

Mackenzie Valley Highway Project Technical Data Report—Surface Water and Sediment Quality

Prepared for:

Government of the Northwest Territories

Prepared by:

K'alo-Stantec Limited

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Project No.: 144903025



K'alo-Stantec

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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 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).

The Project subject to Part 5 of the *Mackenzie Valley Resource Management Act*. As part of the environmental assessment process, the Developer's Assessment Report (DAR) will assess how development of the proposed Project could affect surface water and sediment quality. The purpose of the technical data report (TDR) is to characterize baseline (i.e., existing) surface water quality conditions within local and regional study areas to support the environmental assessment of the Project presented in the DAR.

The main anthropogenic influences on water quality in the Mackenzie River Basin include historical and existing mines, municipal sewage, oil and gas exploration activities, pulp mills and land disturbances, and climate change. Natural influences include soils, bedrock, and forest fires from which naturally occurring constituents can be released.

This TDR presents a summary of the surface water and sediment data collected over the last 20 years within the Regional Study Area (RSA) and Local Study Area (LSA). These data sources can be used to help characterize existing conditions and to support the DAR, as required by the DAR Terms of Reference.

Surface water quality data was reviewed from various government and industry reports. Collectively, sampling programs have acquired surface water quality data for *in situ* parameters (e.g., pH, turbidity, temperature, conductivity, and dissolved oxygen) and laboratory-analyzed parameters (e.g., metals and nutrients) within the RSA at numerous locations and periods over the last few decades. A source of sediment quality data in the RSA was the baseline sampling results for the Mackenzie Gas Project Environmental Impact Statement conducted in 2002 and 2003. Sediment sampling included metals analyses for sediments collected in nine watersheds within the RSA: Prohibition Creek, Nota Creek, Great Bear River, Big Smith Creek, and Saline Creek in the Sahtu Region, and Blackwater River, Strawberry Creek, White Sand Creek, and Hodgson Creek in the Dehcho Region.

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Abbreviations

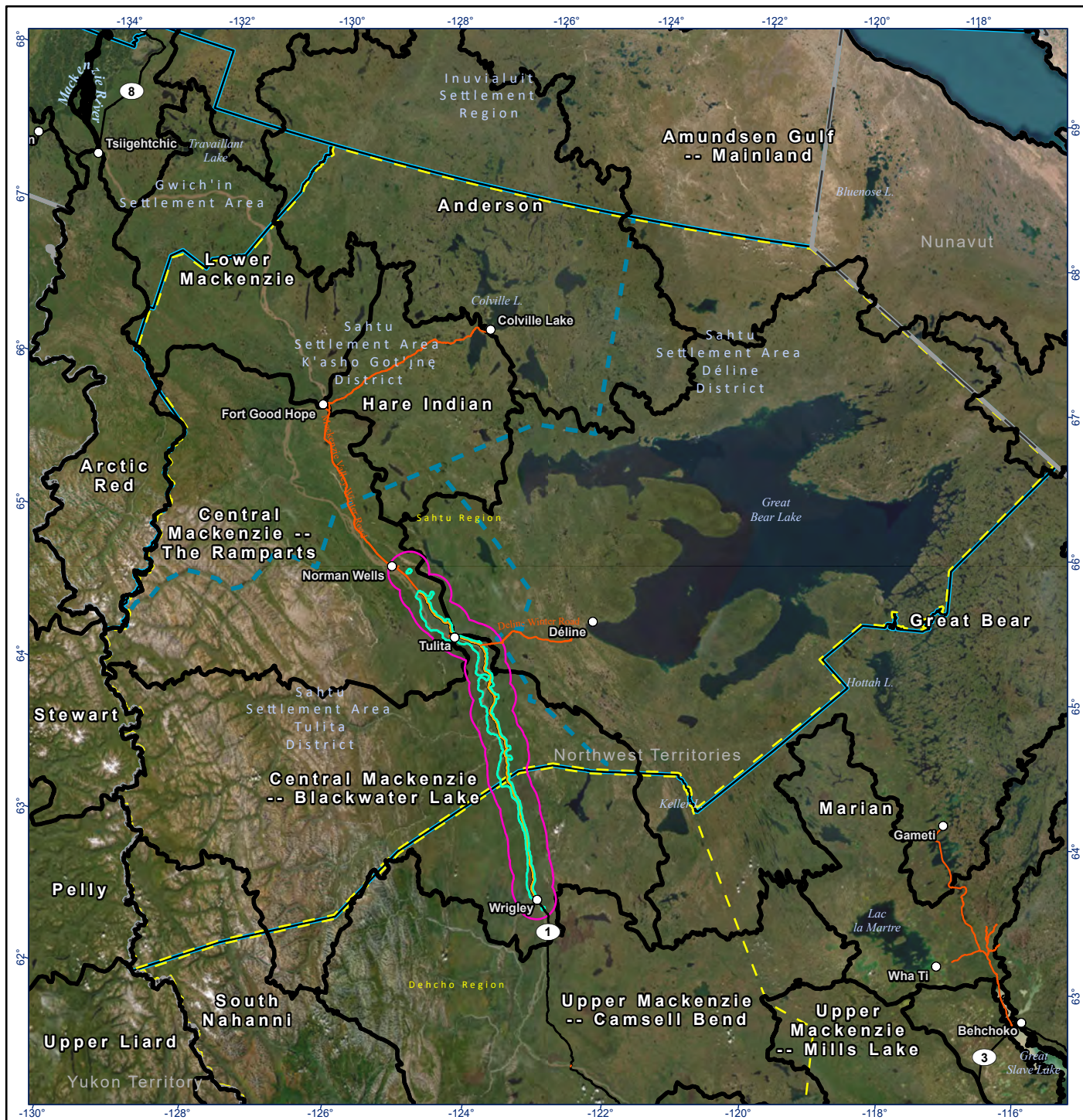
ARD/ML	acid rock drainage and metal leaching
DAR	Developer's Assessment Report
ECCC	Environment and Climate Change Canada
EIS	environmental impact statement
GNWT	Government of the Northwest Territories
HCO ₃ ⁻	bicarbonate ion
INAC	Indigenous and Northern Affairs Canada
INF	Department of Infrastructure
km	kilometre
km ²	square kilometre
LSA	Local Study Area
m	metre
mg/L	milligram per litre
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVLWB	Mackenzie Valley Land and Water Board
MVWR	Mackenzie Valley Winter Road
NT	Northwest Territories
PKFN	Pehdzeh Ki First Nation
RSA	Regional Study Area
TDR	technical data report
the Project	Mackenzie Valley Highway Project
TK	traditional knowledge
TLRU	Traditional Land and Resource Use
TOR	terms of reference

1 Introduction

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

The Project is subject to an environmental assessment and the requirements of Part 5 of *the Mackenzie Valley Resource Management Act*. This technical data report (TDR) presents the existing conditions for surface water quality to support preparation of the Developer's Assessment Report (DAR), as required by the Terms of Reference (MVEIRB, 2015). This TDR presents a summary of the sampling locations within regional and local study areas for which baseline surface water and sediment data have been collected over the last 20 years.

The study areas are described in Section 2 and the summary of existing data is provided in Section 3.



- 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
- Sub-Basin
- Territorial Boundary

0 40 80 Kilometres
(At original document size of 8.5x11)
1:4,500,000



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Project Location

Wrigley to Norman Wells, NWT

Client/Project

Prepared by AT on 2023-03-07

TR by AJ on 2023-03-07

144903025-0063 REV/B

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.

1.1

Title

MVH Project Overview

Notes

1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World 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 the current terminus of the existing all-weather highway in Wrigley (Highway #1, km 690) and Prohibition Creek (located approximately 28 km southeast of Norman Wells). The project highway alignment parallels the Mackenzie River, which is to the west, and is in the Mackenzie River basin within the Central Mackenzie-Blackwater Lake, Central Mackenzie-the Ramparts, and Great Bear sub-basins as defined by the Standard Drainage Area Classification (NRCAN, 2003; Figure 1.1 and Figure 2.1).

2.1 Project Development Area

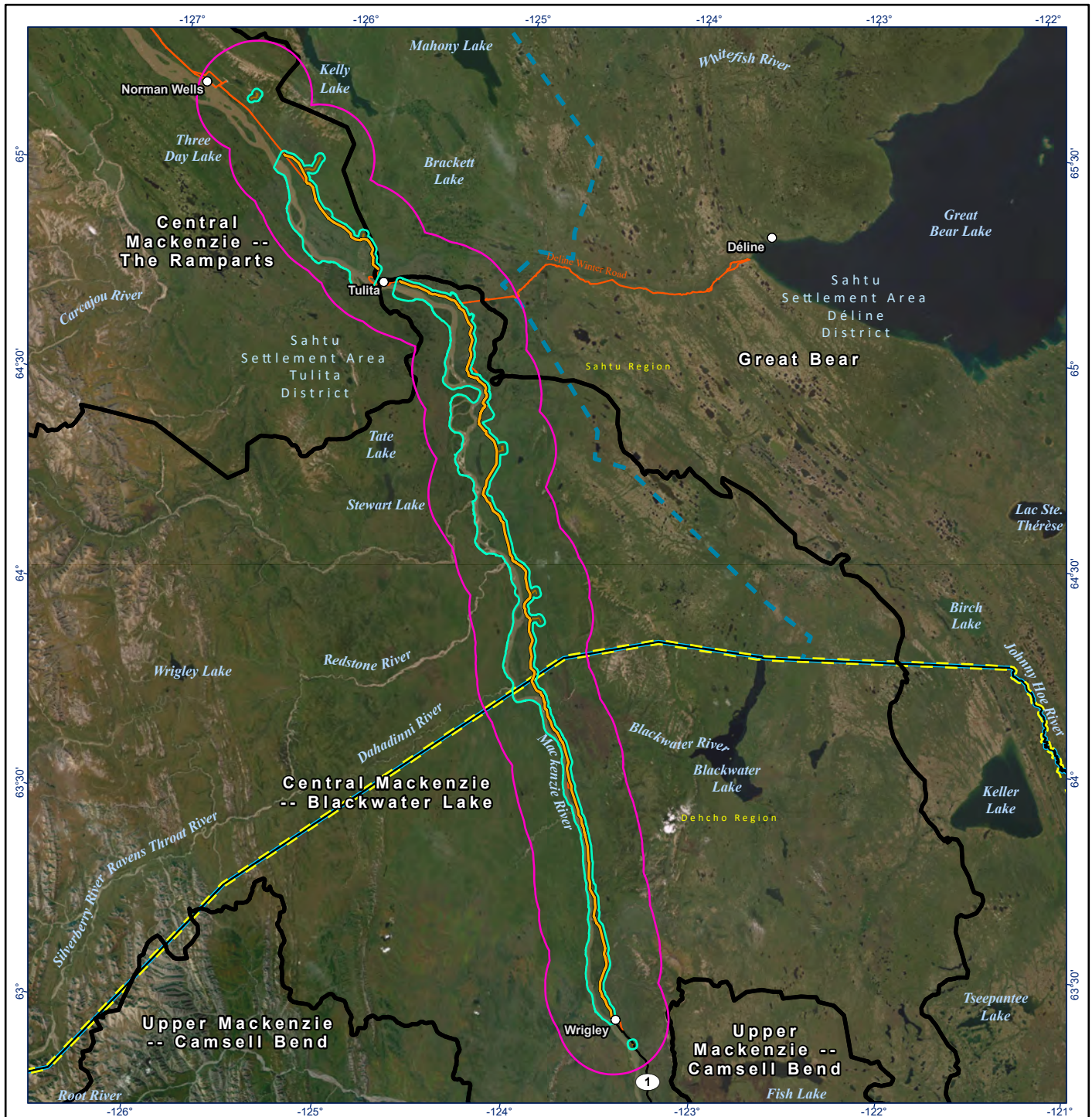
The Project Development Area (PDA) is the area of direct Project disturbance within which works and activities will occur (footprint). This includes a new two-lane gravel highway, 60 m wide highway right-of-way (ROW), laydown and staging areas, maintenance yards, construction camps and quarry/borrow sites with access roads on a 30 m ROW. The PDA is defined as the area to be used by the Project from Wrigley to approximately 25 km Southeast of Norman Wells. The PDA does not include a section of Project (less than 10 km in length) that passes through the hamlet of Tulita.

The local and regional study areas presented in this TDR are the areas where compiled data were collected to allow for an understanding of the environment in support of the Project-specific effects assessment and the cumulative effects assessment.

2.2 Local Study Area

For consistency with the surface water quantity TDR (DAR Volume 4, Appendix 15A, K'alo-Stantec, 2022a), the surface water and sediment quality Local Study Area (LSA) is a 1 km buffer around the alignment, and it is extended to include the mainstem of Mackenzie River and potential water sources for construction of the MVH, so as to encompass the anticipated extent of Project-related direct and indirect effects on surface water quantity (Figure 2.1).

Granular and rock materials for the construction and maintenance of the Project will be sourced from local material sources (quarries and borrow sources). The LSA includes a 1 km buffer around the quarry and borrow source footprints and associated access roads.



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- Regional Study Area
- Community
- All-Season Road
- Winter Road
- District Boundary
- Region Boundary
- Settlement Area Boundary
- Sub-Basin

0 10 20 Kilometres
(At original document size of 8.5x11)
1:1,600,000



Kalo-Stantec



Project Location: Wrigley to Norman Wells, NWT
Prepared by CES on 2023-03-07
TR by CS on 2023-03-07
Client/Project: 144903025-0064 REV B

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No. 2.1

Title

**Water and Sediment Quality
Assessment Areas**

Notes

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

For consistency with the surface water quantity TDR (DAR Volume 4, Appendix 15A, K'alo-Stantec, 2022a), the surface water quality Regional Study Area (RSA) is a 15 km buffer around the PDA. The RSA includes surface water quality-related features that could be affected by the cumulative effects of Project activities interacting with the effects of other existing, past or reasonably foreseeable projects in the area. The RSA does not include the entire Central Mackenzie-Blackwater Lake, Central Mackenzie-the Ramparts, and Great Bear sub-basins because:

- the majority of the Central Mackenzie-Blackwater Lake and Central Mackenzie-the Ramparts sub-basins are to the west of the Mackenzie River, which are not affected by the Project.
- the majority of the Great Bear sub-basin is upstream of the Project and, therefore, not likely to be affected by the Project.

3 Review of Existing Data

3.1 Traditional Knowledge and Traditional Use

Traditional knowledge (TK) and traditional land and resource use (TLRU) information and supporting literature were reviewed for the characterization of the existing surface water quality conditions, as summarized below.

3.1.1 Sahtu Region

Golder (2015) provides TK and TLRU information about surface water quality in the Sahtu Region. Golder (2015) states that in the Sahtu Region:

- *Water quality is of the utmost importance to the Dene and Métis in the Sahtu [and] access to clean water is needed for the maintenance of healthy populations of people, fish, and animals.*
- *The Dene have relied on and lived off the clean waters of the Sahtu for many generations, and insist that all water bodies should be kept clean throughout the course of development.*
- *Water quality monitoring should be carried out for developments, even on the smallest of streams, to preserve the integrity of the water quality over the entire area...[these monitoring programs] should be carried out from within communities.*
- *Wastewater associated with developments be removed from site, and that the footprint of [the Project] be limited and work areas be kept clean to minimize runoff and contamination*
- *Shore and wetland vegetation should be kept in place to act as a filter and to provide bank stability*
- *The quality of most waterbodies in the Sahtu is considered by community consultation participants to be good and suitable for drinking*
- *Community participants indicated that when the waterfowl are plentiful and appear healthy, the water must be good.*
- *Big Smith Creek was identified as a good source of drinking water and has been used for many years.*
- *Although many small creeks are not actively used by many people, they are of good, drinkable quality and impacts should be minimized*
- *Community elders have seen waters that were once used for cooking and drinking change so that they are no longer good or safe to use (Golder, 2015).*

As stated in Golder (2015), community concerns regarding changes to water quality because of development in the Sahtu Region include:

- increased sedimentation from construction and clearing of vegetation along the edges of water bodies
- impacts of blasting
- impacts of melting permafrost and the resulting land subsidence, erosion, flooding, and scouring,
- resulting impacts on fish, wildlife, and habitat

Results from the Project-specific TLRU study developed by the Tulita Renewable Resources Council (TRRC, 2022) indicates that:

- Overflows have resulted from previous road construction and operation and has affected valued resources.
- Overflow within the LSA and along existing portions of the MVWR has affected undertaking of TLRU.
- There are many beaver dams within the LSA that have caused overflow.
- All the water resources within the LSA are still used (drinking) and accessed for TLRU.
- More water and wildlife monitoring in the LSA should be used to mitigate potential Project effects.
- There are concerns about potential Project effects on water flowing into the Bear River (community drinking water source).
- The sewer lagoon seeps towards the winter road between Tulita and Four Mile Creek, which causes the overflow on winter road access.
- There are concerns about potential Project effects from vehicle breakdown near open-water sources, specifically near Bear Rock, which is of interest to the community, that have potential to contaminate water sources.
- MVWR flooding occurs near Frank Yalle cabin area, and between the community of Tulita and Four Mile Creek.
- Bear River floods in the spring during the Mackenzie River ice breakup.
- Water is collected from any river or lake nearby the construction of the Bear River Bridge Project which has potential to affect community drinking because the community of Tulita requires a water truck to access water intake from Bear River on the other Bear River Bridge (all year round).
- The MVWR is too close to Plane Lake and could lead to contamination of the water.
- Tulita should be given priority (provide feedback and be the lead) when undertaking Project-related TK studies, monitoring and TK-based monitoring for water, land and wildlife to improve TK-based monitoring, avoid/mitigate potential Project effects and improve safety.

3.1.2 Dehcho Region

Dessau (2012) provides TK and TLRU information pertaining to surface water quality in the Dehcho Region. Dessau (2012) reports that in the Dehcho Region:

- Pehdzeh Ki First Nation (PKFN) have identified watercourses and riverbanks as traditional land use areas, and these traditional areas require protection.
- The PKFN have indicated that the rivers, creeks, and forests should be protected for the future generations and moose, caribou, and fish also need to be protected.
- The PKFN indicated Blackwater River, (which is crossed by the Project's proposed alignment) is one of the watercourses that is very important to protect due to its cultural significance as a sacred burial site.
- Several known fish spawning sites are located near the Project in the Dehcho Region (e.g., spawning sites are located near the mouths of the Ochre River and Blackwater River). Fishing is an important sustenance harvesting activity that is tied to traditional use and non-traditional use (e.g., commercial use) throughout the Mackenzie Valley.
- Drainage areas along the Project are considered potential waterfowl habitat. This includes Mackenzie River, Blackwater River and Ochre River, as well as major creeks and other smaller watercourses.

As stated in Dessau (2012), a Wrigley Community consultation meeting regarding the Project (as “MVH Project”) (January 25 and 26th, 2012) included the following community comments and questions pertaining to water quality:

- Environment and safety are a priority for the Project.
- What is the effect of the MVH Project on the Mackenzie River? What are the mitigation measures in case of a spill?
- If the MVH Project is built, will natural resources such as water be protected? Is this resource guaranteed to not be contaminated or destroyed by the chemicals and resources that will be transported for the construction of the highway?

3.2 Literature Review

A literature review was completed to understand the extent of available surface water quality data along the project highway alignment (and within the RSA and LSA). Background information on surface water quality for the Sahtu and Dehcho regions was obtained from the following sources:

- GNWT Community-Based Monitoring Program (GNWT, 2020, pers. comm.)
- GNWT Water Quality Monitoring Network Evaluation report (Summit Environmental Ltd., 2014)
- Environment and Climate Change Canada (ECCC), Northern Water Quality Monitoring Network (ECCC, 2021)

- Mackenzie Gas Project Environmental Impact Statement (EIS), Biophysical Baseline Report for Water Quality (EIS Volume 3, Section 6; IORVL, 2004)
- data from Water Resources, Indigenous and Northern Affairs Canada (INAC) for the Mackenzie Valley Pipeline (GNWT, 2021, pers. comm.)
- Rempel and Gill (2011): *Bioassessment of streams along the Mackenzie River Valley, Canada, using the Reference Condition Approach: biological, habitat, landscape, and climate data*
- Golder (2015): *Central Mackenzie Surface Water and Groundwater Baseline Assessment. Report 1: Technical State of Knowledge*
- Mackenzie River Basin Board (MRBB, 2021): *State of the Aquatic Ecosystem Report (SOAER): Mackenzie-Great Bear Sub-Basin.*
- Mackenzie DataStream open access water quality data hub (DataStream, 2022).

Surface water quality information from the above mentioned resources is summarized in the following sections.

3.2.1 Overview of Study Area Surface Water Quality

The Project is located in the Mackenzie-Great Bear Sub-Basin of the Mackenzie Valley Basin (MRBB, 2021). This Sub-Basin spans roughly a third of the NT and extends from Fort Simpson in the south to the Mackenzie River delta in the north, and from the Nunavut border in the east to the Yukon border in the west (MRBB, 2021).

Based on the Standard Drainage Area Classification (NRCan, 2003), the project highway alignment crosses through the Central Mackenzie-The Ramparts, Great Bear Lake, and Central Mackenzie-Blackwater Lake sub-basins of the Mackenzie Valley Basin. Between the southern and northern extents of the Project, the project highway alignment will cross over numerous tributaries of varying size to the Mackenzie River, including two major tributaries (i.e., the Blackwater River and the Great Bear River).

Although watercourses within the Mackenzie-Great Bear Sub-Basin are generally of good quality, some localized effects on water quality have been observed nearby anthropogenic influences such as wastewater discharges (MRBB, 2003, 2021). In addition, local Indigenous people have expressed concern about water quality and have reported increasing water temperatures and turbidity compared to past years (MRBB, 2021). However, the most recent State of the Aquatic Ecosystem Report (SOAER) for the Mackenzie-Great Bear Sub-Basin (MRBB, 2021) describes that the “*scientific data generally do not show widespread [anthropogenic] impacts on water quality or on fish health, as indicated by the absence of trends from 2000 to 2018 in water quality parameters that have guidelines*”.

Natural water quality of the Mackenzie-Great Bear Sub-Basin, including water flowing through the RSA, is generally influenced by water flowing through the Precambrian Shield of the Mackenzie Mountains, as well as mountains surrounding the Liard River, which drains into the Mackenzie River (Golder, 2015). This flowing water causes streambank erosion, which mobilizes metals and nutrient-rich sediment. Consequently, the Mackenzie River is known for naturally elevated suspended sediment and turbidity compared to other rivers in the arctic. Natural turbidity in the Mackenzie River is highest during the spring

snow melt and is often in exceedance of Canadian Water Quality Guidelines (CWQG) for recreation and aesthetics (MRBB, 2003).

Between 2012 and 2018, TSS was measured in the months of July, August, and September in the Mackenzie River at Norman Wells (Figure 3.1), Tulita (Figure 3.2), and Wrigley (Figure 3.3) as part of the NT-wide Community-Based Monitoring Program (data retrieved from DataStream, 2022). Except for a few elevated concentrations, TSS generally remained below 400 mg/L in the Mackenzie River at Norman Wells and Wrigley, and below 200 mg/L at Tulita. In the context of the proposed Project, historical concentrations of TSS in the Mackenzie River are considered background concentrations, regardless of natural or anthropogenic influences. Therefore, the CWQGs generally do not apply to these historical TSS concentrations because the guidelines for TSS are narrative and based on changes relative to background conditions (CCME, 2022).

Overall, the recorded TSS concentrations trended downward at Norman Wells and Wrigley, but generally remained consistent at Tulita (except for one elevated sample in 2017). Summary statistics for TSS at these three locations are provided in Table 3.1.

Figure 3.1 Total Suspended Solids in the Mackenzie River at Norman Wells: 2012 to 2018

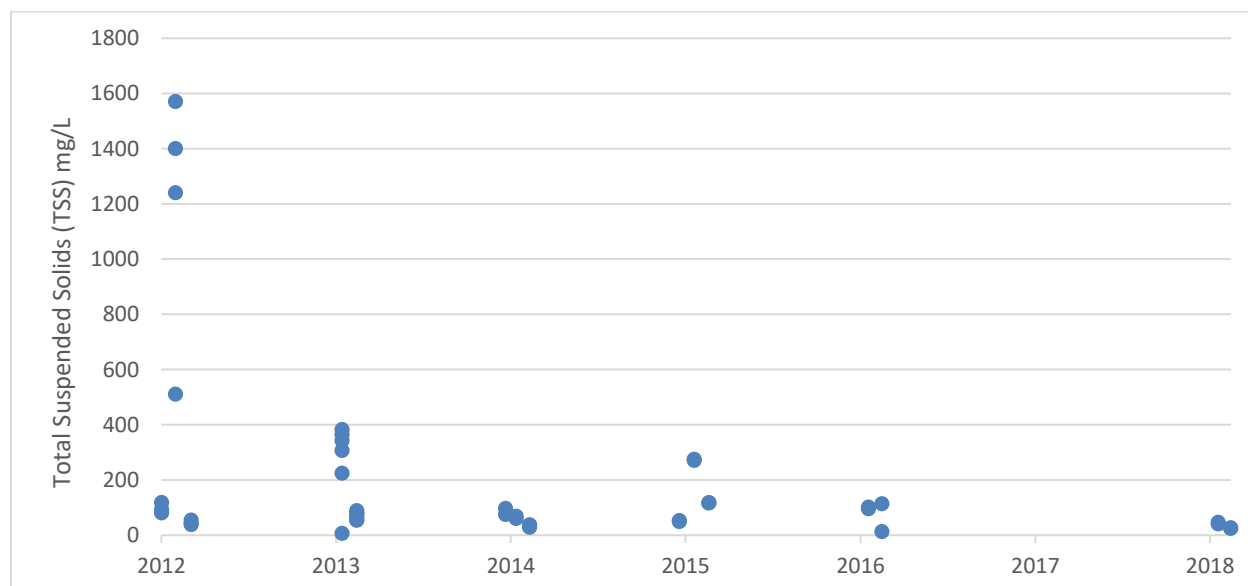


Figure 3.2 Total Suspended Solids in the Mackenzie River at Tulita: 2012 to 2018

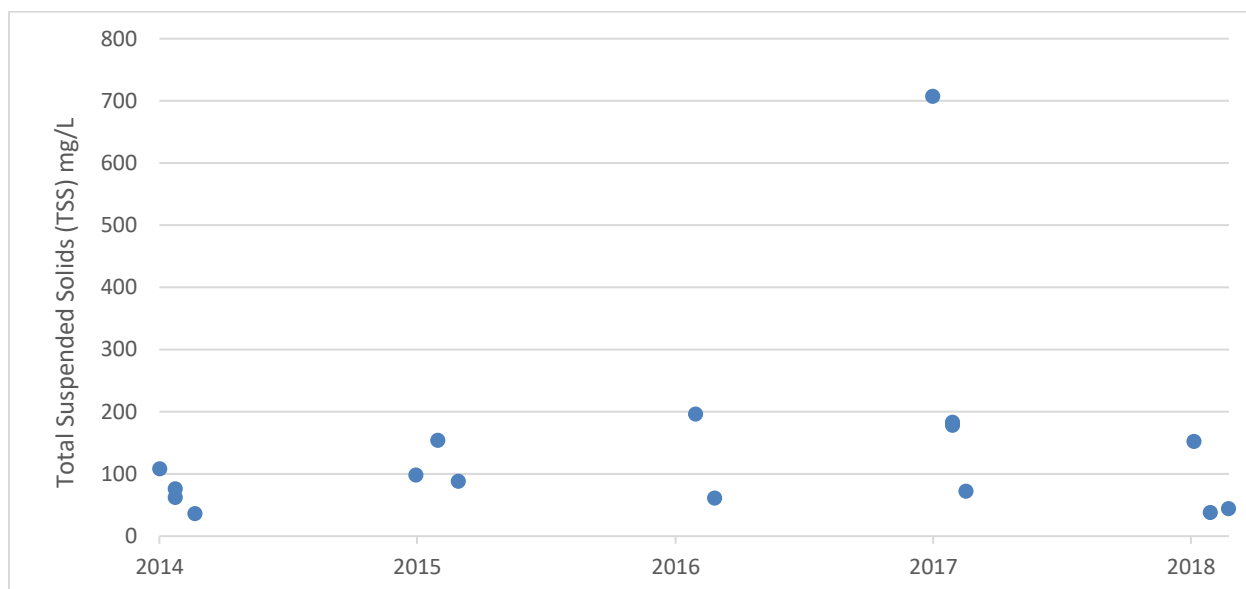


Figure 3.3 Total Suspended Solids in the Mackenzie River at Wrigley: 2013 to 2018

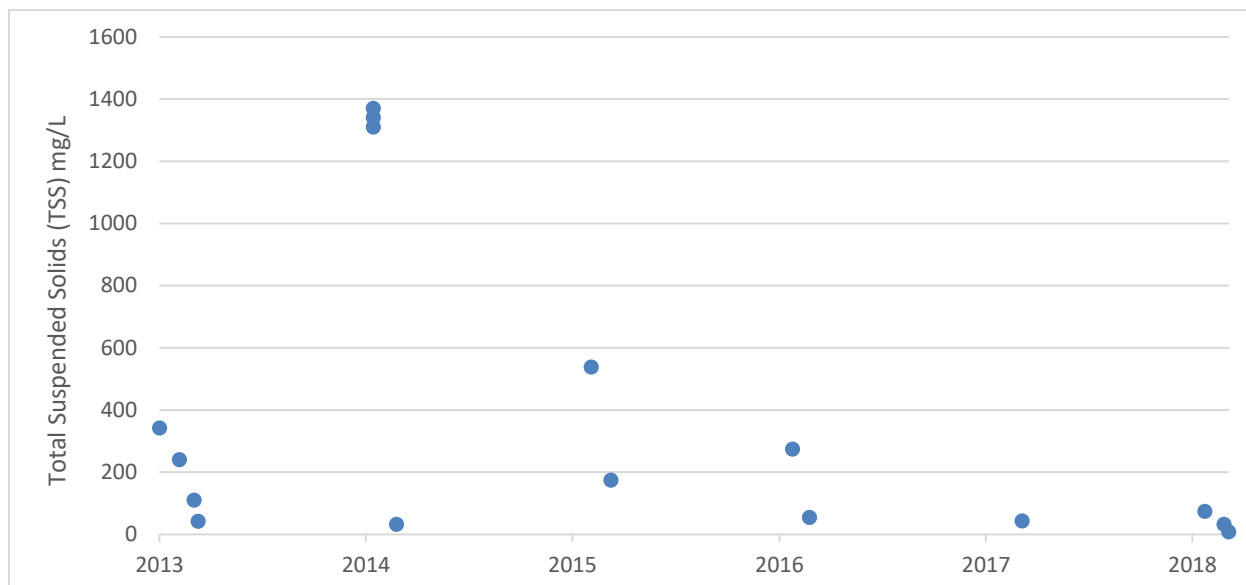


Table 3.1 Total Suspended Solids (TSS) at Different Sites Along the Mackenzie River

Location	Map ID	Date Range	TSS (mg/L)				
			N	Min	Mean	95th P	Max
Norman Wells	1	July 2012 to August 2018	45	6	200	1,352	1,570
Tulita	27	July 2014 to August 2018	16	36	141	324	707
Wrigley	69	June 2013 to August 2018	16	8	374	1,348	1,370

Notes:

TSS = total suspended solids

Map ID = sample site as presented in Figure 3.4 and Figure 3.5;

N = Number of samples collected; 95th P = 95th percentile

Data retrieved from Mackenzie DataStream (<https://mackenziedatastream.ca/>)

3.2.2 Existing Influences on Surface Water Quality

Surface water quality in the Mackenzie-Great Bear Sub-Basin is influenced by two main sources: local sources and global sources. Local anthropogenic sources (i.e., sources within the Mackenzie-Great Bear Sub-Basin) include historical and existing mines, municipal sewage, oil and gas exploration activities, pulp mills, and other industries (MRBB, 2004, 2021). Local natural sources include soils, bedrock, and forest fires from which naturally occurring constituents can be released. Some water quality parameters observed in the Mackenzie-Great Bear Sub-Basin originate in other parts of the world and travel through the atmosphere before being deposited there (MRBB, 2004, 2021).

In the Mackenzie Valley, uses of water and deposits waste as subject to the *Waters Act* and Waters Regulations. According to the Sahtu Land and Water Board, there are six active water licenses within the RSA as of May 2022:

- The Hamlet of Tulita municipal operations (S16L8-002)
- Imperial Oil Norman Wells Operations (S13L1-007)
- Town of Norman Wells municipal operations (S18L3-003)
- Geotechnical drilling for the proposed bridge development crossing the Great Bear River at Tulita (S19LI-004) - completed
- Norman Wells Soil Treatment Facility (Sahtu Land and Water Board license S18L1-002)
- Prohibition Creek Access Road (S20L8-002) – not yet constructed

Of these, generally only the Hamlet of Tulita municipal operations has the potential to currently influence water quality in the LSA because the others are either completed or occur at the northern limit of the RSA or downstream of the Project. Other local sources of potential anthropogenic constituents of interest for surface waters within the RSA include land disturbances associated with existing or proposed quarry/borrow in the RSA. Some of these existing borrow sites are proposed to be repurposed for the construction and maintenance of the Project and its associated infrastructure. The twenty primary quarry

and pit locations (and their associated watersheds) selected as candidate borrow sites for the Project are discussed in Section 3.2.3.1.

Climate change also has the potential to influence water quality in the Mackenzie River Basin, including the RSA. Climate change has altered and will continue to alter the cryosphere (e.g., seasonal snow cover, glaciers, ice caps, permafrost, and ice covering surface waters) and the hydrologic cycle in the arctic (MRBB, 2004; Derksen et al., 2019). These effects, including later freeze-ups in the fall and earlier break-ups in the spring, may contribute to increased streambank erosion and increased mobilization of metals and nutrients from the environment to surface waters (MRBB, 2004, 2021).

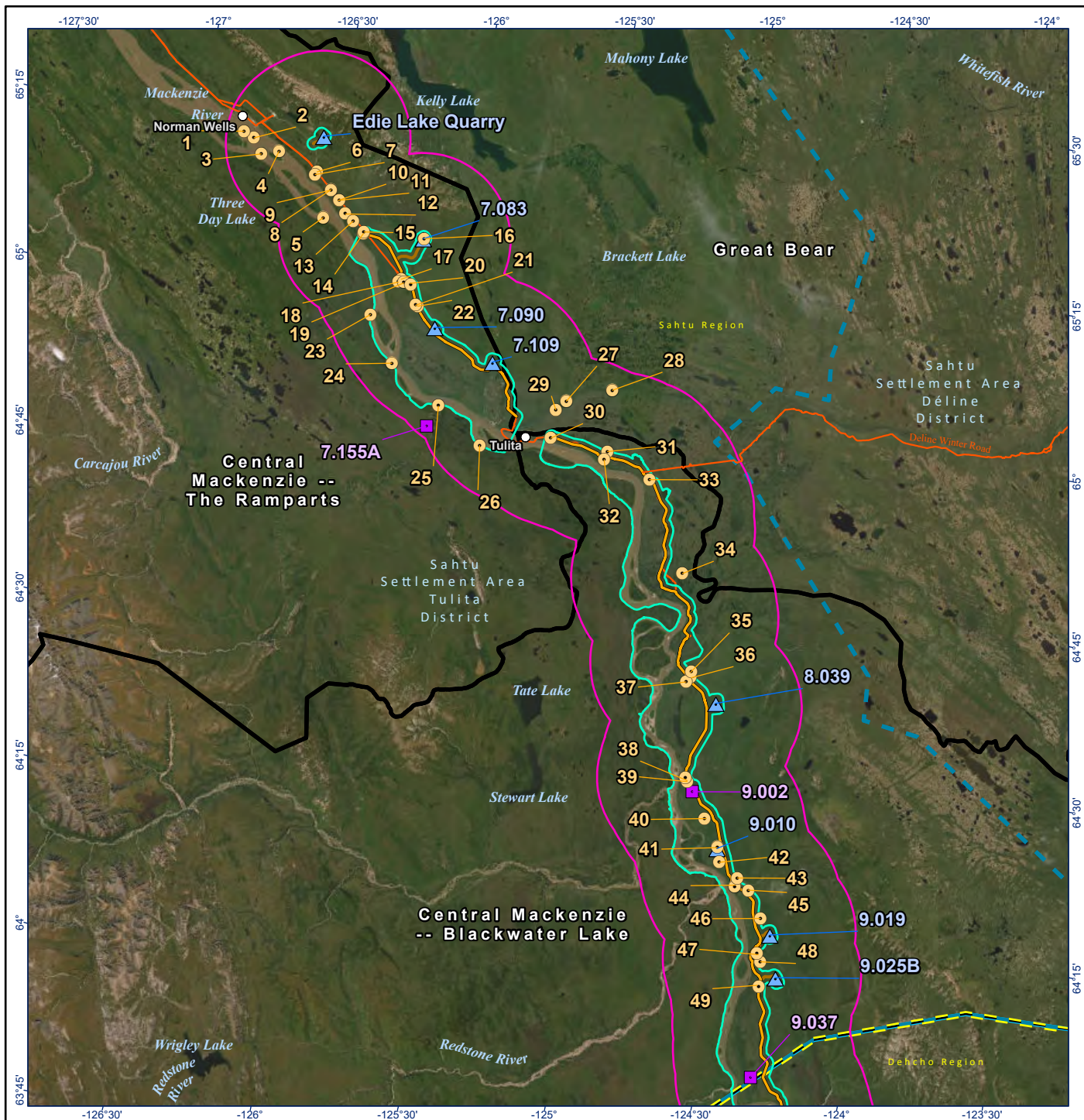
3.2.3 Surface Water Quality Data Sources for the Study Area

Various surface water quality monitoring programs have been conducted in the Mackenzie River Basin, including long-term monitoring conducted by ECCC, Fisheries and Oceans Canada, community-based monitoring programs supported by GNWT, and monitoring conducted for industrial projects. Collectively, these programs have acquired data for in situ parameters (e.g., pH, turbidity, temperature, conductivity, and dissolved oxygen) and laboratory-analyzed parameters (e.g., metals and nutrients) at different locations and periods over the last few decades.

The search for relevant sources of surface water quality data that could be used to characterize baseline surface water quality for watercourses within the RSA focused primarily on data collected within the last 20 years. Identified surface water quality data includes data for the Mackenzie River and multiple watersheds and tributaries to the Mackenzie River between Wrigley in the Dehcho Region and Norman Wells in the Sahtu Region.

Most of the identified surface water quality monitoring sites in the Dehcho Region are within the RSA but outside the LSA. Watersheds in the RSA for which sources of surface water quality data were not identified include Bob's Canyon in the Dehcho Region, and Bluefish Creek and No Name Creek in the Sahtu Region. Surface water quality downstream of the Project is not consistently represented in each watershed, and seasonal variability in water quality across sites in the RSA is not well characterized with the existing data.

Figure 3.4 and Figure 3.5 show the identified surface water quality monitoring sites in the RSA within the Sahtu Region and Dehcho Region, respectively. Table 3.2, Table 3.3 and Table 3.4 summarize the identified sources of surface water quality data for the RSA watersheds located in the Ramparts sub-basin (Sahtu Region), the Great Bear River and Blackwater Lake sub-basins (Sahtu Region), and the Blackwater Lake sub-basin (Dehcho Region), respectively. The watersheds presented in these tables include the major streams (i.e., tributaries of the Mackenzie River), which the project highway alignment will cross.



- Water Quality Sampling Site**
- Borrow Source**
- Primary - Granular
 - Primary - Quarry
 - Proposed Mackenzie Valley Highway Alignment - Issued for EA 2022
 - Granular Borrow / Rock Quarry Site and Access
 - Local Study Area
 - Regional Study Area
 - Community
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 - Winter Road
 - District Boundary
 - Region Boundary
 - Settlement Area Boundary
 - Sub-Basin

0 10 20 Kilometers
(At original document size of 8.5x11)
1:1,000,000



Kalo-Stantec



Project Location
Wrigley to Norman Wells, NWT

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

Client/Project 144903025-0070-REVB

Government of Northwest Territories
Mackenzie Valley Highway Project

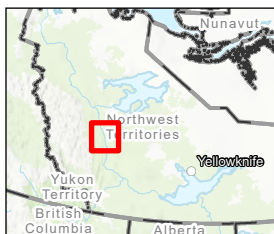
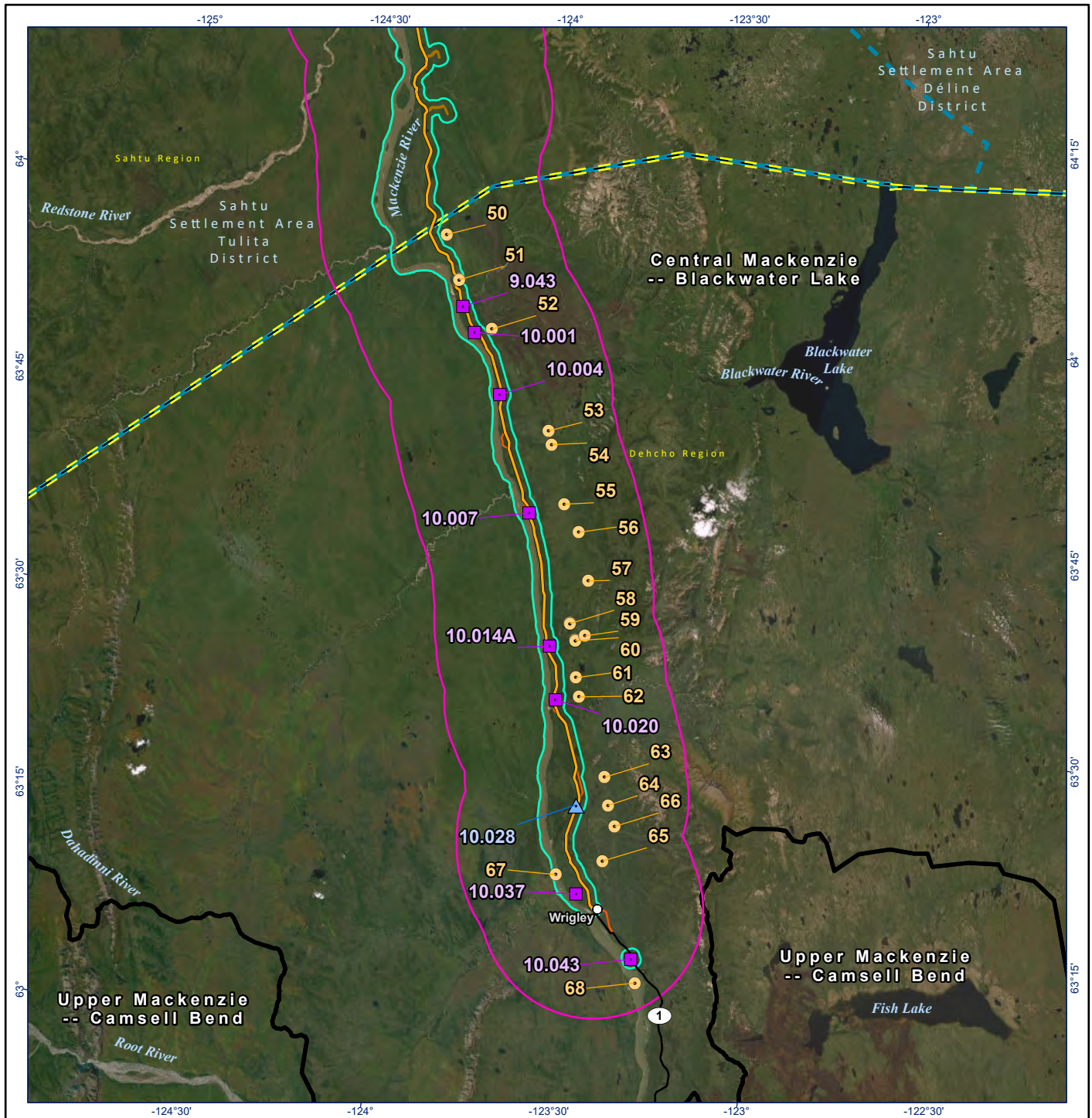
Figure No.
3.4

Title

Identified Water Quality Monitoring Sites in the RSA (Sahtu Region)

Notes

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



Borrow Source

- Primary - Granular
- ▲ Primary - Quarry
- 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
- Sub-Basin

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Kalo-Stantec



Project Location
Wrigley to Norman Wells, NWT

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Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.

3.5

Title

Identified Water Quality Monitoring Sites in the RSA (Dehcho Region)

Notes

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

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Table 3.2 Identified Sources of Surface Water and Sediment Quality Data for RSA and LSA Watersheds Located in The Ramparts Sub-Basin (Sahtu Region)

Watershed/ Watercourse	Map ID ¹	Sampling Site in LSA or RSA	Water Quality Data			Sediment Quality Data	Years of Water Quality Data	UTM Coordinates ²			Source Site ID or Object ID	Source(s)
			In situ parameters	Metals and Nutrients	Total Suspended Solids			Zone	Easting	Northing		
Mackenzie River at Norman Wells	1	RSA	YES	YES	YES	-	2012	9W	601910	7239319	Mack-NW-02	1
Mackenzie River at Norman Wells	2	RSA	YES	YES	YES	-	2012	9W	603856	7238703	Object ID 427	1
Mackenzie River at Norman Wells	3	RSA	YES	YES	YES	-	2012 to 2018	9W	605801	7236373	Mack-NW-01	1
Mackenzie River at Norman Wells	4	RSA	YES	YES	YES	-	2013	9W	608614	7237661	Object ID 426	1
Mackenzie River at Norman Wells	5	RSA	YES	YES	-	-	2000 to 2019	9W	618938	7228696	NW10KA0001	2
Canyon Creek	6	RSA	YES	YES	YES	-	2002, 2003, 2005, 2006, 2007	9W	615838	7235994	RPR-306	3, 4
Canyon Creek	7	RSA	YES	YES	YES	-	2005	9W	615611	7235425	Canyon Ck	5
Francis Creek	8	RSA	YES	YES	YES	-	2002, 2003, 2005, 2006	9W	618967	7233677	RPR-308	3, 4
Francis Creek	9	RSA	YES	YES	YES	-	2005	9W	618969	7233614	Francis Ck	5
Helava Creek	10	RSA	YES	YES	YES	-	2002, 2003, 2005, 2006	9W	620763	7232296	RPR-310	3, 4
Helava Creek	11	RSA	YES	YES	YES	-	2005	9W	620781	7232324	Heleva Ck	5
Christina Creek	12	RSA	YES	-	YES	-	2002, 2003	9W	622383	7230390	RPR-311	3
Unnamed Creek	13	RSA	YES	-	YES	-	2002, 2003	9W	624057	7229536	RPR-312	3
Prohibition Creek	14	LSA	YES	YES	YES	YES	2002, 2003, 2005, 2006	9W	626292	7227921	RPR-313	3, 4
Prohibition Creek	15	LSA	YES	YES	YES	-	2005	9W	626304	7228212	Prohibition Ck	5
Vermillion Creek North	16	LSA	YES	-	-	-	2020	9W	636588	7229804	7.083-SW-1	6
Vermillion Creek North	17	LSA	YES	YES	YES	-	2002, 2003, 2005, 2006	9W	634623	7222098	RPR-323	3, 4
Vermillion Creek North	18	LSA	YES	YES	YES	-	2005	9W	634277	7221560	Vermillion Ck	5
Nota Creek	19	LSA	YES	YES	YES	YES	2002, 2003, 2005, 2006	9W	635169	7221789	RPR-324	3, 4
Nota Creek	20	LSA	YES	YES	YES	-	2005	9W	636476	7221669	Nota Ck	5
Jungle Ridge Creek	21	LSA	YES	YES	YES	-	2002, 2005, 2006	9W	638592	7218394	RPR-325	3, 4
Jungle Ridge Creek	22	LSA	YES	YES	YES	-	2005	9W	638206	7218535	Jungle Ridge Ck	5
Bluefish Creek	-	-	-	-	-	-	-	-	-	-	-	-
No Name Creek	-	-	-	-	-	-	-	-	-	-	-	-
Bog Creek at Mackenzie River	23	RSA	YES	YES	YES	-	2014 to 2016	9W	631206	7214889	Mack Tul-05	1
Slater Creek	24	RSA	YES	YES	YES	-	2014 to 2016	9W	636935	7207841	Mack-Tul-04	1
Little Bear	25	LSA	YES	YES	YES	-	2013 to 2018	10W	362829	7202526	Mack-Tul-03	1
MacKay Creek	26	RSA	YES	YES	YES	-	2014 to 2016	10W	370992	7197018	Mack-Tul-02	1
Mackenzie River at Tulita	27	RSA	YES	YES	YES	-	2014 to 2021	10W	376412	7198985	TUL-MR	1

Notes:

¹ Map IDs correspond to Figure 3.4 and Figure 3.5.

² Sampling coordinates may differ between years and monitoring programs. In cases where sources 3 and 4 are both cited, the coordinates were obtained from source 4 (source 3 did not report sampling site coordinates). **Bold** coordinates were estimated from source maps because the site coordinates were not reported.

Source: 1 = GNWT Community Based Monitoring; 2 = ECCC Northern Water Quality Monitoring Network; 3 = Mackenzie Gas Project EIS Baseline Report (Volume 3, Section 6); 4 = Mackenzie Valley Pipeline (i.e., Mackenzie Gas Project), raw data from INAC; 5 = Rempel and Gill (2011); 6 = Stantec surface water sampling, October 2020

“ - ” indicates where monitoring data were not identified

Table 3.3 Identified Sources of Surface Water Quality and Sediment Data for RSA and LSA Watersheds Located in The Great Bear and Blackwater Lake Sub-Basins (Sahtu Region)

Sub-Basin	Watershed/Watercourse	Map ID	Sampling Site in LSA or RSA (outside of LSA)	Water Quality Data			Sediment Quality Data	Years of Water Quality Data	UTM Coordinates ²			Source Site ID or Object ID	Source(s)
				In situ parameters	Metals and Nutrients	Total Suspended Solids			Zone	Easting	Northing		
Great Bear	Great Bear River	28	RSA	YES	YES	-	-	2000 to 2019	10W	384271	7207108	NW10JC0001	2
Great Bear	Great Bear River	29	RSA	YES	YES	YES	-	2013 to 2018	10W	391699	7210301	GBR-Tul-01	1
Great Bear	Great Bear River	30	RSA	YES	YES	YES	YES	2002, 2003	10W	382752	7205332	RPR-330	3
Blackwater Lake	Four Mile Creek	31	LSA	YES	-	YES	-	2002	10W	382747	7200398	Site 404	3
Blackwater Lake	Between Four Mile Creek and Gotcha Creeks	32	LSA	YES	-	YES	-	2002	10W	392694	7199822	RPR-332	3
Blackwater Lake	Between Four Mile Creek and Gotcha Creeks	33	LSA	YES	-	YES	-	2002	10W	392406	7198380	Site 406	3
Blackwater Lake	Gotcha Creek	34	LSA	YES	-	YES	-	2002	10W	400623	7196362	RPR-335	3
Blackwater Lake	Between Gotcha Creek and Big Smith Creek	35	RSA	YES	-	YES	-	2002	10W	408984	7181513	RPR-342	3
Blackwater Lake	Big Smith Creek	36	LSA	YES	-	YES	-	2002	10W	413466	7164316	RPR-349	3
Blackwater Lake	Big Smith Creek	37	LSA	YES	YES	YES	-	2006	10W	413453	7165223	Big Smith Ck	5
Blackwater Lake	Big Smith Creek	38	LSA	YES	-	YES	YES	2002	10W	412876	7163349	Site 435/436	3
Blackwater Lake	Little Smith Creek	39	LSA	YES	-	YES	-	2002	10W	415616	7147203	RPR-351	3
Blackwater Lake	Little Smith Creek	40	LSA	YES	YES	YES	-	2006	10W	416039	7146590	Little Smith Ck	5
Blackwater Lake	Seagrams Creek	41	LSA	YES	-	YES	-	2002	10W	420085	7140860	RPR-353	3
Blackwater Lake	Between Seagrams Creek and Saline Creek	42	LSA	YES	YES	-	-	2020	10W	423075	7136476	9.010-SW-1	6
Blackwater Lake	Between Seagrams Creek and Saline Creek	43	LSA	YES	-	YES	YES	2002, 2003	10W	423833	7133940	RPR-355	3
Blackwater Lake	Saline Creek	44	LSA	YES	YES	YES	YES	2002, 2003	10W	427363	7131821	RPR-358	3
Blackwater Lake	Saline Creek	45	LSA	YES	YES	YES	-	2006	10W	427168	7130338	Saline Ck	5
Blackwater Lake	Devil's Creek	46	LSA	YES	-	YES	-	2002	10W	429599	7130048	RPR-359	3
Blackwater Lake	Between Devil's Creek and Steep Creek	47	RSA	YES	-	YES	-	2002	10W	432482	7125723	RPR-367	3
Blackwater Lake	Steep Creek	48	LSA	YES	-	YES	-	2002, 2003	10W	432915	7119668	RPR-371	3
Blackwater Lake	Steep Creek	49	RSA	YES	YES	YES	-	2006	10W	433727	7118390	Steep Ck	5
Blackwater Lake	Between Steep Creek and Blackwater Creek	50	LSA	YES	-	YES	-	2002	10W	434212	7114190	RPR-373	3

Notes:

¹ Map IDs correspond to Figure 3.4 and Figure 3.5.
² Sampling coordinates may differ between years and monitoring programs. **Bold** coordinates were estimated from source maps because the site coordinates were not reported.
Source: 1 = GNWT Community Based Monitoring; 2 = ECCC Northern Water Quality Monitoring Network; 3 = Mackenzie Gas Project EIS Baseline Report (Volume 3, Section 6); 5 = Rempel and Gill (2011); 6 = Stantec surface water sampling, October 2020
“ – ” indicates where monitoring data were not identified

Table 3.4 Identified Sources of Surface Water Quality and Sediment Data for RSA and LSA Watersheds Located in The Blackwater Lake Sub-Basin (Dehcho Region)

Sub-Basin	Watershed/Watercourse	Map ID	Sampling Site in LSA or RSA (outside of LSA)	Water Quality Data			Sediment Quality Data	Years of Water Quality Data	UTM Coordinates 2			Source Station ID or Object ID	Source(s)
				In situ parameters	Metals and Nutrients	Total Suspended Solids			Zone	Easting	Northing		
Blackwater Lake	Between Steep Creek and Blackwater Creek	51	RSA	YES	-	YES	-	2002	10V	439979	7099197	RPR-376	3
Blackwater Lake	Blackwater River	52	LSA	YES	YES	YES	YES	2002	10V	442738	7093381	RPR-377	3
Blackwater Lake	Between Blackwater River and Dam Creek	53	RSA	YES	-	YES	-	2002	10V	448340	7087520	RPR-379	3
Blackwater Lake	Dam Creek	54	RSA	YES	-	YES	-	2002	10V	458431	7075122	RPR-381	3
Blackwater Lake	Dam Creek	55	RSA	YES	YES	YES	-	2006	10V	459162	7073334	Dam Ck	5
Blackwater Lake	Bob's Canyon	-	-	-	-	-	-	-	10V	-	-	-	-
Blackwater Lake	Vermillion Creek South	56	RSA	YES	-	YES	-	2002	10V	462324	7065608	RPR-383	3
Blackwater Lake	Strawberry Creek	57	RSA	YES	-	YES	-	2002	10V	464919	7062148	RPR-385	3
Blackwater Lake	Strawberry Creek	58	RSA	YES	-	YES	YES	2002	10V	467369	7055805	Site 488	3
Blackwater Lake	Between Strawberry Creek and White Sand Creek	59	RSA	YES	-	YES	-	2002, 2003	10V	465928	7049606	RPR-388	3
Blackwater Lake	White Sand Creek	60	RSA	YES	-	YES	-	2002	10V	468234	7048309	Site 491	3
Blackwater Lake	White Sand Creek	61	RSA	YES	YES	YES	-	2007	10V	467066	7047426	White Sand Ck	5
Blackwater Lake	White Sand Creek	62	RSA	YES	YES	YES	YES	2002	10V	468041	7042453	RPR-391	3
Blackwater Lake	Ochre River	63	RSA	YES	YES	YES	-	2007	10V	468926	7039934	Ochre R	5
Blackwater Lake	Hodgson Creek	64	RSA	YES	-	YES	-	2003	10V	474289	7029712	RPR-398	3
Blackwater Lake	Hodgson Creek	65	RSA	YES	YES	YES	YES	2002	10V	475442	7025964	RPR-399	3
Blackwater Lake	Hodgson Creek	66	RSA	YES	-	YES	-	2002, 2003	10V	476019	7018323	RPR-403	3
Blackwater Lake	Hodgson Creek	67	RSA	YES	YES	YES	-	2006	10V	476802	7023301	Hodgson Ck	5
Blackwater Lake	Mackenzie River at Wrigley	68	LSA	YES	YES	-	-	1969 to 1994	10V	470025	7015379	NW10HC0001	2
Blackwater Lake	Mackenzie River at Wrigley	69	RSA	YES	YES	YES	-	2013 to 2018	10V	483308	7002633	Mack-WRI-01	1

Notes:

¹ Map IDs correspond to Figure 3.4 and Figure 3.5.

² Sampling coordinates may differ between years and monitoring programs. **Bold** coordinates were estimated from source maps because the site coordinates were not reported.

Source: 1 = GNWT Community Based Monitoring; 2 = ECCC Northern Water Quality Monitoring Network; 3 = Mackenzie Gas Project EIS Baseline Report (Volume 3, Section 6); 5 = Rempel and Gill (2011); 6 = Stantec surface water sampling, October 2020

“ - ” indicates where monitoring data were not identified

3.2.3.1 Surface Water Quality Data Sources for Watersheds Associated with Borrow Pits and Rock Quarries

Fifteen material sources have been identified for the Project, with seven of these already existing as sources of gravel or rock for other uses in the Sahtu and Dehcho regions. A preliminary assessment of these sources was completed, as reported in (K'alo-Stantec, 2022b). The potential current or historical uses of these existing borrow sites include bridge construction, road construction, winter road maintenance, pipeline maintenance, and municipal uses. The existing surface water quality data for watercourses located in the same watersheds as the 15 proposed primary material sources are listed in Table 3.5.

Table 3.5 Surface Water Quality Data Sources for Watersheds Associated with Borrow/Quarry Sites

Region	Pit or Quarry	Quarry/ Pit Site ID	Existing /New	Associated Watershed(s)	Map ID of Water Quality Site in Same Watershed as Quarry or Pit
Sahtu	Quarry	Edie Lake	Existing	Bosworth Creek	-
Sahtu	Quarry	7.083*	Existing	Vermillion Creek North	16, 17, 18
Sahtu	Quarry	7.090	New	Jungle Ridge Creek	21, 22
Sahtu	Quarry	7.109	New	Bluefish Creek	-
Sahtu	Quarry	8.039	New	Big Smith Creek	35, 36, 37
Sahtu	Granular Pit	9.002	Existing	Little Smith Creek	38, 39
Sahtu	Quarry	9.019	New	Between Devil's Creek and Steep Creek	46
Sahtu	Quarry	9.025B	New	Steep Creek	47, 48
Dehcho	Granular Pit	9.043	Existing	Between Blackwater River and Dam Creek	52
Dehcho	Granular Pit	10.004	New	Between Blackwater River and Dam Creek	52
Dehcho	Granular Pit	10.007	Existing	Between Bob's Canyon Creek and Vermillion Creek	-
Dehcho	Granular Pit	10.014A	New	Between Strawberry Creek and White Sand Creek	58
Dehcho	Granular Pit	10.020	Existing	Between White Sand Creek and Ochre River	-
Dehcho	Quarry	10.028	New	Hodgson Creek	63 to 66
Dehcho	Granular Pit	10.043	Existing	South of Hodgson Creek	-

Notes:

“ - ” = indicates no water quality data have been identified for the associated watershed

* = Surface water quality has been sampled at the borrow site (October 2020)

Map IDs correspond to Figure 3.4 and Figure 3.5

In most cases, contact water from a material source (i.e., borrow or rock quarry) does not enter the environment from a single point source. Furthermore, the existing hydraulic connectivity from each of these sites to watercourses in the watershed is not well defined and contact water from a material source does not necessarily flow to the corresponding historical water quality monitoring sites listed for the watersheds in Table 3.5. In addition, the development of material sources may alter hydraulic connectivity to the receiving environment. Therefore, the potential for existing and future material sources to influence surface water quality in the RSA is not well understood.

Prospective material sources were accessed in October 2020 (K'alo-Stantec, 2022b). Eleven granular sources, where clast lithology indicated the possibility of Acid Rock Drainage/Metal Leaching (ARD/ML) potential, were sampled (nine of these eleven sites are identified as primary material sources). Results of the preliminary assessment indicate that the ARD/ML potential of the tested prospective material sources is low and is not expected to adversely affect water quality of the receiving watercourses.

3.2.4 Sediment Quality Data Sources for the Study Area

Sediment quality has been sampled less frequently than surface water quality within the RSA. The only identified source of sediment quality data within the RSA was a baseline characterization study performed for the Mackenzie Gas Project EIS (IORVL, 2004). Sediment sampling for the Mackenzie Gas Project EIS baseline study was conducted in 2002 and 2003 and included metals analyses for sediments collected in nine watersheds within the RSA: Prohibition Creek, Nota Creek, Great Bear River, Big Smith Creek, and Saline Creek in the Sahtu Region; and Blackwater River, Strawberry Creek, White Sand Creek, and Hodgson Creek in the Dehcho Region.

Table 3.2, Table 3.3, and Table 3.4 summarize the identified sediment quality data sources for the RSA watersheds located in the Ramparts sub-basin (Sahtu Region), the Great Bear River and Blackwater Lake sub-basins (Sahtu Region), and the section of the Blackwater Lake sub-basin located in the Dehcho Region, respectively. The watersheds presented in these tables represent the major streams (i.e., tributaries of the Mackenzie River) that the project highway alignment will cross.

3.3 Data Gaps and Future Monitoring

Data gaps for existing conditions were identified for this TDR. These data gaps include, but are not limited to, information requested in the DAR Terms of Reference (TOR; MVEIRB, 2015) and are as follows:

- The TOR requires a description of sediment load (suspended and bed load) for each major drainage or major watercourse (TOR Section 5.1.3; MVEIRB, 2015). Historical concentrations of TSS are summarized for three locations in the Mackenzie River (i.e., Wrigley, Tulita, and Norman Wells) in Section 3.2.1. However, suspended sediments and/or sediment bed loads are not identified for each watercourse that may be affected by the Project. Sites within the RSA and LSA for which historical TSS data are available are summarized in Table 3.3, Table 3.4, and Table 3.5.

- The TOR requires the identification of existing water quality and variations for each area of water use that may be affected by the Project (TOR Section 5.1.3; MVEIRB, 2015). Except for TSS described above, information on the seasonal and/or annual variability of surface water and sediment quality for watercourses that may be affected by Project-related activities (i.e., particularly smaller watercourses that intersect the PDA) is limited and not summarized.
- Detailed information about traditional water-use locations that may be affected by the Project are not identified. Protection of water quality in the Mackenzie Valley is of high cultural importance. Watercourses in the RSA are traditionally used as sources of sustenance, including drinking water and for harvesting of fish. Information on specific water uses and locations, if available, could be incorporated in the design of site-specific monitoring programs that reflect the intended use of a watercourse.

For the Mackenzie Valley Highway Project, management plans and mitigation measures will be implemented to reduce effects to surface water and sediment quality from erosion and sedimentation, ARD/ML, and explosives-related nitrogen loading. As a result, collection of additional site-specific baseline water and sediment quality data is not anticipated for supporting the DAR. Additional water quality data, however, will be required for pre-construction and compliance monitoring and to facilitate adaptive management. Surface water quality data will be collected as part of pre-construction and compliance monitoring program at watercourse crossings and in waterbodies adjacent to borrow sources. Suspended sediments (i.e., total suspended solids; TSS) in surface water will also be monitored during construction at upstream and downstream sites.

In specific cases where historical water/sediment quality data may be appropriate to investigate potential Project-related effects, the available surface water and sediment quality data identified for sites within the RSA and LSA (as identified in Table 3.3, Table 3.4, and Table 3.5) may be used to support future Project-specific monitoring programs. Ongoing consultation and engagement with potentially affected parties will also help inform the design of future monitoring programs to account for specific water uses and water-use locations within the RSA and LSA.

4 Summary

The Project is in the Mackenzie-Great Bear Sub-Basin of the Mackenzie Valley Basin (MRBB, 2021). Although watercourses within the Mackenzie-Great Bear Sub-Basin are generally of good quality, some localized effects to water quality have been observed nearby anthropogenic influences such as wastewater discharges (MRBB, 2003, 2021). In addition, Indigenous people have reported increasing water temperatures and turbidity compared to past years. However, the scientific data generally do not show widespread anthropogenic impacts on water quality or on fish health (MRBB, 2021).

Watercourses that will intersect the PDA drain into the Mackenzie River, which is known for naturally elevated suspended sediment and turbidity compared to other rivers in the arctic (MRBB, 2003). Turbidity in the Mackenzie River is highest during the spring snow melt and is often in exceedance of CWQG for recreation and aesthetics (MRBB, 2003). Between 2012 and 2018, TSS generally remained below 400 mg/L in the Mackenzie River at Norman Wells and Wrigley, and below 200 mg/L at Tulita. However, the CWQGs generally do not apply to these historical TSS concentrations because the guidelines for TSS are narrative and are based on changes relative to background conditions (CCME, 2022). The sources of surface water and sediment quality data identified for monitoring sites specific to sub-basins and watersheds in the RSA include data collected by ECCC (2021), Fisheries and Oceans Canada (Rempel and Gill, 2011), GNWT community-based monitoring (GNWT, 2020, pers. comm.), and industry (IORVL, 2004; GNWT, 2021, pers. comm.).

In addition to the identification of monitoring data for the Mackenzie River, sources of water quality data were identified for most watersheds in the RSA that have major streams (i.e., tributaries of the Mackenzie River) that the Project will cross. Watersheds in the RSA for which sources of surface water quality data were not identified include Bob's Canyon Creek in the Dehcho Region, and Bluefish Creek and No Name Creek in the Sahtu Region. Based on the identified sources of water quality data for the RSA, many monitoring sites in the Sahtu Region were within the LSA (and, therefore, relatively close to the Project); however, most identified monitoring sites in the Dehcho Region are outside the LSA.

The identified sources of water quality data for the RSA were generally collected within the last 20 years, with some sites having broader temporal coverage than others (e.g., several years vs. a single year of monitoring data). Most sites included both in situ measurements (e.g., pH, turbidity, conductivity, dissolved oxygen) and laboratory analyses for metal concentrations and nutrients; however, several sites were only sampled for in situ parameters. Furthermore, sources of water quality data have not been identified for all watersheds within the RSA where candidate borrow/quarry sources have been proposed.

Sediment quality has been sampled in nine watersheds in the RSA (IORVL, 2004). These sites were also sampled for surface water quality. The watercourses sampled were Prohibition Creek, Nota Creek, Great Bear River, Big Smith Creek, and Saline Creek in the Sahtu Region, and Blackwater River, Strawberry Creek, White Sand Creek, and Hodgson Creek in the Dehcho Region.

Prospective material sources were screened for ARD/ML potential in October 2020 (K'alo-Stantec, 2022b). Eleven granular sources where clast lithology indicated the possibility of ARD/ML potential were sampled (nine of these eleven sites are identified as primary material sources). Results of the preliminary screening indicate that ARD/ML potential of the tested prospective material sources is low and is not expected to adversely affect water quality of the receiving watercourses.

5 Closure

This TDR was prepared for the sole benefit of GNWT to describe existing conditions related to surface water quality 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

6 References

6.1 Literature Cited

CCME (Canadian Council of Ministers of the Environment). 2022. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Accessed online June 2022 at: <https://ccme.ca/en/current-activities/water>.

DataStream. 2022. Accessed online June 2022 at: <https://mackenziedatastream.ca/en/>.

Derksen, C., Burgess, D., Duguay, C., Howell, S., Mudryk, L., Smith, S., Thackeray, C. and Kirchmeier-Young, M. (2019): Changes in snow, ice, and permafrost across Canada; Chapter 5 in Canada's Changing Climate Report, (ed.) E. Bush and D.S. Lemmen; Government of Canada, Ottawa, Ontario, p.194–260.

Dessau. 2012. Mackenzie Valley Highway Extension Pehdzeh Ki Ndeh – Dehcho Region. Project Description Report (PDR). 004-P037500-0200-EI-R200-00. March 2012.

ECCC (Environment and Climate Change Canada). 2021. National Long-term Water Quality Monitoring Data. Government of Canada. <https://open.canada.ca/data/en/dataset/67b44816-9764-4609-ace1-68dc1764e9ea>.

Golder. 2015. Central Mackenzie Surface Water and Groundwater Baseline Assessment. Report 1: Technical State of Knowledge. Report Number: 1401835 Final Report 1. May 21, 2015.

IORVL (Imperial Oil Resources Ventures Limited). 2004. Environmental Impact Statement. Volume 3: Biophysical Impact Assessment. Section 6 Water Quality.

K'alo-Stantec (K'alo-Stantec Limited). 2022a. Mackenzie Valley Highway Project. Technical Data Report—Surface Water Quantity. Prepared for the Department of Infrastructure, the Government of the Northwest Territories, Yellowknife, Northwest Territories.

K'alo-Stantec. 2022b. Mackenzie Valley Highway – Assessment of Prospective Borrow Sources: Preliminary Acid Rock Drainage / Metal Leaching Assessment. Prepared for the Government of Northwest Territories, Department of Infrastructure. February 2021.

MRBB (Mackenzie River Basin Board). 2003. Mackenzie River Basin: State of the Aquatic Ecosystem Report 2003. Mackenzie River Basin Board Secretariat. Fort Smith, NT.

MRBB. 2021. Mackenzie River Basin: State of the Aquatic Ecosystem Report (SOAER) 2021. Accessed online June 2022 at: <https://soaer.ca/>.

MVEIRB (Mackenzie Valley Environmental Impact Review Board). 2015. Terms of Reference EA1213-02 Mackenzie Valley Highway Extension Project Wrigley to Norman Wells Government of Northwest Territories. February 13, 2015. PR#66.



NRCan (Natural Resources Canada). 2003. National Scale Frameworks Hydrology – Drainage Areas, Canada. Developed in partnership with Environment Canada and Statistics Canada

Rempel, L.L. and G.J. Gill. 2011. Bioassessment of streams along the Mackenzie River Valley, Canada, using the Reference Condition Approach: biological, habitat, landscape, and climate data. Can. Data Rep. Fish. Aquat. Sci. 1236: viii + 247 p

Summit Environmental Ltd. 2014. Devolution 3-5: Water Quality Monitoring Network Evaluation. Prepared by Summit Environmental Consultants Ltd. for the Government of the Northwest Territories (GNWT), Environment and Natural Resources.

TRRC (Tulita Renewable Resource Council). 2022. Tulita Renewable Resources Council Traditional Land and Resource Use Study for Tulita District Mackenzie Highway Project. Prepared by K'alo-Stantec Limited. Prepared for Tulita Renewable Resources Council.

6.2 Personal Communications

GNWT (The Government of the Northwest Territories). 2020. Personal communication. Email from Laurie McGregor, GNWT on August 26, 2020.

GNWT. 2021. Personal communication. Email from GNWT on January 14, 2021.