

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

Prepared for:

Government of the Northwest Territories

Prepared by:

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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	<i>Mackenzie Valley Resource Management Act</i>
MVWR	Mackenzie Valley Winter Road
NT	Northwest Territories
NTCMA	Northwest Territories Conference of Management Authorities
PDR	Project Description Report
RSA	regional study area
SARA	<i>Species at Risk Act</i>
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

**Mackenzie Valley Highway Project
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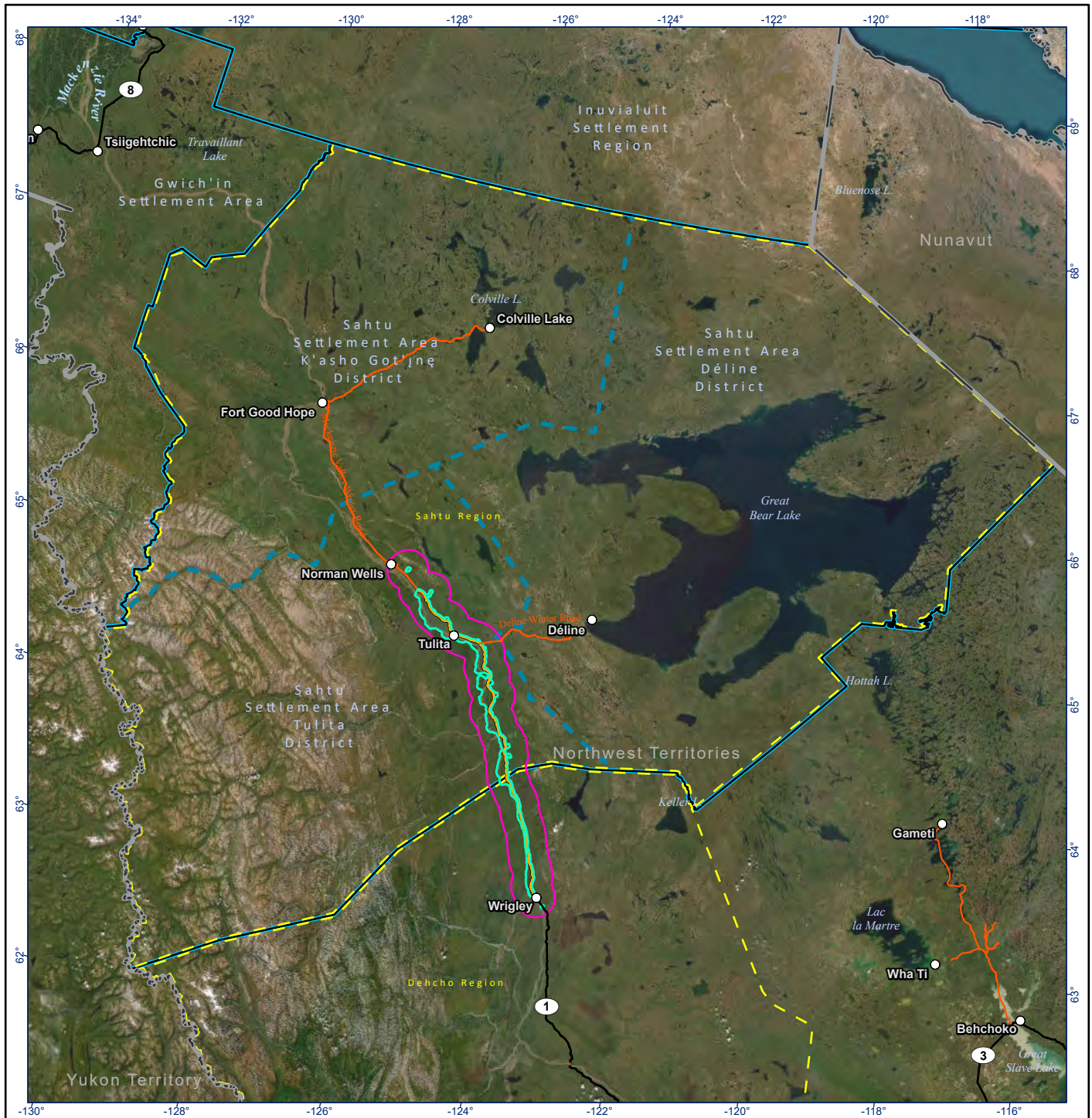
Section 1: Introduction
December 2022

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



Kalo-Stantec



Project Location

Wrigley to Norman Wells, NWT

Client/Project

Prepared by AT on 2023-03-07

TR by AJ on 2023-03-07

144903025-0066 REV/B

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.

1.1

**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

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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 quantitatively. 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 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 [*Oncorhynchus 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	<i>Catostomus</i>	No status	Not assessed	Secure
	white sucker	<i>Catostomus commersonii</i>	No status	Not assessed	Secure
Cottidae	slimy sculpin	<i>Cottus cognatus</i>	No status	Not assessed	Secure
	spoonhead sculpin	<i>Cottus ricei</i>	No status	Not at risk	Secure
Cyprinidae	emerald shiner	<i>Notropis atherinoides</i>	No status	Not assessed	Secure
	fathead minnow	<i>Pimephales promelas</i>	No status	Not assessed	Undetermined
	finescale dace	<i>Chrosomus neogaeus</i>	No status	Not assessed	Secure
	flathead chub	<i>Platygobio gracilis</i>	No status	Not assessed	Secure
	lake chub	<i>Couesius plumbeus</i>	No status	Not assessed	Secure
	longnose dace	<i>Rhinichthys cataractae</i>	No status	Not assessed	Secure
	northern redbelly dace	<i>Chrosomus eos</i>	No status	Not assessed	Secure
	pearl dace	<i>Semotilus margarita</i>	No status	Not assessed	Secure
	spottail shiner	<i>Notropis hudsonius</i>	No status	Not assessed	Secure
Esocidae	northern pike	<i>Esox lucius</i>	No status	Not assessed	Secure
Gadidae	burbot	<i>Lota lota</i>	No status	Not assessed	Secure
Gasterosteidae	brook stickleback	<i>Cluea inconstans</i>	No status	Not assessed	Secure
	ninespine stickleback	<i>Pungitius pungitius</i>	No status	Not assessed	Secure
Hiodontidae	goldeye	<i>Hiodon alosoides</i>	No status	Not assessed	Secure
Percidae	walleye	<i>Sander vitreus</i>	No status	Not assessed	Secure
Percopsidae	trout-perch	<i>Percopsis omiscomaycus</i>	No status	Not assessed	Secure
Peteromyzontidae	Arctic lamprey	<i>Lampetra arcticus</i>	No status	Not assessed	Undetermined

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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	<i>Coregonus autumnalis</i>	No status	Not assessed	Sensitive
	Arctic grayling	<i>Thymallus arcticus</i>	No status	Not assessed	Secure
	broad whitefish	<i>Coregonus nasus</i>	No status	Not assessed	Secure
	bull trout	<i>Salvelinus confluentus</i>	Special Concern	Special Concern	Sensitive
Salmonidae (cont'd)	Dolly Varden	<i>Salvelinus malma</i>	Special Concern	Special Concern	Sensitive
	Inconnu	<i>Stenodus leucichthys</i>	No status	Not assessed	Sensitive
	lake trout	<i>Salvelinus namaycush</i>	No status	Not assessed	Secure
	lake whitefish	<i>Coregonus clupeaformis</i>	No status	Not assessed	Secure
	least cisco	<i>Coregonus sardinella</i>	No status	Not assessed	Secure
	mountain whitefish	<i>Prosopium williamsoni</i>	No status	Not assessed	Secure
	round whitefish	<i>Prosopium cylindraceum</i>	No status	Not assessed	Secure
	Chum salmon	<i>Oncorhynchus keta</i>	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 et 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.

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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

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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

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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

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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

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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

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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 was 1.8 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 trees. 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 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 depth 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 to 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 to 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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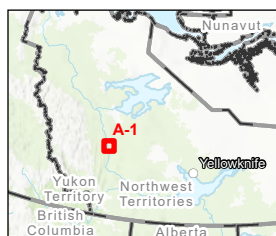
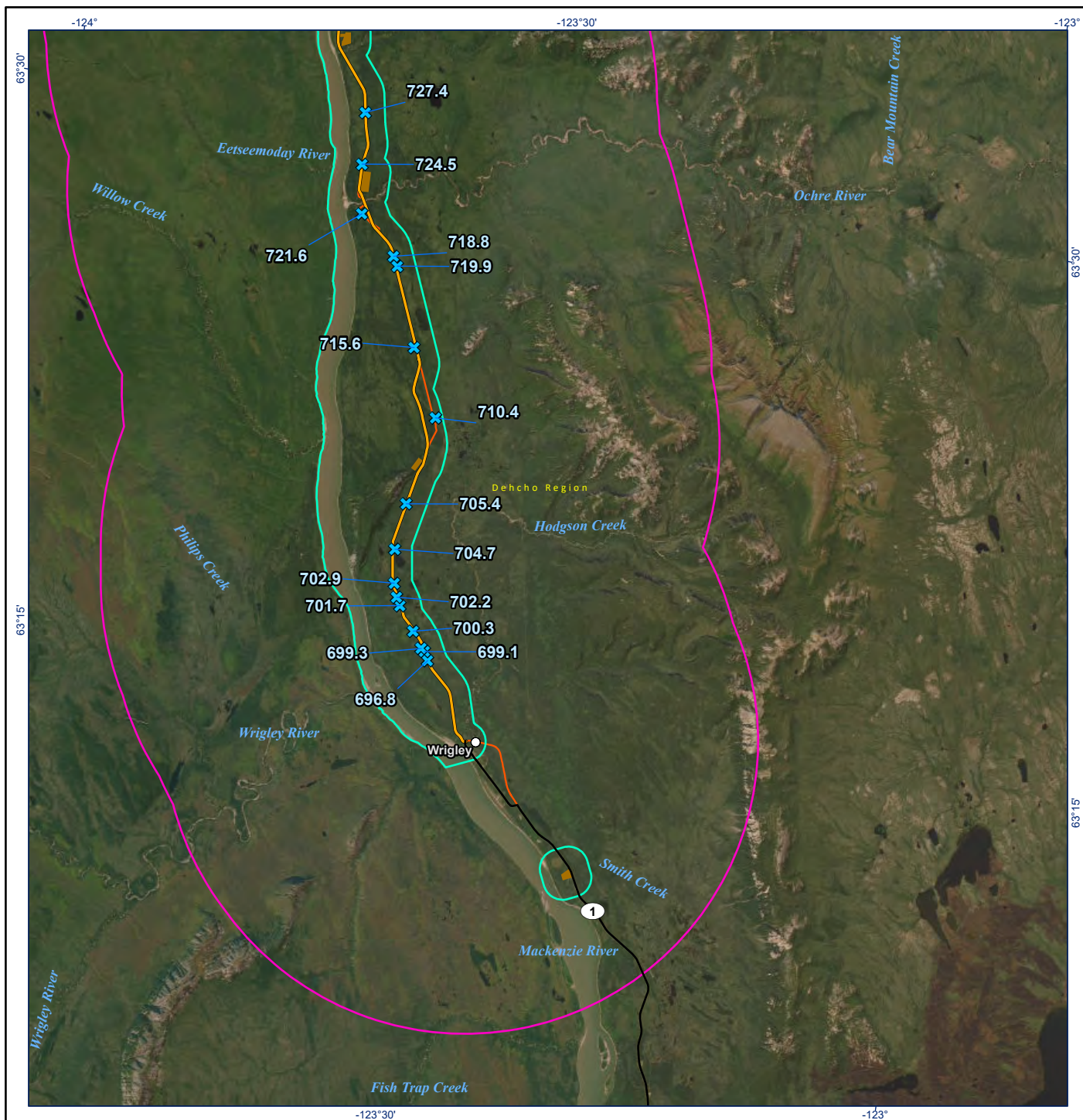
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Appendix A Watercourse Crossing Locations



- X 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



Project Location Prepared by AT on 2023-03-07
Wrigley to Norman Wells, NWT TR by AJ on 2023-03-07
Client/Project 144903025-0067-REVC

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.

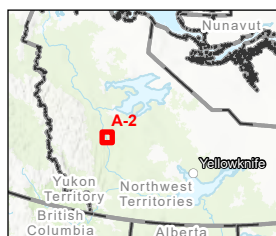
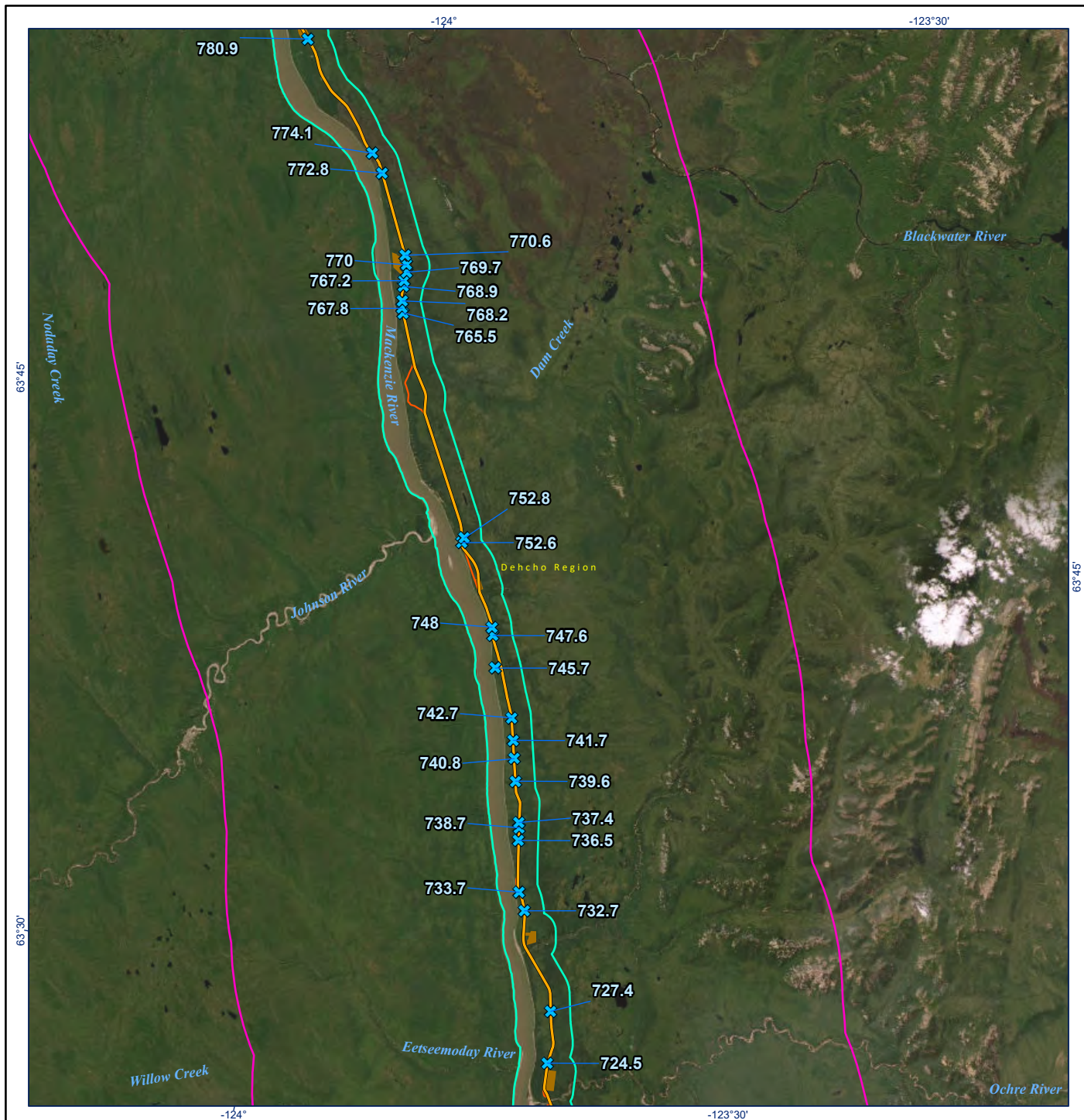
A.1

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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- Assessed Proposed Watercourse Crossing
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- Region Boundary
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0 2.5 5 Kilometres
(At original document size of 8.5x11)
1:300,000



Project Location: Wrigley to Norman Wells, NWT
Client/Project: 144903025-0067-REVC

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.

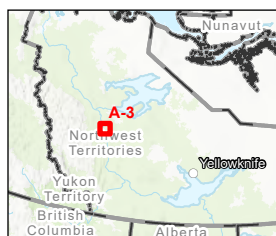
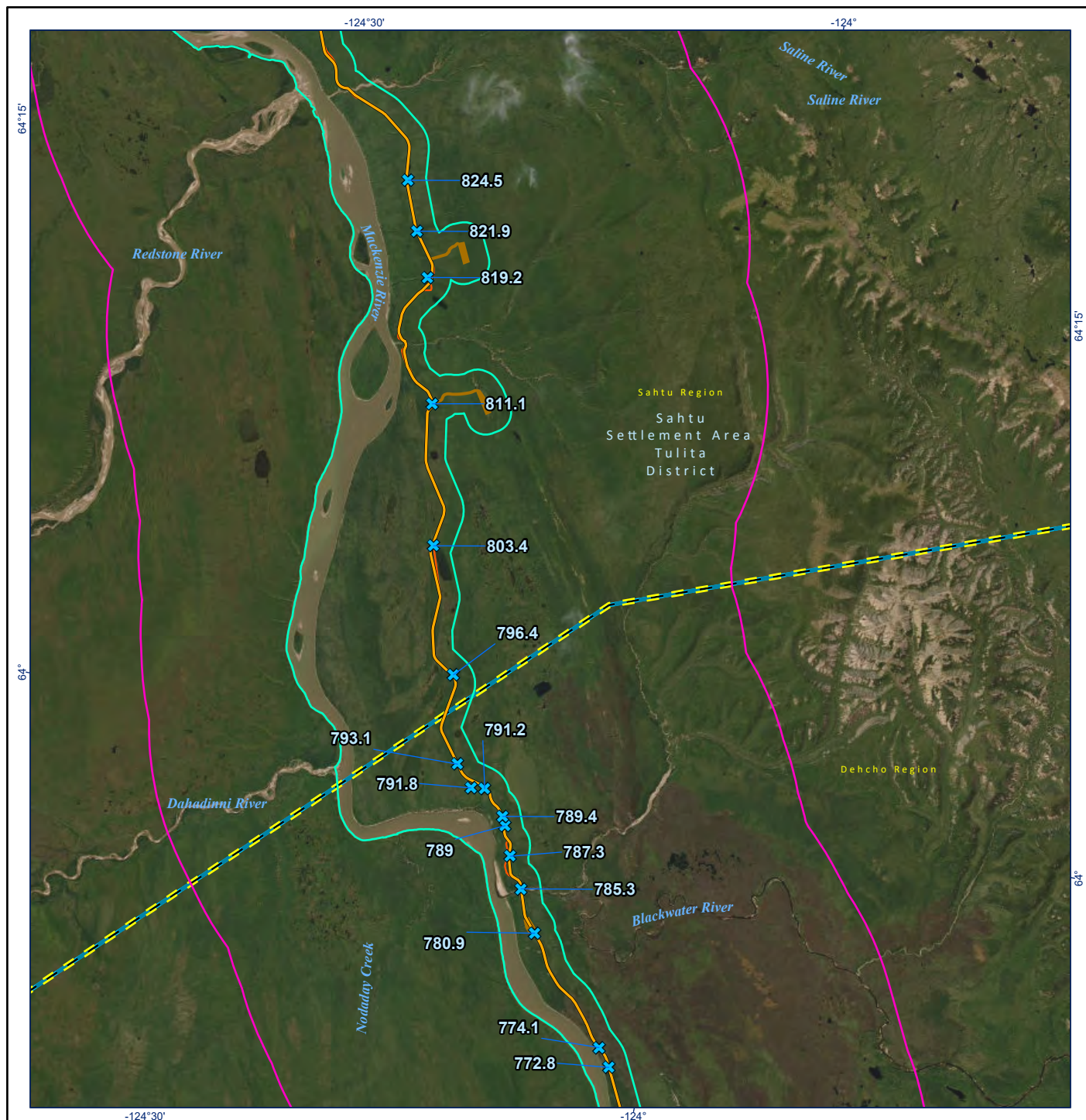
A.2

Assessed Proposed Watercourse Crossings
Sites Km 780.9 to Km 724.5

Notes

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

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- All-Season Road
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0 2.5 5 Kilometres
(At original document size of 8.5x11)
1:300,000



Project Location Prepared by AT on 2023-03-07
Wrigley to Norman Wells, NWT TR by AJ on 2023-03-07
Client/Project 144903025-0067-REVC

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.

A.3

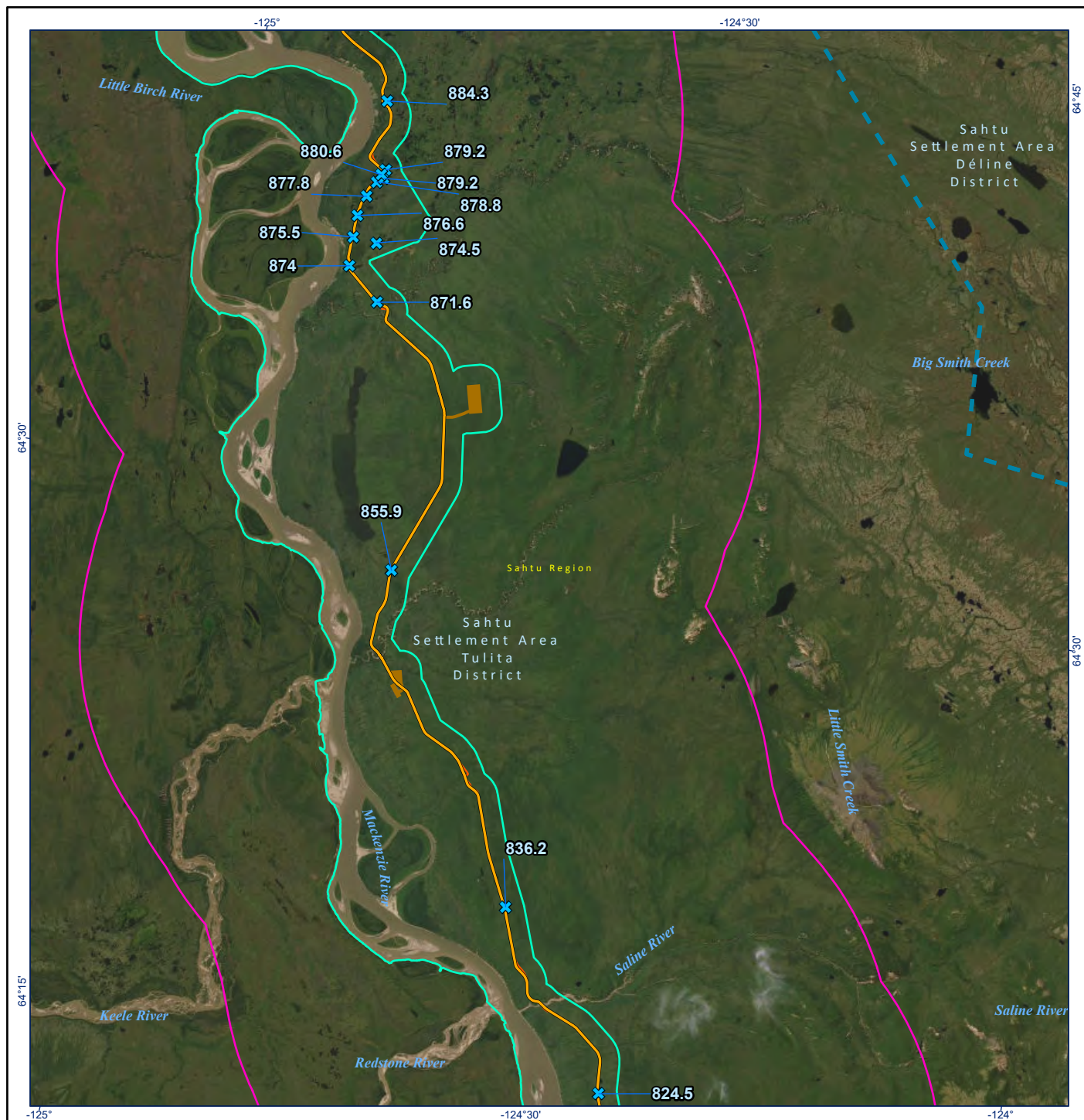
Title

**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

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- ✕ Assessed Proposed Watercourse Crossing
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- Winter 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



Project Location Wrigley to Norman Wells, NWT
Client/Project 144903025-0067-REVC

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.

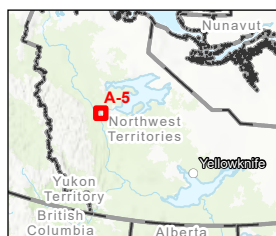
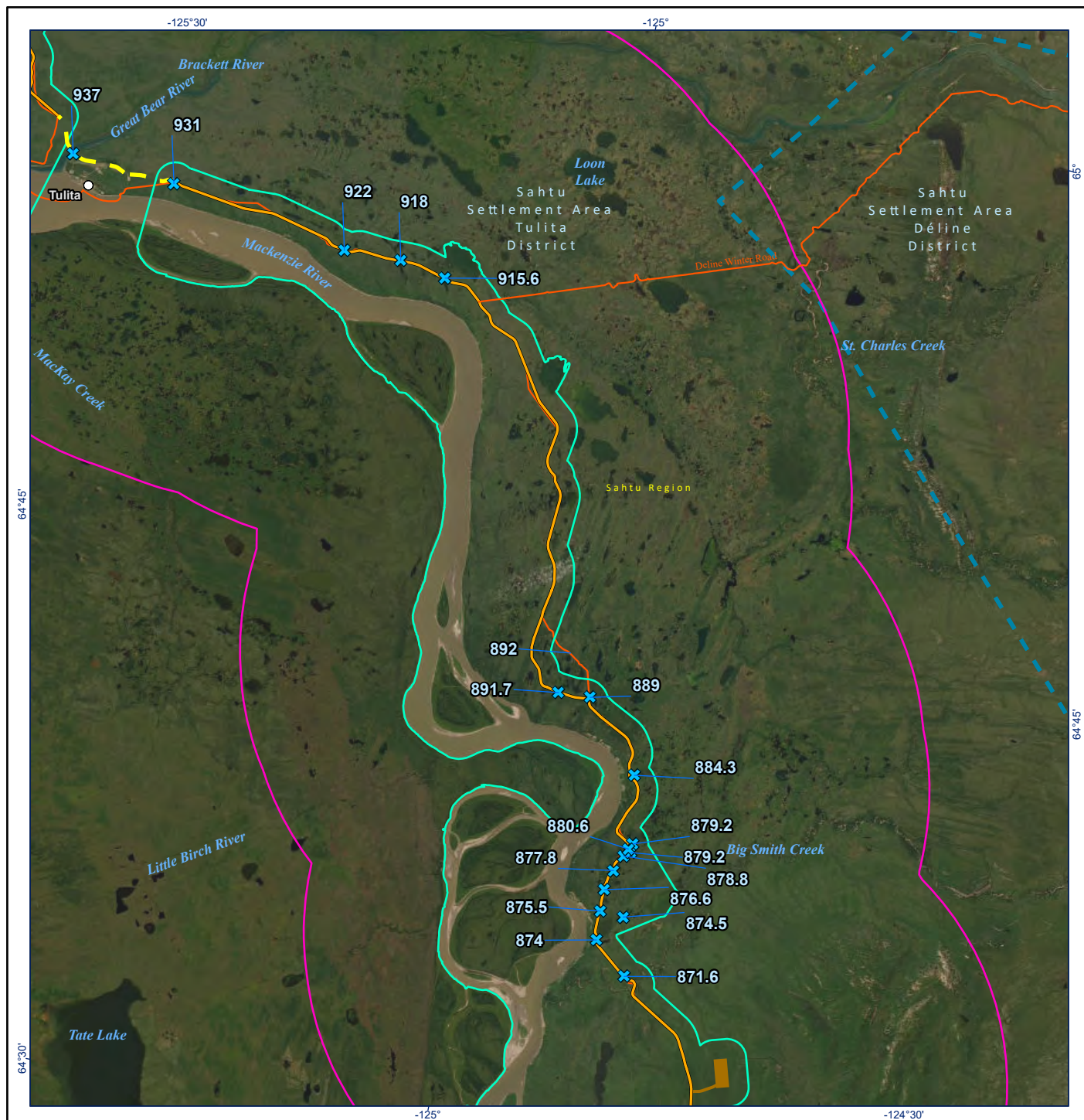
A.4

Assessed Proposed Watercourse Crossings
Sites Km 884.3 to Km 824.5

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

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- ✕ Assessed Proposed Watercourse Crossing
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- Region Boundary
- Settlement Area Boundary

0 2.5 5 Kilometres
(At original document size of 8.5x11)
1:300,000



Project Location Prepared by AT on 2023-03-07
Wrigley to Norman Wells, NWT TR by AJ on 2023-03-07
Client/Project 144903025-0067-REVC

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.

A.5

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

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- ✕ Assessed Proposed Watercourse Crossing
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- All-Season Road
- Winter 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



Kalo-Stantec



Project Location

Wrigley to Norman Wells, NWT

Client/Project

Prepared by AT on 2023-03-07

TR by AJ on 2023-03-07

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

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





TETRA TECH

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

Habitat Inventory / Reach Data

Transect # (Location)	1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)		Instream Cover (%): 30 Overhead Cover (%): 10						
Channel Width (m)	4.1		5.8		4.3		13.0		16.8		-		Dom. Instream Cover: WD Dom. Overhead Cover: C						
Wetted Width (m)	2.7		3.7		3.7		7.1		5.6		-		Subdom. Instream Cover: G Subdom. Overhead Cover: S						
Depth at LDB + 25% (m)	0.4		0.3		0.9		0.9		0.2		-		Maximum Depth (m) 1.2 Dom. Aquatic Veg. Type: -						
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		Time of Day (HH:MM): 10:55 Pattern: IR					
	Fines	50		80		60		70		30		0		Water Temperature (°C): 4.5 Islands: O					
	Small Gravel	0		0		0		0		0		0		Dissolved Oxygen (mg/L): 10.49 Bars: N					
	Large Gravel	0		0		0		0		0		0		Sp. Conductivity (µs/cm): 339 Coupling: PC					
	Cobble	0		0		0		0		0		0		pH: 7.50 Confinement: OC					
	Boulder	0		0		0		0		0		0		Turbidity (NTU): Lightly Turbid Flow Stage: Flood					
	Bedrock	0		0		0		0		0		0							
	Embeddedness	N		N		N		N		N		N							
Fish Habitat Assessment Ratings																			
														Forage Fish		Coarse Fish		Sport Fish	
Bank Measurements		Left		Right		Left		Right		Left		Right		Left		Right		Spawning: Moderate None-Poor None-Poor	
Bank Height (m)		0.9		1.0		1.0		0.6		0.2		0.2		0.3		0.3		Overwintering: Poor-Moderate Poor-Moderate Poor-Moderate	
Bank Slope (°)		90		60		50		50		90		60		30		30		Rearing: Good Good Moderate	
Bank Stability		US		US		MS		MS		S		S		S		S		Passage: Moderate-Good Moderate-Good Moderate-Good	
Dom. Bank Material		F		F		F		F		F		F		O		F			
Subdom. Bank Material		O		O		O		O		O		O		F		O			
Dom. Riparian Veg.		G		G		G		G		G		G		G		G			
Subdom. Riparian Veg.		S		S		G		D		G		G		M		C			

Water Quality Data

Channel Characteristics

Time of Day (HH:MM):	10:55	Pattern:	IR
Water Temperature (°C):	4.5	Islands:	O
Dissolved Oxygen (mg/L):	10.49	Bars:	N
Sp. Conductivity (µs/cm):	339	Coupling:	PC
pH:	7.50	Confinement:	OC
Turbidity (NTU):	Lightly Turbid	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		Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
No Electrofishing		-	(s)	BROOK STICKLEBACK	-	13	-	0.18	2.5%
Minnow Trap (MT)		72.0	(hr)	PEARL DACE	-	20	-	0.28	3.9%
Electrofisher Settings				-	-	1	-	0.01	0.2%
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)	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.



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
	Fines	0	20	50	30	10
	Small Gravel	0	50	0	40	30
	Large Gravel	0	0	0	0	10
	Cobble	0	0	0	10	50
	Boulder	0	0	0	0	0
	Bedrock	0	0	0	20	0
	Embeddedness	N	M	N	L	N

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	Pattern:	IR
Water Temperature (°C):	0.1	Islands:	N
Dissolved Oxygen (mg/L):	12.53	Bars:	N
Sp. Conductivity (µs/cm):	435	Coupling:	DC
pH:	7.74	Confinement:	FC
Turbidity (NTU):	CLEAR	Flow Stage:	Low

Channel Characteristics

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

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

Fish Sampling Data

				Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	Rel. Abundance	
Method		Effort		Species	(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)
Backpack Electrofisher (EB)		263	(s)	NO FISH CAPTURED	-	-	-	-	-
No Trapping		-	(hr)		-	-	-	-	
Electrofisher Settings					-	-	-	-	
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)	-	-	-	-		
225	30	12	150	-	-	-	-		

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 create 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.



Site 815 Unnamed Watercourse

Survey Date: 10/2/2021; 13:05

Zone:

Restricted Activity Period:

Physical Channel Transect Data													Habitat Inventory / Reach Data								
Transect # (Location)		1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)		Instream Cover (%):		30 Overhead Cover (%):		80			
Channel Width (m)		1.8		2.4		1.9		1.8		2.5		-		Dom. Instream Cover:		WD Dom. Overhead Cover:		S			
Wetted Width (m)		1.3		1.0		1.4		1.0		0.6		-		Subdom. Instream Cover:		- Subdom. Overhead Cover:		G			
Depth at LDB + 25% (m)		0.1		0.1		0.1		0.0		0.0		-		Maximum Depth (m)		- Dom. Aquatic Veg. Type:		-			
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		-								
	Fines		30		0		60		10		10		-								
	Small Gravel		30		20		20		40		0		-								
	Large Gravel		20		40		0		20		0		-								
	Cobble		20		40		10		20		0		-								
	Boulder		0		0		0		0		0		-								
	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		pH:		8.37		Confinement: FC			
Bank Height (m)		0.4 0.4		0.3 0.3		0.3 0.3		0.2 0.3		- -		- -		Turbidity (NTU):		Clear		Flow Stage: Moderate			
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		- -		Spawning:		Poor-Moderate		Poor None-Poor			
Subdom. Bank Material		F F		O O		SG SG		O O		O O		- -		Overwintering:		Poor		Poor Poor			
Dom. Riparian Veg.		S S		S S		S S		D D		D D		- -		Rearing:		Poor-Moderate		Poor-Moderate None-Poor			
Subdom. Riparian Veg.		C D		G G		G G		S S		S S		- -		Passage:		Poor-Moderate		Poor Poor			
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 Trapping						- (hr)															
Electrofisher Settings																					
Volts		Freq. (Hz)		Duty Cycle (%)		Dist. (m)															
-		-		-		-															
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.																					



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	

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

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

Channel Characteristics

Assessment Ratings

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

	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

				Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	Rel. Abundance	
Method		Effort		Species	(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)
No Electrofishing		-		NO FISH CAPTURED					
Minnow Trap (MT)		50.0							
Electrofisher Settings									
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)						
-	-	-	-						

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

Habitat Inventory / Reach 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. Bankfull Depth (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
	Fines	30	0	50	0	30
	Small Gravel	50	60	30	100	30
	Large Gravel	0	0	20	0	0
	Cobble	0	0	0	0	0
	Boulder	0	0	0	0	0
	Bedrock	0	0	0	0	0
Embeddedness	N	N	N	N	N	N

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

Channel Characteristics

Time of Day (HH:MM):	11:13	Pattern:	ST
Water Temperature (°C):	1.4	Islands:	N
Dissolved Oxygen (mg/L):	7.52	Bars:	N
Sp. Conductivity (µs/cm):	1,097	Coupling:	PC
pH:	7.78	Confinement:	OC
Turbidity (NTU):	Lightly Turbid	Flow Stage:	Moderate

Fish Habitat Assessment Ratings

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

	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	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
No Electrofishing	- (s)						
No Trapping	- (hr)						
Electrofisher Settings							
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)				
-	-	-	-				

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 throughout, the watercourse creating potential barriers to fish. Woody debris overhanging throughout. No fishing conducted due to freezing conditions..



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
	Fines	0	0	0	10	40
	Small Gravel	0	0	0	30	20
	Large Gravel	20	30	30	40	30
	Cobble	30	30	30	20	0
	Boulder	45	39	30	0	10
	Bedrock	5	1	20	0	0
Embeddedness	L	L	N	L	L	L

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	Pattern:	ST
Water Temperature (°C):	0.3	Islands:	I
Dissolved Oxygen (mg/L):	11.60	Bars:	N
Sp. Conductivity (µs/cm):	1,123	Coupling:	CO
pH:	8.14	Confinement:	OC
Turbidity (NTU):	Clear	Flow Stage:	Low

Channel Characteristics

Fish Habitat Assessment Ratings

		Left		Right		Left		Right		Left		Right			
Bank Measurements		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Forage Fish	Sport Fish
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	Moderate-Good	Poor
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	Poor-Moderate	Poor
Bank Stability		MS	MS	MS	MS	MS	MS	MS	MS	US	US	MS	MS	Good	Moderate
Dom. Bank Material		F	F	O	O	F	F	F	F	O	O	O	O	Moderate-Good	Moderate-Good
Subdom. Bank Material		O	O	F	F	O	O	O	O	F	F	F	F	Moderate-Good	Moderate-Good
Dom. Riparian Veg.		D	C	S	S	S	S	S	S	S	S	S	S	Moderate-Good	Moderate-Good
Subdom. Riparian Veg.		S	S	C	C	C	C	M	M	C	C	C	C	Moderate-Good	Moderate-Good

Fish Sampling Data

				Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	rel. Abundance
Method		Effort	Species	(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)
No Electrofishing		- (s)						
No Trapping		- (hr)						
Electrofisher Settings								
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)					
-	-	-	-					

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.



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
	Fines	100	100	40	0	0
	Small Gravel	0	0	0	0	0
	Large Gravel	0	0	0	0	0
	Cobble	0	0	0	0	0
	Boulder	0	0	0	0	0
	Bedrock	0	0	0	0	0
Embeddedness	N	N	N	N	N	N

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	Pattern:	ME
Water Temperature (°C):	2.0	Islands:	N
Dissolved Oxygen (mg/L):	11.82	Bars:	N
Sp. Conductivity (µs/cm):	439	Coupling:	PC
pH:	7.82	Confinement:	OC
Turbidity (NTU):	lightly Turbid	Flow Stage:	Pooled

Fish Habitat Assessment Ratings

Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right		Forage Fish	Coarse Fish	Sport Fish
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	Spawning:	Moderate-Good	None	None
Bank Slope (°)	45	60	45	45	80	90	10	10	80	50	50	50	Overwintering:	Moderate-Good	Moderate	Poor-Moderate
Bank Stability	MS	US	MS	MS	MS	MS	US	US	US	US	US	US	Rearing:	Moderate-Good	Moderate-Good	Moderate-Good
Dom. Bank Material	O	O	O	O	F	F	O	O	O	O	F	O	Passage:	Moderate	Moderate	Moderate
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				

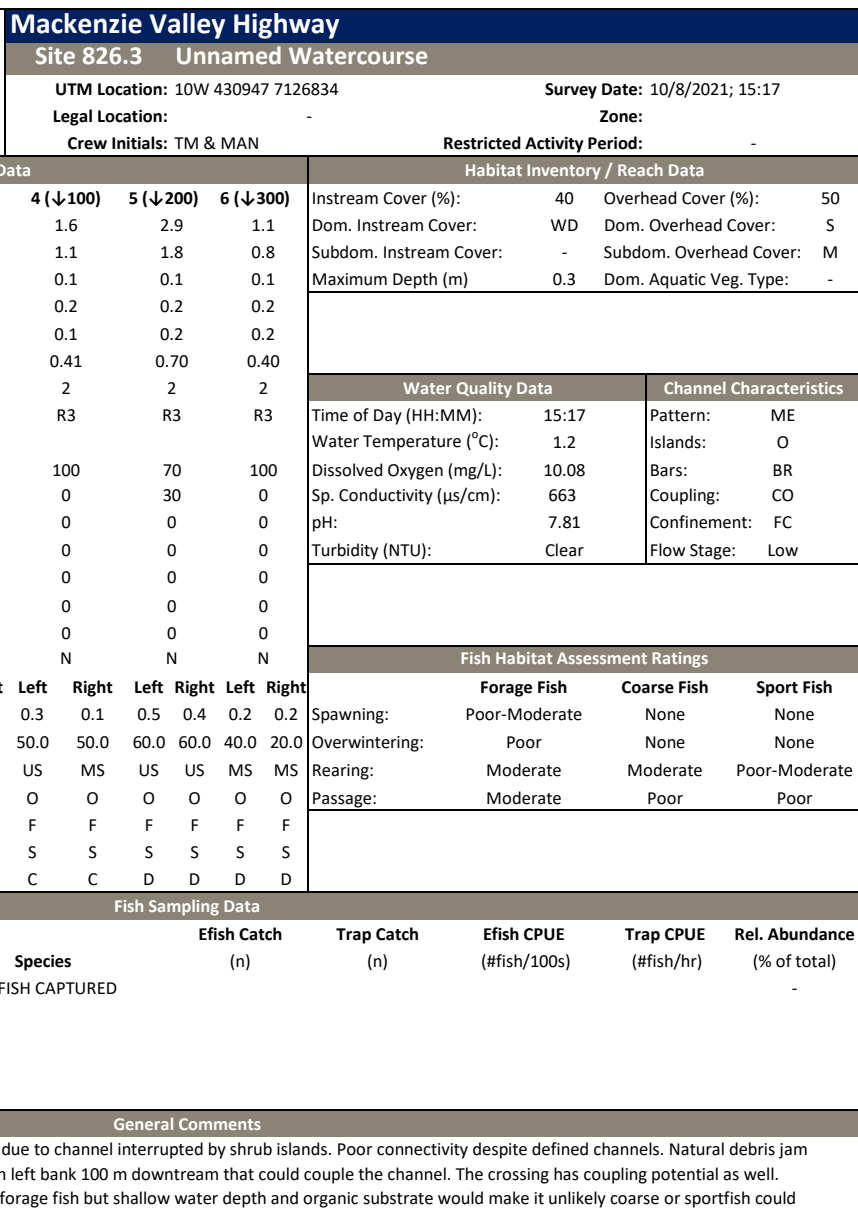
Fish Sampling Data

				Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	rel. Abundance
Method		Effort	Species	(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)
No Electrofishing		- (s)	NO FISH CAPTURED					
Minnow Trap (MT)		44.7 (hr)						
Electrofisher Settings								
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)					
-	-	-	-					

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

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												Habitat Inventory / Reach Data																			
Transect # (Location)		1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)		Instream Cover (%):		40	Overhead Cover (%):		70												
Channel Width (m)		0.9		0.6		0.8		1.8		1.9		1.6		Dom. Instream Cover:		WD	Dom. Overhead Cover:		WD												
Wetted Width (m)		0.3		0.6		0.7		0.8		1.3		0.6		Subdom. Instream Cover:		UCB	Subdom. Overhead Cover:		S												
Depth at LDB + 25% (m)		0.1		0.5		0.4		0.3		0.4		0.3		Maximum Depth (m)		0.5	Dom. Aquatic Veg. Type:		-												
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																			
	Fines	60		0		60		40		40		40																			
	Small Gravel	40		30		30		40		40		60																			
	Large Gravel	0		40		10		20		10		0																			
	Cobble	0		30		0		0		0		0																			
	Boulder	0		0		0		0		0		0																			
	Bedrock	0		0		0		0		0		0																			
Embeddedness		L		L		L		L		M		L																			
Bank Measurements		Left		Right		Left		Right		Left		Right																			
Bank Height (m)		0.6		0.3		0.3		0.5		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		MS								MS		MS		MS		S		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		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							
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 Trapping				-				(hr)																							
Electrofisher Settings																															
Volts		Freq. (Hz)		Duty Cycle (%)		Dist. (m)																									
-		-		-		-																									
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

Habitat Inventory / Reach 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. Bankfull Depth (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

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:	-

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	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

Water Quality Data		Channel Characteristics	
Time of Day (HH:MM):	13:50	Pattern:	IR
Water Temperature (°C):	1.1	Islands:	N
Dissolved Oxygen (mg/L):	9.42	Bars:	N
Sp. Conductivity (µs/cm):	736	Coupling:	PC
pH:	7.44	Confinement:	OC
Turbidity (NTU):	Clear	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	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
No Electrofishing	- (s)						
No Trapping	- (hr)						
Electrofisher Settings							
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)				
-	-	-	-				

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.



TETRA TECH

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

Habitat Inventory / Reach 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. Bankfull Depth (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

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

Water Quality Data		Channel Characteristics	
Time of Day (HH:MM):	15:00	Pattern:	ST
Water Temperature (°C):	0.1	Islands:	N
Dissolved Oxygen (mg/L):	11.78	Bars:	N
Sp. Conductivity (µs/cm):	1,001	Coupling:	PC
pH:	8.07	Confinement:	CO
Turbidity (NTU):	Clear	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	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	rel. Abundance (% of total)
No Electrofishing		- (s)						
No Trapping		- (hr)						
Electrofisher Settings								
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)					
-	-	-	-					

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.



Site 837.1 Unnamed Watercourse

Survey Date: 10/11/2021; 12:34

Zone:

Restricted Activity Period:

Physical Channel Transect Data												Habitat Inventory / Reach Data											
Transect # (Location)		1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)		Instream Cover (%):		30	Overhead Cover (%):		10				
Channel Width (m)		1.5		1.7		1.2		2.7		2.1		1.9		Dom. Instream Cover:		C	Dom. Overhead Cover:		S				
Wetted Width (m)		1.3		1.3		0.9		1.3		1.0		1.4		Subdom. Instream Cover:		-	Subdom. Overhead Cover:		-				
Depth at LDB + 25% (m)		0.2		0.2		0.1		0.0		0.1		0.2		Maximum Depth (m)		0.2	Dom. Aquatic Veg. Type:		-				
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																Water Quality Data				Channel Characteristics			
Substrate (% of Transect Area)		Organics		0		0		0		0		0		Time of Day (HH:MM):		12:34	Pattern:		ME				
		Fines		0		0		0		0		10		Water Temperature (°C):		1.1	Islands:		N				
		Small Gravel		10		25		20		10		20		30		Dissolved Oxygen (mg/L):		12.27	Bars:		SD		
		Large Gravel		30		30		35		45		30		45		Sp. Conductivity (µs/cm):		482	Coupling:		DC		
		Cobble		30		30		10		30		40		5		pH:		8.20	Confinement:		OC		
		Boulder		30		10		25		20		10		0		Turbidity (NTU):		Clear	Flow Stage:		Low		
		Bedrock		0		0		0		0		0		0									
		Embeddedness		N		N		N		N		N		N									
Fish Habitat Assessment Ratings																							
Bank Measurements		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Forage Fish		Coarse Fish		Sport Fish					
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	Spawning:		Moderate-Good	Moderate		Moderate				
Bank Slope (°)		90	90	70	70	70	70	10	10	30	20	60	55	Overwintering:		None-Poor	None-Poor		None-Poor				
Bank Stability		MS	US	US	US	US	US	MS	MS	MS	MS	MS	MS	Rearing:		Moderate	Moderate		Moderate				
Dom. Bank Material		O	O	O	O	O	O	O	O	LG	O	O	O	Passage:		Moderate	Poor-moderate		Poor-moderate				
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										
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 Trapping				- (hr)																			
Electrofisher Settings																							
Volts		Freq. (Hz)		Duty Cycle (%)		Dist. (m)																	
-		-		-		-																	
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.																							



TETRA TECH

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	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
No Electrofishing	- (s)						
No Trapping	- (hr)						
Electrofisher Settings							
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)				
-	-	-	-				

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

Habitat Inventory / Reach Data

Transect # (Location)	1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)		Instream Cover (%): 30		Overhead Cover (%): 30		
Channel Width (m)	-		-		-		2.5		2.3		2.1		Dom. Instream Cover: WD		Dom. Overhead Cover: -		
Wetted Width (m)	-		-		-		2.3		1.9		1.7		Subdom. Instream Cover: -		Subdom. Overhead Cover: -		
Depth at LDB + 25% (m)	-		-		-		0.5		0.2		0.1		Maximum Depth (m) 0.8		Dom. Aquatic Veg. Type: -		
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	pH: 7.97			
Bank Height (m)		-	-	-	-	-	-	0.7	0.3	0.3	0.2	0.1	0.1	Turbidity (NTU): Lightly Turbid			
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				
														Time of Day (HH:MM): 14:00		Pattern: SI	
														Water Temperature (°C): 0.1		Islands: S	
														Dissolved Oxygen (mg/L): 12.21		Bars: N	
														Sp. Conductivity (µs/cm): 264		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																	



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
	Fines	20	100	40	20	40
	Small Gravel	0	0	0	0	0
	Large Gravel	0	0	0	0	0
	Cobble	0	0	0	0	0
	Boulder	0	0	0	0	0
	Bedrock	0	0	0	0	0
Embeddedness	N	N	N	N	N	N

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	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
No Electrofishing	- (s)						
No Trapping	- (hr)						
Electrofisher Settings							
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)				
-	-	-	-				

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

				Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	Rel. Abundance	
Method		Effort		Species	(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)
No Electrofishing		- (s)		NO FISH CAPTURED					
Minnow Trap (MT)		1.0 (hr)							
Electrofisher Settings									
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)						
-	-	-	-						

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

				Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	Rel. Abundance	
Method		Effort		Species	(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)
No Electrofishing		- (s)		NO FISH CAPTURED					
Minnow Trap (MT)		36.5 (hr)							
Electrofisher Settings									
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)						
-	-	-	-						

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
	Fines	0	0	0	90	100
	Small Gravel	0	0	0	10	0
	Large Gravel	0	0	0	0	0
	Cobble	0	0	0	0	0
	Boulder	0	0	0	0	0
	Bedrock	0	0	0	0	0
Embeddedness	0	0	0	0	0	0

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	Pattern:	ME
Water Temperature (°C):	0.6	Islands:	N
Dissolved Oxygen (mg/L):	10.81	Bars:	N
Sp. Conductivity (µs/cm):	193	Coupling:	CO
pH:	7.37	Confinement:	FC
Turbidity (NTU):	Clear	Flow Stage:	Flood

Channel Characteristics

Fish Habitat Assessment Ratings

		Left		Right		Left		Right		Left		Right		Left		Right		Left		Right		Left		Right	
Bank Measurements		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	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	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Bank Slope (°)		0	0	0	0	10	10	40	40	20	40	75	40	40	40	40	40	40	40	40	40	40	40	40	40
Bank Stability		S	S	S	S	S	S	US	US	MS	US	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
Dom. Bank Material		O	O	O	O	O	O	O	O	O	O	O	O	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	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	S	S	S	S	S	S	S	S	S	S	S	S	S
Subdom. Riparian Veg.		S	S	S	S	S	S	M	M	C	C	M	S	M	S	M	S	M	S	M	S	M	S	M	S

Fish Sampling Data

				Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	Rel. Abundance	
Method		Effort		Species	(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)
No Electrofishing		-	(s)						
No Trapping		-	(hr)						
Electrofisher Settings									
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)						
-	-	-	-						

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.



Site 880.2 Unnamed Watercourse

Survey Date: 10/1/2021; 16:23

Zone:

Restricted Activity Period:

Habitat Inventory / Reach Data

Transect # (Location)		1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)		Instream Cover (%):		20	Overhead Cover (%):		30		
Channel Width (m)		-		1.2		2.7		2.6		3.2		0.9		Dom. Instream Cover:		-	Dom. Overhead Cover:		-		
Wetted Width (m)		-		0.8		0.7		1.0		0.7		0.5		Subdom. Instream Cover:		-	Subdom. Overhead Cover:		-		
Depth at LDB + 25% (m)		-		0.1		0.1		0.1		0.1		0.1		Maximum Depth (m)		0.2	Dom. Aquatic Veg. Type:		-		
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									
	Fines	-		10		100		40		80		90									
	Small Gravel	-		0		0		0		10		0									
	Large Gravel	-		0		0		0		0		0									
	Cobble	-		0		0		0		0		0									
	Boulder	-		0		0		0		0		0									
	Bedrock	-		0		0		0		0		0									
Embeddedness		-		N		N		N		L		N									
Bank Measurements		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right			Forage Fish		Coarse Fish		Sport Fish	
Bank Height (m)		-	-	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	Spawning:		None	None	None	None	None	
Bank Slope (°)		-	-	20	20	45	80	45	50	10	80	45	45	Overwintering:		None	None	None	None	None	
Bank Stability		-	-	MS	MS	S	MS	US	MS	US	US	MS	MS	Rearing:		None	Poor	None	None	None	
Dom. Bank Material		-	-	O	O	O	O	O	O	F	F	O	O	Passage:		None-Poor	None-Poor	None-Poor	None-Poor	None-Poor	
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								
Fish Sampling Data																					
												Efish Catch		Trap Catch		Efish CPUE		Trap CPUE		Rel. Abundance	
Method				Effort				Species				(n)		(n)		#(fish/100s)		#(fish/hr)		(% of total)	
No Electrofishing				-				(s)				NO FISH CAPTURED									
No Trapping				-				(hr)													
Electrofisher Settings																					
Volts		Freq. (Hz)		Duty Cycle (%)		Dist. (m)															
-		-		-		-															
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

Habitat Inventory / Reach 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. Bankfull Depth (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
	Fines	100	90	70	80	70
	Small Gravel	0	0	0	0	20
	Large Gravel	0	0	0	0	0
	Cobble	0	0	0	0	0
	Boulder	0	0	0	10	0
	Bedrock	0	0	0	0	0
Embeddedness	0	0	0	0	0	0

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

Channel Characteristics

Time of Day (HH:MM):	16:30	Pattern:	ST
Water Temperature (°C):	1.6	Islands:	N
Dissolved Oxygen (mg/L):	13.61	Bars:	N
Sp. Conductivity (µs/cm):	240	Coupling:	PC
pH:	7.66	Confinement:	CO
Turbidity (NTU):	Moderately Turbid	Flow Stage:	High

Fish Habitat Assessment Ratings

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

	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	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	tel. Abundance (% of total)
Backpack Electrofisher (EB)	246 (s)	BROOK STICKLEBACK	2	-	2.86	-	40.0%
No Trapping	- (hr)	FINESCALE DACE	1	-	1.43	-	20.0%
Electrofisher Settings		PEARL DACE	2	-	2.86	-	40.0%
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)				
200	30	12	200				

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.



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
	Fines	0	0	0	10	0	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	0	0	0	0
	Bedrock	0	0	0	0	0	0
Embeddedness	N	N	N	N	N	N	

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

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

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

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 downstream, 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.



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

Habitat Inventory / Reach 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
	Fines	0	90	90	80	80	40
	Small Gravel	0	10	10	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	M	H	N	N	N	

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

Channel Characteristics

Time of Day (HH:MM):	14:22	Pattern:	IR
Water Temperature (°C):	3.2	Islands:	O
Dissolved Oxygen (mg/L):	-	Bars:	BR
Sp. Conductivity (µs/cm):	338	Coupling:	CO
pH:	7.70	Confinement:	CO
Turbidity (NTU):	lightly Turbid	Flow Stage:	Low

Fish Habitat Assessment Ratings

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	60	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

	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	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Backpack Electrofisher (EB)	471 (s)	BROOK STICKLEBACK	3	-	0.64	-	9.4%
No Trapping	- (hr)	PEARL DACE	29	-	6.16	-	90.6%
Electrofisher Settings							
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)				
190	30	12	300				

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.



TETRA TECH

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

Habitat Inventory / Reach 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	Instream Cover (%):	10	Overhead Cover (%):	10
Wetted Width (m)	-	-	-	5.0	5.0	-	Dom. Instream Cover:	WD	Dom. Overhead Cover:	C
Depth at LDB + 25% (m)	-	-	1.3	0.5	0.5	-	Subdom. Instream Cover:	C	Subdom. Overhead Cover:	S
Depth at LDB + 50% (m)	-	-	-	0.5	0.5	-	Maximum Depth (m)	>1	Dom. Aquatic Veg. Type:	-
Depth at LDB + 75% (m)	-	-	-	0.3	0.7	-				
Max. Bankfull Depth (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
Bank Height (m)	-	-	-	-	1.3	-	-	-	-	-
Bank Slope (°)	80	80	70	70	65	65	50	50	50	50
Bank Stability	MS	MS	MS	US	US	US	US	US	US	US
Dom. Bank Material	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG
Subdom. Bank Material	F	F	F	F	F	F	F	F	F	F
Dom. Riparian Veg.	C	C	C	C	C	C	C	C	C	C
Subdom. Riparian Veg.	G	G	G	G	G	G	G	G	G	G

Water Quality Data

Channel Characteristics

Time of Day (HH:MM):	11:00	Pattern:	ST
Water Temperature (°C):	3.3	Islands:	N
Dissolved Oxygen (mg/L):	10.25	Bars:	N
Sp. Conductivity (µs/cm):	340	Coupling:	CO
pH:	8.04	Confinement:	CO
Turbidity (NTU):	Lightly Turbid	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	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
No Electrofishing	- (s)						
No Trapping	- (hr)						
Electrofisher Settings							
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)				
-	-	-	-				

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

Habitat Inventory / Reach 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. Bankfull Depth (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
	Fines	0	0	60	70	40
	Small Gravel	0	0	0	0	0
	Large Gravel	0	0	0	0	0
	Cobble	0	0	0	0	0
	Boulder	0	0	10	0	0
	Bedrock	0	0	0	0	0
Embeddedness	VH	VH	L	H	H	H

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

Channel Characteristics

Time of Day (HH:MM):	10:27	Pattern:	ME
Water Temperature (°C):	2.9	Islands:	O
Dissolved Oxygen (mg/L):	5.96	Bars:	BR
Sp. Conductivity (µs/cm):	182	Coupling:	DC
pH:	6.50	Confinement:	UN
Turbidity (NTU):	Lightly Turbid	Flow Stage:	Flood

Fish Habitat Assessment Ratings

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

	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	Species	Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	Rel. Abundance	
				(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)	
No Electrofishing		- (s)		NO FISH CAPTURED					
Minnow Trap (MT)		46.6 (hr)							
Electrofisher Settings									
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)						
-	-	-	-						

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	

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	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
No Electrofishing	- (s)						
No Trapping	- (hr)						
Electrofisher Settings							
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)				
-	-	-	-				

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.



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

Habitat Inventory / Reach Data

Transect # (Location)		1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)		Instream Cover (%):		25	Overhead Cover (%):		40						
Channel Width (m)		1.4		2.2		2.6		2.0		4.0		1.4		Dom. Instream Cover:		Co	Dom. Overhead Cover:		S						
Wetted Width (m)		0.9		1.1		1.4		1.5		1.4		0.7		Subdom. Instream Cover:		Bo	Subdom. Overhead Cover:		C						
Depth at LDB + 25% (m)		0.1		0.1		0.0		0.2		0.5		0.2		Maximum Depth (m)		0.8	Dom. Aquatic Veg. Type:		-						
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			
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		US		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	
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	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Backpack Electrofisher (EB)		485 (s)	NO FISH CAPTURED					
No Trapping		- (hr)						
Electrofisher Settings								
Volts	Freq. (Hz)	Duty Cycle (%)						
235	30	12						

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	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
No Electrofishing		- (s)	BROOK STICKLEBACK	-	106	-	2.39	67.9%
Minnow Trap (MT)		44.4 (hr)	PEARL DACE	-	50	-	1.13	32.1%
Electrofisher Settings								
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)					
-	-	-	-					

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	Sinuuous
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>i.e.</i> , 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



K'alo-Stantec

Dehcho Territory Fish and Fish Habitat

030CF: Drainage

UTM Location: 10U 473070 7015812

km Marker: 699.1

Crew Initials: LD MAN

Survey Date: September 16, 2020

Zone: 2

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.



K'alo-Stantec

Dehcho Territory Fish and Fish Habitat

SWA: Wetland Area

UTM Location: 10U 472880 7015938

km Marker: 699.3

Crew Initials: LD MAN

Survey Date: September 23, 2020

Zone: 2

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.



Kalo-Stantec

Dehcho Territory Fish and Fish Habitat

UWB: Wetland Area

UTM Location: 10U 472322 7016741

km Marker: 700.3

Crew Initials: LD MAN

Survey Date: September 23, 2020

Zone: 2

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 habitat.



Kalo-Stantec

Dehcho Territory Fish and Fish Habitat

UWB-7: Wetland Area

UTM Location: 10U 471421 7017918

km Marker: 701.7

Crew Initials: LD MAN

Survey Date: September 16, 2020

Zone: 2

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.



K'alo-Stantec

Dehcho Territory Fish and Fish Habitat

SWA-1: Wetland Area

UTM Location: 10U 471183 7018318

km Marker: 702.2

Crew Initials: LD MAN

Survey Date: September 23, 2020

Zone: 2

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.



Kalo-Stantec

Dehcho Territory Fish and Fish Habitat

UWB-1: Wetland Area

UTM Location: 10U 470932 7019008

km Marker: 702.9

Crew Initials: LD MAN

Survey Date: September 16, 2020

Zone: 2

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.



Kalo-Stantec

Dehcho Territory Fish and Fish Habitat

UWB-2: Wetland Area

UTM Location: 10U 470653 7020732

km Marker: 704.7

Crew Initials: LD MAN

Survey Date: September 23, 2020

Zone: 2

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 habitat potential.



K'alo-Stantec

Dehcho Territory Fish and Fish Habitat

SWA-3: Wetland Area

UTM Location: 10U 471528 7027742

km Marker: 710.35

Crew Initials: LD MAN

Survey Date: September 16, 2020

Zone: 2

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.



K'alo-Stantec

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.



K'alo-Stantec

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.



Kalo-Stantec

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.



Kalo-Stantec

Dehcho Territory Fish and Fish Habitat

WX-036: Unnamed Watercourse

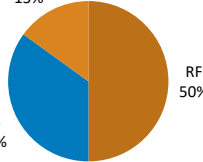
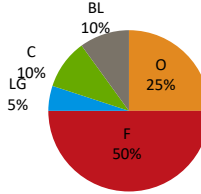
UTM Location: 10U 465977 7037399

Survey Date: Septemeber 22, 2020

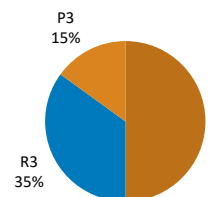
km Maker: 721.61

Zone: 2

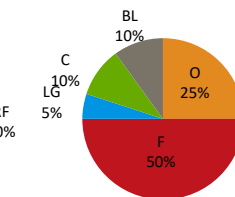
Crew Initials: LD MAN Restricted Activity Timing Window: August 15 to July 15

Physical Channel Transect Data												Habitat Inventory / Reach Data																																																					
Transect # (Location)		1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)		Instream Cover (%): 11		Overhead Cover (%): 24																																																	
Channel Width (m)		2.7		2.2		1.8		1.9		1.6		1.2		Dom. Instream Cover: WD		Dom. Overhead Cover: TS																																																	
Wetted Width (m)		1.9		2.1		1.7		2.6		1.4		1.7		Subdom. Instream Cover DC		Subdom. Overhead Cove UB																																																	
Depth at LDB + 25% (m)		0.1		0.2		0.2		0.2		0.1		0.2		Maximum Depth (m) 0.4		Dom. Aquatic Veg. Type: -																																																	
Depth at LDB + 50% (m)		0.2		0.1		0.2		0.2		0.3		0.2		Habitat Distribution  Substrate Composition 																																																			
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		Water Quality Data <table><tr><td>Time of Day (HH:MM):</td><td>14:03</td><td colspan="2">Pattern:</td><td>SI</td></tr><tr><td>Water Temperature (°C):</td><td>2.9</td><td colspan="2">Islands:</td><td>N</td></tr><tr><td>Dissolved Oxygen (mg/L)</td><td>8.59</td><td colspan="2">Bars:</td><td>SD</td></tr><tr><td>Sp. Conductivity (µs/cm)</td><td>81.0</td><td colspan="2">Coupling:</td><td>CO</td></tr><tr><td>pH:</td><td>6.27</td><td colspan="2">Confinement:</td><td>FC</td></tr><tr><td>Turbidity (NTU):</td><td>-</td><td colspan="2">Flow Stage:</td><td>Low</td></tr></table> Fish Habitat Assessment Ratings <table><tr><th></th><th>Forage Fish</th><th>Coarse Fish</th><th>Sport Fish</th></tr><tr><td>Spawning:</td><td>Poor</td><td>Poor</td><td>Poor</td></tr><tr><td>Overwintering:</td><td>Poor</td><td>Poor</td><td>Poor</td></tr><tr><td>Rearing:</td><td>Moderate</td><td>Moderate</td><td>Poor-Moderate</td></tr><tr><td>Passage:</td><td>Good</td><td>Good</td><td>Good</td></tr></table>		Time of Day (HH:MM):	14:03	Pattern:		SI	Water Temperature (°C):	2.9	Islands:		N	Dissolved Oxygen (mg/L)	8.59	Bars:		SD	Sp. Conductivity (µs/cm)	81.0	Coupling:		CO	pH:	6.27	Confinement:		FC	Turbidity (NTU):	-	Flow Stage:		Low		Forage Fish	Coarse Fish	Sport Fish	Spawning:	Poor	Poor	Poor	Overwintering:	Poor	Poor	Poor	Rearing:	Moderate	Moderate	Poor-Moderate	Passage:	Good	Good	Good
	Time of Day (HH:MM):	14:03	Pattern:		SI																																																												
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Passage:	Good	Good	Good																																																														
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																																																						
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Time of Day (HH:MM):	14:03	Pattern:		SI																																																													
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Spawning:	Poor	Poor	Poor																																																														
Overwintering:	Poor	Poor	Poor																																																														
Rearing:	Moderate	Moderate	Poor-Moderate																																																														
Passage:	Good	Good	Good																																																														
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 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

				Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	Rel. Abundance	
Method		Effort		Species	(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)
Backpack Electrofisher (EB)		450	(s)	NO FISH CAPTURED	0	-	0.00	-	-
No Trapping		-	(hr)						
Electrofisher Settings									
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)						
400	30	12	346						

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.



Kalo-Stantec

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													Habitat Inventory / Reach Data					
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)	Instream Cover (%):		9	Overhead Cover (%):		21						
Channel Width (m)	1.6	1.1	1.5	1.4	2.3	0.9	Dom. Instream Cover:		DC	Dom. Overhead Cover:		UB						
Wetted Width (m)	1.1	1.0	1.1	1.2	1.8	0.8	Subdom. Instream Cover		-	Subdom. Overhead Cove		WD						
Depth at LDB + 25% (m)	0.1	0.2	0.3	0.3	0.2	0.3	Maximum Depth (m)		0.4	Dom. Aquatic Veg. Type:		-						
Depth at LDB + 50% (m)	0.1	0.2	0.3	0.3	0.2	0.4	Habitat Distribution			Substrate Composition								
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												
	Fines	50	50	50	50	50												
	Small Gravel	5	5	5	5	5												
	Large Gravel	5	5	5	5	5												
	Cobble	10	10	10	10	10												
	Boulder	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								
Bank Height (m)	0.4	0.4	0.3	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						
													Water Quality Data				Channel Characteristics	
Time of Day (HH:MM):									17:26		Pattern:				ME			
Water Temperature (°C):									2.5		Islands:				N			
Dissolved Oxygen (mg/L)									9.26		Bars:				DG			
Sp. Conductivity (µs/cm)									74.0		Coupling:				CO			
pH:									7.53		Confinement:				FC			
Turbidity (NTU):									-		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

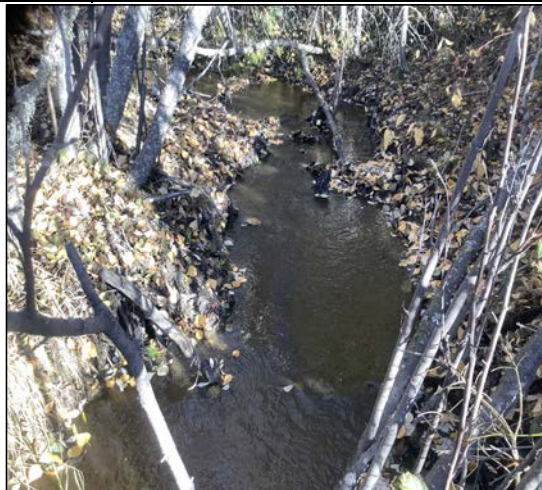


Photo 2: Facing upstream at centerline.

Fish Sampling Data								
Method		Effort	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Backpack Electrofisher (EB)		432 (s)	NO FISH CAPTURED	0	-	0.00	-	-
No Trapping		- (hr)						
Electrofisher Settings								
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)					
400	30	12	317					
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.								



Kalo-Stantec

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)	10	10	10	10	10	10
Organics	10	10	10	10	10	10
Fines	40	40	40	40	40	40
Small Gravel	0	0	0	0	0	0
Large Gravel	0	0	0	0	0	0
Cobble	15	15	15	15	15	15
Boulder	35	35	35	35	35	35
Bedrock	0	0	0	0	0	0
Embeddedness	M	M	M	M	M	M

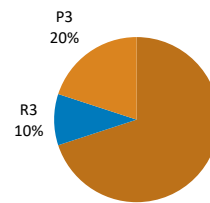
Bank Measurements

	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

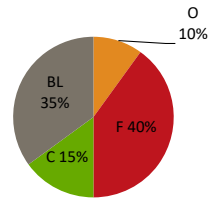
Habitat Inventory / Reach Data

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 downstream of centerline.

Fish Sampling Data

				Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	Rel. Abundance
Method		Effort	Species	(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)
No Electrofishing		- (s)	NO FISH CAPTURED					-
No Trapping		- (hr)						
Electrofisher Settings								
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)					

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.



Kalo-Stantec

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)	5	5	5	5	5	-
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	-

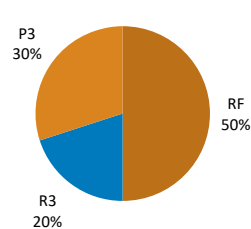
Bank Measurements

	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	-	-

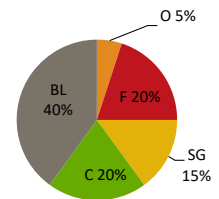
Habitat Inventory / Reach Data

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	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

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

 Kalo-Stantec			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							Habitat Inventory / Reach Data												
Transect # (Location) 1 (↑100) 2 (↑50) 3 (CL) 4 (↓100) 5 (↓200) 6 (↓300)							Instream Cover (%): 7 Overhead Cover (%): 16												
Channel Width (m) 0.8 1.1 0.9 1.2 1.3 1.2							Dom. Instream Cover: WD Dom. Overhead Cover: UB												
Wetted Width (m) 0.9 1.0 1.0 1.0 0.9 1.7							Subdom. Instream Cover DC Subdom. Overhead Cove TS												
Depth at LDB + 25% (0.2 0.1 0.3 0.1 0.3 0.1							Maximum Depth (m) 0.3 Dom. Aquatic Veg. Type: -												
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													
	Fines	30	30	30	30	30													
	Small Gravel	20	20	20	20	20													
	Large Gravel	5	5	5	5	5													
	Cobble	10	10	10	10	10													
	Boulder	15	15	15	15	15													
	Bedrock	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																			
							Water Quality Data												
							Channel Characteristics												
							Time of Day (HH:MM): 10:27 Pattern: SI												
							Water Temperature (°C): 0.7 Islands: N												
							Dissolved Oxygen (mg/L) 8.88 Bars: N												
							Sp. Conductivity (µs/cm) 78.0 Coupling: CO												
							pH: 6.52 Confinement: CO												
							Turbidity (NTU): - 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.																			
LD Reviewed by: DC																			



Kalo-Stantec

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												Habitat Inventory / Reach Data																											
Transect # (Location)		1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)		Instream Cover (%):		9		Overhead Cover (%):		15																			
Channel Width (m)		1.4		0.9		1.8		1.1		1.4		1.5		Dom. Instream Cover:		DC		Dom. Overhead Cover:		TS																			
Wetted Width (m)		1.2		1.0		1.1		1.0		1.0		1.1		Subdom. Instream Cover:		BL		Subdom. Overhead Co		UB																			
Depth at LDB + 25% (m)		0.2		0.1		0.2		0.3		0.2		0.1		Maximum Depth (m)		0.3		Dom. Aquatic Veg. Typ		-																			
Depth at LDB + 50% (m)		0.2		0.2		0.2		0.3		0.2		0.0		Habitat Distribution <table><tr><th>Habitat</th><th>Percentage</th></tr><tr><td>RF</td><td>60%</td></tr><tr><td>R3</td><td>30%</td></tr><tr><td>P3</td><td>10%</td></tr></table> Substrate Composition <table><tr><th>Substrate</th><th>Percentage</th></tr><tr><td>F</td><td>40%</td></tr><tr><td>C</td><td>20%</td></tr><tr><td>SG</td><td>20%</td></tr><tr><td>BR</td><td>5%</td></tr><tr><td>LG</td><td>5%</td></tr><tr><td>O</td><td>10%</td></tr></table>				Habitat	Percentage	RF	60%	R3	30%	P3	10%	Substrate	Percentage	F	40%	C	20%	SG	20%	BR	5%	LG	5%	O	10%
Habitat	Percentage																																						
RF	60%																																						
R3	30%																																						
P3	10%																																						
Substrate	Percentage																																						
F	40%																																						
C	20%																																						
SG	20%																																						
BR	5%																																						
LG	5%																																						
O	10%																																						
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																			
Bank Height (m)		0.3		0.3		0.3		0.4		0.5		0.3		0.4		0.2		0.3		0.3																			
Bank Slope (°)		95		110		120		110		90		50		90		90		80		40																			
Bank Stability		MS		MS		MS		MS		MS		US		MS		MS		MS		US																			
Dom. Bank Material		O		O		O		O		O		O		O		O		O		F																			
Subdom. Bank Material		F		F		F		F		F		F		F		F		F		O																			
Dom. Riparian Veg.		G		G		G		G		G		G		G		G		G		G																			
Subdom. Riparian Veg.		C		C		S		S		S		S		C		S		S		S																			



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



Photo 2: Facing upstream at 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)
Backpack Electrofisher (EB)		573 (s)	NO FISH CAPTURED	0	-	0.00	-	-
No Trapping		- (hr)						
Electrofisher Settings								
Volts Freq. (Hz)		Duty Cycle (%)	Dist. (m)					
350	30	12	378					
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.								



Kalo-Stantec

Dehcho Territory Fish and Fish Habitat Drainage 3 Unnamed Watercourse

UTM Location: 10U 461404 7053822

Survey Date: September 21, 2020

km Marker: 739.55

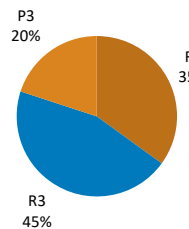
Zone: 2

Crew Initials: LD MAN

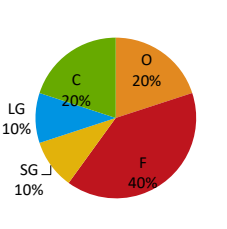
Restricted Activity Timing Window: August 15 to July 15

Physical Channel Transect Data												Habitat Inventory / Reach Data																				
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)	Instream Cover (%):		13	Overhead Cover (%)		11																				
Channel Width (m)	2.4	2.2	1.6	1.7	2.4	1.7	Dom. Instream Cover:		WD	Dom. Overhead Cov		TS																				
Wetted Width (m)	1.9	1.1	1.2	1.4	2.2	1.4	Subdom. Instream Cover:		DC	Subdom. Overhead		UB																				
Depth at LDB + 25% (m)	0.1	0.2	0.2	0.2	0.1	0.1	Maximum Depth (m)		0.3	Dom. Aquatic Veg. T		-																				
Depth at LDB + 50% (m)	0.1	0.2	0.2	0.2	0.1	0.2	Habitat Distribution <table><thead><tr><th>Habitat</th><th>Percentage</th></tr></thead><tbody><tr><td>R3</td><td>45%</td></tr><tr><td>RF</td><td>35%</td></tr><tr><td>P3</td><td>20%</td></tr></tbody></table> Substrate Composition <table><thead><tr><th>Substrate</th><th>Percentage</th></tr></thead><tbody><tr><td>F</td><td>40%</td></tr><tr><td>O</td><td>20%</td></tr><tr><td>C</td><td>20%</td></tr><tr><td>LG</td><td>10%</td></tr><tr><td>SG</td><td>10%</td></tr></tbody></table>						Habitat	Percentage	R3	45%	RF	35%	P3	20%	Substrate	Percentage	F	40%	O	20%	C	20%	LG	10%	SG	10%
Habitat	Percentage																															
R3	45%																															
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Substrate	Percentage																															
F	40%																															
O	20%																															
C	20%																															
LG	10%																															
SG	10%																															
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																					
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 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

			Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	Rel. Abundance
Method	Effort	Species	(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)
No Electrofishing	- (s)	NO FISH CAPTURED					-
No Trapping	- (hr)						
Electrofisher Settings							
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)				

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.



K'alo-Stantec

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

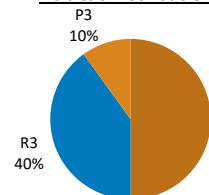
Substrate (% of Transect Area)	Organics	Fines	Small Gravel	Large Gravel	Cobble	Boulder	Bedrock	Embeddedness
	20	70	0	5	5	0	0	M
	20	70	0	5	5	0	0	M
	20	70	0	5	5	0	0	M
	20	70	0	5	5	0	0	M
	20	70	0	5	5	0	0	M
	20	70	0	5	5	0	0	M
	20	70	0	5	5	0	0	M

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

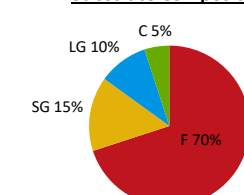
Habitat Inventory / Reach Data

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	Pattern:	IR
Water Temperature (°C):	2.5	Islands:	N
Dissolved Oxygen (mg/L):	17.83	Bars:	DG
Sp. Conductivity (µs/cm):	83.0	Coupling:	CO
pH:	7.99	Confinement:	CO
Turbidity (NTU):	-	Flow Stage:	Low

Channel Characteristics

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

			Data Summary Table					
Method		Effort	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Backpack Electrofisher (EB)		359 (s)	NO FISH CAPTURED	0	-	0.00	-	-
No Trapping		- (hr)						
Electrofisher Settings								
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)					
300	30	12	367					

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.



Kalo-Stantec

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													Habitat Inventory / Reach Data						
Transect # (Location)		1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)		Instream Cover (%):		2	Overhead Cover (%):		15
Channel Width (m)		0.9		1.3		1.2		1.3		1.7		0.8		Dom. Instream Cover:		DC	Dom. Overhead Cover:		TS
Wetted Width (m)		0.6		0.7		1.0		1.0		1.1		0.9		Subdom. Instream Cover		-	Subdom. Overhead Cove		WD
Depth at LDB + 25% (m)		0.3		0.1		0.5		0.1		0.1		0.2		Maximum Depth (m)		0.6	Dom. Aquatic Veg. Type:		-
Depth at LDB + 50% (m)		0.2		0.0		0.6		0.2		0.1		0.2		<u>Habitat Distribution</u>		<u>Substrate Composition</u>			
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						



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	Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
Backpack Electrofisher (EB)		331 (s)	NO FISH CAPTURED	0	-	0.00	-	-
No Trapping		- (hr)						
Electrofisher Settings								
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)					
300	30	12	321					
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.								



Kalo-Stantec

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												Habitat Inventory / Reach Data						
Transect # (Location)	1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)	Instream Cover (%):		0	Overhead Cover (%):		19						
Channel Width (m)	0.6	0.6	1.0	1.6	1.4	0.8	Dom. Instream Cover:		-	Dom. Overhead Cover:		TS						
Wetted Width (m)	1.1	1.2	1.4	2.0	1.8	1.1	Subdom. Instream Cover		-	Subdom. Overhead Cove		OV						
Depth at LDB + 25% (m)	0.1	0.1	0.1	0.1	0.1	0.1	Maximum Depth (m)		0.2	Dom. Aquatic Veg. Type:		-						
Depth at LDB + 50% (m)	0.1	0.2	0.1	0.1	0.1	0.1	Habitat Distribution			Substrate Composition								
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												
	Fines	90	90	90	90	90												
	Small Gravel	10	10	10	10	10												
	Large Gravel	0	0	0	0	0												
	Cobble	0	0	0	0	0												
	Boulder	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		pH:		7.32	Confinement:		FC	
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	Turbidity (NTU):		-	Flow Stage:		Low
Bank Slope (°)	70	70	60	60	20	20	-	50	-	-	110	70	Fish Habitat Assessment Ratings					
Bank Stability	US	US	US	US	US	US	US	US	US	US	US	US	Forage Fish		Coarse Fish		Sport Fish	
Dom. Bank Material	F	F	F	F	F	F	F	F	F	F	F	F	Spawning:	Poor	Poor	Poor	Poor	
Subdom. Bank Material	O	O	O	O	O	O	O	O	O	O	O	O	Overwintering:	Poor	Poor	Poor	Poor	
Dom. Riparian Veg.	N	N	S	S	N	N	S	S	S	S	S	S	Rearing:	Poor	Poor	Poor	Poor	
Subdom. Riparian Veg.	G	G	G	G	S	S	N	N	N	N	N	N	Passage:	Poor	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	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								
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.								



WX-043: Unnamed Watercourse

Survey Date: September 20, 2020

Zone: 2

Restricted Activity Timing Window: August 15 to July 15

Habitat Distribution

Habitat	Percentage
RF	70%
P3	20%
R3	10%

Substrate Composition

Substrate	Percentage
BL	30%
F	25%
SG	20%
C	20%
LG	5%



Photo 2: Facing downstream 50 m downstream of centerline.

				Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	Rel. Abundance	
Method		Effort		Species	(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)
Backpack Electrofisher (EB)		213	(s)	NO FISH CAPTURED	0	-	0.00	-	-
No Trapping		-	(hr)						
Electrofisher Settings									
Volts		Freq. (Hz)		Duty Cycle (%)	Dist. (m)				
355		30		12	131				

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.



Kalo-Stantec

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.



Kalo-Stantec

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												Habitat Inventory / Reach Data							
Transect # (Location)		1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓200)		6 (↓300)		Instream Cover (%):		8	Overhead Cover (%):		18
Channel Width (m)		1.2		1.6		1.6		0.8		1.7		-		Dom. Instream Cover:		DC	Dom. Overhead Cover:		UB
Wetted Width (m)		1.0		0.5		1.0		0.9		1.4		-		Subdom. Instream Cover		BL	Subdom. Overhead Cove		TS
Depth at LDB + 25% (m)		0.1		0.2		0.1		0.1		0.1		-		Maximum Depth (m)		0.3	Dom. Aquatic Veg. Type:		-
Depth at LDB + 50% (m)		0.1		0.3		0.1		0.1		0.1		-		<u>Habitat Distribution</u>		<u>Substrate Composition</u>			
Depth at LDB + 75% (m)		0.1		0.3		0.2		0.1		0.1		-		SP 70% R3 30% C 40% BL 15% F 20% SG 10% LG 15%					
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		-		Water Quality Data Channel Characteristics					
	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		pH:		6.59	Confinement:		CO
Bank Height (m)		0.4 0.5		0.1 0.2		0.4 0.4		0.1 0.2		0.3 0.3		-		Turbidity (NTU):		-	Flow Stage:		Moderate
Bank Slope (°)		100 110		30 110		30 70		90 110		100 130		-		Fish Habitat Assessment Ratings					
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		-		Forage Fish		Coarse Fish		Sport Fish	
Spawning:		Poor		Poor		Poor		Poor		Poor		Poor		Poor		Poor		Poor	
Overwintering:		Poor		Poor		Poor		Poor		Poor		Poor		Poor		Poor		Poor	
Rearing:		Poor		Poor		Poor		Poor		Poor		Poor		Poor		Poor		Poor	
Passage:		Poor		Poor		Poor		Poor		Poor		Poor		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		Species		Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	Rel. Abundance
								(n)	(n)	(#fish/100s)	(#fish/hr)	(% of total)
No Electrofishing				335 (s)		NO FISH CAPTURED		0	-	0.00	-	-
No Trapping				- (hr)								
Electrofischer Settings												
Volts		Freq. (Hz)		Duty Cycle (%)		Dist. (m)						
375		30		12		251						

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.						



Kalo-Stantec

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 has accumulated within the culvert near the outlet.



Kalo-Stantec

Dehcho Territory Fish and Fish Habitat

Bob's Canyon Creek

UTM Location: 10U 456554 7065466

Survey Date: Septembe 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												Habitat Inventory / Reach Data													
Transect # (Location)		1 (↑100)		2 (↑50)		3 (CL)		4 (↓100)		5 (↓150)		6 (↓300)		Instream Cover (%):		4	Overhead Cover (%):		24						
Channel Width (m)		1.7		3.4		2.0		2.5		1.9		-		Dom. Instream Cover:		DC	Dom. Overhead Cover:		TS						
Wetted Width (m)		1.5		2.5		1.8		2.75		1.65		-		Subdom. Instream Cover		-	Subdom. Overhead Cove		UB						
Depth at LDB + 25% (m)		0.2		0.2		0.2		0.1		0.3		-		Maximum Depth (m)		0.4	Dom. Aquatic Veg. Type:		-						
Depth at LDB + 50% (m)		0.2		0.3		0.2		0.1		0.2		-		<u>Habitat Distribution</u> <u>Substrate Composition</u>											
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	-	-												
														Water Quality Data						Channel Characteristics					
														Time of Day (HH:MM):		21:47		Pattern:		IR					
														Water Temperature (°C):		5.1		Islands:		N					
														Dissolved Oxygen (mg/L)		88.10		Bars:		DG					
														Sp. Conductivity (µs/cm):		52.0		Coupling:		CO					
														pH:		8.01		Confinement:		OC					
														Turbidity (NTU):		-		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		Species	Efish Catch	Trap Catch	Efish CPUE	Trap CPUE	Rel. Abundance	
				(n)		(n)	(#fish/100s)	(#fish/hr)	(% of total)		
No Electrofishing			-	(s)		NO FISH CAPTURED					-
No Trapping			-	(hr)							
Electrofisher Settings											
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)								
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.											



WX-045: Unnamed Watercourse

Survey Date: September 18, 2020

Zone: 2

Restricted Activity Timing Window: August 15 to July 15

Habitat Distribution

Habitat	Percentage
RF	50%
R3	30%
P3	20%

Substrate Composition

Substrate	Percentage
BL	40%
F	20%
C	20%
SG	10%
O	10%



Photo 2: Facing upstream at centerline.

Electrofisher Settings			
Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
405	30	12	377

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.



Kalo-Stantec

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 habitat 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.



Kalo-Stantec

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

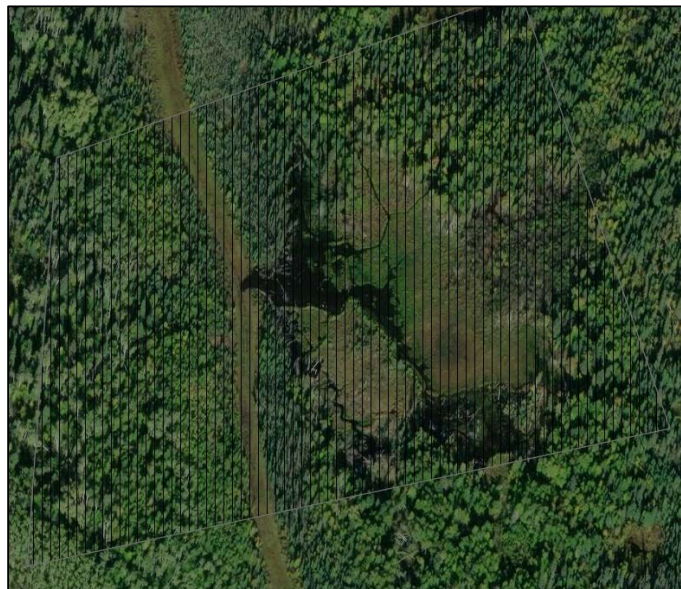


Photo 4. Aerial imagery showing wetland area

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 habitat assessment was not completed. Fish habitat potential is assumed.



Kalo-Stantec

Dehcho Territory Fish and Fish Habitat

WX-046: Drainage

UTM Location: 10U 451297 7077881

km Marker: 768.9

Crew Initials: LD MAN

Survey Date: September 16, 2020

Zone: 2

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 road



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.



Kalo-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 from existing winter road

General Comments

Ephemeral drainage oriented east to west. Drainage runs along existing winter road for approximately 100 m. Discontinuous to the west of existing winter road. No known connectivity with the Mackenzie River. No defined bed or banks. No fish habitat potential.



Kalo-Stantec

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.



Kalo-Stantec

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.



Kalo-Stantec

Dehcho Territory Fish and Fish Habitat

New-2: Wetland Area

UTM Location: 10U 451104 7079480

km Marker: 770.6

Crew Initials: LD MAN

Survey Date: September 18, 2020

Zone: 2

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.



Kalo-Stantec

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.



Kalo-Stantec

Dehcho Territory Fish and Fish Habitat

Drainage 4 Unnamed Watercourse

UTM Location: 10U 448523 7084338

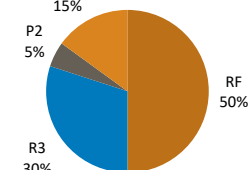
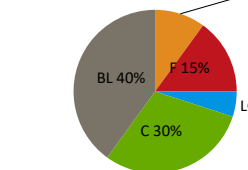
Survey Date: September 18, 2020

km Marker: 774.04

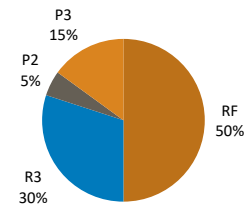
Zone: 2

Crew Initials: LD MAN

Restricted Activity Timing Window: August 15 to July 15

Physical Channel Transect Data													Habitat Inventory / Reach Data							
Transect # (Location)		1 (↑100)	2 (↑50)	3 (CL)	4 (↓100)	5 (↓200)	6 (↓300)	Instream Cover (%):		18	Overhead Cover (%):		9							
Channel Width (m)		4.2	5.1	4.1	4.1	6.0	6.5	Dom. Instream Cover:		BL	Dom. Overhead Cover:		WD							
Wetted Width (m)		3.6	4.8	4.3	3.5	5.1	4.9	Subdom. Instream Cover		DC	Subdom. Overhead Cover:		GF							
Depth at LDB + 25% (		0.3	0.3	0.5	0.4	0.5	0.3	Maximum Depth (m)		0.6	Dom. Aquatic Veg. Type:		-							
Depth at LDB + 50% (		0.3	0.4	0.5	0.4	0.5	0.3	Habitat Distribution  Substrate Composition 												
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 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 Veg		S	G	C	G	G	G	G	G	G	S	S	S							
													Water Quality Data				Channel Characteristics			
													Time of Day (HH:MM):		09:04		Pattern:		TM	
													Water Temperature (°C):		4.8		Islands:		F	
													Dissolved Oxygen (mg/L)		11.29		Bars:		BR	
													Sp. Conductivity (µs/cm):		121		Coupling:		CO	
													pH:		7.39		Confinement:		FC	
													Turbidity (NTU):		-		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			

Habitat Distribution



Substrate Composition

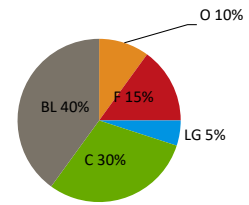


Photo 1: Facing downstream 100 m upstream from centerline.



Photo 2: Facing upstream 100 m downstream 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 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.



Kalo-Stantec

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.



Kalo-Stantec

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 or outlet visible from aerial survey. Does not afford fish habitat potential.



Kalo-Stantec

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 habitat potential.



Kalo-Stantec

Dehcho Territory Fish and Fish Habitat

SWA-9: Wetland Area

UTM Location: 10U 439719 7096318

km Marker: 791.8

Crew Initials: LD MAN

Survey Date: September 21, 2020

Zone: 2

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.



Kalo-Stantec

Dehcho Territory Fish and Fish Habitat

SWA-10: Wetland Area

UTM Location: 10U 438820 7097394

km Marker: 793.1

Crew Initials: LD MAN

Survey Date: September 18, 2020

Zone: 2

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.