6. WATER QUALITY

Introduction

The findings of the environmental impact assessment for water quality for the Mackenzie Gas Project (see EIS Volume 5, Section 6) were based on the following components (see Section 1, Introduction, of this document):

- anchor fields
- gathering pipelines and associated facilities
- NGL and gas pipeline corridor
- infrastructure
- NGTL NWML Dickins Lake Section

The two NGTL pipeline sections, Dickins Lake Section and Vardie River Section, are located in northwestern Alberta. The Dickins Lake assessment was included in the EIS. This EIS supplemental information includes:

- updated information for the Dickins Lake Section
- new information for the Vardie River Section
- an impact assessment for northwestern Alberta based on the updated and new information
- a combined project effects assessment that includes the Mackenzie Gas Project and NGTL's Dickins Lake and Vardie River sections

See under EIS Summary for a summary of the EIS findings for water quality.

EIS Summary

Potential effects from the Mackenzie Gas Project (see EIS Volume 5, Section 6) on water quality were related primarily to:

- acid deposition caused by air emissions
- wastewater releases, leaks and spills
- suspended sediment

Predicted effects on water quality will be low magnitude and local in extent for hydrostatic pressure test water discharges, land disturbance and release of domestic wastewater. Watercourse crossings along the Mackenzie Valley pipeline could have localized effects that range from no effect to moderate in magnitude.

No effects from acid deposition were predicted. Effects from Mackenzie Gas Project infrastructure were low magnitude and localized.

No significant effects on water quality were predicted in the EIS.

Study Areas

Study areas for the project were delineated near project elements to provide a conservative assessment of effects. For descriptions of the LSA and RSA, see EIS Volume 5, Section 6. For generic descriptions of the LSAs and RSAs, see Table 6-1.

Table 6-1: Study Areas and Boundaries

Study Area Type	Study Area	Geographic Extent
Local study area	Pipeline corridor	Watercourses situated within a 1-km-wide zone centred along the pipeline
	Pipeline corridor infrastructure	Disturbed land and drainage area of site at receiving waterbodies
Regional study area	All areas	LSAs and downstream to next major stream or waterbody
	Pipeline corridor	Watercourses situated within a 30-km-wide zone centred along the pipeline

The study area of northwestern Alberta extends from the Northwest Territories–Alberta boundary to the South Shekilie River (see Figure 6-1). The predominant named surface water features that might be affected by the project, and which are all part of the Mackenzie River basin, are:

- Thinahtea River
- Petitot River
- Shekilie River
- South Shekilie River

The air quality LSA was adopted for evaluating the effects of acidifying emissions on water quality. In northwestern Alberta, effects of acid deposition were evaluated in a 20-by-20 km study area centered on emission sources, i.e., the NGTL Thunder Creek compressor station (see Section 2, Air Quality).

Baseline

Methods

Effects along the Dickins Lake Section, north of the Vardie River Section, were assessed in EIS Volume 5, Section 6.

Additional field water quality data collected during winter 2004 along the Dickins Lake Section, and available baseline data along the Vardie River Section are described in this section. For the location of the Dickins Lake and Vardie River sections, and associated watercourse crossings, see Figure 6-1.

Baseline data for the Dickins Lake Section includes 2002 and 2003 samples collected from the Petitot River and Thinahtea Creek, and field parameters measured in 12 unnamed streams during winter 2004.

Field parameters were measured in three waterbodies along the Vardie River Section during September 2004.

The Canadian Water Quality Guidelines for the Protection of Aquatic Life, i.e., the aquatic life guidelines (CCME 1999), and the *Canadian Drinking Water Guidelines for the Protection of Drinking Water Supply*, i.e., the drinking water guidelines (Health Canada 2001), were used to evaluate baseline water quality.

Dickins Lake Section

The baseline data for the Dickins Lake Section was updated by fieldwork in winter 2004. Field parameters were measured in 12 unnamed streams along the Dickins Lake Section (see Table 6-2). The pH of these waterbodies ranged from 6.4 to 7.8, with only one observation below the aquatic life and drinking water guideline. Dissolved oxygen concentrations were typically below the minimum aquatic life guideline of 6.5 mg/L. Field-measured conductance values ranged from 310 to 620 µS/cm. Based on these conductance values and the typically strong relationship between conductivity and alkalinity, these streams are unlikely to be acid sensitive. Turbidity levels were low (3.4 to 25.4 NTU) in most of the streams sampled, with moderate values (42.3 and 45.8 NTU) recorded at two sites.

Vardie River Section

The pH values of waterbodies sampled along the Vardie River Section were 7.3 to 7.6, which are within the aquatic life and drinking water guidelines (see Table 6-3). Dissolved oxygen concentrations were variable, with one value below the minimum aquatic life guideline of 6.5 mg/L. Turbidity levels were low. Field-measured conductance values ranged from moderately low to very high. Based on these conductance values, these streams are unlikely to be acid sensitive.

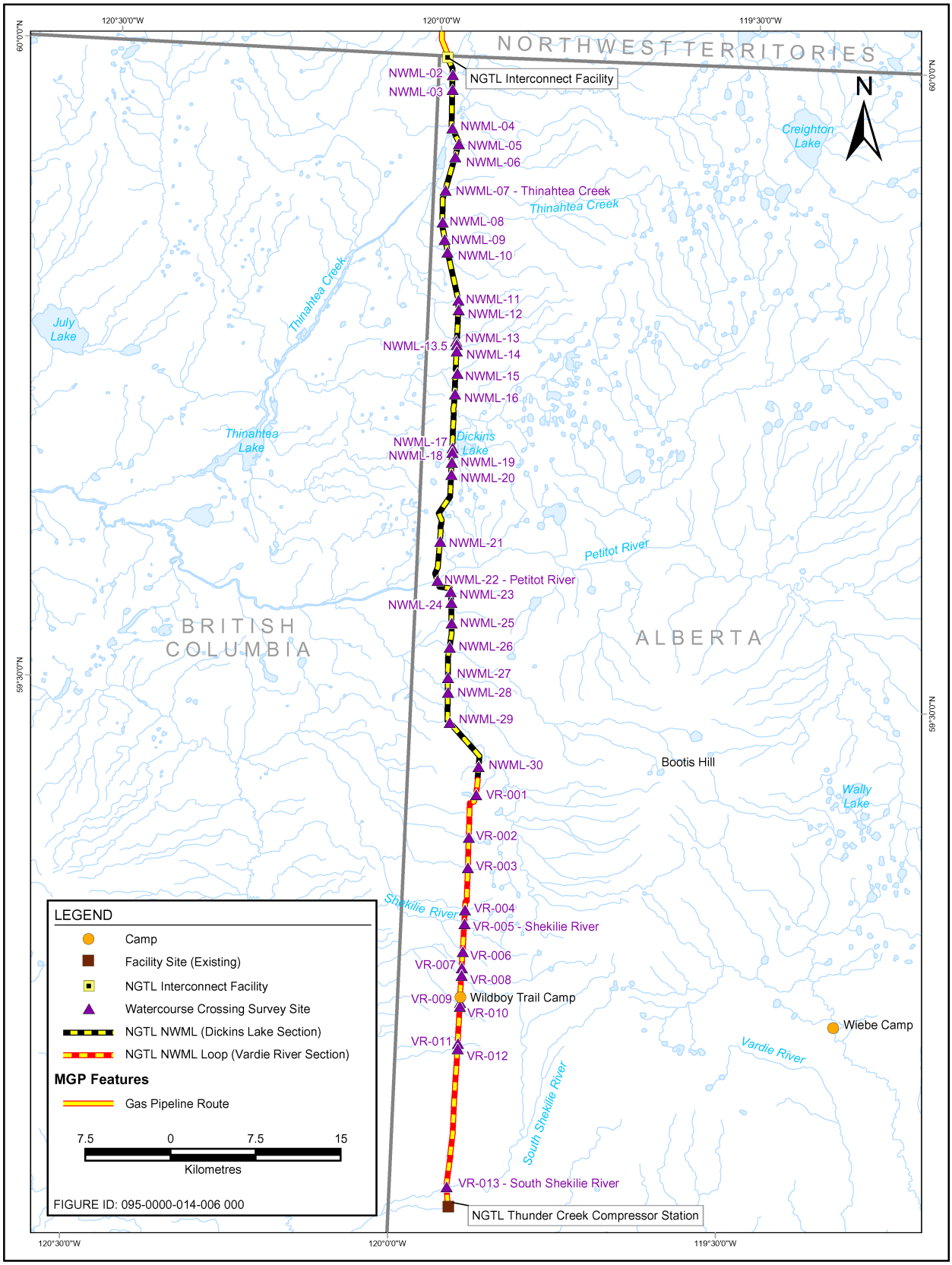

Figure 6-1: Watercourse Crossing Survey Sites

Table 6-2: Field Water Quality Data Collected Along the Dickins Lake Section – Winter 2004

Waterbody Name	Crossing ID		Date	Dissolved Oxygen (mg/L)	pH	Conductance (µS/cm)	Temp. (°C)	Turbidity (NTU)
	2002	2003 and 2004						
Unnamed stream	N/A	NWML-05	March 21, 2004	**0.8**[C]	7.1	520	0.4	3.4
Unnamed stream	Site 708	NWML-07	March 21, 2004	**1.0**[C]	7.1	490	0.1	11.1
Unnamed stream	N/A	NWML-08	March 21, 2004	**0.2**[C]	6.9	440	0.6	4.8
Unnamed stream	N/A	NWML-09	March 21, 2004	**0.6**[C]	**6.4**[C,W]	320	0.0	10.8
Unnamed stream	N/A	NWML-10	March 21, 2004	**0.2**[C]	6.7	510	0.4	13.6
Unnamed stream	N/A	NWML-13.5	March 20, 2004	**0.6**[C]	7.5	590	0.1	25.4
Unnamed stream	N/A	NWML-15	March 20, 2004	**0.6**[C]	6.8	620	0.1	10.8
Unnamed stream	N/A	NWML-16	March 20, 2004	7.4	7.3	310	0.3	7.3
Unnamed stream	N/A	NWML-23	March 19, 2004	**0.1**[C]	7.1	480	0.3	45.8
Unnamed stream	Site 741	NWML-26	March 19, 2004	**0.8**[C]	7.7	580	1.2	23.1
Unnamed stream	N/A	NWML-27	March 18, 2004	**0.1**[C]	7.4	550	1.2	42.3
Unnamed stream	Site 744	NWML-28	March 19, 2004	7.7	7.8	590	0.4	24.5

NOTES:
N/A = not available
NTU = nephelometric turbidity unit
C = concentration is below the recommended dissolved oxygen or pH range for the protection of aquatic life
W = concentration is below the recommended pH range for drinking water quality
Boldface identifies values outside ranges defined by water quality guidelines

Table 6-3: Field Water Quality Data Collected Along the Vardie River Section – September 2004

Waterbody Name	Crossing ID		Date	Dissolved Oxygen (mg/L)	pH	Conductance (µS/cm)	Temp. (°C)	Turbidity (NTU)
	2002	2003 and 2004						
Shekilie River	N/A	VR-005	September 28, 2004	6.6	7.3	290	8.1	3.8
Unnamed stream	N/A	VR-007	September 29, 2004	**3.0[c]**	7.3	500	6.1	2.2
South Shekilie River	N/A	VR-013	September 29, 2004	8.1	7.6	910	4.8	3.2

NOTES:
N/A = not available
NTU = nephelometric turbidity unit
C = concentration is below the recommended dissolved oxygen or pH range for the protection of aquatic life
Boldface identifies values outside ranges defined by water quality guidelines

Effects on Water Quality

Effect Pathways

The effect pathway diagram for northwestern Alberta (see Figure 6-2) is consistent with that in EIS Volume 5, Section 6. It shows key and intermediate pathways, indicating how the Dickins Lake and Vardie River sections could affect water quality. A subset of the pathways shown, i.e., the pathways relevant to northwestern Alberta, is evaluated in this assessment.

Each relevant pathway was evaluated to determine if it would be applicable, given the planned mitigation measures and effect predictions for other EIS disciplines. For an evaluation of nonapplicable pathways, see EIS Volume 5, Section 6.

All pathways are considered to apply in northwestern Alberta except:

- leaks and spills
- sediment input from frost bulb formation
- change in water level or flows because of:
  - change in runoff amount
  - frost bulbs
  - water withdrawals
- change in groundwater quality and quantity
- releases of process wastewater, drilling wastewater, ballast water and barge wastewater

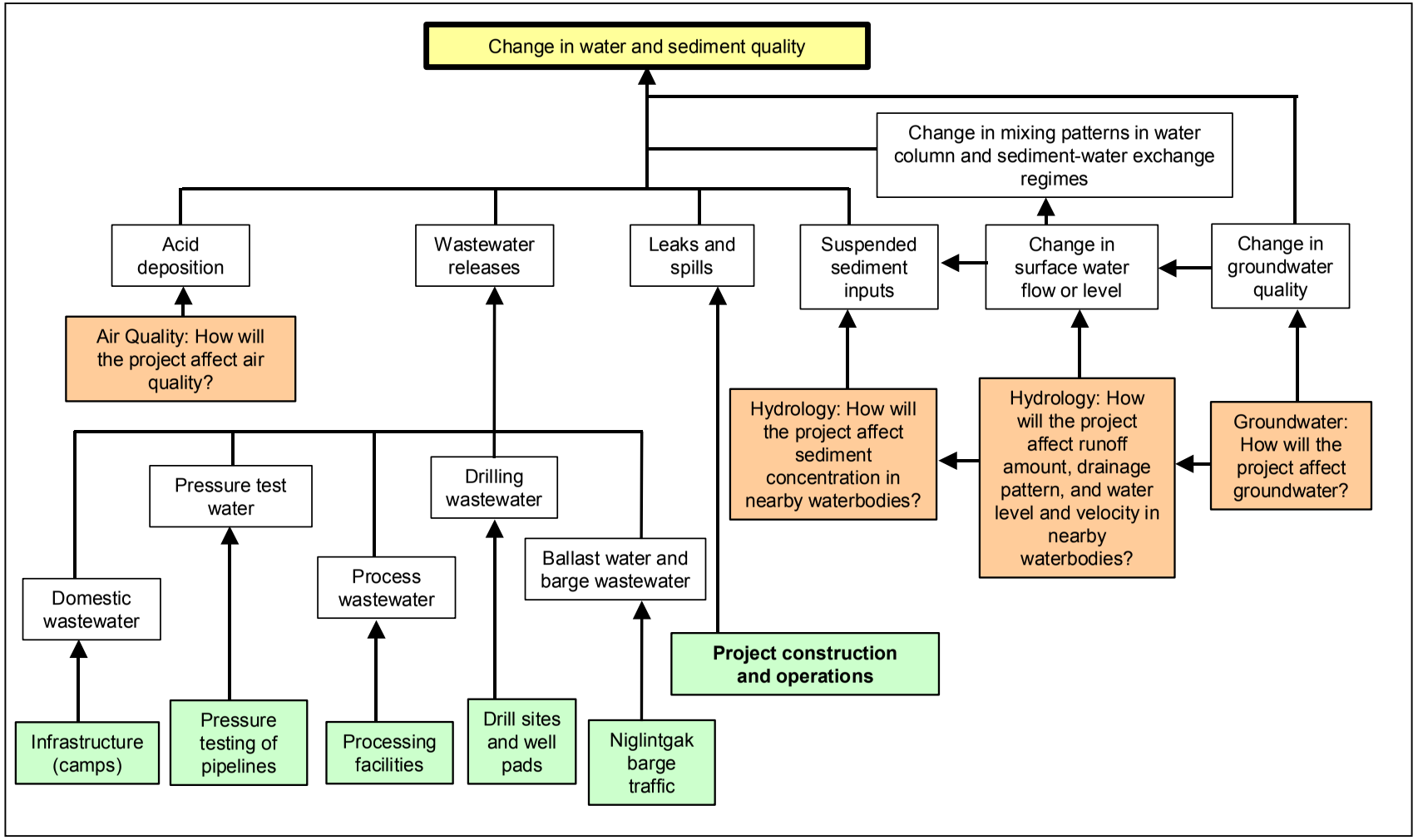

Figure 6-2: Effect Pathways – Water and Sediment Quality

Effect Attributes

Definitions of Effect Attributes

For a detailed description of effect attributes, see EIS Volume 5, Section 6. For definitions of effect attributes for water and sediment quality, see Table 6-4.

Table 6-4: Definitions of Effect Attributes for Water and Sediment Quality

Attribute	Definition	
Direction		
Adverse	Effect is an increase in concentrations[1]	
Neutral	No change in comparison to baseline concentrations	
Positive	Not applicable for water quality	
Magnitude – Protection of Aquatic Life		
Attribute	**Parameters with Guidelines**	**Parameters without Guidelines**
No effect	No measurable change in water or sediment quality	No measurable change in water or sediment quality
Low	Measurable change, but KI concentrations would remain below guideline values, except for KIs that exceed guideline values under natural conditions[2]	The magnitude of an effect will be evaluated based on KI and site-specific considerations
Moderate	For KIs that are toxic to aquatic life: an increase in KI concentration such that it exceeds a guideline value, where the guideline value is not previously exceeded under baseline concentrations and where the expected increase is within the factor of safety range of the guideline[3] The moderate category is not applicable for KIs with no inherent safety factor	The magnitude of an effect will be evaluated based on KI and site-specific considerations
High	KI concentrations would increase such that guideline values are exceeded and beyond the factor of safety range, if applicable[3]	The magnitude of an effect will be evaluated based on KI and site-specific considerations
Magnitude – Drinking Water		
No effect	No measurable change in water quality	
Low	Measurable change in water quality, but KI concentrations in waterbody or potable water intake would remain below drinking water guideline values	
Moderate	Measurable change in water quality and KI concentrations in waterbody or potable water intake would increase such that aesthetic drinking water guideline values are exceeded Concentrations would not increase such that non-aesthetic drinking water guideline values are exceeded	

Table 6-4: Definitions of Effect Attributes for Water and Sediment Quality (cont'd)

Attribute	Definition
Magnitude – Drinking Water (cont'd)	
High	Measurable change in water quality and KI concentrations in waterbody or potable water intake would increase such that nonaesthetic drinking water guideline values[3] are exceeded
Magnitude – Acid Deposition	
No effect	Potential acid input value would remain below critical load for a waterbody, or no acidification is predicted based on weight of evidence
Potential effect	Potential acid input value would increase such that the critical load is exceeded for a waterbody
Geographic Extent	
Local	Effect is limited to the local study area
Regional	Effect is limited to the regional study area
Beyond regional	Effect extends beyond the regional study area
Duration	
Short term	The effect is limited to less than 1 year
Medium term	The effect occurs from 1 to 4 years
Long term	The effect lasts longer than 4 years, but does not extend more than 30 years after decommissioning and abandonment
Far future	The effect extends more than 30 years after decommissioning and abandonment

NOTES:
KI = key indicator
1 Exceptions include dissolved oxygen and pH, which can also have adverse effects if concentrations decrease beyond the lower guideline values
2 If the natural baseline concentration of a KI exceeds the guideline values and the project is predicted to further increase its concentration, magnitude is evaluated based on KI and site-specific considerations
3 Magnitude of effects also depends on duration of effect, depending on the KI and site-specific considerations. For example, high-magnitude effects that last only a short time, i.e., hours, following the project activity, e.g., watercourse crossing construction, could be reduced to a moderate rating.

Analysis and Significance

For effects on water and sediment quality in northwestern Alberta, see Table 6-5.

Table 6-5: Effects on Water and Sediment Quality

Pathway	Phase When Impact Occurs	Effect Attribute				
		Direction	Magnitude	Geographic Extent	Duration	Significant
Acid Deposition						
Acid deposition to waterbodies	Construction	Neutral	No effect	N/A	N/A	No
	Operations	Neutral	No effect	N/A	N/A	No
	Decommissioning and abandonment	Neutral	No effect	N/A	N/A	No
Wastewater Releases						
Discharge of domestic wastewater	Construction	Adverse	Low[1]	Local	Medium term	No
	Operations	Adverse	Low[1]	Local	Long term	No
	Decommissioning and abandonment	Adverse	Low[1]	Local	Medium term	No
Discharge of pressure test water	Construction	Adverse	Low[1]	Local	Short term	No
	Operations	N/A	N/A	N/A	N/A	No
	Decommissioning and abandonment	N/A	N/A	N/A	N/A	No
Suspended Sediment Inputs						
Land disturbance	Construction	Adverse	Low[3]	Local	Medium term	No
	Operations	Adverse	Low[3]	Local	Long term	No
	Decommissioning and abandonment	Neutral	No effect	N/A	N/A	No
Watercourse crossings	Construction	Adverse	No effect to moderate[3]	Local	Short term[2]	No
	Operations	N/A	N/A	N/A	N/A	No
	Decommissioning and abandonment	N/A	N/A	N/A	N/A	No

NOTES:
N/A = not applicable
1 Rating assumes that regulatory requirements will be met and that receiving waterbodies will be chosen to eliminate effects or limit them to a low magnitude
2 Rating refers to the duration of effect for each affected waterbody
3 See Section 5, Hydrology, for predicted total suspended solid levels. The rating in this table refers to water quality KIs other than total suspended solids.

Acid Deposition

During all project phases, acid deposition rates will be low around the NGTL Thunder Creek compressor station (see Section 2, Air Quality). Based on available baseline water quality data, surface waters are not sensitive to acid deposition in the LSA surrounding this facility. Therefore, no effects are predicted from acid deposition.

Discharge of Domestic Wastewater

Concerns about domestic wastewater releases include high concentrations of nutrients and biochemical oxygen demand, which might increase biological productivity and reduce dissolved oxygen concentrations in receiving waters. Wastewater treatment methods are available to reduce nutrient concentrations and biochemical oxygen demand, thereby reducing or eliminating effects.

To comply with regulatory requirements, effects resulting from this pathway will be managed using water treatment and disposal methods that will reduce effects on water quality. Water will be released to the watershed in a controlled manner, to reduce the effects on the receiving waterbodies. Quality of discharged water will meet applicable water quality discharge limits. Therefore, domestic wastewater discharge is predicted to have a low-magnitude effect on water quality during all project phases. No significant effects on water quality are predicted.

Discharge of Pressure Test Water

If pressure test water discharge is required, it will meet the following regulatory requirements:

- *Code of Practice for the Temporary Diversion of Water for Hydrostatic Testing of Pipelines*
- *Code of Practice for the Release of Hydrostatic Test Water from Hydrostatic Testing of Petroleum Liquids and Gas Pipelines*

Pressure test water will be tested and treated before release, if necessary, to reduce effects. Therefore, discharge of pressure test water is predicted to have a low-magnitude effect on water quality during construction. No significant effects on water quality are predicted.

Land Disturbance

Section 5, Hydrology, predicted effects of low magnitude on total suspended solid concentrations from land disturbance. Effects of land disturbance on water quality are expected to be transient, i.e., limited to increases in concentrations of sediment-associated KIs, e.g., nutrients and metals, during periods of elevated total suspended solid concentration. These periods would occur during and immediately after snowmelt and rainstorms. Suspended sediments would ultimately settle out in depositional areas, resulting in a return to background concentrations of sediment-associated KIs.

Natural sediment inputs also occur during snowmelt and rainstorms, implying the likelihood of naturally elevated background levels of sediment-associated KIs. Although changes in KI concentrations caused by land disturbance might be measurable, the incremental changes in concentrations are not expected to be of concern to water quality in terms of nutrient enrichment or toxicity to aquatic life.

Therefore, effect magnitude is predicted to be low during construction and operations. No effects are predicted during decommissioning and abandonment, based on the hydrology prediction of no effects on suspended sediment concentrations (see Section 5, Hydrology).

Watercourse Crossings

Using a conservative approach, the hydrology assessment (see Section 5, Hydrology) predicted no effects to localized, high-magnitude effects on suspended sediment concentrations during construction, depending on the crossing method and stream classification. Based on this prediction, the effects on water quality are predicted to range in magnitude from no effect to moderate. Because sediment releases at watercourse crossings will only result in a redistribution of naturally occurring bottom sediments, no effects are predicted on sediment quality.

The moderate rating for water quality accounts for sediment being released from disturbed bed materials that might have naturally high levels of some KIs, e.g., metals and polycyclic aromatic hydrocarbons, which are likely associated with particulate material. However, the effects on water quality will be short duration. The predicted effects on water quality are not significant.

Prediction Confidence

The precautionary approach used to predict effects on water quality indicates a high degree of confidence in the assessment of significance of effects. The level of confidence is consistent with that in EIS Volume 5, Section 6.

Combined Project Effects

The EIS concluded that the Mackenzie Gas Project in combination with NGTL's Dickins Lake Section would produce no significant effects on:

- water quality
- sediment quality

This assessment for northwestern Alberta concludes that the Mackenzie Gas Project combined with NGTL's Dickins Lake and Vardie River sections will also produce no significant effects.