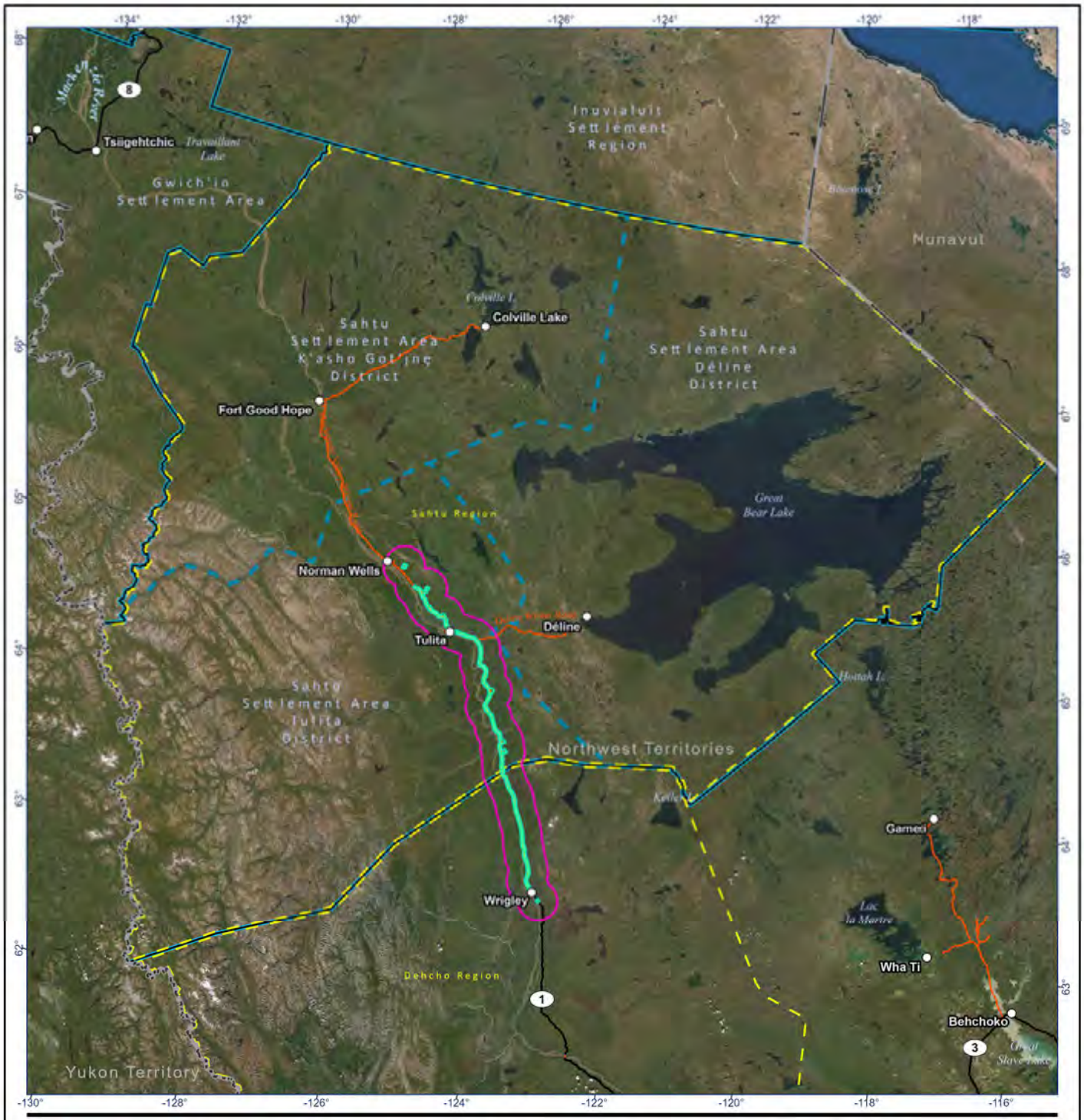
The Government of the Northwest Territories (GNWT), Department of Infrastructure (INF) is proposing the Mackenzie Valley Highway Project (the Project) that will extend the Mackenzie Highway (Northwest Territories Highway #1) from Wrigley to Norman Wells to replace the Mackenzie Valley Winter Road (MVWR) along this portion. The Project includes construction of approximately 281 kilometres (km) of new all-season highway, and the construction and operation of temporary and permanent quarry and borrow sources. The project highway alignment will pass through the Dehcho Region and a portion of the Tulita District of the Sahtu Region within the Northwest Territories (NT; Figure 1.1).

The Project is subject to an environmental assessment and the requirements of Part 5 of the *Mackenzie Valley Resource Management Act*. This technical data report (TDR) presents the existing baseline conditions for vegetation to support the Developer's Assessment Report (DAR), as required by the Terms of Reference (ToR; MVEIRB, 2015).

With respect to vegetation and wetlands, this TDR provides a description of existing conditions within the study areas based on available desktop information, including:

- vegetation and vegetation assemblages
- identification of species or assemblages that are considered species of conservation concern (SOCC), valued, protected or designated (e.g., vulnerable, threatened, endangered); for any species at risk or of concern, as well as location, population status, limits and size, sensitivity and limiting factors
- historic and current human use of vegetation, including subsistence and commercial harvesting, (e.g., berry picking, forestry)
- baseline contaminant concentrations in harvested species or vegetation (e.g., berries) that may change as a result of the highway and as available
- locations and quantities of merchantable timber (based on desktop timber volumes)
- listing and locations of existing non-native plant species
- frequency of forest fires; and, post-fire vegetation succession, if applicable

Vegetation and wetland baseline data has important influence on wildlife habitat, including old growth forest, as discussed in Caribou and Moose TDR (EDI, 2022), Wildlife and Wildlife Habitat TDR (K'alo-Stantec, 2022a) and Birds and Bird Habitat TDR (K'alo-Stantec, 2022b). The influence of vegetation on thermal exchange between air and ground, therefore influencing overall ice-rich soils and permafrost distribution is discussed in the Soils, Terrain and Permafrost TDR (K'alo-Stantec, 2022c). Due to low resolution of available permafrost information, permafrost extent could not be quantified or correlated with vegetation assemblages (i.e., land cover) in this TDR.



- Proposed Mackenzie Valley Highway Alignment - Issued for EA 2022
- Granular Borrow / Rock Quarry Site and Access
- Local Study Area
- Regional Study Area
- Community
- All-Season Road
- Winter Road
- District Boundary
- Region Boundary
- Settlement Area Boundary
- Territorial Boundary

0 40 80 Kilometres

(At original document size of 8.5x11)
1:4,500,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 2022-06-03
TR by AJ on 2022-06-03

Client/Project
144903025-0048 REVB

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.
1.1

Title
Project Overview

Notes
1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Imagery: Earthstar Geographics World Topographic Map: Esri, FAO, NOAA, NRCan World Hillshade: Esri, USGS

2 Study Areas

The Project is located in the Mackenzie Valley region of the NT between Hodgson Creek (located approximately 1 km north of Wrigley) and Prohibition Creek (located approximately 28 km southeast of Norman Wells) (Figure 1.1). The Project parallels the Mackenzie River, located to the west, and generally follows the MVWR. The Project is located within three ecoregions, each distinguished by different degrees of climatic factors (Figure 2.1).

Two study areas, the Local Study Area (LSA) and the Regional Study Area (RSA), are used to evaluate potential project-related effects and potential cumulative effects. The LSA and RSA are relatively anthropogenically undisturbed except for communities, the existing MVWR, and the Norman Wells Pipeline. Oil and gas exploration and production infrastructure in the RSA occurs on the west side of and in the Mackenzie River near Norman Wells (Auld and Kershaw, 2005). Other existing disturbances include quarries and borrow sources, a fibre optic line, and bridges associated with the MVWR.

2.1 Project Development Area

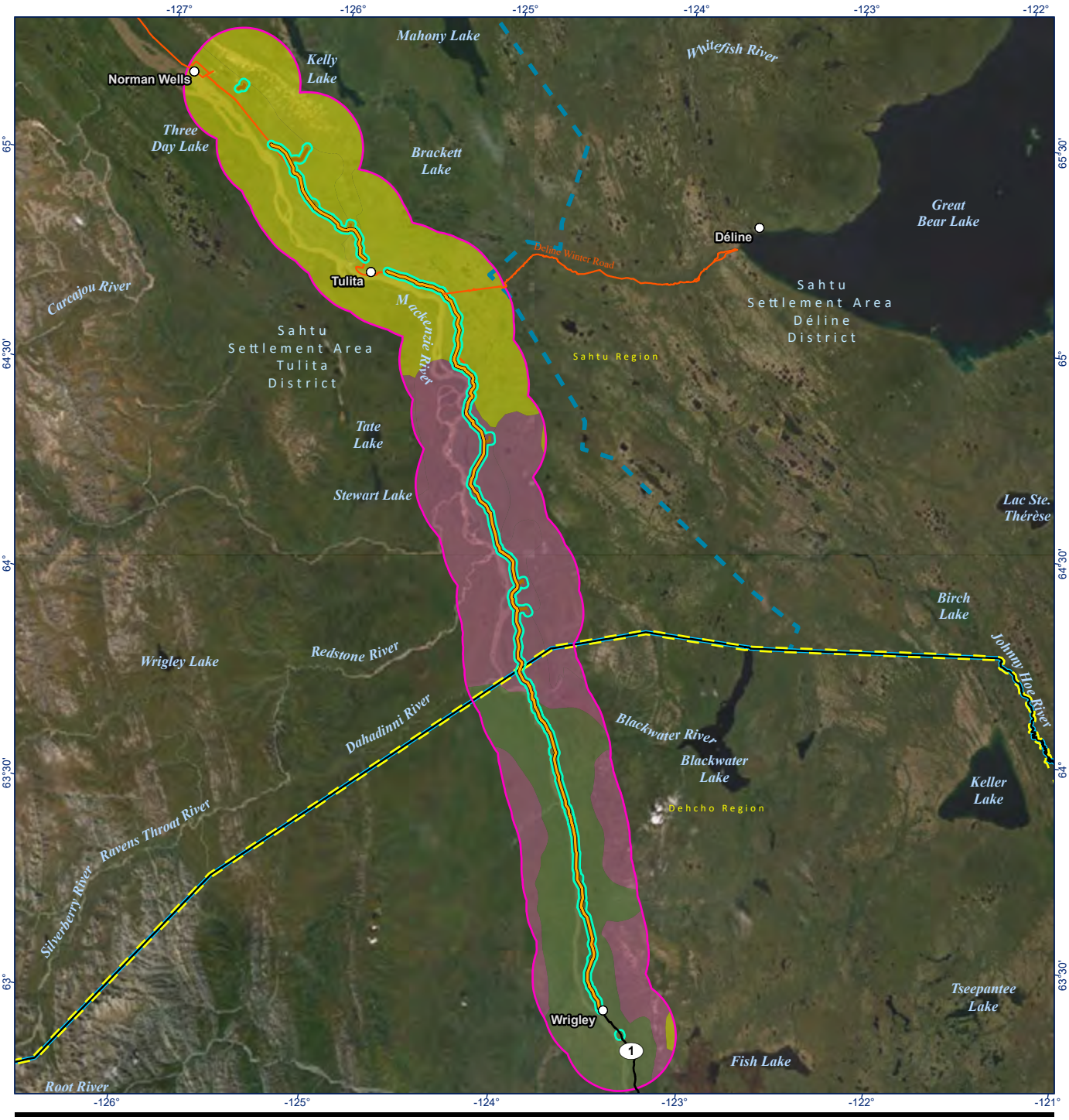
This is the area of direct Project disturbance within which works and activities will occur (footprint), and includes a new two-lane gravel highway, 60 metres (m) wide highway right-of-way (ROW), laydown and staging areas, maintenance yards, construction camps and quarry/borrow sites with access roads on a 30 m ROW.

2.2 Local Study Area

The Local Study Area (LSA) for vegetation and wetlands is consistent with that for wildlife and wildlife habitat and is a 1 km buffer around the project highway alignment centreline and proposed borrow/quarry access roads and quarry sites (Figure 2.1). The size of the LSA is based on measurable extent of Project-related effects (direct or indirect) on vegetation and wetlands, while also considering recommended setback distances for wildlife and wildlife habitat features consistent with guidance provided by Environment and Climate Change Canada (Dufour, 2020, pers. comm.). Results of this TDR are presented for the LSA by region; Dehcho Region and Sahtu Region.

2.3 Regional Study Area

The Regional Study Area (RSA) for vegetation and wetlands is consistent with that for wildlife and wildlife habitat and is a 15 km buffer around the Project's proposed road alignment centreline (Figure 2.1), which provides context for determining significance of Project-specific effects and potential cumulative effects; the RSA is consistent with other highway projects in the NT (e.g., Inuvik to Tuktoyaktuk Highway [Kiggiak - EBA Consulting Ltd., 2011]) and follows recommendations from Environment and Climate Change Canada (Dufour, 2020, pers. comm.). Results of this TDR are presented for the RSA by region; Dehcho Region and Sahtu Region.



- Proposed Mackenzie Valley Highway Alignment - Issued for EA 2022
- Granular Borrow / Rock Quarry Site and Access
- Local Study Area
- Regional Study Area
- Community
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- Winter Road
- District Boundary
- Region Boundary

Ecoregion

- Boreal Cordillera High Boreal
- Taiga Cordillera Low Subarctic
- Taiga Plains,Low Subarctic
- Settlement Area Boundary

0 10 20 Kilometres
(At original document size of 8.5x11)
1:600,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 2022-05-20
TR by AJ on 2022-05-20

Client/Project
144903025-0058 REVB

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.
2.1

Title
Vegetation and Wetlands Study Areas

Notes
1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Imagery: Earthstar Geographics
World Topographic Map: Esri, FAO, NOAA, NRCan
World Hillshade: Esri, USGS

2.4 Intersected Ecoregions

2.4.1 Taiga Plains Low Subarctic

The Taiga Plains Low Subarctic is a Level III ecoregion in the central third of the Taiga Plains (Level II) (Ecosystem Classification Group, 2007). The Taiga Plains Low Subarctic ecoregion extends north to the Taiga Plains High Subarctic ecoregion (Level III) and extends 650 km south to the Taiga Plains High Boreal ecoregion (Level III) and includes outlying Cameron Plateau along the NT-AB border (Ecosystem Classification Group, 2007). To the west, the Taiga Plains Low Subarctic ecoregion is bordered by the Taiga Cordillera ecoregion (Level II); to the east, by the Taiga Shield ecoregion (level II); and to the northeast, by Great Bear Lake (Ecosystem Classification Group, 2007). The ecoregion is characterized by undulating plains, upland communities of white and black spruce, and permafrost-influenced wetlands (Ecosystem Classification Group, 2007). Human activity within the Taiga Plains Low Subarctic ecoregion includes industrial activities such as mining, petroleum extraction, and forestry (Wiken, 1986).

The northern section of the Project is located within the North Mackenzie Plain Low Subarctic ecoregion, a Level IV classification within the Taiga Plains Low Subarctic ecoregion. The North Mackenzie Plain Low Subarctic ecoregion parallels the Mackenzie River and consists of level to undulating terrain. The North Mackenzie Plains ecoregion has been subject to recent burns, which have influenced vegetation community and structure, resulting in a patchwork of low-canopy black spruce and successional shrublands and regenerating forests communities (Ecosystem Classification Group, 2007). Vegetation consists of white and black spruce (*Picea mariana*), Alaska paper birch *(Betula neoalaskana)*, and dwarf birch *(Betula nana)* communities. Occurrences of trembling aspen and jack pine occur on well-drained sites south of Tulita. Bogs and fens occupy approximately 15% of the ecoregion (Ecosystem Classification Group, 2007).

A small section of the project highway alignment north of Tulita intersects the Norman Range Low Subarctic ecoregion, a Level IV classification within the Taiga Plains Low Subarctic ecoregion. The Norman Range Low Subarctic ecoregion is located northeast of the North Mackenzie Plain ecoregion and is more rugged terrain. Southwest portions of this ecoregion are composed of mixedwood deciduous and coniferous forest. Upland deciduous areas typically contain trembling aspen and Alaska paper birch; and coniferous forests typically contain white and black spruce. Bogs and fens cover approximately 4% of the ecoregion (Ecosystem Classification Group, 2007). The Sahtu Land Use plan states that plants are harvested in Norman Range Low Subarctic ecoregion by Sahtu and Pehdzeh Ki/Dehcho First Nations; this harvesting is discussed in the Cultural and Traditional Land Use TDR (K'alo-Stantec, 2022d).

2.4.2 Taiga Cordillera Low Subarctic

The Taiga Cordillera Low Subarctic ecoregion (Level III) consists of mountain ranges, foothills, tundra and spruce woodlands located in the central third of the Taiga Cordillera (Level II). In comparison to the Taiga Plains, the Taiga Cordillera Low Subarctic ecoregion has very few waterbodies and peatland establishment (Ecosystem Classification Group, 2010). Human activity within the Taiga Cordillera Low Subarctic ecoregion includes hunting, fishing, trapping, and tourism (Wiken, 1986).

Central sections of the project highway alignment intersect the Central Mackenzie Plain ecoregion, a Level IV classification within the Taiga Cordillera Low Subarctic ecoregion. The Central Mackenzie Plain is located between the Dahadinni and Blackwater Rivers to the south and the boundary of the Taiga Plains ecoregion to the north. Topography includes level to gently sloping terrain, which supports a diverse array of forest types. Almost half the ecoregion has been exposed to fires, leading to widespread shrubby and deciduous community development. Black spruce – shrub – moss woodlands are common and similar in structure to the North Mackenzie Plain ecoregion. Jack pine *(Pinus banksiana)* and trembling aspen *(Populus tremuloides)* occur but are limited to southern sections. Wetlands occupy approximately 10% to 20% of the ecoregion and consist of mainly peatlands (Ecosystem Classification Group, 2010). The Sahtu Land Use plan states that plants are harvested in Norman Range Low Subarctic ecoregion by Sahtu and Pehdzeh Ki/Dehcho First Nations and is discussed in the Cultural and Traditional Land Use TDR (K'alo-Stantec, 2022d).

2.4.3 Boreal Cordillera High Boreal

The Boreal Cordillera High Boreal ecoregion (Level III) is in the southeast portion of the Boreal Cordillera (Level II), south of the Taiga Cordillera Low Subarctic ecoregion. In comparison to the Taiga Cordillera Low Subarctic, the Boreal Cordillera High Boreal has a milder climate, greater precipitation and taller, more dense stands of spruce woodlands. Mixedwood forest of trembling aspen, white spruce, paper birch, and balsam poplar are common (Ecosystem Classification Group, 2010). Human activity includes mining, forestry, and tourism (Wiken, 1986).

Southern portions of the project highway alignment intersect the Central Mackenzie Valley ecoregion, a Level IV classification within the Taiga Cordillera High Boreal ecoregion. The Central Mackenzie Valley ecoregion is bordered by the Dahadinni and Blackwater Rivers to the north and by higher elevation slopes to the south, east, and west. Topography is undulating terrain, rolling slopes, and level plains. Northern sections consist of closed black spruce woodlands and peat plateaus. Southern sections near Wrigley are composed of productive mixedwood stands of trembling aspen and white spruce *(Picea glauca).* Wetlands occupy less than 10% of the entire ecoregion and consist mainly of peat plateaus, sedge fens, northern ribbed fens, and horizontal fens (Ecosystem Classification Group, 2010). The Sahtu Land Use plan states that plants are harvested within the Dehcho Region along portions of the Mackenzie River by Sahtu Dene and Métis and is discussed in K'alo-Stantec (2022d).

3 Review of Existing Data

3.1 Traditional Knowledge and Traditional Land and Resource Use

This section presents a review of relevant traditional knowledge (TK) and traditional land and resource (TLRU) use information summarized from publicly available sources for consideration for baseline reporting that provides information on existing conditions and potential Project effects, as identified by Indigenous groups.

3.1.1 Methods

TK and TLRU plant information for the Dehcho and Sahtu regions was determined using publicly available reports:

Dehcho Region

- IMG-Golder Corporation (2006) – Renewable Resource Assessment of the Pehdzeh Ki Ndeh Area of Interest. Prepared for the Canadian Parks and Wilderness Society, Northwest Territories Chapter. Yellowknife.
- Dehcho Land Use Planning Committee (2006) – Respect for the Land: The Dehcho Land Use Plan – Final Draft
- Dehcho First Nations. 2011. Traditional Knowledge Assessment of Boreal Caribou (Mbedzih) in the Dehcho Region. Prepared by Dehcho First Nations for the Canadian Wildlife Service. Published by the Dehcho First Nations Fort Simpson, Northwest Territories.
- Dessau. 2012. Mackenzie Valley Highway Extension Pehdzeh Ki Ndeh – Dehcho Region. Project Description Report. Prepared for Government of the Northwest Territories, Department of Transport.
- NWT Bureau of Statistics. 2018. NWT Community Survey. NWT Bureau of Statistics.

Sahtu Region

- EBA Engineering Consultants (2006) – Traditional Knowledge Study Report Tulita, NT, Great Bear River Bridge.
- The Sahtu Heritage Places and Sites Joint Working Group (2000) – Rakekée Gok'é Godi: Places We Take Care Of.
- McDonald, R. 2010. Boreal Caribou Traditional Knowledge Collection Study: The Sahtu Settlement Area. Edited by Andrea Hrynkiw and Glen Guthrie and McDonald. For the Canadian Wildlife Service, Environment Canada.
- 5658 NWT Ltd. and the Government of Northwest Territories (2011) – Project Description Report for Construction of the Mackenzie Valley Highway Tulita District, Sahtu Settlement Area.

- Sahtu Land Use Planning Board (2013) – Sahtu Land Use Plan. Government of Northwest Territories. Good Hope.
- Golder. 2015. Central Mackenzie Surface Water and Groundwater Baseline Assessment. Report 1: Technical State of Knowledge. Report Number: 1401835 Final Report 1. May 21, 2015.
- Tulita Renewable Resource Council (2019) – Traditional Knowledge Study for the Great Bear River Bridge Project. Prepared by Tulita Renewable Resource Council.

Information was also obtained from the Tulita Renewable Resources Council's Project-specific TLRU study (Tulita Renewable Resource Council, 2022).

3.1.2 Results

3.1.2.1 Dehcho Region

A review of the available information indicates 140 plants or groups of plants are used for traditional purposes in the Dehcho Region (Table 3.1 and Table 3.2), with 122 expected in the ecoregions intersected by the LSA and RSA. Most of the expected plants, 101, are ranked *secure* in the NT, three are ranked *sensitive* and seven are ranked *may be at risk* (GNWT, 2016a). Many plant species serve different purposes, such as for medicine, food, craft, ritual ceremonies, spiritual endeavours, and home fuel. For example, birch bark (*Betula papyrifera, Betula neoalaskana*) is used for baskets, berries are collected for food and for dyeing materials (e.g., blueberries [*Vaccinium* spp.]), and pasture sage (*Artemisia frigida*) is used for spiritual, ritual or medicinal purposes (IMG-Golder Corporation, 2006).

Both wood and wood pellets are an important fuel for heating homes in the Dehcho Region. Within the Dehcho Region, wood is used for house heating in 388 (36%) households with 265 (24%) homes reporting wood as their main heat source (NWT Bureau of Statistics, 2018). Wood pellets are used for house heating in 65 (6%) households with 30 (3%) homes reporting wood pellets as their main heat source (NWT Bureau of Statistics, 2018).

The most common berry picking location in the Dehcho Region is adjacent to the Mackenzie Highway towards Fort Simpson and along existing trails through Pehdzeh Ki Ndeh. People also pick berries along an existing pipeline corridor near Wrigley (IMG-Golder Corporation, 2006). Within the Dehcho Region, 38% of the general population reported gathering berries (NWT Bureau of Statistics, 2020), with 50% of indigenous population of Wrigley reporting engaging in berry gathering (NWT Bureau of Statistics, 2019a).

Recent changes in climate are include warmer temperatures, increased rain in November, milder winters and increasing summer storms. Boreal woodland caribou food sources are affected by precipitation. During colder times, food becomes less accessible because it is covered by more snow, making it harder for caribou to access. Climate change does not yet appear to be affecting ground or hanging lichens, although some monitoring of future changes to lichen due to climate change should be undertaken (Dehcho First Nations, 2011).

Contaminants may be a concern for certain traditional foods, including berries and medicinal teas, in some areas (GNWT, 2017). The GNWT publishes contaminant fact sheets on many traditional meats, but no fact sheets are published for plant species (GNWT, 2016b). The Northern Contaminants Program focuses on heavy metals and on persistent organic pollutants that can bioaccumulate in wildlife and human populations (Government of Canada, 2021). There are some studies that link increased industrial activity and dust generation to increases in concentrations of some heavy metals in berries (Shotyk, 2020). Heavy metals linked to dust by Shotyk (2020) include aluminum, chromium, iron, lead, scandium, thorium, vanadium, yttrium, and lanthanides. No specific data on contaminants in berries and plants has been found for the Dehcho Region.

Table 3.1 Traditional Plant Species – Dehcho Region

Form	Scientific Name [1]	Common Name(s)	Rank[2]
Tree	*Abies lasiocarpa**	alpine fir	-
Tree	*Betula papyrifera*	white birch, paper birch	Secure
Tree	*Larix laricina*	tamarack	Secure
Tree	*Picea glauca*	white spruce	Secure
Tree	*Picea mariana*	black spruce	Secure
Tree	*Pinus banksiana*	jack pine	Secure
Tree	*Pinus contorta*	lodgepole pine	Secure
Tree	*Populus balsamifera*	balsam poplar	Secure
Tree	*Populus tremuloides*	trembling aspen	Secure
Shrub	*Alnus rugosa**	mountain alder	-
Shrub	*Alnus tenufolia** (*Alnus tenuifolia*)	speckled alder, river alder	-
Shrub	*Amelanchier alnifolia*	Saskatoon	Secure
Shrub	*Andromeda polifolia*	dwarf bog rosemary	Secure
Shrub	*Arctostaphylos uva-ursi*	common bearberry, Kinnikinnick,	Secure
Shrub	*Arctostaphylos alpina* (Arctous alpina)*	alpine bearberry, torpedoberry	Secure
Shrub	*Arctostaphylos rubra* (Arctous rubra)*	red bearberry	Secure
Shrub	*Betula glandulosa*	bog birch	Secure
Shrub	*Betula occidentalis*	water birch	Secure
Shrub	*Betula pumila* var. *glandulifera*	dwarf birch	Secure
Shrub	*Chamaedaphne calyculata*	leatherleaf	Secure
Shrub	*Cornus sericea*	red osier dogwood	Secure
Shrub	*Potentilla fruticosa* (Dasiphora fruticosa)*	shrubby cinquefoil	Secure
Shrub	*Elaegnus commutata* (*Elaeagnus commutata*)	silverberry	Secure
Shrub	*Empetrum nigrum*	crowberry, black berry	Secure
Shrub	*Gaultheria hispidula**	creeping wintergreen, teaberry	-

Form	Scientific Name [1]	Common Name(s)	Rank[2]
Shrub	*Hudsonia tomentosa*	sand heather	Sensitive
Shrub	*Juniperus communis*	common juniper	Secure
Shrub	*Juniperus horizontalis*	creeping juniper	Secure
Shrub	*Kalmia polifolia*	northern bog laurel, pale bog laurel	Secure
Shrub	*Ledum groenlandicum*	common Labrador tea	Secure
Shrub	*Lonicera dioica*	twinning/ red honeysuckle	Secure
Shrub	*Lonicera involucrata**	bracted honeysuckle, black twin berry	-
Shrub	*Myrica gale*	sweet gale	Secure
Shrub	*Prunus pensylvanica*	pin cherry	Secure
Shrub	*Prunus virginiana*	choke cherry	Sensitive
Shrub	*Ribes americanum**	wild black currant	-
Shrub	*Ribes glandulosum*	skunk currant, wild red currant	Secure
Shrub	*Ribes hudsonianum*	northern black currant	Secure
Shrub	*Ribes lacustre*	bristly black currant	Secure
Shrub	*Ribes oxyacanthoides*	northern gooseberry, Canada gooseberry	Secure
Shrub	*Ribes triste*	wild red currant	Secure
Shrub	*Rosa acicularis*	prickly rose, rose hips	Secure
Shrub	*Rubus idaeus*	wild red raspberry red raspberry	Secure
Shrub	*Salix* spp.	multiple willow species, including diamond willow and red willow	N/A multiple species
Shrub	*Sorbus scopulina*	western mountain ash	Secure
Shrub	*Shepherdia canadensis*	buffaloberry, soopolallie, soapberry,	Secure
Shrub	*Symphoricarpos albus*	common snowberry	Undetermined
Shrub	*Symphoricarpos occidentalis*	western snowberry	Secure
Shrub	*Vaccinium myrtilloides*	common blueberry, velvet leaf blueberry	Sensitive[+]
Shrub	*Vaccinium caespitosum*	dwarf blueberry	Undetermined
Shrub	*Vaccinium oxycoccus* (*Vaccinium oxycoccos*)	small bog cranberry	Secure
Shrub	*Vaccinium vitis-idaea*	lingonberry, bog cranberry, cowberry, mountain cranberry	Secure
Shrub	*Viburnum edule*	low bush cranberry, mooseberry	Secure
Shrub	*Viburnum opulus**	high bush cranberry	-
Graminoid	*Acorus americanus (Acorus calamus)*	sweetflag, calamus	May Be At Risk[+]
Graminoid	*Calamagrostis canadensis*	blue-jointed reed grass, marsh reedgrass	Secure
Graminoid	*Carex aquatilis*	water sedge	Secure
Graminoid	*Phragmites australis** *(Phragmites communis)*	common reed	Undetermined

Form	Scientific Name [1]	Common Name(s)	Rank[2]
Graminoid	*Hierochloe odorata*	sweet-grass	Secure
Graminoid	*Hordeum jubatum*	fox-tail barley	Secure
Graminoid	*Schoenoplectus acutus*	bulrush	Secure
Graminoid	*Typha latifolia*	broad-leaf cattail	Secure
Graminoid	*Triglochin maritima*	seaside arrow-grass	Secure
Forb	*Achillea millefolium*	yarrow	Secure
Forb	*Actaea rubra*	red baneberry	Secure
Forb	*Agastache foeniculum*	giant hyssop	May Be At Risk+
Forb	*Allium textile**	wild onion and chives	-
Forb	*Androsace septentrionalis*	pygmyflower, fairy candelabra	Secure
Forb	*Angelica lucida (Coelopleurum gmelinii)*	seaside angelica	May Be At Risk
Forb	*Apocynum androsaemifolium*	spreading dogbane	Secure
Forb	*Artemisia campestris*	field sagewort	Secure
Forb	*Artemisia frigida*	pasture sage	Secure
Forb	*Aralia nudicalis* (*Aralia nudicaulis*)	wild sarsaparilla	Secure
Forb	*Aster ciliolatus* (Symphyotrichum ciliolatum)*	Lindley's aster, fringed aster	Secure
Forb	*Aster laevis* (Symphyotrichum laeve)*	smooth aster	Presence Expected
Forb	*Aster puniceus* (Symphyotrichum puniceum)*	purple-stemmed aster	Undetermined
Forb	*Aster umbellatus**	flat-topped white aster	-
Forb	*Astragalus americanus*	American milk-vetch	Secure
Forb	*Boschniakia rossica*	northern ground-cone	Secure
Forb	*Calla palustris*	water calla	Secure
Forb	*Campanula rotundifolia**	bluebell	-
Forb	*Chenopodium album*	lamb's quarters	Alien
Forb	*Chenopodium capitatum*	strawberry blite	Secure
Forb	*Cicuta maculata*	water hemlock, spotted water-hemlock	Secure
Forb	*Claytonia tuberosa*	tuberous spring beauty	Secure
Forb	*Chimaphila umbellata*	pipsissewa	May Be At Risk+
Forb	*Cornus canadensis*	bunchberry	Secure
Forb	*Dryopteris carthusiana (Dryopteris spinulosa)*	spiney wood fern	May Be At Risk
Forb	*Epilobium angustifolium*	fireweed	Secure
Forb	*Equisetum arvense*	horsetail	Secure
Forb	*Fragaria vesca*	woodland strawberry, wild strawberry	Secure
Forb	*Fragaria virginiana*	wild strawberry,	Secure

Form	Scientific Name [1]	Common Name(s)	Rank[2]
Forb	*Galeopsis tetrahit*	hemp nettle	Alien
Forb	*Galium boreale*	northern bedstraw	Secure
Forb	*Geocaulon lividum*	northern comandra	Secure
Forb	*Geum aleppicum*	yellow avens	Secure
Forb	*Geum rivale**	purple avens	-
Forb	*Grindelia squarrosa**	gumweed	-
Forb	*Hedysarum alpinum*	American alpine sweet-vetch, sweetbroom	Secure
Forb	*Hellenium atumnale* (Helenium autumnale)*	sneezeweed	Secure
Forb	*Heracleum lanatrum* (Heracleum maximum, Heracleum lanatum)*	cow parsnip	Secure
Forb	*Heuchera richardsonii*	alum root	May Be At Risk[+]
Forb	*Leucanthemum vulgare*	ox-eye daisy	Invasive Alien
Forb	*Lycopodium annotinum*	clubmoss	Secure
Forb	*Maianthemum canadense*	wild lily-of-the-valley	Secure
Forb	*Matteauccia struthiopteris* (Matteuccia struthiopteris)*	ostrich fern	Sensitive
Forb	*Mentha arvensis*	wild mint	Secure
Forb	*Mertensia paniculata*	lungwort, tall bluebells	Secure
Forb	*Mitella nuda*	mitrewort	Secure
Forb	*Oxyria digyna*	mountain sorrel	Secure
Forb	*Pedicularis langsdorffii*	lousewort	Secure
Forb	*Petasites sagittatus*	arrow-leaved coltsfoot	Not Assessed
Forb	*Plantago major*	broad-leaved plantain	Alien
Forb	*Polygonum amphibium*	water smartweed	Secure
Forb	*Polygonum viviparum* (*Bistorta vivipara*)	bistort, serpent grass	Secure
Forb	*Polypodium vulgare*	rock polypody fern	Secure
Forb	*Potentilla gracilis**	cinquefoil	-
Forb	*Pyrola asarifolia*	pink wintergreen	Secure
Forb	*Rubus arcticus*	dewberry, dwarf raspberry	Secure
Forb	*Rubus chamaemorus*	cloudberry, baked apple berry, yellowberry	Secure
Forb	*Rumex aquaticus*	western dock	Secure
Forb	*Sagittaria cuneata*	arrowhead	Secure
Forb	*Sarracenia purpurea*	pitcher plant	Secure
Forb	*Scutellaria galericulata*	marsh skullcap	Secure
Forb	*Sium suave*	water parsnip	Secure

Form	Scientific Name [1]	Common Name(s)	Rank[2]
Forb	*Solidago canadensis*	Canadian goldenrod	Secure
Forb	*Taraxacum officinale*	dandelion	Alien
Forb	*Urtica dioica*	stinging nettle	Secure
Forb	*Utricularia macrorhiza*	bladderwort	Secure
Forb	*Veratrum viride*	false hellebore	Secure
Forb	*Zigadenus elegans*	mountain death camus	Secure

Notes:

[1] Scientific name as reported by Dehcho Land Use Planning Committee (2006). Associated accepted synonym is provided in brackets where available.

[2] General NWT Rank as per NWT Species list (GNWT, 2016a) unless invasive. Alien plant rankings as described in Carriere (2008) and in Oldham and Delisle-Oldham (2016).

* Plant names that do not appear on the NWT Species list (GNWT, 2016a).

[+] Sensitive and At Risk Species not expected to occur in the Dehcho RSA.

Source: Adapted from Dehcho Land Use Planning Committee (2006) and IMG-Golder Corporation (2006).

Table 3.2 Additional Potential Traditional Plant Species – Dehcho Region

Form	Scientific Name [1]	Common Name(s)	Rank[2]
Tree	*Abies bifolia*	rocky mountain subalpine fir	Secure
Tree	*Betula neoalaskana*	Alaska paper birch	Secure
Shrub	*Alnus alnobetula (Alnus viridis)*	green alder	Secure
Shrub	*Alnus incana (Alnus incana* ssp. *tenuifolia)*	speckled alder (mountain alder, gray alder, hoary alder)	Secure
Forb	*Allium schoenoprasum*	wild chives	Secure
Forb	*Campanula alaskana*	bluebell, Alaska bellflower	Undetermined
Forb	*Campanula gieseckeana*	bluebell, Giesecke bellflower	Undetermined
Forb	*Nuphar polysepala (Nuphar lutea* ssp *polysepala)*	rocky mountain pond lily	May Be At Risk
Forb	*Nuphar variegata (Nuphar variegatum, Nuphar lutea)*	variegated pond lily	Secure[+]

Notes:

[1] Scientific name as per NWT Species list (GNWT, 2016a).

[2] Ranks as per GNWT 2016a.

[+] Species not expected to occur in the Dehcho RSA.

Source: NWT Plant list (GNWT, 2016a) of similar plants to those identified by Dehcho Land Use Planning Committee (2006) and IMG-Golder Corporation (2006) that reportedly do not occur in the NT.

3.1.2.2 Sahtu Region

A review of the available information indicates 24 plants or groups of plants are used for traditional purposes in the Sahtu Region and all 24 are expected to occur in the ecoregions intersected by the LSA and RSA (Table 3.3). Most of the plants, or plant groups, are ranked *secure* in the NT, with none of the of the identified traditional use species considered *sensitive* or *may be at risk* (GNWT, 2016a).

Table 3.3 Traditional Plant Species – Sahtu Region

Form	Scientific Name[1]	Common Name(s)	Rank[2]
Tree	*Betula neoalaskana*	resin birch, Alaska paper birch	Secure
Tree	*Betula papyrifera*	white birch, paper birch	Secure
Tree	*Picea glauca*	white spruce	Secure
Tree	*Picea mariana*	black spruce	Secure
Shrub	*Arctostaphylos uva-ursi*	common bearberry, Kinnikinnik,	Secure
Shrub	*Arctous alpina*	alpine bearberry, torpedoberry	Secure
Shrub	*Arctous rubra*	red bearberry	Secure
Shrub	*Betula glandulosa*	bog birch	Secure
Shrub	*Betula occidentalis*	water birch	Secure
Shrub	*Betula pumila var. glandulifera*	dwarf birch	Secure
Shrub	*Empetrum nigrum*	crowberry, black berry	Secure
Shrub	*Rosa acicularis*	prickly rose, rose hips	Secure
Shrub	*Ribes glandulosum*	skunk currant, wild red currant	Secure
Shrub	*Ribes hudsonianum*	northern black currant	Secure
Shrub	*Ribes lacustre*	bristly black currant	Secure
Shrub	*Ribes triste*	wild red currant	Secure
Shrub	*Rubus idaeus*	wild red raspberry red raspberry	Secure
Shrub	*Salix* spp.	multiple willow species, including diamond willow and red willow	N/A multiple species
Shrub	*Vaccinium caespitosum*	dwarf blueberry	Undetermined
Shrub	*Vaccinium oxycoccus*	small bog cranberry	Secure
Shrub	*Vaccinium vitis-idaea*	lingonberry, bog cranberry, cowberry, mountain cranberry	Secure
Shrub	*Viburnum edule*	low bush cranberry, mooseberry	Secure
Forb	*Rubus arcticus*	dewberry, dwarf raspberry	Secure
Forb	*Rubus chamaemorus*	cloudberry, baked apple berry, yellowberry	Secure

Notes:
1 Scientific name as per NWT Species list (GNWT, 2016a).
2 Ranks as per GNWT, 2016a.
Sources: EBA, 2006; 5658 NWT Ltd. and GNWT, 2011; Tulita Renewable Resource Council, 2019.

Wood for fuel and tools, and berries were identified as important for traditional use (EBA, 2006; 5658 NWT Ltd. and GNWT, 2011). Both wood and wood pellets are an important fuel for heating homes in the Sahtu Region. Within the Sahtu Region, wood is used for house heating in 274 (34%) households with 109 (13%) homes reporting wood as their main heat source (NWT Bureau of Statistics, 2018). Wood pellets are used for house heating in 18 (2%) households with 14 (2%) homes reporting wood pellets as their main heat source (NWT Bureau of Statistics, 2018).

Within the Sahtu Region, 34% of the general population reported gathering berries (NWT Bureau of Statistics, 2020), with 28% of the Indigenous population of Tulita and 32% of the Indigenous population of Norman Wells reporting they were engaged in berry gathering (NWT Bureau of Statistics, 2019b, 2019c).

Contaminants may be a concern for certain traditional foods, including berries and medicinal teas, in some areas (GNWT, 2017). The GNWT publishes contaminant fact sheets on many traditional meats, but no fact sheets are published for plant species (GNWT, 2016b). The Northern Contaminants Program focuses on heavy metals, and persistent organic pollutants, which can bioaccumulate in wildlife and human populations (Government of Canada, 2021). There are some studies that link increased industrial activity and dust generation to increases in concentrations of some heavy metals in berries (Shotyk, 2020). Heavy metals linked to dust (Shotyk, 2020) include aluminum, chromium, iron, lead, scandium, thorium, vanadium, yttrium, and lanthanides. No specific data on contaminants in berries and plants has been found for the Sahtu Region.

The Tulita Renewable Resources Council TLRU study developed for the Project (Tulita Renewable Resource Council, 2022) reports that:

- Country food is an important part of community residents' diet, and is shared among the community, family members, and friends in all seasons (particularly during spring and winter); and the community relies on and is in constant need of wildlife/country food for sustenance.
- Changes in the LSA such as increase of fires and disappearing plants have affected the ability to conduct TLRU.
- Harvesting plants and berries within the LSA, and along the MVWR in the summertime.
- Healing wood is harvested in the LSA.
- Firewood is harvested along the MVRW during the wintertime.
- More invasive species and vegetation in the LSA that have affected ability to conduct TLRU and recommend further studies to assess change / impact.
- Birch barks, willows and spruce branches are collected in the LSA and are used for medicinal purposes in the LSA.
- Plants and wildlife are still needed to conduct TLRU, food and hides (personal use).
- A berry harvesting area on the west side of Bear River, and near Plane Lake.
- Willows, birch bark and spruce boughs are harvested within the LSA.
- Blueberries are harvested within the LSA.

3.2 Literature Review

3.2.1 Methods

Available vegetation and wetland information was compiled to identify conditions in the study areas. The following data sources were reviewed:

- Earth Observation of Sustainable Development (EOSD) of Forests Northwest Territories geospatial database raster data – (Natural Resources Canada and GNWT, 2017)
- Canadian Wildland Fire Information System Datamart – Canadian National Fire Database fire polygon data (Canadian Forest Service, 2020)
- Species at Risk Act (SARA) Public Registry threatened and endangered species occurrences and ranking data – (Government of Canada, 2019)
- NWT species 2016-2020 – general status ranks of wild species in the Northwest Territories – (Working Group on General Status of NWT Species, 2016)
- Northwest Territories species monitoring Infobase – (GNWT, 2016a)
- Alien and invasive alien plant species occurrence data – (AKEPIC, 2020)
- Project Description Report (PDR) for Construction of the Mackenzie Valley Highway Tulita District, Sahtu Settlement Area – (5658 NWT Ltd. and GNWT, 2011)
- Project Description Report for Mackenzie Valley Highway Extension Pehdzeh Kı Ndeh – Dehcho Region – (Dessau, 2012)

3.2.1.1 Landcover/Plant Assemblages and Timber

Landcover/plant assemblages and timber within the LSA and RSA were quantified using EOSD NWT data (Natural Resources Canada and GNWT, 2017). This dataset is part of the Multisource Inventory Project (Natural Resources Canada, 2020) and uses an unsupervised classification and cluster analysis to classify landcover/plant assemblages.

The EOSD NWT dataset includes modelled cover type and density classes, as well as forest structure height and volume information based on Landsat TM imagery collected from 2007 to 2013. Mapping was done at a scale of 1:250,000 and refined through field evaluation by the GNWT (Natural Resources Canada and GNWT, 2017).

Crown Closure Class uses three categories with a range of percentage to quantify canopy closure coverage: sparse (6-25%), open (26-55%), and dense (56-100%).

Merchantable timber is defined by timber supply plans and, if timber supply plans are not available, by the Commercial Timber Harvest Planning and Operations Standard Operating Procedures Manual (GNWT Environment and Natural Resources, 2005). Generally, this includes soft-wood species with a diameter-at-breast-height of 18 centimetres (cm) and larger. Available timber data from EOSD does not include species-specific data; therefore, estimates of merchantable timber volumes were not completed. Included in this TDR are estimates of coniferous and mixedwood volumes in the LSA and RSA, which can be used

to inform future field data collection for determination of merchantable timber locations and volumes. Future merchantable timber estimates should address the amount of merchantable timber removed during ROW clearing and the potential for facilitating use of waste timber by communities.

No vegetation assemblages are considered rare in the Boreal Cordillera ecoregion or the Taiga Cordillera ecoregion (Working Group on General Status of NWT Species, 2016).

3.2.1.2 Fire History

Forest fire polygon data from the Canadian National Fire Database (CNFDB) (Canadian Forest Service, 2020) was examined for the frequency and extent of fire in the LSA and RSA and differences with landcover types/plant assemblages. CNFDB fire polygon data is compiled by Canadian fire agencies (provincial, territories and Parks Canada) and can be used for spatial and temporal analysis of fire effects at a landscape scale. CNFDB fire polygon data for NT is current as of 2019 (Canadian Forest Service, 2020). Frequency of burns, area burned (hectares [ha]), and proportion of area burned were determined by decade (1960 to 2019) for the LSA and RSA.

3.2.1.3 Plant SOCC

The Northwest Territories Species Monitoring Infobase was searched to identify known vascular and non-vascular plant SOCC that could potentially occur in the LSA and RSA (GNWT, 2016a).

Plant SOCC observations from the Mackenzie Gas Project (Mackenzie Project Environment Group, 2004) detailed in the Mackenzie Valley Highway Tulita District PDR (5658 NWT Ltd. and GNWT, 2011) and the PDR for Mackenzie Valley Highway Extension Pehdzeh Ki Ndeh – Dehcho Region (Dessau, 2012) were also reviewed for documented plant SOCC in the RSA.

3.2.1.4 Alien and Invasive Alien Plant Species

Alien plant species are defined as plants introduced to the NT from Eurasia or other parts of North America as a result of human activities (Oldham and Delisle-Oldham, 2016). Invasive alien plant species are those with potential to cause significant ecological harm to native environments through high rates of dispersal and establishment (Snyder and Anions, 2008). Some human developments and activities can promote the establishment and spread of alien and invasive alien plant species through introduction of propagules and increasing habitat invasiveness. Changes in disturbance frequency and intensity of natural habitats can alter species composition, including invasion by alien and invasive alien plant species. Invasive alien plant species are plants listed in Carriere (2008). Additional invasive alien plant species are plants which are described as ‘priority invasive plant species’ in Oldham and Delisle-Oldham (2016). Alien plant species are plants which appear in Oldham and Delisle-Oldham (2016) and GNWT (2015), but the latter does not specifically identify plant species as “Invasive Alien”; however, the report does list species that are invasive by nature. Additionally, alien species are identified in Working Group on General Status of NWT Species (2016). That report also does not specifically identify plant species as invasive alien.

Alien and alien invasive plant species potentially occurring in the RSA were identified using Oldham and Delisle-Oldham (2016), for which a field survey was conducted to identify occurrences of alien and invasive alien plant species along the Mackenzie Highway from the northern Alberta border to Wrigley, NT, and conducting a search of the Northwest Territories Species Monitoring Infobase (GNWT, 2016a) to identify potential alien and invasive alien plant species occurring within Level II ecoregions (Taiga Plains, Taiga Cordillera and Boreal Cordillera) intersected by the RSA. Occurrences identified in this TDR do not directly overlap the Project Development Area (PDA); however, they are within the RSA and indicate plants that may occur in the vegetation LSA or project PDA. Known occurrences of alien and invasive alien plant species in the RSA were determined using the Alaska Exotic Plants Information Clearinghouse (AKEPIC), a geospatial mapping tool which tracks occurrences of alien species (AKEPIC, 2020).

3.2.2 Results

3.2.2.1 Dehcho Region

Landcover/Plant Assemblages

Coniferous forest is the most abundant landcover type/plant assemblage in the Dehcho Region of the LSA, occupying 44.8% (9,512.2 ha), with similar proportions of sparse, open and dense stands present (Table 3.4). Broadleaf and mixedwood forests are also present, but are less common, with broadleaf forest occupying 3.5% (733.2 ha) and mixedwood forest occupying 4.4% (932.8 ha). Most coniferous forest cover types are located east of the Mackenzie River, whereas most broadleaf and mixedwood forest cover types are located west of the Mackenzie River, which has historically been burned (Figure 3.1). Figure 3.2 shows areas of sparse and open forest cover in the Dehcho Region portion of the LSA.

Remaining upland areas in the Dehcho Region of the LSA are largely composed of exposed land, 5.9% of the LSA (1,255.3 ha), low shrub, 1.6% of the LSA (347.4 ha), and tall shrub, 1.4% of the LSA (307.4 ha) (Table 3.4). Exposed land includes areas that naturally have less than 5% vegetative cover, such as shorelines of rivers and lakes, exposed rock, recently burned areas, and moraines; the areas also include cleared areas such as roads and areas of infrastructure development, including the two existing cleared ROW for the Norman Wells Pipeline and MVWR. Exposed land occurs predominantly along the east side of the Mackenzie River in the LSA in the Dehcho Region (Figure 3.1). Tall and low shrub are distributed predominately west of the Mackenzie River and, typically, associated with broadleaf stands and lower areas with open water.

Wetlands occupy 19.6% of the LSA in the Dehcho Region (4,152.9 ha). Treed and shrub wetlands are the most common wetland types, occupying 8.3% (1,768.5 ha) and 7.9% (1,667.2 ha), respectively. Wetlands are located throughout the LSA in the Dehcho Region, with the highest concentrations of wetlands occurring along watercourses adjacent to Mackenzie River (Figure 3.1).

Table 3.4 Landcover/Plant Assemblage Types in the LSA and RSA – Dehcho Region

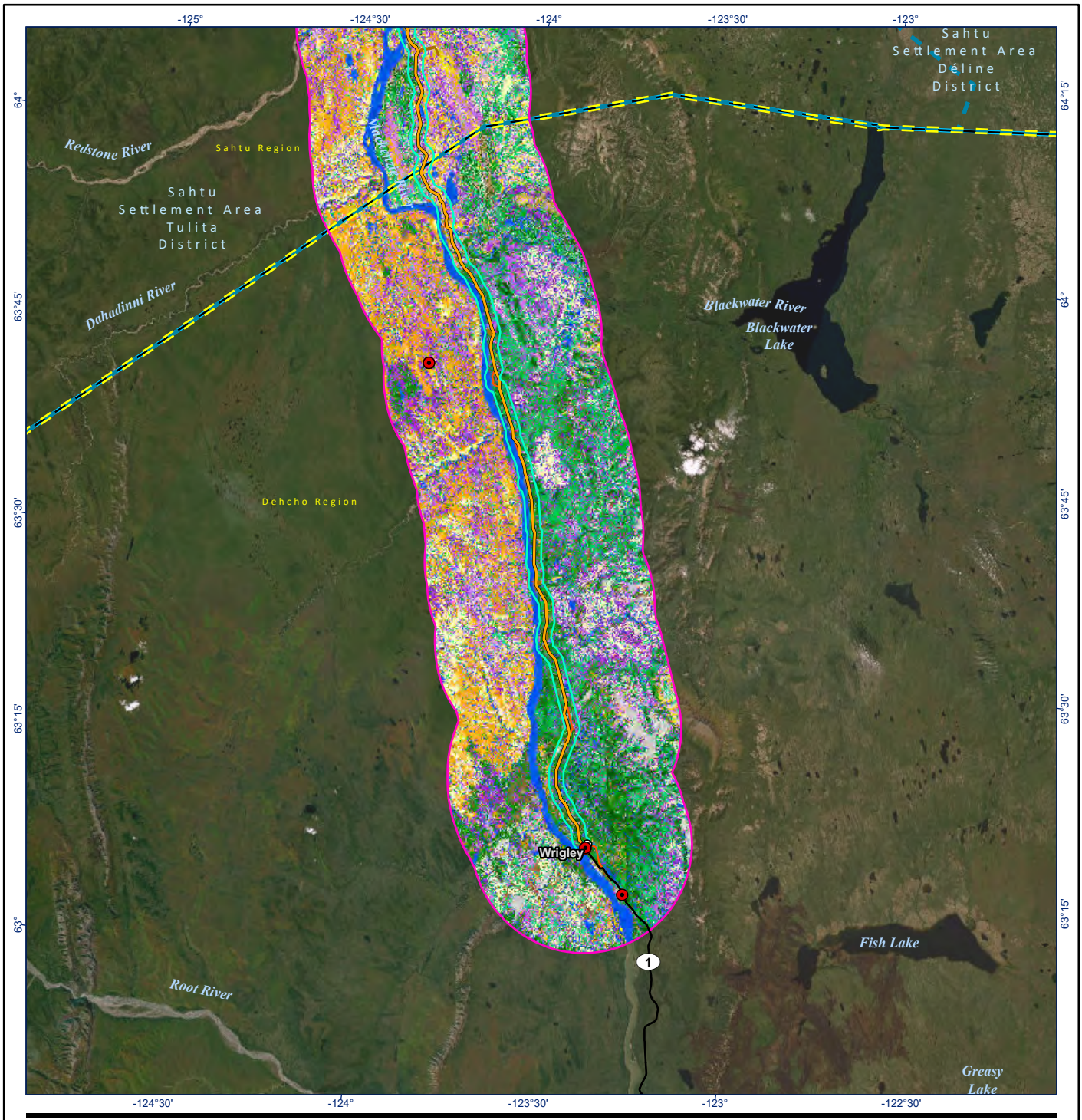
Landcover/Plant Assemblage Type	Cover Type Class	LSA		RSA	
		ha	%	ha	%
Broadleaf Forest	Broadleaf – Dense	665.0	3.1	43,789.4	12.2
	Broadleaf – Open	68.3	0.3	4,129.7	1.2
	Broadleaf Subtotal	**733.2**	**3.5**	**47,919.1**	**13.4**
Coniferous Forest	Coniferous – Dense	2,724.7	12.8	25,081.4	7.0
	Coniferous – Open	3,694.9	17.4	40,004.2	11.2
	Coniferous – Sparse	3,092.7	14.6	51,385.1	14.3
	Coniferous Subtotal	**9,512.2**	**44.8**	**116,470.7**	**32.5**
Mixedwood Forest	Mixedwood – Dense	825.5	3.9	6,772.1	1.9
	Mixedwood – Open	107.3	0.5	2,727.8	0.8
	Mixedwood Subtotal	**932.8**	**4.4**	**9,499.9**	**2.6**
Shrubland	Shrub – Tall	307.4	1.4	1,642.0	0.5
	Shrub – Low	347.4	1.6	38,961.7	10.9
	Shrubland Subtotal	**654.8**	**3.1**	**40,603.7**	**11.3**
Herbaceous and Un-vegetated	Herb	42.7	0.2	1,248.9	0.3
	Bryoids	7.0	<0.1	20.3	<0.1
	Rock/Rubble	44.1	0.2	4,877.5	1.4
	Exposed Land[1]	1,255.3	5.9	4,844.1	1.4
	Herbaceous and Un-vegetated Subtotal	**1,349.1**	**6.4**	**10,990.8**	**3.1**
	Upland Subtotal[2]	**13,182.0**	**62.1**	**225,484.3**	**62.9**
Wetland	Wetland – Treed	1,768.5	8.3	46,837.6	13.1
	Wetland – Shrub	1,667.2	7.9	44,668.8	12.5
	Wetland – Herb	717.3	3.4	12,623.9	3.5
	Wetland Subtotal[2]	**4,152.9**	**19.6**	**104,130.4**	**29.0**
Open Water		3,894.1	18.3	28,828.2	8.0
No data		0.0	0.0	95.5	0.0
Total[2]		**21,229.0**	**100.0**	**358,538.4**	**100.0**

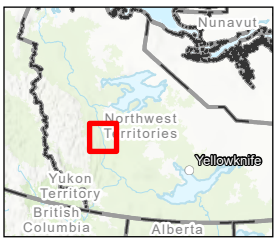
Notes:

1 Exposed land includes areas which naturally have less than 5% vegetative cover such as shorelines of rivers and lakes, exposed rock, recently burned areas, and moraines, and includes cleared areas such as roads and areas of infrastructure development.

2 Sub-totals and totals may not equal sums of individual values due to rounding.

Source: Natural Resources Canada and GNWT (2017).





Alien and Alien Invasive (weed) Occurrence*

Landcover Type

- Water
- Rock/Rubble
- Exposed Land
- Bryoids
- Shrub - Tall
- Shrub - Low
- Wetland - Treed
- Wetland - Shrub
- Wetland - Herb
- Herb
- Coniferous - Dense
- Coniferous - Open
- Coniferous - Sparse
- Broadleaf - Dense
- Broadleaf - Open
- Mixedwood - Dense
- Mixedwood - Open
- Mixedwood - Sparse

* More than one alien or alien invasive plant may occur at each mapped location

- Proposed Mackenzie Valley Highway Alignment - Issued for EA 2022
- Granular Borrow / Rock Quarry Site and Access
- Local Study Area
- Regional Study Area
- Community
- All-Season Road
- Winter Road
- District Boundary
- Region Boundary
- Settlement Area Boundary

0 7.5 15 Kilometres

(At original document size of 8.5x11)
1:40,000,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 2023-03-07
TR by AJ on 2023-03-07

Client/Project
144903025-0010-REVB

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.
3.1

Title
Landcover/Plant Assemblage Types within the Mackenzie Valley Highway Project LSA and RSA – Dehcho Region

Notes

1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS

Figure 3.2 Upland Landcover/Plant Assemblage – Dehcho Region

Areas of open water (i.e., lakes, rivers and streams) are also common in the Dehcho Region of the LSA, occupying 18.3% of the LSA (3,894.1 ha), which occur primarily at Mackenzie River and associated watercourses (Figure 3.1). Herb, and rock/rubble areas are also present, both occupying 0.2% of the LSA at 42.7 ha and 44.1 ha, respectively. Bryoid dominated areas are uncommon, occupying less than 0.1% of the Dehcho Region of the LSA (7.0 ha).

Like the LSA, the RSA in the Dehcho Region is dominated by coniferous forest 32.5% (116,470.7 ha); however, cover decreases with stand density (Table 3.4). Broadleaf forests in the RSA occupy a greater proportion of landcover 13.4% (47,919.1 ha) than in the LSA. Compared to the LSA, relative abundance of mixedwood forest within the RSA is lower, representing just 2.6% (9,499.9 ha). Broadleaf and mixedwood forests are dominated by dense stands with 56% to 100% tree closure.

The remaining upland composition in the RSA in the Dehcho Region is mostly low shrub 10.9% (39,961.7 ha), followed by rock/rubble 1.4% (4,877.5 ha), exposed land 1.4% (4,844.1 ha), and tall shrub 0.5% (1,642.0 ha). Herb dominated areas are also present in the RSA, occupying 0.3% (1,248.9 ha). Small amounts of bryoid landcover/plant assemblage is also present in the RSA, but they are found at less than 0.1% (Table 3.4).

Wetlands cover 29.0% (104,130.4ha) of the RSA in the Dehcho Region, with similar proportions of treed wetlands and shrub wetlands, occupying 13.1% (46,837.6 ha) and 12.5% (44,668.8 ha), respectively. Herb wetlands are also present at 3.5% (12,623 ha). Wetlands are predominately located in areas associated with open water and broadleaf stands, occurring primarily adjacent to watercourses throughout the Dehcho Region.

A lower percentage of open water areas are observed in the RSA in the Dehcho Region 8.0% (28,828.2 ha), compared to the LSA (Table 3.4). This difference is due to the presence of the Mackenzie River in the LSA (Figure 3.1). Smaller areas of open water also occur and are surrounded by various wetland classes (Figure 3.3).

Coniferous forest has an average stand volume density of 40.2 cubic metres per hectare (m^3/ha; Standard Deviation [SD] = 17.7) (Table 3.5). Tree height in conifer stands in the LSA range from 5 m to 19 m with an average height of 9.1 m (SD = 2.2). Mixedwood forest has a greater average stand volume density (42.2 m^3/ha, SD = 13.6) than coniferous (40.2 m^3/ha, SD = 17.7), and deciduous forests (34.6 m^3/ha, SD = 17.9). Deciduous forest has slightly shorter minimum tree height (5 m) than mixedwood forest (6 m), but both have similar maximum tree heights of 17 m. Average tree height for deciduous forest is 8.5 m (SD = 2.2), whereas average tree height for mixedwood forest is 9.5 m (SD = 1.6) (Table 3.5). More detailed species information from ground data is needed to provide detailed merchantable timber volume estimates, but from volume metrics, merchantable timber is expected in the Dehcho Region of the LSA.

Figure 3.3 Open Water and Wetland Landcover/Plant Assemblage – Dehcho Region

Table 3.5 Tree Height, Stand Volume Density and Total Volume by Forest Type in the LSA – Dehcho Region

Landcover/Plant Assemblage Type	Tree Height (m)				Stand Volume Density (m^3/ha)				Total Volume[2] (m^3)
	Minimum	Maximum	Average	SD[1]	Minimum	Maximum	Average	SD[1]	
Coniferous	5	19	9.1	2.2	13	148	40.2	17.7	448,465
Deciduous	5	17	8.5	2.2	13	125	34.9	17.9	15,209
Mixedwood	6	17	9.5	1.6	17	125	42.2	13.6	26,803

Notes:
[1] Standard Deviation.
[2] Total volume determined by multiplying average stand volume by land cover area (ha) in the LSA.
Source: Natural Resources Canada and GNWT (2017).

Average stand volume density of coniferous forest in the RSA is lower than that of the LSA at 31.0 m^3/ha (SD = 21.7) (Table 3.6). Average tree height in coniferous forest is also shorter in the RSA than the LSA, equaling 7.7 m (SD = 2.5), with heights ranging from 4 m to 22 m (Table 3.6). Deciduous forest in the Dehcho Region of the RSA shares the same range of stand heights as coniferous forest; however, average height is 6.7 m and tree height is less variable (SD = 1.9). Mixedwood forest has an average stand volume density of 38.7 m^3/ha (SD = 19). Mixedwood forest ranges from 5 m to 21 m in height with an average tree height of 8.9 m (SD = 2.1). Average stand volume density of deciduous and mixedwood stands in the RSA is lower than the LSA. Average tree heights of deciduous and mixedwood stands in the LSA are taller than the RSA.

Table 3.6 Tree Height, Stand Volume Density and Total Volume by Forest Type in the RSA – Dehcho Region

Landcover/Plant Assemblage Type	Tree Height (m)				Stand Volume Density (m^3/ha)				Total Volume[2] (m^3)
	Minimum	Maximum	Average	SD[1]	Minimum	Maximum	Average	SD[1]	
Coniferous	4	22	7.7	2.5	10	180	31.0	21.7	3,927,036
Deciduous	4	22	6.7	1.9	10	182	23.2	14.9	1,190,127
Mixedwood	5	21	8.9	2.1	13	174	38.7	18.8	276,288

Notes:
[1] Standard Deviation
[2] Total volume determined by multiplying average stand volume by land cover area (ha) in the RSA.
Source: Natural Resources Canada and GNWT (2017).

Fire History

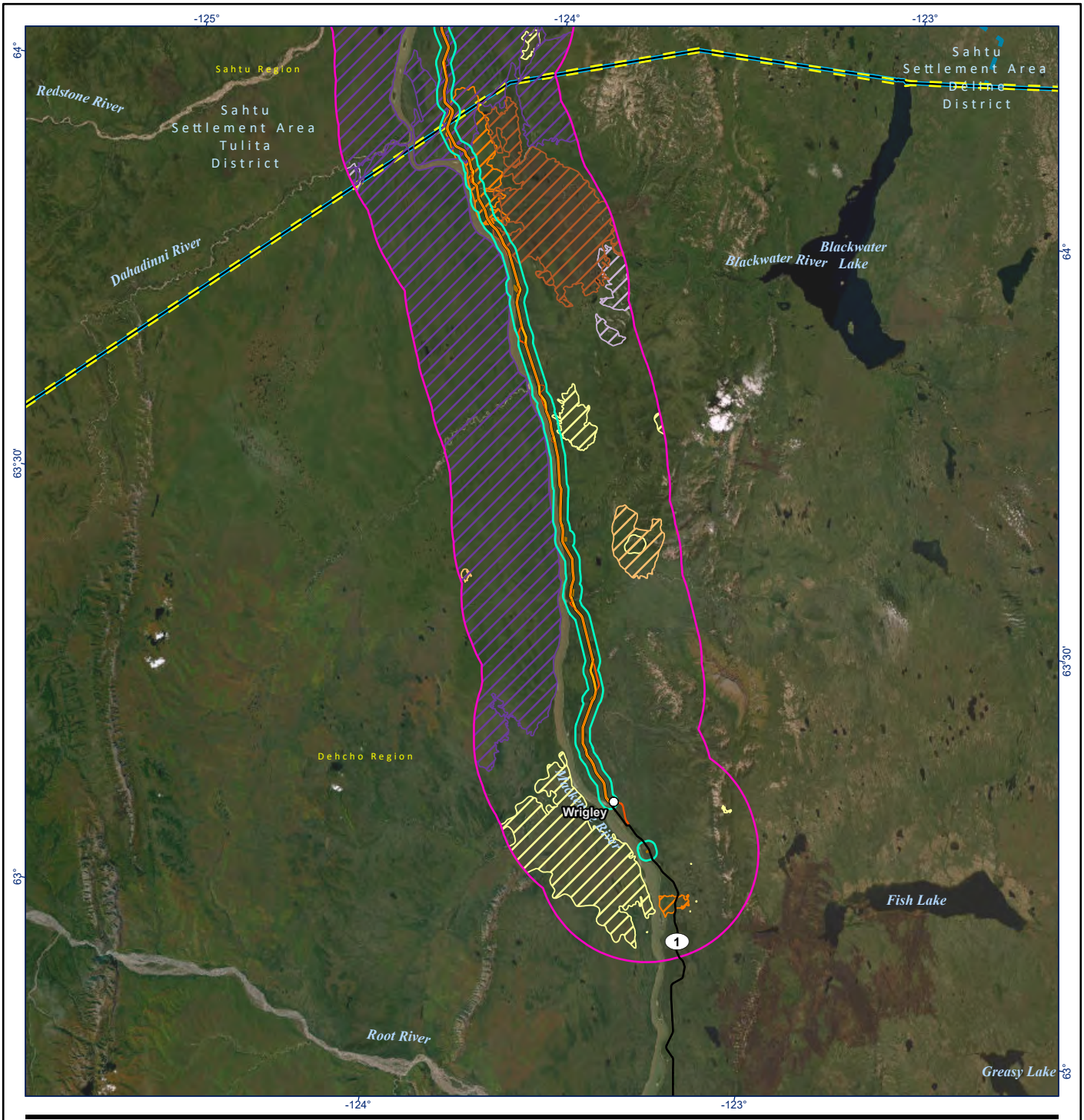
Between 1960 and 2019, five fires occurred within some portion of the LSA in the Dehcho Region, burning a total area of 4,830.3 ha (22.8% of the LSA) (Table 3.7). Total area burned within the Dehcho Region of the LSA ranged from 0 to 2,713.0 ha, with zero to two fires occurring per decade. Some areas burned more than once during this time, with certain areas experiencing burns in more than one decade. Most of the recorded fires have occurred west and northeast of the Mackenzie River. During the period of 1990-2009, the majority of the LSA west of the Mackenzie River had been affected by fire (Figure 3.4).

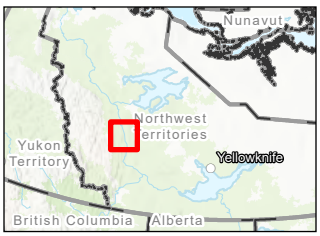
There were 24 fires within the RSA in the Dehcho Region between 1960 and 2019, burning a total of 182,269.2 ha (50.8% of the RSA) (Table 3.7). Fire sizes within the RSA ranged from 3,390.3 ha to 115,739.5 ha. In comparison to the LSA, the RSA burned more frequently, and had a greater proportion burned. This is likely an artifact of the size of the LSA and is not suspected to reflect a greater resistance to burning.

Table 3.7 Forest Fire Occurrence within the LSA and RSA from 1960 to 2019 – Dehcho Region

Time Period	Number of Fires		Total Area Burnt (ha)		Percent Area Burnt (%)	
	LSA	RSA	LSA	RSA	LSA	RSA
1960-1969	0	2	0.0	4,864.3	0.0	1.4
1970-1979	1	2	2,713.0	7,523.0	12.8	2.1
1980-1989	0	3	0.0	3,390.3	0.0	0.9
1990-1999	2	4	1,466.5	115,739.5	6.9	32.3
2000-2009	1	9	36.1	26,066.8	0.2	7.3
2010-2019	1	4	614.7	24,685.3	2.9	6.9
TOTAL	5	24	4,830.3	182,269.2	22.8	50.8

Source: Canadian Forest Service (2020).





National Fire Database
- 1960-1969
- 1970-1979
- 1980-1989
- 1990-1999
- 2000-2009
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Proposed Mackenzie Valley Highway Alignment - Issued for EA 2022

- Granular Borrow / Rock Quarry Site and Access
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0 7.5 15 Kilometres

(At original document size of 8.5x11)
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Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 2023-03-07
TR by AJ on 2023-03-07

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Mackenzie Valley Highway Project

Figure No.
3.4

Title
Area Burnt per Decade within the Mackenzie Valley Highway LSA and RSA between 1960 and 2019 - Dehcho Region

Notes
1. Coordinate System: NAD 1983 Northwest Territorries Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS

Fires within the LSA of the Dehcho Region affected 2,819.8 ha of upland areas and 1,757.1 ha of wetland areas (Table 3.8). Fires within the RSA of the Dehcho Region affected 114,208.9 ha of upland areas and 59,383.3 ha of wetland areas (Table 3.8). All upland and wetland types were burned at least once in the LSA and RSA between 1960 and 2019. Areas burned of rock/rubble, exposed land and open water reflect the coarse scale of available data in fact, these areas likely did not actually burn.

Figure 3.5 is a box plot, which shows the median area burned per landcover/plant assemblage type in the LSA and RSA in the Dehcho Region between 1960 and 2019. The heavy horizontal bar in each box indicates median value, with inter-quartile range represented as upper and lower boundaries on opposite areas in the box. Standard deviation is represented as bars and outliers as points. This figure shows that fire size in the LSA and RSA of the Dehcho Region is highly variable.

Data on changes in plant composition with varying time since burned (i.e., succession) were not found for the LSA or RSA. Available studies indicate burned areas are dominated by plants capable of vegetative reproduction following fire, with a later increase in abundance of plants reproducing by seed and slower growing plants capable of vegetative reproduction. Plants with light abundant seeds and species also colonize burned areas rapidly and abundance decreases after a few years due to short life spans of the plants (Johnson, 1981). Trees required 5 to 6 years, on average, to reach a height of 0.3 m following high severity fires in High Boreal, Low Subarctic, and High Subarctic ecoregions of the Taiga Shield (Lewis et al., 2018). Following low to mixed-severity fires, trees took 10.7 years, on average, in the High Boreal ecoregion and 15.5 years in the Low Subarctic. Tree regeneration times may differ for the ecoregions intersected by the RSA.

Figure 3.5 Area Burned by Landcover/Plant Assemblage Type from 1960 to 2019 in the LSA and RSA – Dehcho Region

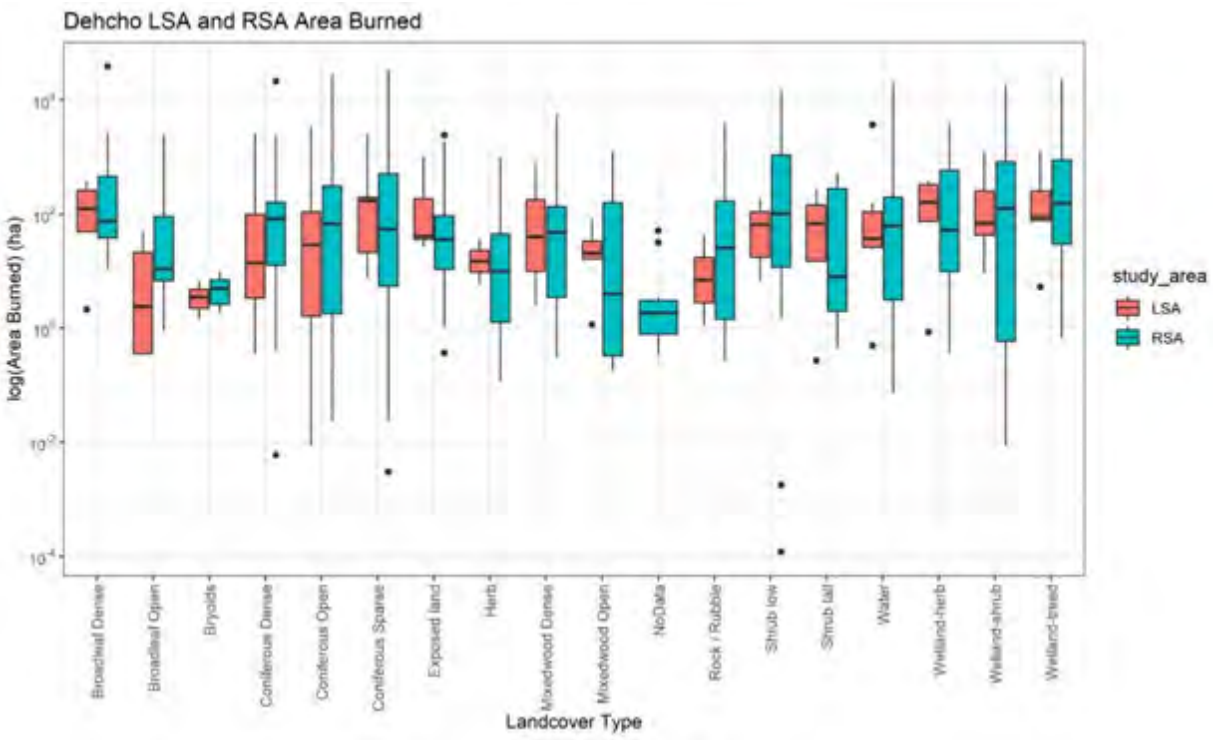


Table 3.8 Number of Fires per Landcover/Plant Assemblage Type and Total Area Burned from 1960 to 2019 – Dehcho Region

Landcover/Plant Assemblage Type [1]	Cover Type Class	Total number of Fires [2]		Total area burned (ha)	
		LSA	RSA	LSA	RSA
Broadleaf Forest	Broadleaf – Dense	10	47	565.3	41,556.8
	Broadleaf – Open	4	29	16.7	3,196.0
	Broadleaf Subtotal	**-**	**-**	**582.0**	**44,752.8**
Coniferous Forest	Coniferous – Dense	6	34	117.1	3,847.3
	Coniferous – Open	8	45	225.5	11,819.8
	Coniferous – Sparse	11	50	568.6	17,743.1
	Coniferous Subtotal	**-**	**-**	**911.2**	**33,110.2**
Mixedwood Forest	Mixedwood – Dense	2	24	42.7	1,322.8
	Mixedwood – Open	10	33	133.5	1,583.7
	Mixedwood Subtotal	**-**	**-**	**176.2**	**2,906.5**
Shrubland	Shrub – Low	11	54	341.3	27,963.2
	Shrub – Tall	10	36	498.8	1,578.6
	Shrubland Subtotal	**-**	**-**	**840.1**	**29,541.8**
Herbaceous and Un-vegetated	Herb	1	20	6.0	268.3
	Bryoids	9	14	11.6	23.8
	Rock/Rubble	1	10	1.1	827.9
	Exposed Land [3]	13	38	291.6	2,477.6
	Herbaceous and Un-vegetated Subtotal	**-**	**-**	**310.3**	**3,597.6**
	Upland Subtotal	**-**	**-**	**2,819.8**	**114,208.9**
Wetland	Wetland – Herb	10	47	564.4	9,136.9
	Wetland – Shrub	11	52	577.6	26,273.5
	Wetland – Treed	11	49	615.1	23,972.9
	Wetland Subtotal	**-**	**-**	**1,757.1**	**59,383.3**
Open Water		11	49	253.5	8,630.6
No Data		-	16	-	46.3
Total		**-**	**-**	**4,830.3**	**182,269.2**

Notes:

1 Landcover/plant assemblage type in 2020. Landcover/plant assemblage may have been different prior to fire events.

2 Many fires affected more than one vegetation type; therefore, the total number of fires are given for each vegetation type but cannot be summed among vegetation types.

3 Exposed land includes areas which naturally have less than 5% vegetative cover such as shorelines of rivers and lakes, exposed rock, recently burned areas, and moraines, and includes cleared areas such as roads and areas of infrastructure development.

Source: Canadian Forest Service (2020)

Plant SOCC

A search of the Northwest Territories Species Monitoring Infobase (Working Group on General Status of NWT Species, 2016)—queried to the ecoregions (Boreal Cordillera and Taiga Cordillera) that are intersected by the RSA of the Dehcho Region—identified 107 vascular plant, bryophytes and lichen SOCC with potential to occur within the RSA, including 77 vascular plants, six mosses, and 24 lichens (Appendix A.1). Of the 77 vascular plants identified, 33 are listed territorially as *may be at risk* and 44 are listed as *sensitive* under the NWT General Species Rankings. Of the six moss species identified, four are listed territorially as *may be at risk* and two are listed as *sensitive* under the NWT General Species Rankings. Two lichen species are listed as *may be at risk* and 22 as *sensitive* (GNWT, 2016a). No plant or lichen SOCC occurring in the Boreal Cordillera ecoregion or the Taiga Cordillera ecoregion are listed under SARA or Committee on The Status of Endangered Wildlife in Canada (COSEWIC), and no vegetation assemblages are considered *rare*.

No plant SOCC occurrences have been documented within the Dehcho Region of the LSA or RSA (Dessau, 2012). Several species reported by Dessau (2012) were previously considered SOCC but have since been downgraded. Pre-construction field surveys should be conducted to evaluate plant SOCC occurrences of higher potential areas potentially impacted by the Project (e.g., riparian areas, uncommon plant assemblages).

Alien and Invasive Alien Plant Species

A search of the AKEPIC Data Portal (AKEPIC, 2020) found 14 locations of 12 alien and invasive alien plant species within the RSA in the Dehcho Region (Table 3.9). Nine of the species are classified as alien plant species and three as invasive alien species. Oldham and Delisle-Oldham (2016) identified 34 alien and invasive alien plant species, of which 22 species were classified as alien and 12 as invasive alien in the RSA in the Dehcho Region (Appendix B). Specific locations of these occurrences are not available; however, locations were sampled in ditches along human infrastructure.

Table 3.9 Alien and Invasive Alien Plant Species Recorded within the RSA – Dehcho Region

Listing	Scientific Name	Common Name	Number of Occurrences	Closest Occurrence to the PDA (km)
Alien	*Taraxacum officinale*	common dandelion	1	0.56
Alien	*Erucastrum gallicum*	common dog mustard	1	0.56
Alien	*Lappula squarrosa*	European stickseed	1	0.56
Alien	*Brassica rapa*	field mustard	1	8.77
Alien	*Thlaspi arvense*	field pennycress	1	8.77
Alien	*Matricaria discoidea*	pineapple weed	1	0.56
Alien	*Taraxacum erythrospermum*	rock dandelion	1	0.56
Alien	*Phleum pratense*	timothy	1	0.56
Alien	*Lepidium virginicum*	wild peppergrass	1	8.78
Invasive Alien	*Crepis tectorum*	narrow-leaf hawksbeard	3	0.56
Invasive Alien	*Phalaris arundinacea*	reed canary grass	1	6.39
Invasive Alien	*Melilotus albus*	white sweet-clover	1	8.78

Source: AKEPIC (2020)

3.2.2.2 Sahtu Region

Landcover/Plant Assemblages

Coniferous forest dominates upland area within the LSA in the Sahtu Region, occupying 28.3% (11,798.9 ha), with open and sparse stands being most abundant (Table 3.10). Broadleaf and mixedwood forests are also present, but less common, with broadleaf forest occupying 6.9% (2,892.5 ha) and mixedwood forest occupying 5.6% (2,315.2 ha) of the LSA. Coniferous forests are primarily distributed west and northeast of the Mackenzie River, broadleaf forests occur in the southwest portion of the LSA, and mixedwood forests are distributed throughout (Figure 3.6). Remaining upland areas in the LSA in the Sahtu Region are largely composed of low shrub at 16.6% (6,935.0 ha), followed by exposed land 4.1% (1,688.2 ha), and tall shrub 4.1% (1,688.7 ha) (Table 3.10). Exposed land occurs predominately adjacent to the Mackenzie River (Figure 3.6). Tall and low shrub landcover/plant assemblage types are located predominately in the northwest portion of the LSA and typically adjacent to conifer stands and near wetlands (Figure 3.6).

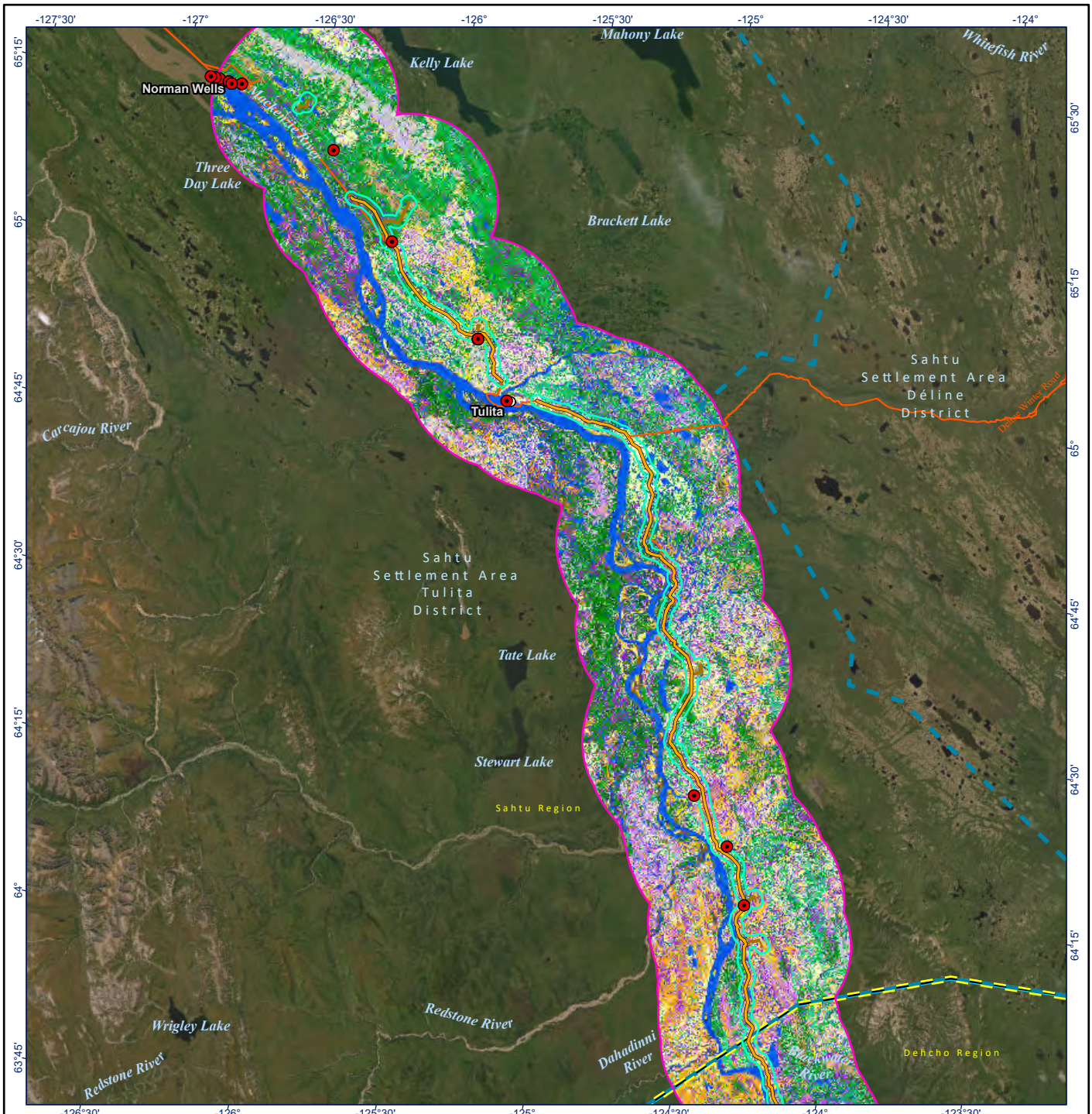
Table 3.10 Landcover/Plant Assemblage Types in the LSA and RSA – Sahtu Region

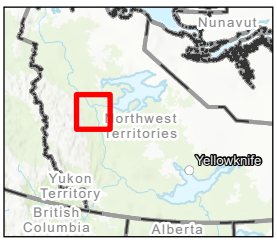
Landcover/Plant Assemblage Type	Cover Type Density	LSA		RSA	
		ha	%	ha	%
Broadleaf Forest	Broadleaf – Dense	2,004.4	4.8	34,264.7	5.3
	Broadleaf – Open	888.1	2.1	14,627.8	2.2
	Broadleaf Subtotal	**2,892.5**	**6.9**	**48,892.5**	**7.5**
Coniferous Forest	Coniferous – Dense	893.2	2.1	18,581.1	2.9
	Coniferous – Open	5,555.5	13.3	113,324.1	17.4
	Coniferous – Sparse	5,350.3	12.8	71,839.7	11.0
	Coniferous Subtotal	**11,798.9**	**28.3**	**203,744.8**	**31.3**
Mixedwood Forest	Mixedwood – Dense	318.9	0.8	7,492.9	1.1
	Mixedwood – Open	1,991.2	4.8	23,821.0	3.7
	Mixedwood – Sparse	5.1	<0.1	11.7	<0.1
	Mixedwood Subtotal	**2,315.2**	**5.6**	**31,325.7**	**4.8**
Shrubland	Shrub – Tall	1,688.7	4.1	16,523.1	2.5
	Shrub – Low	6,935.0	16.6	72,610.1	11.1
	Shrubland Subtotal	**8,623.7**	**20.7**	**89,133.2**	**13.7**
Herbaceous and Un-vegetated	Herb	191.0	0.5	4,093.5	0.6
	Bryoids	5.9	<0.1	137.1	0.0
	Rock/Rubble	62.2	0.1	10,281.4	1.6
	Exposed Land [1]	1,688.2	4.1	9,900.7	1.5
	Herbaceous and Un-vegetated Subtotal	**1,947.3**	**4.7**	**24,412.6**	**3.7**
	Upland Subtotal	**27,577.4**	**66.2**	**397,508.9**	**61.0**
Wetland	Wetland – Treed	4,121.8	9.9	64,770.4	9.9
	Wetland – Shrub	3,819.0	9.2	55,334.7	8.5
	Wetland – Herb	2,666.8	6.4	44,856.6	6.9
	Wetland Subtotal	**10,607.6**	**25.5**	**164,961.7**	**25.3**
Open Water		3,489.1	8.4	89,310.5	13.7
No Landcover Data		0.0	0.0	164.4	0.0
Total		**41,674.1**	**100.0**	**651,945.4**	**100.0**

Note:

[1] Exposed land includes areas which naturally have less than 5% vegetative cover, such as on the shorelines of rivers and lakes, exposed rock, recently burned areas, and moraines; it includes cleared areas, such as roads and areas of infrastructure development.

Source: Natural Resources Canada and GNWT (2017).





Alien and Alien Invasive (weed) Occurrence*

Landcover Type

- Water
- Rock/Rubble
- Exposed Land
- Bryoids
- Shrub - Tall
- Shrub - Low
- Wetland - Treed
- Wetland - Shrub
- Wetland - Herb
- Herb
- Coniferous - Dense
- Coniferous - Open
- Coniferous - Sparse
- Broadleaf - Dense
- Broadleaf - Open
- Mixedwood - Dense
- Mixedwood - Open
- Mixedwood - Sparse
- Proposed Mackenzie Valley Highway Alignment - Issued for EA 2022
- Granular Borrow / Rock Quarry Site and Access
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- All-Season Road
- Winter Road
- Settlement Area Boundary
- Region Boundary
- District Boundary

* More than one alien or alien invasive plant may occur at each mapped location

0 10 20 Kilometres

(At original document size of 8.5x11)
1:1,000,000

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Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 2023-03-07
TR by AJ on 2023-03-07

Client/Project
144903025-0010-REVB

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Figure No.
3.6

Title
Landcover/Plant Assemblage Types within the Mackenzie Valley Highway Project LSA and RSA – Sahtu Region

Notes

1. Coordinate System: NAD 1983 Northwest Territorries Lambert
2. Data Sources: Government of Canada
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
   World Imagery: Earthstar Geographics
   World Hillshade: Esri, USGS

Wetlands occupy 25.5% of the LSA in the Sahtu Region (10,607.6 ha). Treed and shrub wetlands are the most common wetland types in the LSA, occupying 9.9% (4,121.8 ha) and 9.2% (3,819.0 ha) of the LSA in the Sahtu Region, respectively. Wetlands are located throughout the LSA in the Sahtu Region with the highest concentrations occurring near areas of open water (Figure 3.6). Areas of open water (i.e., lakes, rivers, and streams) are also common in the LSA in the Sahtu Region, occupying 8.4% (3,489.1 ha) and primarily associated with the Mackenzie River and Three Day Lake in the northwest portion of the LSA (Figure 3.6). Herb, bryoid dominated areas and rock/rubble areas are uncommon, occupying less than 0.1% or less within the LSA in the Sahtu Region.

Like the LSA, the RSA in the Sahtu Region is dominated by coniferous forest, 31.3% (203,744.8 ha), with abundance decreasing with increased stand density (Table 3.10). In comparison to the LSA, proportions of broadleaf forest within the RSA were greater, 7.5% (48,892.5 ha), while proportions of mixedwood forest were lower, at 4.8% (31,325.7 ha). Remaining upland areas in the RSA in the Sahtu Region are largely composed of low shrub 11.1% (72,610.1 ha), followed by tall shrub 2.5% (16,523.1 ha), with similar proportions of rock/rubble 1.6% (10,281.4 ha) and exposed land 1.5% (9,900.7 ha) (Table 3.10). Areas of rock/rubble are located on steeper slopes (Figure 3.7) and other scattered areas in the LSA and RSA.

Figure 3.7 Unvegetated Rock/Rubble (foreground) in the LSA – Sahtu Region

Wetlands cover 25.3% (164,961.7 ha) of the RSA in the Sahtu Region, predominantly as treed wetlands 9.9% (64,770.4 ha). Shrub wetlands and herb wetlands are also present in the RSA in the Sahtu Region, occupying 8.5% (55,334 ha) and 6.9% (44,856.6 ha), respectively. Wetlands are located throughout the RSA in the Sahtu Region and are often located adjacent to areas of open water (Figure 3.8) and watercourses east of the Mackenzie River (Figure 3.6). Areas of open water are also present in the RSA, occupying 13.7% (89,310.5 ha) of the RSA.

Figure 3.8 Open Water Surrounded by Herb and Shrub Wetland in the LSA – Sahtu Region

Coniferous forest of the LSA in the Sahtu Region has an average stand volume density of 23.7 m^3/ha (SD = 12.4) (Table 3.11). Conifer forest tree heights range from 5 m to 17 m with an average height of 6.9 m (SD = 1.7). Mixedwood forest has a greater average stand volume density (32.2 m^3/ha, SD = 14.5) than deciduous forest (23.0 m^3/ha, SD = 10.6). Although deciduous cover types have a greater maximum height (18 m) than mixedwood cover types (15 m), the average tree height in mixedwood stands is greater than in deciduous stands, at 8.2 m (SD = 1.9) and 6.8 m (SD = 1.5), respectively (Table 3.11). More detailed species information from ground data is needed to provide detailed merchantable timber volume estimates, but from volume metrics, merchantable timber is expected in the Sahtu Region LSA.

Table 3.11 Cover Type and Stand Volume Density per Landcover/Plant Assemblage Type in the LSA – Sahtu Region

Landcover/Plant Assemblage Type	Tree Height (m)				Stand Volume Density (m^3/ha)				Total Volume[2] (m^3)
	Minimum	Maximum	Average	SD[1]	Minimum	Maximum	Average	SD[1]	
Coniferous	5	17	6.9	1.7	10	116	23.7	12.4	288,702
Deciduous	5	18	6.8	1.5	11	126	23.0	10.6	55,036
Mixedwood	5	15	8.2	1.9	14	88	32.2	14.5	47,027

Notes:
1 Standard deviation.
2 Total volume determined by multiplying average stand volume by land cover area (ha) in LSA.
Source: Canadian Forest Service (2020)

Coniferous forest in the RSA in the Sahtu Region has an average stand volume density of 25.7 m^3/ha (SD = 15.3) (Table 3.12). Average tree height in coniferous forest is 7.2 m (SD = 2.0), with heights ranging from 4 m to 21 m. Deciduous forest in the Sahtu Region has a similar range of stand height and similar average height as coniferous forest. The average stand volume density in mixedwood forest is 30.2 m^3/ha, (SD = 16.5). Mixedwood stands range from 5 m to 22 m with an average tree height of 7.8 m (SD = 2.0) (Table 3.12).

Table 3.12 Tree Height, Stand Volume Density and Total Volume per Forest Type in the RSA – Sahtu Region

Cover Type	Tree Height (m)				Stand Volume Density (m^3/ha)				Total Volume[2] (m^3)
	Minimum	Maximum	Average	SD[1]	Minimum	Maximum	Average	SD[1]	
Coniferous	4	21	7.2	2.0	9	166	25.7	15.3	5,590,767
Deciduous	4	19	7.0	2.0	10	149	24.8	15.1	1,040,433
Mixedwood	5	22	7.8	2.0	11	177	30.2	16.5	665,412

Notes:
1 Standard deviation.
2 Total volume is determined by multiplying average stand volume by land cover area (ha) in LSA.
Source: Canadian Forest Service (2020)

Fire History

From 1960 to 2019, 17 fires within the LSA in the Sahtu Region burned 33,041.3 ha (79.3% of the LSA) (Table 3.13). Fires were generally common in the LSA with every decade since 1960 experiencing at least one burn. The number of fires ranged from one (1960-1969, 2010-2019) to a maximum of five (1990-1999). The area burned, by decade, within the LSA in the Sahtu Region ranged from 156.8 ha (0.4% of the LSA) to 25,453.9 ha (61.1% of the LSA). Fires from 1960 to 1989 occurred primarily east of Tulita (Figure 3.9). From 1990 to 2019, fires occurred mostly in the southern and central parts of the LSA.

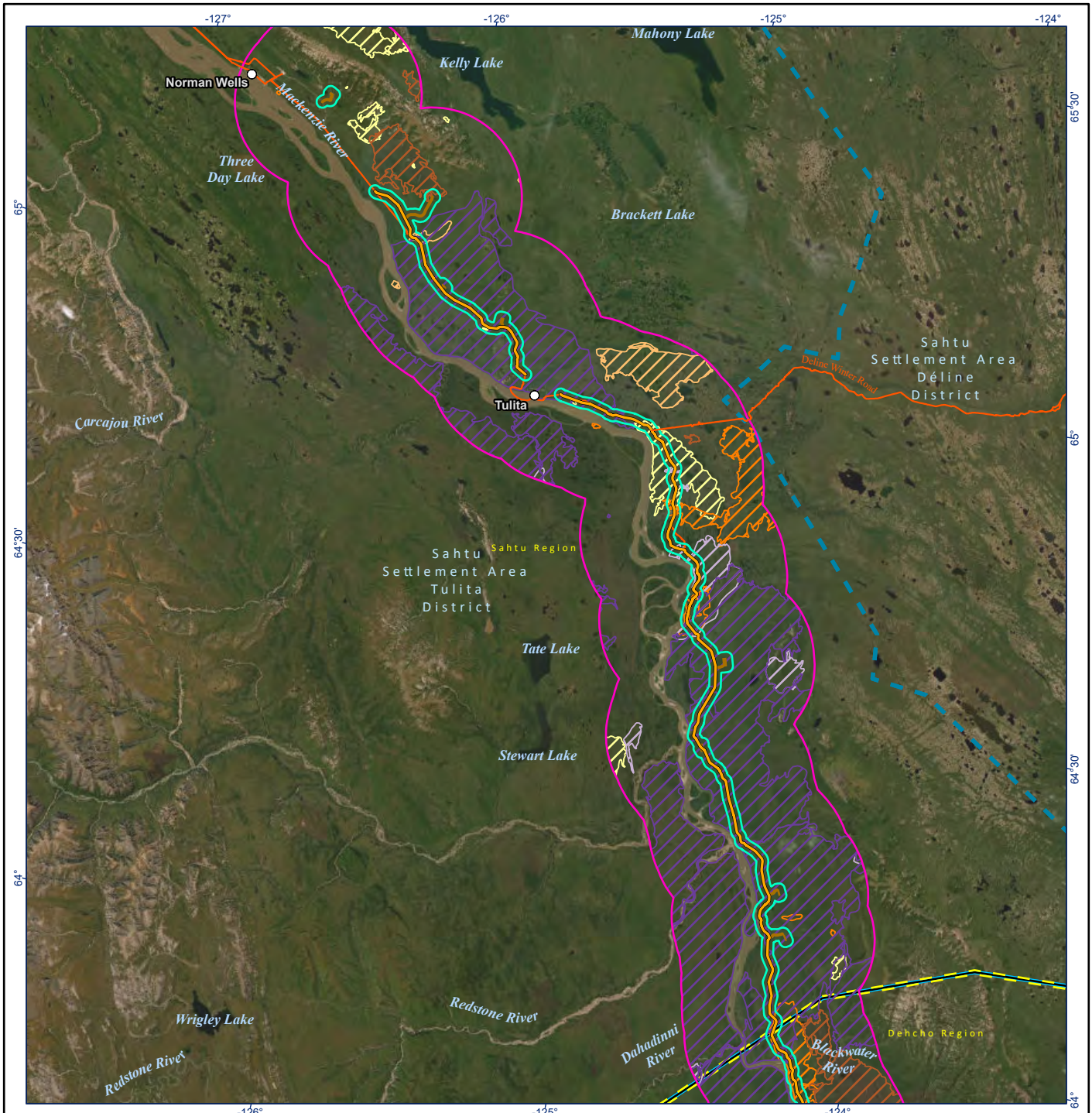
There were 47 fires in the RSA during the same time interval and covered a total of 325,204.0 ha (49.9% of the RSA) (Table 3.13). Like the LSA, the RSA had the highest frequency of burns and largest area burned from 1990 to 1999. During that period, 13 fires occurred in the RSA covering 253,799.8 ha (38.9% of the RSA). Fire size ranged from 8,965.7 ha to 253,799.8 ha.

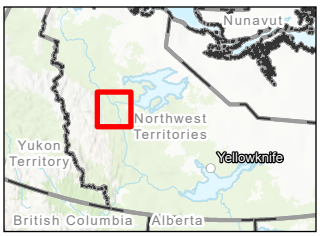
Fires within the LSA of the Sahtu Region affected 22,175.0 ha of upland areas and 8,799.6 ha of wetland areas (Table 3.14). Fires within the RSA of the Sahtu Region burned 203,518.8 ha of upland areas and 99,517.3 ha of wetlands. As with the Dehcho fire metrics, areas burned that were rock/rubble, exposed land and open water, reflecting the coarse scale of available data; in fact, these areas likely did not actually burn.

Table 3.13 Forest Fire Occurrence within the LSA and RSA from 1960 to 2019 – Sahtu Region

	Number of Fires		Total Area Burnt (ha)		Percent Area Burnt (%)	
Time Period	**LSA**	**RSA**	**LSA**	**RSA**	**LSA**	**RSA**
1960-1969	1	4	257.7	11,853.9	0.6	1.8
1970-1979	3	7	1,728.4	15,807.6	4.1	2.4
1980-1989	4	9	2,160.2	13,956.9	5.2	2.1
1990-1999	5	13	25,453.9	253,799.8	61.1	38.9
2000-2009	3	10	3,284.3	20,820.1	7.9	3.2
2010-2019	1	4	156.8	8,965.7	0.4	1.4
TOTAL	17	47	33,041.3	325,204.0	79.3	49.9

Source: Canadian Forest Service (2020)





National Fire Database
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Figure No.
3.9

Title
Area Burnt per Decade within the Mackenzie Valley Highway LSA and RSA between 1960 and 2019 - Sahtu Region

Notes
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2. Data Sources: Canadian Forest Service (2020), Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS

Table 3.14 Number of Fires and Total Area Burned by Landcover/Assemblage Type from 1960 to 2019 – Sahtu Region

Landcover/ Assemblage Type [1]	Cover Type Class	Total Number of Fires in Each Cover Type [2]		Total Area Burned (ha)	
		LSA	RSA	LSA	RSA
Broadleaf Forest	Broadleaf – Dense	28	101	2,054.13	27,554.3
	Broadleaf – Open	14	89	837.3	8,929.6
Broadleaf Subtotal		**-**	**-**	**2,891.43**	**36,483.9**
Coniferous Forest	Coniferous – Dense	21	68	237.2	2,400.1
	Coniferous – Open	33	120	2,624.0	25,195.7
	Coniferous – Sparse	37	128	4,384.3	40,470.6
Coniferous Subtotal		**-**	**-**	**7,245.5**	**68,066.4**
Mixedwood Forest	Mixedwood – Dense	18	47	127.5	1,286.6
	Mixedwood – Open	31	89	1,518.6	11,078.2
	Mixedwood – Sparse	1	2	5.1	11.7
Mixedwood Subtotal		**-**	**-**	**1,651.2**	**12,376.5**
Shrubland	Shrub – Tall	35	97	1,703.7	12,137.1
	Shrub – Low	38	128	6,981.6	66,370.1
Shrubland Subtotal		**-**	**-**	**8,685.3**	**78,507.2**
Herbaceous and Un-vegetated	Exposed Land [3]	37	72	1,475.8	3,490.0
	Herb	10	44	166.3	3,056.5
	Bryoids	5	18	4.9	46.9
	Rock/Rubble	4	22	54.6	1,491.4
Herbaceous and Un-vegetated Subtotal		**-**	**-**	**1,701.6**	**8,084.8**
Upland Subtotal		**-**	**-**	**22,175.0**	**203,518.8**
Wetland	Wetland – Herb	35	126	1,905.6	20,343.5
	Wetland – Shrub	37	122	3,829.7	48,900.2
	Wetland – Treed	35	123	3,064.3	30,273.6
Wetland Subtotal		**-**	**-**	**8,799.6**	**99,517.3**
Open Water		35	120	2,066.6	22,113.4
No Data		-	32	-	54.7
Total		**-**	**-**	**33,041.3**	**325,204.0**

Notes:

1 Landcover/assemblage type in 2020. Landcover/assemblage may have been different prior to fire events.

2 Many fires affected more than one vegetation type; therefore, the total number of fires are given for each vegetation type but cannot be summed among vegetation types.

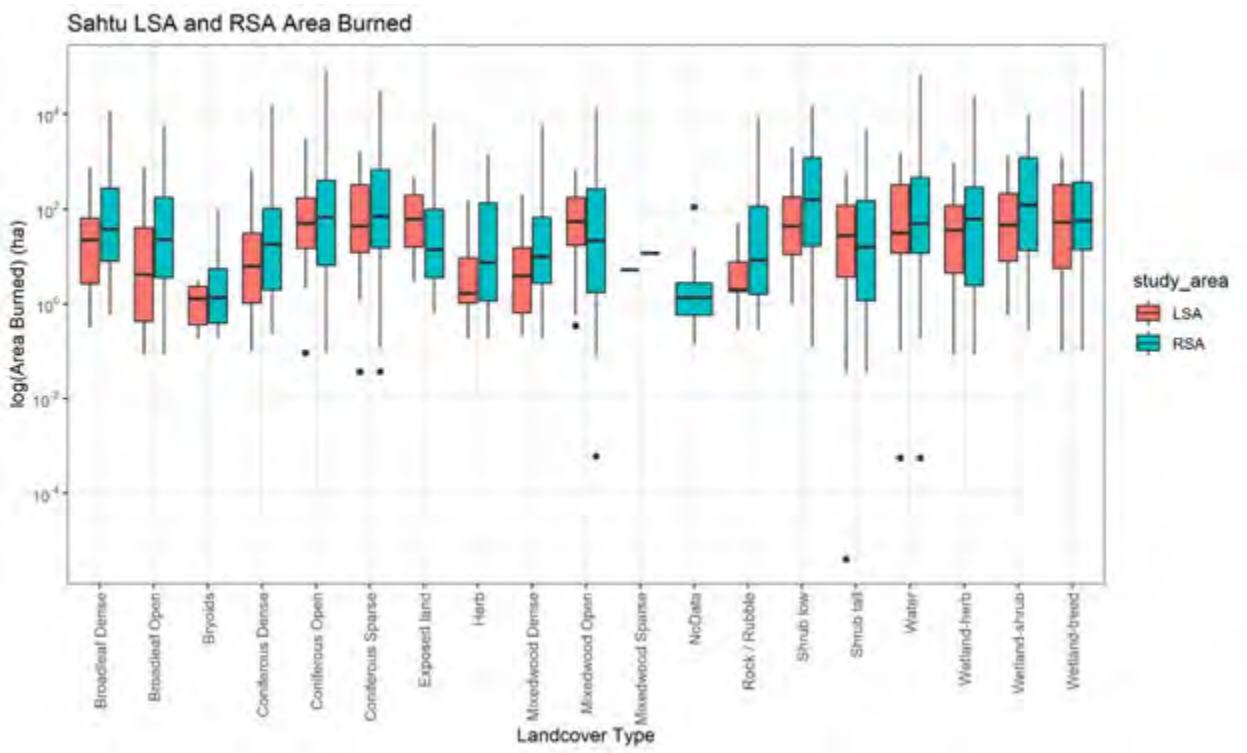
3 Exposed land includes areas, which naturally have less than 5% vegetative cover, such as shorelines of rivers and lakes, exposed rock, recently burned areas, and moraines; the areas also include cleared areas such as roads and areas of infrastructure development.

Source: Canadian Forest Service (2020)

Figure 3.10 is a box plot showing the median area burned per landcover/assemblage type in the LSA and RSA in the Sahtu Region between 1960 and 2019. The heavy horizontal bar in each box indicates the median value, with inter-quartile ranges indicating upper and lower boundaries on opposite areas in the box. The standard deviation is represented by bars and by outliers as points. This figure shows fire size in the LSA and RSA of the Sahtu Region is highly variable.

Data on changes in plant composition with varying time since burned (i.e., succession) were not found for the LSA or RSA. Available studies indicated burned areas are dominated by plants capable of vegetative reproduction following fire, with a later increase in abundance of plants reproducing by seed and slower growing plants capable of vegetative reproduction. Plants with light abundant seeds and species also colonize burned areas rapidly; abundance decreases after a few years due to short life spans of the plants (Johnson, 1981). Trees required 5 to 6 years, on average, to reach a height of 0.3 m following high severity fires in High Boreal, Low Subarctic, and High Subarctic ecoregions of the Taiga Shield (Lewis et al., 2018). Following low to mixed-severity fires, trees took 10.7 years, on average, in the High Boreal ecoregion and 15.5 years in the Low Subarctic to reach a height of 0.3 m (Lewis et al., 2018). Tree regeneration times may differ for the ecoregions intersected by the RSA.

Figure 3.10 Area Burned by Landcover/Assemblage Type from 1960 to 2019 in the LSA and RSA – Sahtu Region



Plant SOCC

A search of the Northwest Territories Species Monitoring Infobase (Working Group on General Status of NWT Species, 2016)—queried to the Taiga Plains, Taiga Cordillera, and Boreal Cordillera ecoregions—identified 215 vascular, non-vascular plant and lichen SOCC with potential to occur within the Sahtu Region of the RSA (Appendix A.2). Of the 215 plants, 167 are vascular plants, 42 are lichens, and 6 are moss.

Of the 167 vascular plants identified, 85 are listed as *may be at risk* and 82 are listed as *sensitive* in the NT. Yukon aster (*Symphyotrichum yukonense*) and Tyrrell's willow (*Salix tyrrellii*) are on the SARA registry but were downgraded to *not at risk* in 1996 and 1999. Both species are still listed as *may be at risk* under NWT General Species Rankings (Working Group on General Status of NWT Species, 2016). Of the 42 lichen species identified, 6 are listed as *may be at risk* and 36 are listed as *sensitive*. No lichen species with potential to occur within the RSA are listed under COSEWIC. Of the eight moss species identified, four are listed as *may be at risk* and two are listed as *sensitive*, territorially. No moss species with potential to occur within the RSA are listed under COSEWIC (Working Group on General Status of NWT Species, 2016). No vegetation assemblages are considered SOCC.

5658 NWT Ltd. and GNWT (2011) identified seven plant SOCC documented during field surveys for the Mackenzie Gas Project in the Sahtu Region of the RSA. All seven plant SOCC occurrences were vascular plants, of which six were listed as *sensitive* and one as *may be at risk* in the NT (Table 3.15). None of these species are listed by SARA or COSEWIC (Government of Canada, 2019). The locations of these plants are within the Sahtu RSA, and, therefore, their potential presence in the Sahtu LSA is unknown. Pre-construction field surveys should be conducted to evaluate plant SOCC occurrences of higher potential areas potentially impacted by the Project (e.g., riparian areas, uncommon plant assemblages).

Table 3.15 Documented Plant SOCC Occurrences within the RSA – Sahtu Region

Scientific Name[1]	Common Name	NWT General Species Rank[1]	SARA Status[2]	COSEWIC Status[2]
Elymus canadensis	Canada nodding wild rye	Sensitive	-	-
Potamogeton natans	floating pondweed	Sensitive	-	-
Potamogeton foliosus	leafy pondweed	Sensitive	-	-
Juncus stygius	moor rush	Sensitive	-	-
Danthonia spicata	poverty wild oat grass	Sensitive	-	-
Najas flexilis	slender naiad	Sensitive	-	-
Rhynchospora alba	white beakrush	May Be At Risk	-	-

Notes:
1 Working Group on General Status of NWT Species (2016).
2 Government of Canada (2019)
Source: 5658 NWT Ltd. and the GNWT (2011)

Alien and Invasive Alien Plant Species

Forty-two locations of 13 alien and invasive alien plant species occurrences are documented within the RSA in the Sahtu Region (AKEPIC, 2020) (Table 3.16). Of these 13 species, 10 are classified as alien and 3 as invasive alien. In addition to documented occurrences, 36 alien and 7 invasive alien plant species have been identified in the RSA in the Sahtu Region without specific location attribution by Oldham and Delisle-Oldham (2016). These are presented in Appendix B.

Table 3.16 Alien and Invasive Alien Plant Species Recorded within the RSA – Sahtu Region

Listing	Scientific Name	Common Name	Number of Occurrences	Closest Occurrence to the PDA (km)
Alien	*Artemisia biennis*	biennial wormwood	4	0.92
Alien	*Capsella bursa-pastoris*	shepherd's purse	4	0.92
Alien	*Chenopodiastrum simplex (Chenopodium simplex; Chenopodium hybridum* var. *gigantospermum)*	maple-leaved goosefoot	1	0.92
Alien	*Chenopodium album*	lamb's quarters	4	0.92
Alien	*Descurainia sophia*	herb Sophia	6	0.15
Alien	*Lappula squarrosa*	European stickseed	1	14.55
Alien	*Matricaria discoidea*	pineapple weed	2	14.55
Alien	*Plantago major*	common plantain	6	0.15
Alien	*Polygonum aviculare*	prostrate knotweed	1	0.92
Alien	*Thlaspi arvense*	field pennycress	5	0.92
Invasive Alien	*Crepis tectorum*	narrow-leaf hawksbeard	2	0.92
Invasive Alien	*Melilotus albus*	white sweet-clover	3	14.55
Invasive Alien	*Trifolium hybridum*	alsike clover	3	14.55

Source: AKEPIC (2020)

4 Key Results and Findings

4.1 Dehcho Region

Coniferous forest is the most abundant landcover/assemblage type in upland areas within the LSA (44.8%) and the RSA (32.5%) in the Dehcho Region. Wetland cover types occupy 19.6% of the LSA and 29.0% of the RSA in the Dehcho Region. The most common wetland types in both LSA and RSA are treed and shrub wetlands. Large portions of the LSA and RSA have burned in the past; however, fires in the LSA are not common with a maximum of 2 fires per decade recorded (1990-1999). Percentage of the LSA burned ranged from 0% to 12.8% per decade from 1960 to 2019. Although coniferous forests had the greatest total volume in the LSA (448,465 m^3) and RSA (3,927,036 m^3), mixedwood forests had the highest stand volume density.

Except for the existing MVWR and the Enbridge Norman Wells Pipeline the LSA in the Dehcho Region is relatively anthropogenically undisturbed.

No plant SOCC have been documented in the RSA or LSA. Nine alien and three invasive alien plant species have been documented in the RSA in the Dehcho Region. Additional alien and invasive alien plant species documented in the RSA by Oldham and Delisle-Oldham (2016) can be found in Appendix B, although specific distributions of these species are not known.

4.2 Sahtu Region

Upland areas in the Sahtu Region are dominated by coniferous forest in both the LSA (28.3%) and RSA (31.3%). Wetlands occupy 25.5% of the LSA and 25.3% of the RSA. As with the Dehcho Region, large portions of the LSA and RSA in the Sahtu Region have burned in the past. Fires in the LSA and RSA are common, with portions within the Sahtu Region burning at least once per decade. Less than 1% to 61.1% of the LSA burned each decade between 1960 and 2019. Similar to the Dehcho Region, coniferous forests had the greatest total volume in the LSA (288,702 m^3) and RSA (5,590,767 m^3) and mixedwood forests had the highest stand volume density.

Except for the existing MVWR, the Enbridge Norman Wells Pipeline, and communities along these routes (e.g., Hamlet of Tulita), LSA in the Sahtu Region is relatively anthropogenically undisturbed but does contain some disturbance from oil and gas exploration and infrastructure west of Norman Wells (e.g., Auld and Kershaw, 2005).

In the RSA, seven vascular plant SOCC occurrences have been documented, six of which are considered “Sensitive” and one considered “May Be At Risk”. Ten alien and three invasive alien plant species have been documented in the RSA in the Sahtu Region. Additional alien and invasive alien plant species documented in the RSA by Oldham and Delisle-Oldham (2016) can be found in Appendix B, although specific distributions of these species are not known.

5 Closure

This TDR was prepared for the sole benefit of GNWT to describe existing conditions related to vegetation within the Project LSA and RSA. If you have any questions, please do not hesitate to contact the undersigned.

Respectfully submitted,

K’alo-Stantec Limited

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Appendix A Plant SOCC Details

A.1 Potential Plant SOCC Occurrences Within the RSA in the Dehcho Region

Group	Scientific Name[1]	Common Name	NWT General Species Rank [1]	NWT S Rank[1]	SARA Status[1]	COSEWIC Status[1]	Ecoregion[2]
Vascular Plant	*Agrostis exarata*	spike bentgrass	Sensitive	S3	-	-	Boreal Cordillera
Vascular Plant	*Angelica lucida*	seaside angelica	May Be At Risk	S2	-	-	Boreal Cordillera
Vascular Plant	*Arenaria longipedunculata*	long-stemmed sandwort	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Arnica latifolia*	mountain arnica	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Asplenium trichomanes-ramosum*	green spleenwort	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Athyrium filix-femina*	subarctic lady-fern	Sensitive	S2S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Blysmopsis rufa*	red clubrush	Sensitive	S3S4	-	-	Taiga Cordillera
Vascular Plant	*Botrychium minganense*	Mingan moonwort	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Botrychium spathulatum*	spatulate moonwort	May Be At Risk	S2	-	-	Boreal Cordillera
Vascular Plant	*Botrypus virginianus*	rattlesnake fern	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Cardamine pensylvanica*	Pennsylvania bittercress	Sensitive	S3S4	-	-	Taiga Cordillera
Vascular Plant	*Cardamine umbellata*	few-seeded bittercress	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Carex bebbii*	Bebb's sedge	Sensitive	S3	-	-	Boreal Cordillera
Vascular Plant	*Carex eleusinoides*	goosegrass sedge	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Carex filifolia*	thread-leaved sedge	Sensitive	S3	-	-	Boreal Cordillera
Vascular Plant	*Carex heleonastes*	Hudson Bay sedge	Sensitive	S3S4	-	-	Taiga Cordillera
Vascular Plant	*Carex hoodii*	Hood's sedge	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Carex loliacea*	rye-grass sedge	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Carex micropoda*	small-rooted sedge	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Carex peckii*	Peck's sedge	Sensitive	S3	-	-	Boreal Cordillera
Vascular Plant	*Carex retrorsa*	retrorse sedge	May Be At Risk	S2	-	-	Boreal Cordillera
Vascular Plant	*Cerastium maximum*	great chickweed	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Chrysosplenium wrightii*	Wright golden saxifrage	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Claytonia megarhiza*	alpine spring beauty	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Cryptogramma sitchensis*	Alaska parsley-fern	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Cryptogramma stelleri*	slender rock-brake	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Cystopteris montana*	mountain bladder-fern	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Danthonia spicata*	poverty wild oat grass	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Draba albertina*	slender whitlow-grass	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Draba incerta*	Yellowstone whitlow-grass	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Draba lonchocarpa*	lance-pod whitlow-grass	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Draba ogilviensis*	Ogilvie Range whitlow-grass	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Draba porsildii*	Porsild's whitlow-grass	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Drosera linearis*	slenderleaf sundew	Sensitive	S3	-	-	Taiga Cordillera

Group	Scientific Name[1]	Common Name	NWT General Species Rank [1]	NWT S Rank[1]	SARA Status[1]	COSEWIC Status[1]	Ecoregion[2]
Vascular Plant	*Dryopteris carthusiana*	spinulose wood-fern	May Be At Risk	S2	-	-	Boreal Cordillera
Vascular Plant	*Dryopteris expansa*	northern wood-fern	May Be At Risk	S2	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Eleocharis uniglumis*	one-glume spikerush	Sensitive	S3	-	-	Boreal Cordillera
Vascular Plant	*Elymus canadensis*	Canada nodding wild rye	Sensitive	S3	-	-	Boreal Cordillera
Vascular Plant	*Epilobium lactiflorum*	white-flower willowherb	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Erigeron denalii*	Denali fleabane (Mex's fleabane)	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Erythranthe guttata*	common large monkey flower	May Be At Risk	S2	-	-	Boreal Cordillera
Vascular Plant	*Festuca lenensis*	tundra fescue	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Gentiana prostrata*	pygmy gentian	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Geranium richardsonii*	Richardson geranium	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Geum glaciale*	glacier avens	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Hieracium albiflorum*	white-flowered hawkweed	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Koenigia islandica*	Iceland purslane	Sensitive	S3	-	-	Boreal Cordillera
Vascular Plant	*Liparis loeselii*	Loesel's twayblade	May Be At Risk	S2	-	-	Boreal Cordillera
Vascular Plant	*Listera cordata*	heart-leaved twayblade	Sensitive	S2S3	-	-	Boreal Cordillera
Vascular Plant	*Luetkea pectinata*	segmented luetkea	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Lysimachia europaea*	arctic starflower	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Matteuccia struthiopteris*	ostrich fern	Sensitive	S2S3	-	-	Boreal Cordillera
Vascular Plant	*Monarda fistulosa*	wild bergamot	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Nuphar polysepala*	rocky mountain pond lily	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Oxytropis scammaniana*	Scamman's locoweed	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Packera ogoturukensis*	Ogotoruk Creek groundsel	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Packera pauciflora*	alpine groundsel (few-flower ragwort)	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Penstemon gormanii*	Gorman's beardtongue	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Phegopteris connectilis*	northern beech fern	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Platanthera dilatata*	white bog orchid	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Potamogeton foliosus*	leafy pondweed	Sensitive	S3S4	-	-	Boreal Cordillera
Vascular Plant	*Potamogeton natans*	floating pondweed	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Potentilla villosula*	Beringian hairy potentilla	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Prunus virginiana*	choke cherry	Sensitive	S3	-	-	Boreal Cordillera
Vascular Plant	*Pseudocherleria macrocarpa*	long-pod stitchwort	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Ranunculus abortivus*	kidney-leaved buttercup	Sensitive	S3	-	-	Boreal Cordillera
Vascular Plant	*Ranunculus turneri*	Turner's buttercup	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Sagina saginoides*	alpine pearlwort	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Salix farriae*	Farr's willow	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Salix raupii*	Raup's willow	May Be At Risk	S2	-	-	Boreal Cordillera

Group	Scientific Name[1]	Common Name	NWT General Species Rank [1]	NWT S Rank[1]	SARA Status[1]	COSEWIC Status[1]	Ecoregion[2]
Vascular Plant	*Senecio sheldonensis*	Mount Sheldon ragwort	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Smelowskia media*	alpine smelowskia	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Streptopus amplexifolius*	clasping twisted stalk	Sensitive	S2S3	-	-	Taiga Cordillera
Vascular Plant	Symphyotrichum nahanniense	Nahanni aster	Sensitive	S3	Not Applicable	Special Concern	Taiga Cordillera
Vascular Plant	Tephroseris lindstroemii	twice-hairy groundsel	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Vaccinium membranaceum*	mountain huckleberry	May Be At Risk	S2	-	-	Boreal Cordillera
Vascular Plant	*Valeriana dioica*	wood valerian	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Veronica americana*	American speedwell	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Lichen	*Ahtiana sphaerosporella*	mountain candlewax lichen	Sensitive	S1S3	-	-	Taiga Cordillera
Lichen	*Arctomia interfixa*	rust-brown tiny rosette lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Cladonia digitata*	finger pixie-cup	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Cladonia thomsonii*	blue pork pixie lichen	Sensitive	S1S3	-	-	Taiga Cordillera
Lichen	*Collema furfuraceum*	effervescent tarpaper lichen	Sensitive	S2S4	-	-	Taiga Cordillera
Lichen	*Enchylium bachmanianum*	Caesar's tarpaper lichen	Sensitive	S2S4	-	-	Taiga Cordillera
Lichen	*Enchylium polycarpon*	gilled tarpaper lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Nephroma helveticum*	fringed kidney lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Pannaria conoplea*	mealy-rimmed shingle lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Peltigera didactyla*	temporary pelt lichen	Sensitive	S2S4	-	-	Taiga Cordillera
Lichen	*Peltigera neckeri*	black-saddle pelt lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Physcia phaea*	black-eyed rosette lichen	Sensitive	S2S4	-	-	Taiga Cordillera
Lichen	*Placynthium asperellum*	Lilliput Ink lichen	Sensitive	S2S4	-	-	Taiga Cordillera
Lichen	*Polycauliona polycarpa*	pin-cushion sunburst lichen	Sensitive	S2S4	-	-	Taiga Cordillera
Lichen	*Polychidium muscicola*	eyed mossthorns lichen	Sensitive	S2S3	-	-	Taiga Cordillera,
Lichen	*Solorina spongiosa*	blinking owl lichen	Sensitive	S2S4	-	-	Taiga Cordillera
Lichen	*Stereocaulon arenarium*	sandy foam lichen	May Be At Risk	S2?	-	-	Taiga Cordillera
Lichen	*Stereocaulon botryosum*	cauliflower foam lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Stereocaulon vesuvianum*	variegated foam lichen; variegated coral lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Tholurna dissimilis*	arboreal bottle-collection lichen	May Be At Risk	S1S3	-	-	Boreal Cordillera
Lichen	*Umbilicaria arctica*	arctic rocktripe lichen	Sensitive	S2S4	-	-	Taiga Cordillera
Lichen	*Umbilicaria havaasii*	Havaas's rock tripe	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Umbilicaria polyphylla*	petaled rocktripe lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Umbilicaria virginis*	blushing rocktripe lichen	Sensitive	S2S4	-	-	Taiga Cordillera
Bryophyte (Moss)	*Buxbaumia aphylla*	brown shield moss	May Be At Risk	-	-	-	Taiga Cordillera
Bryophyte (Moss)	*Cynodontium jenneri*	Jenner's dogtooth moss	Sensitive	-	-	-	Taiga Cordillera
Bryophyte (Moss)	*Grimmia torquata*	twisted grimmia moss	May Be At Risk	-	-	-	Taiga Cordillera

Group	Scientific Name[1]	Common Name	NWT General Species Rank [1]	NWT S Rank[1]	SARA Status[1]	COSEWIC Status[1]	Ecoregion[2]
Bryophyte (Moss)	*Hilpertia velenovskyi*	Velenovsky's moss	May Be At Risk	-	-	-	Taiga Cordillera
Bryophyte (Moss)	*Hypnum callichroum*	downy plait moss	Sensitive	-	-	-	Taiga Cordillera
Bryophyte (Moss)	*Seligeria oelandica*	Irish bristle moss	May Be At Risk	-	-	-	Taiga Cordillera

Notes:

[1] Species scientific names, common names and species ranks from GNWT (2016a).

[2] Rare Species List For Boreal Cordillera and Taiga Cordillera From GNWT Species Monitoring Infobase (2016c).

A.2 Potential Plant SOCC Occurrences within the RSA in the Sahtu Region

Group	Scientific Name[1]	Common Name	NWT General Species Rank [1]	NWT S Rank[1]	SARA Status[1]	COSEWIC Status[1]	Ecoregion[2]
Vascular Plant	*Agoseris glauca*	pale false dandelion	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Agrostis exarata*	spike bentgrass	Sensitive	S3	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Alisma triviale*	northern water plantain	Sensitive	S3S4	-	-	Taiga Plains
Vascular Plant	*Anaphalis margaritacea*	pearly everlasting	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Angelica lucida*	seaside angelica	May Be At Risk	S2	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Arenaria longipedunculata*	long-stemmed sandwort	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Arethusa bulbosa*	dragon's mouth	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Arnica latifolia*	mountain arnica	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Artemisia alaskana*	Alaska sagebrush	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Artemisia ludoviciana*	white sagebrush	May Be At Risk	S2	-	-	Taiga Plains, Boreal Plains
Vascular Plant	*Asplenium trichomanes-ramosum*	green spleenwort	May Be At Risk	S2	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Astragalus canadensis*	Canadian milk-vetch	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Athyrium filix-femina*	subarctic lady-fern	Sensitive	S2S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Avenula hookeri*	Hooker's alpine oat grass	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Blysmopsis rufa*	red clubrush	Sensitive	S3S4	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Boechera calderi*	Calder's rockcress	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Botrychium minganense*	mingan moonwort	May Be At Risk	S2	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Botrychium pinnatum*	northwestern moonwort	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Botrychium spathulatum*	spatulate moonwort	May Be At Risk	S2	-	-	Boreal Cordillera
Vascular Plant	*Botrypus virginianus*	rattlesnake fern	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains, Boreal Cordillera
Vascular Plant	*Cardamine microphylla*	small-leaved bittercress	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Cardamine pensylvanica*	Pennsylvania bittercress	Sensitive	S3S4	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Cardamine umbellata*	few-seeded bittercress	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Carex bebbii*	Bebb's sedge	Sensitive	S3	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Carex crawfordii*	Crawford's sedge	Sensitive	S3	-	-	Taiga Plains, Boreal Plains
Vascular Plant	*Carex duriuscula (*	needle-leaved sedge	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Carex eleusinoides*	goosegrass sedge	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Carex filifolia*	thread-leaved sedge	Sensitive	S3	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Carex heleonastes*	Hudson Bay sedge	Sensitive	S3S4	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Carex hoodii*	Hood's sedge	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Carex lasiocarpa*	slender sedge	Sensitive	S3	-	-	Taiga Plains, Taiga Shield
Vascular Plant	*Carex laxa*	weak sedge	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Carex livida*	livid sedge	Sensitive	S3S4	-	-	Taiga Plains
Vascular Plant	*Carex loliacea*	rye-grass sedge	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains

Group	Scientific Name[1]	Common Name	NWT General Species Rank [1]	NWT S Rank[1]	SARA Status[1]	COSEWIC Status[1]	Ecoregion[2]
Vascular Plant	*Carex mackenziei*	Mackenzie's sedge	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Carex micropoda*	small-rooted sedge	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Carex peckii*	Peck's sedge	Sensitive	S3	-	-	Boreal Cordillera
Vascular Plant	*Carex prairea*	prairie sedge	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Carex retrorsa*	retrorse sedge	May Be At Risk	S2	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Carex richardsonii*	Richardson's sedge	Sensitive	S3	-	-	Taiga Plains, Taiga Shield
Vascular Plant	*Carex sychnocephala*	many-headed sedge	Sensitive	S3	-	-	Taiga Plains, Boreal Plains
Vascular Plant	*Cerastium maximum*	great chickweed	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Ceratophyllum demersum*	common hornwort	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Chamaerhodos erecta*	rose chamaerhodos	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Chrysosplenium wrightii*	wright golden saxifrage	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Cirsium drummondii*	Drummond thistle	Sensitive	S3	-	-	Taiga Plains, Taiga Shield
Vascular Plant	*Claytonia megarhiza*	alpine spring beauty	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Coleanthus subtilis*	moss grass	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Corispermum hookeri*	Hooker's bugseed	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Cryptogramma sitchensis*	Alaska parsley-fern	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Cryptogramma stelleri*	slender rock-brake	May Be At Risk	S2	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Cystopteris montana*	mountain bladder-fern	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Danthonia spicata*	poverty wild oat grass	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains, Boreal Cordillera
Vascular Plant	*Descurainia pinnata*	pinate tansy mustard	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Draba albertina*	slender whitlow-grass	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Draba incerta*	Yellowstone whitlow-grass	May Be At Risk	S2	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Draba lonchocarpa*	lance-pod whitlow-grass	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Draba ogilviensis*	Ogilvie range whitlow-grass	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Draba porsildii*	Porsild's whitlow-grass	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Drosera linearis*	slenderleaf sundew	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Dryopteris carthusiana*	spinulose wood-fern	May Be At Risk	S2	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Dryopteris expansa*	northern wood-fern	May Be At Risk	S2	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Eleocharis elliptica*	slender spikerush	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Eleocharis uniglumis*	one-glume spikerush	Sensitive	S3	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Elymus canadensis*	Canada nodding wild rye	Sensitive	S3	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Epilobium lactiflorum*	white-flower willowherb	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Erigeron denalii*	Denali fleabane (Mex's fleabane)	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Erigeron yukonensis*	Yukon fleabane	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Eritrichium splendens*	showy forget-me-not	May Be At Risk	S2	-	-	Taiga Plains

Group	Scientific Name[1]	Common Name	NWT General Species Rank [1]	NWT S Rank[1]	SARA Status[1]	COSEWIC Status[1]	Ecoregion[2]
Vascular Plant	*Erythranthe guttata*	common large monkey flower	May Be At Risk	S2	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Festuca auriculata*	lobed fescue	May Be At Risk	S2S3	-	-	Taiga Plains
Vascular Plant	*Festuca brevissima*	Alaska fescue	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Festuca lenensis*	tundra fescue	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Gentiana prostrata*	pygmy gentian	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains, Boreal Cordillera
Vascular Plant	*Gentianopsis virgata*	Macoun's fringed gentian	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Geranium richardsonii*	Richardson geranium	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Geum glaciale*	glacier avens	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Geum triflorum*	prairie-smoke	May Be At Risk	S2	-	-	Taiga Plains, Boreal Plains
Vascular Plant	*Hesperostipa curtiseta*	Canadian needle grass	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Heuchera richardsonii*	Richardson alumroot	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Hieracium albiflorum*	white-flowered hawkweed	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Hippuris tetraphylla*	four-leaved marestail	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Hudsonia tomentosa*	woolly beach-heath (sand heather)	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Isoetes lacustris*	lake quillwort	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Juncus stygius*	moor rush	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Koeleria asiatica*	oriental koeler's grass	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Koeleria macrantha*	prairie koeler's grass	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Koenigia islandica*	Iceland purslane	Sensitive	S3	-	-	Boreal Cordillera
Vascular Plant	*Lathyrus japonicus*	beach pea	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Limosella aquatica*	northern mudwort	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Liparis loeselii*	Loesel's twayblade	May Be At Risk	S2	-	-	Boreal Cordillera
Vascular Plant	*Listera cordata*	heart-leaved twayblade	Sensitive	S2S3	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Luetkea pectinata*	segmented luetkea	May Be At Risk	S2	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Luzula kjellmaniana*	kjellman woodrush	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Luzula rufescens*	rufous wood rush	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Lysimachia europaea*	arctic starflower	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Lysimachia maritima*	sea milkwort	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Malaxis paludosa*	bog adder's-mouth	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Matteuccia struthiopteris*	ostrich fern	Sensitive	S2S3	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Mertensia maritima*	sea bluebell	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Micranthes ferruginea*	rusty-hair saxifrage	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Minuartia michauxii*	bog stitchwort	Sensitive	S3S4	-	-	Taiga Plains
Vascular Plant	*Monarda fistulosa*	wild bergamot	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Myriophyllum alterniflorum*	alternate-flower water milfoil	Sensitive	S3	-	-	Taiga Plains

Group	Scientific Name[1]	Common Name	NWT General Species Rank [1]	NWT S Rank[1]	SARA Status[1]	COSEWIC Status[1]	Ecoregion[2]
Vascular Plant	*Najas flexilis*	slender naiad	Sensitive	S2S3	-	-	Taiga Plains
Vascular Plant	*Nassella viridula*	green tussock grass (feather grass)	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Nuphar polysepala*	Rocky Mountain pond lily	May Be At Risk	S2	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Nymphaea leibergii*	dwarf white waterlily	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Nymphaea tetragona*	pygmy white waterlily (small white water-lily)	Sensitive	S3	-	-	Taiga Plains, Taiga Shield
Vascular Plant	*Oxybasis glauca*	Rocky Mountain goosefoot	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Oxybasis rubra*	red pigweed (coast-blite goosefoot)	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Oxytropis scammaniana*	Scamman's locoweed	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Packera ogoturukensis*	Ogotoruk Creek groundsel	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Packera pauciflora*	alpine groundsel (few-flower ragwort)	Sensitive	S3	-	-	Taiga Cordillera, Boreal Cordillera
Vascular Plant	*Papaver mcconnellii*	McConnell's poppy	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Pedicularis flammea*	red-tip lousewort	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Pedicularis oederi*	Oeder's lousewort	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Pedicularis verticillata*	whorled lousewort	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Pellaea glabella*	smooth cliff-brake	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Penstemon gormanii*	Gorman's beardtongue	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Phegopteris connectilis*	northern beech fern	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Physaria calderi*	Calder's bladderpod	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Plantago maritima*	seaside plantain	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Platanthera dilatata*	white bog orchid	May Be At Risk	S2	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Platanthera orbiculata*	small round-leaved bog orchid	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Poa ammophila*	sand bluegrass	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Poa pseudoabbreviata*	polar bluegrass	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Podistera macounii*	Macoun's podistera	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Potamogeton foliosus*	leafy pondweed	Sensitive	S3S4	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Potamogeton illinoensis*	Illinois pondweed	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Potamogeton natans*	floating pondweed	Sensitive	S3	-	-	Taiga Cordillera
Vascular Plant	*Potamogeton subsibiricus*	Yenisei River pondweed	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Potentilla villosula*	Beringian hairy potentilla	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Primula pumila*	arctic primrose	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Prunus virginiana*	choke cherry	Sensitive	S3	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Pseudocherleria macrocarpa*	long-pod stitchwort	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Ranunculus abortivus*	kidney-leaved buttercup	Sensitive	S3	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Ranunculus grayi*	tundra buttercup	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Ranunculus turneri*	Turner's buttercup	May Be At Risk	S2	-	-	Taiga Cordillera, Taiga Plains

Group	Scientific Name[1]	Common Name	NWT General Species Rank [1]	NWT S Rank[1]	SARA Status[1]	COSEWIC Status[1]	Ecoregion[2]
Vascular Plant	*Rhynchospora alba*	white beakrush	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Rorippa barbareifolia*	hoary yellowcress	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Rorippa crystallina*	Mackenzie River yellowcress (asiatic cress)	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Rumex lapponicus*	Lapland sorrel	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Sagina nodosa*	knotted pearlwort	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Sagina saginoides*	alpine pearlwort	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Salix chamissonis*	Chamisso's willow	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Salix discolor*	pussy willow	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Salix farriae*	Farr's willow	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Salix ovalifolia*	arctic seashore willow	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Salix raupii*	Raup's willow	May Be At Risk	S2	-	-	Taiga Plains, Boreal Cordillera
Vascular Plant	*Salix tyrrellii*	Tyrrell's willow	May Be At Risk	S2	-	Not At Risk	Taiga Plains
Vascular Plant	*Saxifraga bronchialis ssp. Funstonii*	yellowdot saxifrage	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Sceptridium multifidum*	leathery grape-fern	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Schoenoplectus pungens*	three-square bulrush	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Senecio sheldonensis*	Mount Sheldon ragwort	May Be At Risk	S2	-	-	Taiga Cordillera
Vascular Plant	*Smelowskia media*	alpine smelowskia	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains, Boreal Cordillera
Vascular Plant	*Stellaria umbellata*	umbellate stitchwort	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Streptopus amplexifolius*	clasping twisted stalk	Sensitive	S2S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Symphyotrichum yukonense*	Yukon aster	May Be At Risk	S2	-	Not At Risk	Taiga Plains
Vascular Plant	*Tanacetum bipinnatum*	floccose tansy	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Tephroseris lindstroemii*	twice-hairy groundsel	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Utricularia ochroleuca*	northern bladderwort	Sensitive	S3	-	-	Taiga Plains
Vascular Plant	*Vaccinium membranaceum*	mountain huckleberry	May Be At Risk	S2	-	-	Boreal Cordillera
Vascular Plant	*Valeriana dioica*	wood valerian	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains
Vascular Plant	*Veronica alaskensis*	Alaska kitten-tail	May Be At Risk	S2	-	-	Taiga Plains
Vascular Plant	*Veronica americana*	American speedwell	Sensitive	S3	-	-	Taiga Cordillera, Taiga Plains, Boreal Cordillera
Vascular Plant	*Zannichellia palustris*	horned pondweed	Sensitive	S3	-	-	Taiga Plains, Boreal Plains
Lichen	*Ahtiana sphaerosporella*	mountain candlewax lichen	Sensitive	S1S3	-	-	Taiga Cordillera
Lichen	*Anaptychia crinalis*	hairy fringe lichen	Sensitive	S2S4	-	-	Taiga Plains
Lichen	*Arctomia interfixa*	rust-brown tiny rosette lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Cetraria kamczatica*	Kamchatka icelandmoss lichen	Sensitive	S2S3	-	-	Taiga Plains
Lichen	*Cladonia digitata*	finger pixie-cup	Sensitive	S2S3	-	-	Taiga Cordillera, Taiga Plains
Lichen	*Cladonia grayi*	Gray's pixie-cup lichen	Sensitive	S2S4	-	-	Taiga Plains
Lichen	*Cladonia scabriuscula*	winged pixie lichen	Sensitive	S1S3	-	-	Taiga Plains

Group	Scientific Name[1]	Common Name	NWT General Species Rank [1]	NWT S Rank[1]	SARA Status[1]	COSEWIC Status[1]	Ecoregion[2]
Lichen	*Cladonia thomsonii*	blue pork pixie lichen	Sensitive	S1S3	-	-	Taiga Cordillera, Taiga Plains
Lichen	*Collema furfuraceum*	effervescent tarpaper lichen	Sensitive	S2S4	-	-	Taiga Cordillera, Taiga Plains
Lichen	*Dermatocarpon intestiniforme*	quilted stippleback lichen	Sensitive	S2S3	-	-	Taiga Plains
Lichen	*Enchylium bachmanianum*	Caesar's tarpaper lichen	Sensitive	S2S4	-	-	Taiga Cordillera
Lichen	*Enchylium polycarpon*	gilled tarpaper lichen	Sensitive	S2S3	-	-	Taiga Cordillera, Taiga Plains
Lichen	*Heterodermia speciosa*	powdered fringe lichen	May Be At Risk	S1S2	-	-	Taiga Plains
Lichen	*Lasallia caroliniana*	origami rocktripe lichen	May Be At Risk	S2S3	-	-	Taiga Plains
Lichen	*Lasallia papulosa*	brown-bellied toadskin lichen	Sensitive	S2S4	-	-	Taiga Plains
Lichen	*Lathagrium undulatum*	jelly flakes lichen	Sensitive	S2S3	-	-	Taiga Plains
Lichen	*Lobaria linita*	cabbage lung lichen	Sensitive	S2S3	-	-	Taiga Plains
Lichen	*Masonhalea inermis*	thornless tumbleweed lichen	Sensitive	S2S4	-	-	Taiga Plains
Lichen	*Nephroma helveticum*	fringed kidney lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Pannaria conoplea*	mealy-rimmed shingle lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Peltigera didactyla*	temporary pelt lichen	Sensitive	S2S4	-	-	Taiga Cordillera, Taiga Plains
Lichen	*Peltigera neckeri*	black-saddle pelt lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Peltigera praetextata*	born-again pelt lichen	Sensitive	S2S4	-	-	Taiga Plains
Lichen	*Physcia phaea*	black-eyed rosette lichen	Sensitive	S2S4	-	-	Taiga Cordillera, Taiga Plains
Lichen	*Pilophorus robustus*	robust matchstick lichen	May Be At Risk	S1	-	-	Taiga Plains
Lichen	*Placynthium asperellum*	Lilliput ink lichen	Sensitive	S2S4	-	-	Taiga Cordillera, Taiga Plains
Lichen	*Polycauliona polycarpa*	pin-cushion sunburst lichen	Sensitive	S2S4	-	-	Taiga Cordillera
Lichen	*Polychidium muscicola*	eyed mossthorns lichen	Sensitive	S2S3	-	-	Taiga Cordillera, Taiga Plains
Lichen	*Scytinium tenuissimum*	birdnest vinyl lichen	Sensitive	S2S4	-	-	Taiga Plains
Lichen	*Solorina spongiosa*	blinking owl lichen	Sensitive	S2S4	-	-	Taiga Cordillera, Taiga Plains
Lichen	*Sphaerophorus fragilis*	cushion coral lichen	Sensitive	S2S4	-	-	Taiga Plains
Lichen	*Stereocaulon arenarium*	sandy foam lichen	May Be At Risk	S2?	-	-	Taiga Cordillera
Lichen	*Stereocaulon botryosum*	cauliflower foam lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Stereocaulon vesuvianum*	variegated foam lichen; variegated coral lichen	Sensitive	S2S3	-	-	Taiga Cordillera
Lichen	*Tholurna dissimilis*	arboreal bottle-collection lichen	May Be At Risk	S1S3	-	-	Boreal Cordillera
Lichen	*Umbilicaria angulata*	starred rocktripe lichen	Sensitive	S2S3	-	-	Taiga Plains
Lichen	*Umbilicaria arctica*	arctic rocktripe lichen	Sensitive	S2S4	-	-	Taiga Cordillera
Lichen	*Umbilicaria decussata*	netted rocktripe lichen	Sensitive	S2S4	-	-	Taiga Plains, Taiga Shield
Lichen	*Umbilicaria havaasii*	Havaas's rock tripe	Sensitive	S2S3	-	-	Taiga Cordillera, Taiga Plains
Lichen	*Umbilicaria polyphylla*	petaled rocktripe lichen	Sensitive	S2S3	-	-	Taiga Cordillera, Taiga Plains
Lichen	*Umbilicaria virginis*	blushing rocktripe lichen	Sensitive	S2S4	-	-	Taiga Cordillera, Taiga Plains
Lichen	*Vestergrenopsis isidiata*	peppered brownette lichen	May Be At Risk	S1S2	-	-	Tundra Cordillera, Taiga Plains

Group	Scientific Name[1]	Common Name	NWT General Species Rank [1]	NWT S Rank[1]	SARA Status[1]	COSEWIC Status[1]	Ecoregion[2]
Bryophyte (Moss)	*Buxbaumia aphylla*	brown shield moss	May Be At Risk	-	-	-	Taiga Plains, Taiga Cordillera
Bryophyte (Moss)	*Cynodontium jenneri*	Jenner's dogtooth moss	Sensitive	-	-	-	Taiga Cordillera
Bryophyte (Moss)	*Grimmia torquata*	twisted grimmia moss	May Be At Risk	-	-	-	Taiga Cordillera
Bryophyte (Moss)	*Hilpertia velenovskyi*	Velenovsky's moss	May Be At Risk	-	-	-	Taiga Cordillera
Bryophyte (Moss)	*Hypnum callichroum*	downy plait moss	Sensitive	-	-	-	Taiga Cordillera, Taiga Plains
Bryophyte (Moss)	*Seligeria oelandica*	Irish bristle moss	May Be At Risk	-	-	-	Taiga Cordillera

Notes:

1 Species scientific names, common names and species ranks from GNWT (2016a).

2 Rare species list for Boreal Cordillera, Taiga Plains and Taiga Cordillera from GNWT Species Monitoring Infobase (2016c).

Appendix B Alien and Invasive Alien Plant Details

B.1 Alien and Invasive Alien Species Occurring and Potentially Occurring within the RSA

Northwest Territories Listing[1]	Scientific Name	Common Name	Occurrence Within RSA[2]	Observed Along Mackenzie Valley Winter Road[3]	Ecoregion with Potential Occurrences[4]
Alien	*Achillea millefolium*	common yarrow	-	-	Taiga Plains, Boreal Cordillera
Alien	*Agropyron cristatum (Agropyron cristatum ssp pectinatum; Agropyron pectiniforme)*	crested wheatgrass	No	No	Taiga Plains
Alien	*Alopecurus arundinaceus*	creeping meadow-foxtail	No	No	Taiga Plains
Alien	*Alopecurus pratensis*	field meadow foxtail	No	Yes	-
Alien	*Ambrosia artemisiifolia*	annual ragweed	No	No	Taiga Plains
Alien	*Artemisia biennis*	biennial wormwood	Yes	Yes	-
Alien	*Atriplex patula*	spreading orache	No	No	Taiga Plains
Alien	*Bellis perennis*	English daisy	No	No	Taiga Plains
Alien	*Brassica rapa*	field mustard	Yes	No	-
Alien	*Capsella bursa-pastoris*	shepherd's purse	Yes	No	-
Alien	*Caragana arborescens*	Siberian pea-tree	No	No	Taiga Plains
Alien	*Carum carvi*	wild caraway	No	No	Taiga Plains
Alien	*Cerastium fontanum (Cerastium glomeratum, Cerastium vulgatum)*	common chickweed	No	No	Taiga Plains
Alien	*Cerastium nutans*	nodding chickweed	No	No	Taiga Plains
Alien	*Chenopodiastrum simplex (Chenopodium simplex; Chenopodium hybridum var gigantospermum)*	maple-leaved goosefoot	Yes	No	Taiga Plains
Alien	*Chenopodium album*	lamb's quarters	Yes	Yes	Taiga Plains
Alien	*Cirsium arvense*	creeping thistle	No	Yes	-

Northwest Territories Listing[1]	Scientific Name	Common Name	Occurrence Within RSA[2]	Observed Along Mackenzie Valley Winter Road[3]	Ecoregion with Potential Occurrences[4]
Alien	*Clematis tangutica*	golden clematis	No	Yes	-
Alien	*Collomia linearis*	narrow-leaved collomia	No	No	Taiga Plains
Alien	*Corispermum villosum*	hairy bugseed	No	No	Taiga Plains
Alien	*Descurainia sophia*	herb Sophia	Yes	Yes	-
Alien	*Dracocephalum thymiflorum*	thyme-leaf dragonhead	No	No	Taiga Plains
Alien	*Elymus repens*	creeping wild rye	No	Yes	-
Alien	*Elymus sibiricus*	Siberian wild rye	No	No	Taiga Plains, Boreal Cordillera
Alien	*Erucastrum gallicum*	common dog mustard	Yes	Yes	-
Alien	*Erysimum cheiranthoides*	worm-seed wallflower	No	No	Taiga Cordillera, Taiga Plains, Boreal Cordillera
Alien	*Festuca trachyphylla*	hard fescue	No	Yes	-
Alien	*Gaillardia aristata*	great blanket-flower	No	No	Taiga Plains
Alien	*Helianthus annuus*	common sunflower	No	No	Taiga Plains
Alien	*Hordeum vulgare*	barley	No	No	Taiga Plains
Alien	*Lactuca serriola*	prickly lettuce	No	No	Taiga Plains
Alien	*Lappula squarrosa*	European stickseed	Yes	Yes	-
Alien	*Lepidium densiflorum*	dense-flowered pepperwort	No	Yes	-
Alien	*Lepidium virginicum*	wild peppergrass	Yes	No	-
Alien	*Leymus cinereus*	great basin lymegrass	No	Yes	-
Alien	*Lolium multiflorum*	annual rye grass	No	No	Taiga Plains
Alien	*Lolium perenne*	perennial rye grass	No	No	Taiga Plains
Alien	*Lonicera tatarica*	Tatarian honeysuckle	No	No	Taiga Plains
Alien	*Lotus corniculatus*	Bird's-foot trefoil	No	No	Taiga Plains
Alien	*Matricaria discoidea*	pineappleweed	Yes	Yes	-

Northwest Territories Listing[1]	Scientific Name	Common Name	Occurrence Within RSA[2]	Observed Along Mackenzie Valley Winter Road[3]	Ecoregion with Potential Occurrences[4]
Alien	*Onobrychis viciifolia*	sainfoin	No	No	Taiga Plains
Alien	*Persicaria lapathifolia (Polygonum lapathifolium, Polygonum scabrum)*	pale smartweed	No	No	Taiga Plains,
Alien	*Phalaris canariensis*	common canary grass	No	No	Taiga Plains
Alien	*Phleum pratense*	common timothy	Yes	Yes	Taiga Cordillera, Taiga Plains
Alien	*Plantago major*	common plantain	Yes	Yes	Taiga Plains
Alien	*Poa compressa*	flat-stem bluegrass	No	No	Taiga Plains
Alien	*Polygonum aviculare*	prostrate knotweed	Yes	Yes	-
Alien	*Puccinellia distans*	spreading alkali grass	No	Yes	-
Alien	*Rheum rhabarbarum*	rhubarb	No	Yes	-
Alien	*Setaria verticillata*	rough bristlegrass	No	No	Taiga Plains
Alien	*Setaria viridis (Seteria viridus)*	green bristle grass	No	No	Taiga Plains
Alien	*Silene csereii*	Balkan catchfly	No	No	Taiga Plains
Alien	*Sonchus oleraceus*	common sow-thistle	No	No	Taiga Plains
Alien	*Taraxacum erythrospermum*	rock dandelion	Yes	No	-
Alien	*Taraxacum officinale*	common dandelion	Yes	Yes	Taiga Cordillera, Taiga Plains, Boreal Cordillera
Alien	*Thinopyrum intermedium*	intermediate quackgrass	No	Yes	Taiga Plains
Alien	*Thlaspi arvense*	field pennycress	Yes	No	-
Alien	*Trifolium repens*	white clover	No	Yes	-
Alien	*Vicia cracca*	tufted vetch	No	Yes	-
Invasive Alien	*Bromus inermis*	awnless brome	No	Yes	-
Invasive Alien	*Crepis tectorum*	narrow-leaf hawksbeard	Yes	Yes	-
Invasive Alien	*Leucanthemum vulgare*	ox-eye daisy	No	Yes	-

Northwest Territories Listing[1]	Scientific Name	Common Name	Occurrence Within RSA[2]	Observed Along Mackenzie Valley Winter Road[3]	Ecoregion with Potential Occurrences[4]
Invasive Alien	*Medicago falcata*	yellow alfalfa	No	Yes	-
Invasive Alien	*Medicago sativa*	alfalfa	No	Yes	-
Invasive Alien	*Melilotus albus*	white sweet-clover	Yes	Yes	-
Invasive Alien	*Melilotus officinalis*	yellow sweet-clover	No	Yes	-
Invasive Alien	*Phalaris arundinacea L. (cultivar)*	reed canarygrass	Yes	No	-
Invasive Alien	*Sonchus arvensis*	perennial sow thistle	No	Yes	-
Invasive Alien	*Tanacetum vulgare*	common tansy	No	Yes	-
Invasive Alien	*Trifolium hybridum*	alsike clover	Yes	Yes	-
Invasive Alien	*Trifolium pratense*	red clover	No	Yes	-
Invasive Alien	*Tripleurospermum inodorum*	scentless chamomile	No	Yes	-

Notes:

1 Invasive alien plant rankings as described in Carriere (2008) as ‘invasive alien’ or occurring as ‘priority invasive plant species’ in Oldham and Delisle-Oldham (2016), others listed as alien as per GNWT (2016a).

2 AKEPIC (2020).

3 Oldham and Delisle-Oldham (2016).

4 Alien and Invasive Alien species list for Taiga Plains, Taiga Cordillera and Boreal Cordillera from Northwest Territories Species Monitoring Infobase (GNWT 2016a).

- indicates occurrence not documented in the Northwest Territories Species Monitoring Infobase for the Taiga Plains, Taiga Cordillera or Boreal Cordillera.

Source: GNWT (2016a).

APPENDIX 18B

Plants of Interest to Indigenous Governments, Indigenous Organizations and Other Affected Parties – Dehcho and Sahtu Regions

Appendix 18B PLANTS OF INTEREST TO INDIGENOUS GOVERNMENTS, INDIGENOUS ORGANIZATIONS AND OTHER AFFECTED PARTIES – DEHCHO AND SAHTU REGIONS

Table 18B.1 Plants of Interest to Indigenous Governments, Indigenous Organizations and Other Affected Parties – Dehcho and Sahtu Regions

Form	Traditionally Used Name	Scientific Name	Provincial Rank	Upland or Wetland Plant	Wetland Status	Upland Landcover Types	Wetland Landcover Types	Region	Identified By
Tree	rocky mountain subalpine fir	*Abies bifolia*	Secure	upland	FACU	Coniferous Forest	None identified	Dehcho	
Tree	alpine fir	*Abies lasiocarpa**	-	upland	UPL	Coniferous Forest	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kı̨ First Nation
Tree	Alaska paper birch, resin birch	*Betula neoalaskana*	Secure	upland	FACU	Coniferous Forest, Deciduous Forest, Mixedwood Forest	Bog - Forested, Fen - Forested, Fen - Shrubby, Fen - Graminoid	Dehcho, Sahtu	
Tree	white birch, paper birch	*Betula papyrifera*	Secure	upland	FACU	Coniferous Forest, Deciduous Forest, Mixedwood Forest	Swamp - Forested	Dehcho, Sahtu	Dehcho First Nations; Pehdzéh Kı̨ First Nation
Tree	tamarack	*Larix laricina*	Secure	wetland	FACW	None identified	Swamp - Forested, Bog - Forested, Fen - Forested, Fen - Shrubby, Fen - Graminoid	Dehcho	Dehcho First Nations; Pehdzéh Kı̨ First Nation
Tree	spruce	*Picea glauca*	Secure	upland	FACU	Coniferous Forest, Deciduous Forest, Mixedwood Forest	None identified	Dehcho, Sahtu	NWRRC; Dehcho First Nations; Pehdzéh Kı̨ First Nation
Tree	spruce	*Picea mariana*	Secure	wetland	FACW	Coniferous Forest, Deciduous Forest, Mixedwood Forest	Swamp - Forested, Bog - Forested, Bog - Shrubby, Bog - Graminoid, Fen - Forested, Fen - Shrubby	Dehcho, Sahtu	Dehcho First Nations; Pehdzéh Kı̨ First Nation
Tree	jackpine	*Pinus banksiana*	Secure	upland	FACU	Coniferous Forest, Mixedwood Forest	Bog - Graminoid	Dehcho	Dehcho First Nations; Pehdzéh Kı̨ First Nation
Tree	lodgepole pine	*Pinus contorta*	Secure	upland	FAC	Coniferous Forest, Mixedwood Forest	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kı̨ First Nation
Tree	balsam poplar	*Populus balsamifera*	Secure	upland	FACW	Deciduous Forest, Mixedwood Forest	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kı̨ First Nation
Tree	trembling aspen	*Populus tremuloides*	Secure	upland	FACU	Deciduous Forest, Mixedwood Forest	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kı̨ First Nation
Shrub	green alder	*Alnus alnobetula*	Secure	-	-	None identified	None identified	Dehcho	
Shrub	speckled alder (mountain alder, gray alder, hoary alder)	*Alnus incana*	Secure	upland	FAC	None identified	None identified	Dehcho	
Shrub	mountain alder	*Alnus rugosa**	-	-	-	Coniferous Forest, Deciduous Forest, Mixedwood Forest	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kı̨ First Nation

Form	Traditionally Used Name	Scientific Name	Provincial Rank	Upland or Wetland Plant	Wetland Status	Upland Landcover Types	Wetland Landcover Types	Region	Identified By
Shrub	speckled alder, river alder	*Alnus tenuifolia**	-	-	-	Coniferous Forest, Deciduous Forest, Mixedwood Forest	None identified	Dehcho	
Shrub	saskatoon berry, saskatoon	*Amelanchier alnifolia*	Secure	upland	FACU	Coniferous Forest, Deciduous Forest, Native Grassland, Mixedwood Forest	None identified	Dehcho	
Shrub	dwarf bog rosemary	*Andromeda polifolia*	Secure	wetland	FACW	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	alpine bearberry, torpedoberry	*Arctostaphylos alpina**	Secure	-	-	Coniferous Forest	Bog - Forested, Bog - Shrubby, Bog - Graminoid	Dehcho	NWRRC; TRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	red bearberry	*Arctostaphylos rubra**	Secure	upland	FAC	None identified	Swamp - Forested	Dehcho	
Shrub	alpine bearberry, torpedoberry	*Arctous alpina*	Secure	upland	FACU	Coniferous Forest	Bog - Forested, Bog - Shrubby, Bog - Graminoid	Sahtu	
Shrub	red bearberry	*Arctous rubra*	Secure	upland	FAC	None identified	Swamp - Forested	Sahtu	
Shrub	bog birch	*Betula glandulosa*	Secure	upland	FAC	None identified	Bog - Forested, Bog - Shrubby, Bog - Graminoid	Dehcho, Sahtu	TRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	water birch	*Betula occidentalis*	Secure	upland	FAC	Coniferous Forest, Deciduous Forest, Mixedwood Forest	Shrubland	Dehcho, Sahtu	Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	dwarf birch	*Betula pumila* var. *glandulifera*	Secure	-	-	None identified	Swamp - Forested, Bog - Forested, Bog - Shrubby, Fen - Forested, Fen - Shrubby	Dehcho, Sahtu	TRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	leatherleaf	*Chamaedaphne calyculata*	Secure	wetland	FACW	Coniferous Forest	Bog - Forested, Bog - Shrubby, Bog - Graminoid, Fen - Forested, Fen - Shrubby	Dehcho	
Shrub	bunchberry	*Cornus canadensis*	Secure	upland	FACU	Coniferous Forest, Deciduous Forest, Mixedwood Forest	None identified	Dehcho	
Shrub	red osier dogwood	*Cornus sericea*	Secure	upland	-	Deciduous Forest	None identified	Dehcho	
Shrub	silverberry	*Elaeagnus commutata*	Secure	-	-	None identified	None identified	Dehcho	
Shrub	crowberry, black berry	*Empetrum nigrum*	Secure	upland	FAC	Coniferous Forest	Bog - Forested, Bog - Shrubby, Bog - Graminoid	Dehcho, Sahtu	Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	creeping wintergreen, teaberry	*Gaultheria hispidula**	-	wetland	FACW	Coniferous Forest	Swamp - Forested, Bog - Forested, Bog - Shrubby, Bog - Graminoid, Fen - Forested, Fen - Shrubby	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation

Form	Traditionally Used Name	Scientific Name	Provincial Rank	Upland or Wetland Plant	Wetland Status	Upland Landcover Types	Wetland Landcover Types	Region	Identified By
Shrub	sand heather	*Hudsonia tomentosa*	Sensitive	-	-	Mixedwood Forest	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	common juniper	*Juniperus communis*	Secure	upland	UPL	None identified	None identified	Dehcho	NWRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	creeping juniper	*Juniperus horizontalis*	Secure	upland	UPL	Native Grassland	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	northern bog laurel, pale bog laurel	*Kalmia polifolia*	Secure	wetland	OBL	None identified	Swamp - Forested, Bog - Forested, Bog - Shrubby, Bog - Graminoid	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	twinning/ red honeysuckle	*Lonicera dioica*	Secure	upland	FACU	None identified	None identified	Dehcho	
Shrub	bracted honeysuckle, black twin berry	*Lonicera involucrata**	-	upland	FACU	None identified	None identified	Dehcho	
Shrub	sweet gale	*Myrica gale*	Secure	wetland	OBL	None identified	Bog - Forested, Bog - Shrubby, Bog - Graminoid, Fen - Forested, Fen - Shrubby	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	shrubby cinquefoil	*Potentilla fruticosa**	Secure	upland	FAC	Coniferous Forest, Deciduous Forest	Fen - Forested, Fen - Shrubby	Dehcho	
Shrub	pin cherry	*Prunus pensylvanica*	Secure	upland	FACU	Mixedwood Forest	None identified	Dehcho	
Shrub	choke cherry	*Prunus virginiana*	Sensitive	upland	FACU	Deciduous Forest, Native Grassland, Mixedwood Forest	None identified	Dehcho	
Shrub	Labrador tea, muskeg tea	*Rhododendron groenlandicum* (synonym *Ledum groenlandicum*)	Secure	upland	FACW	Coniferous Forest, Mixedwood Forest	Bog - Forested, Bog - Shrubby, Bog - Graminoid, Fen - Forested, Fen - Shrubby	Dehcho	NWRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	wild black currant	*Ribes americanum*	-	wetland	FACW	Forests, Shrubland	None identified	Dehcho	
Shrub	skunk currant, wild red currant	*Ribes glandulosum*	Secure	upland	FAC	Coniferous Forest	None identified	Dehcho, Sahtu	
Shrub	northern black current	*Ribes hudsonianum*	Secure	upland	FAC	Coniferous Forest, Deciduous Forest, Mixedwood Forest	Swamp - Forested, Bog - Forested, Bog - Shrubby	Dehcho, Sahtu	Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	bristly black currant	*Ribes lacustre*	Secure	upland	FAC	Coniferous Forest, Deciduous Forest, Mixedwood Forest	Swamp - Forested	Dehcho, Sahtu	
Shrub	blackcurrant	*Ribes nigrum*	Alien	upland	FAC	Anthropogenic habitats	Wet meadows, disturbed streamsides,	Sahtu	NWRRC
Shrub	Canadian gooseberry	*Ribes oxyacanthoides*	Secure	upland	FACU	Coniferous Forest, Deciduous Forest, Mixedwood Forest	None identified	Dehcho	

Form	Traditionally Used Name	Scientific Name	Provincial Rank	Upland or Wetland Plant	Wetland Status	Upland Landcover Types	Wetland Landcover Types	Region	Identified By
Shrub	red currant	*Ribes triste*	Secure	upland	FAC	Deciduous Forest, Mixedwood Forest	None identified	Dehcho, Sahtu	Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	red willow (Alder)	*Salix laevigata*	Undetermined	wetland	FACW	Riparian forests along streams	Seepage areas, springs, subalkaline or brackish lakeshores	Sahtu	NWRRC
Shrub	multiple willow species, including diamond willow and red willow	*Salix* spp.	N/A multiple species	-	-	None identified	None identified	Dehcho, Sahtu	Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	buffaloberry, soopolallie, soapberry	*Shepherdia canadensis*	Secure	upland	FACU	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	western mountain ash	*Sorbus scopulina*	Secure	upland	FACU	Coniferous Forest, Deciduous Forest, Mixedwood Forest	None identified	Dehcho	
Shrub	snowberry	*Symphoricarpos albus*	Undetermined	upland	UPL	Coniferous Forest, Deciduous Forest, Mixedwood Forest	None identified	Dehcho	
Shrub	western snowberry	*Symphoricarpos occidentalis*	Secure	-	-	None identified	None identified	Dehcho	
Shrub	small bog cranberry	*Vaccinium oxycoccos*	Secure	-	-	None identified	Bog - Forested, Bog - Shrubby, Bog - Graminoid, Fen - Forested, Fen - Shrubby	Dehcho, Sahtu	
Shrub	Common Blueberry	*Vaccinium* spp.	N/A multiple species	-	-	None identified	None identified	Dehcho, Sahtu	NWRRC; TRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	low bush cranberry, mooseberry	*Viburnum edule*	Secure	upland	FACU	None identified	None identified	Dehcho, Sahtu	NWRRC; TRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Shrub	highbush cranberry	*Viburnum opulus*	-	upland	FAC	Deciduous Forest	None identified	Dehcho	
Subshrub	common bearberry, bearberry	*Arctostaphylos uva-ursi*	Secure	upland	UPL	Coniferous Forest, Deciduous Forest, Mixedwood Forest	None identified	Dehcho, Sahtu	
Subshrub	sage	*Artemisia frigida*	Secure	upland	-	Native Grassland	None identified	Dehcho	
Subshrub	wintergreen	*Pyrola asarifolia*	Secure	upland	FACU	Deciduous Forest, Mixedwood Forest	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Subshrub	wild rose	*Rosa acicularis*	Secure	upland	FACU	Coniferous Forest, Deciduous Forest, Mixedwood Forest, Native Grassland	None identified	Dehcho, Sahtu	NWRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Subshrub	raspberry	*Rubus idaeus*	Secure	upland	FACU	Deciduous Forest, Mixedwood Forest	None identified	Dehcho, Sahtu	NWRRC: Dehcho First Nations; Pehdzéh Kį First Nation

Form	Traditionally Used Name	Scientific Name	Provincial Rank	Upland or Wetland Plant	Wetland Status	Upland Landcover Types	Wetland Landcover Types	Region	Identified By
Subshrub	dwarf blueberry	*Vaccinium caespitosum*	Undetermined	upland	FAC	Coniferous Forest	None identified	Dehcho, Sahtu	
Subshrub	dwarf blueberry	*Vaccinium myrtilloides*	Sensitive+	wetland	FACW	Coniferous Forest, Mixedwood Forest, Native Grassland	None identified	Dehcho	
Subshrub	lingonberry, lowbush cranberry, "redberry", Logan berry	*Vaccinium vitis-idaea*	Secure	upland	FAC	Coniferous Forest, Mixedwood Forest	None identified	Dehcho, Sahtu	NWRRC; TRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Forb	yarrow	*Achillea millefolium*	Secure	upland	FACU	Mixedwood Forest, Deciduous Forest, Shrubland, Native Grassland	None identified	Dehcho	NWRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Forb	weke, weekay, wee-case (wihkes), wiike	*Acorus americanus* (*Acorus calamus*)	May Be At Risk+	wetland	OBL	None identified	Marsh, Swamp – Forested, Swamp – Shrubby	Dehcho	NWRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Forb	baneberry	*Actaea rubra*	Secure	upland	FACU	Mixedwood Forest, Deciduous Forest	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	Lily Pad Root	*Aeonium* sp.	Alien	wetland	OBL	None identified	None identified	Sahtu	NWRRC
Forb	giant hyssop	*Agastache foeniculum*	May Be At Risk+	upland	-	Deciduous Forest, Shrubland	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	wild chives	*Allium schoenoprasum*	Secure	upland	FAC	Native Grassland	None identified	Dehcho	
Forb	wild onion and chives	*Allium textile**	-	-	-	Native Grassland	None identified	Dehcho	
Forb	pygmyflower, fairy candelabra	*Androsace septentrionalis*	Secure	upland	UPL	Mixedwood Forest, Deciduous Forest, Shrubland, Native Grassland	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	seaside angelica	*Angelica lucida*	May Be At Risk	upland	FACU	None identified	None identified	Dehcho	
Forb	dogbane	*Apocynum androsaemifolium*	Secure	upland	UPL	Coniferous Forest	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	wild sarsaparilla	*Aralia nudicaulis*	Secure	upland	FACU	Coniferous Forest, Deciduous Forest, Mixedwood Forest	None identified	Dehcho	
Forb	field sagewort	*Artemisia campestris*	Secure	upland	FACU	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	Lindley's aster, fringed aster	*Aster ciliolatus**	Secure	-	-	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	smooth aster	*Aster laevis**	Presence Expected	upland	FACU	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	purple-stemmed aster	*Aster puniceus**	Undetermined	wetland	-	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation

Form	Traditionally Used Name	Scientific Name	Provincial Rank	Upland or Wetland Plant	Wetland Status	Upland Landcover Types	Wetland Landcover Types	Region	Identified By
Forb	flat-topped white aster	*Aster umbellatus**	-	-	-	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	American milk-vetch	*Astragalus americanus*	Secure	upland	FAC	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	northern ground-cone	*Boschniakia rossica*	Secure	upland	FAC	Coniferous Forest, Deciduous Forest, Mixedwood Forest	Bog - Forested, Bog - Shrubby, Bog - Graminoid, Fen - Forested, Fen - Shrubby	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	water calla	*Calla palustris*	Secure	wetland	OBL	None identified	Marsh, Swamp - Forested, Bog - Forested, Bog - Shrubby, Bog - Graminoid, Fen - Forested, Fen - Shrubby,	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	bluebell, Alaska bellflower	*Campanula alaskana*	Undetermined	upland	UPL	Coniferous Forest, Deciduous Forest, Mixedwood Forest	None identified	Dehcho	
Forb	bluebell, Giesecke bellflower	*Campanula gieseckeana*	Undetermined	-	-	None identified	None identified	Dehcho	
Forb	harebell, bluebell	*Campanula rotundifolia*	-	upland	FAC	Coniferous Forest, Deciduous Forest, Mixedwood Forest, Native Grassland	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	lamb's quarters	*Chenopodium album*	Alien	upland	FACU	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	strawberry blite	*Chenopodium capitatum*	Secure	-	-	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	pipsissewa	*Chimaphila umbellata*	May Be At Risk+	-	-	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	water hemlock, spotted water-hemlock	*Cicuta maculata*	Secure	wetland	OBL	None identified	None identified	Dehcho	
Forb	tuberous spring beauty	*Claytonia tuberosa*	Secure	wetland	FACW	None identified	None identified	Dehcho	
Forb	spiney wood fern	*Dryopteris carthusiana*	May Be At Risk	wetland	FACW	Coniferous Forest, Deciduous Forest, Mixedwood Forest	Swamp - Forested	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	fireweed	*Epilobium angustifolium*	Secure	upland	FACU	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	horsetail	*Equisetum arvense*	Secure	upland	FAC	None identified	Marsh	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	strawberry	*Fragaria vesca*	Secure	wetland	UPL	Forest, Shrubland	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	wild strawberry	*Fragaria virginiana*	Secure	upland	FACU	Deciduous Forest, Mixedwood Forest	None identified	Dehcho	
Forb	hemp nettle	*Galeopsis tetrahit*	Alien	upland	FACU	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation

Form	Traditionally Used Name	Scientific Name	Provincial Rank	Upland or Wetland Plant	Wetland Status	Upland Landcover Types	Wetland Landcover Types	Region	Identified By
Forb	northern bedstraw	*Galium boreale*	Secure	upland	FACU	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	northern comandra	*Geocaulon lividum*	Secure	upland	FACU	Coniferous Forest	Bog - Forested, Bog - Shrubby	Dehcho	
Forb	yellow avens	*Geum aleppicum*	Secure	upland	FACU	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	purple avens	*Geum rivale**	-	wetland	FACW	Coniferous Forest, Deciduous Forest, Mixedwood Forest	Marsh Fen - Shrubby, Bog - Forested, Bog - Shrubby, Bog - Graminoid, Fen - Forested	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	gumweed	*Grindelia squarrosa**	-	upland	FACU	Disturbed Areas	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	American alpine sweet-vetch, sweetbroom	*Hedysarum alpinum*	Secure	upland	FACU	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	sneezeweed	*Helenium autumnale**	Secure	wetland	FACW	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	cow parsnip	*Heracleum lanatum**	Secure	upland	FACU	None identified	None identified	Dehcho	
Forb	Alumroot	*Heuchera richardsonii*	May Be At Risk⁺	upland	FACU	Deciduous Forest, Native Grassland	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	ox-eye daisy	*Leucanthemum vulgare*	Invasive Alien	upland	UPL	Disturbed Areas	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	clubmoss	*Lycopodium annotinum*	Secure	upland	FACU	Coniferous Forest, Mixedwood Forest, Native Grassland	Swamp - Forested	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	Canada mayflower	*Maianthemum canadense*	Secure	upland	FACU	Coniferous Forest, Mixedwood Forest	None identified	Dehcho	
Forb	ostrich fern	*Matteuccia struthiopteris**	Sensitive	wetland	FACW	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	wild mint, peppermint	*Mentha arvensis*	Secure	wetland	FACW	None identified	Marsh	Dehcho	NWRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Forb	lungwort, tall bluebells	*Mertensia paniculata*	Secure	upland	FACU	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	mitrewort	*Mitella nuda*	Secure	upland	FAC	Coniferous Forest, Mixedwood Forest	Bog - Forested, Bog - Shrubby	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	yellow pond lily	*Nuphar lutea*	Secure	wetland	OBL	None identified	Marsh	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	rocky mountain pond lily	*Nuphar polysepala*	May Be At Risk	wetland	OBL	None identified	Marsh	Dehcho	
Forb	variegated pond lily	*Nuphar variegata*	Secure⁺	wetland	OBL	None identified	Marsh	Dehcho	
Forb	mountain sorrel	*Oxyria digyna*	Secure	upland	FACU	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation

Form	Traditionally Used Name	Scientific Name	Provincial Rank	Upland or Wetland Plant	Wetland Status	Upland Landcover Types	Wetland Landcover Types	Region	Identified By
Forb	lousewort	*Pedicularis langsdorffii*	Secure	wetland	FACW	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	arrow-leaved coltsfoot	*Petasites sagittatus*	Not Assessed	-	-	Disturbed Areas, Coniferous Forest, Mixedwood Forest, Deciduous Forest	Marsh, Fen - Shrubby, Bog - Forested, Bog - Shrubby, Bog - Graminoid, Fen - Forested	Dehcho	
Forb	broad-leaved plantain	*Plantago major*	Alien	upland	FAC	Disturbed Areas	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	water smartweed	*Polygonum amphibium*	Secure	-	-	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	bistort, serpent grass	*Polygonum viviparum*	Secure	upland	FAC	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	rock polypody fern	*Polypodium vulgare*	Secure	-	-	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	cinquefoil	*Potentilla gracilis**	-	upland	FAC	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	blackberry	*Rubus arcticus*	Secure	wetland	FACW	None identified	Fen - Shrubby	Dehcho, Sahtu	
Forb	cloud berry	*Rubus chamaemorus*	Secure	wetland	FACW	None identified	Bog - Forested, Bog - Shrubby, Bog - Graminoid, Fen - Forested	Dehcho, Sahtu	NWRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Forb	western dock	*Rumex aquaticus*	Secure	-	-	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	arrowhead	*Sagittaria cuneata*	Secure	wetland	OBL	None identified	None identified	Dehcho	
Forb	sage	*Salvia officinalis*	Alien	upland	FACU	None identified	None identified	Dehcho, Sahtu	NWRRC; Dehcho First Nations; Pehdzéh Kį First Nation
Forb	pitcher plant	*Sarracenia purpurea*	Secure	wetland	OBL	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	marsh skullcap	*Scutellaria galericulata*	Secure	wetland	OBL	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	water parsnip	*Sium suave*	Secure	wetland	OBL	None identified	None identified	Dehcho	
Forb	Canada goldenrod	*Solidago canadensis*	Secure	upland	FACU	Tame Pasture, Forest	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	dandelion	*Taraxacum officinale*	Alien	upland	FACU	Deciduous Forest, Mixedwood Forest	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	stinging nettle	*Urtica dioica*	Secure	upland	FACU	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	bladderwort	*Utricularia macrorhiza*	Secure	wetland	OBL	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Forb	false hellebore	*Veratrum viride*	Secure	upland	FAC	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation

Form	Traditionally Used Name	Scientific Name	Provincial Rank	Upland or Wetland Plant	Wetland Status	Upland Landcover Types	Wetland Landcover Types	Region	Identified By
Forb	mountain death camus	*Zigadenus elegans*	Secure	-	-	Coniferous Forest, Native Grassland	Bog - Forested, Bog - Shrubby, Bog - Graminoid	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Graminoid	blue-jointed reed grass, marsh reedgrass	*Calamagrostis canadensis*	Secure	upland	FAC	None identified	None identified	Dehcho	
Graminoid	water sedge	*Carex aquatilis*	Secure	wetland	OBL	None identified	Marsh, Bog – Graminoid, Fen - Graminoid	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Graminoid	sweet-grass	*Hierochloe odorata*	Secure	-	-	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Graminoid	fox-tail barley	*Hordeum jubatum*	Secure	upland	FACU	None identified	None identified	Dehcho	
Graminoid	common reed	*Phragmites australis**	Undetermined	wetland	FACW	None identified	None identified	Dehcho	
Graminoid	bulrush	*Schoenoplectus acutus*	Secure	wetland	OBL	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Graminoid	seaside arrow-grass	*Triglochin maritima*	Secure	wetland	OBL	None identified	Marsh	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
Graminoid	broad-leaf cattail	*Typha latifolia*	Secure	wetland	OBL	None identified	Marsh	Dehcho	
lichen	lichen	Various	N/A multiple species	-	-	None identified	None identified	Dehcho	Dehcho First Nations; Pehdzéh Kį First Nation
fungus	chaga	*Inonotus obliquus*	Undetermined	undetermined	undetermined	None identified	None identified	Sahtu	NWRRC

Notes:
+ Species not expected to occur in the RAA.
Wetland Status Codes:
UPL = Obligate upland, almost never occur in wetlands
FACU = Facultative upland, usually occur in non-wetlands, but may occur in wetlands
FAC = Facultative, occur in wetlands and non-wetlands
FACW = Facultative wetland, usually occur in wetlands, but may occur in non-wetlands
OBL = Obligate wetland, almost always occur in wetlands
Sources: EBA, 2006; IMG-Golder Corporation, 2006; NWRRC, 2023; TRRC, 2022