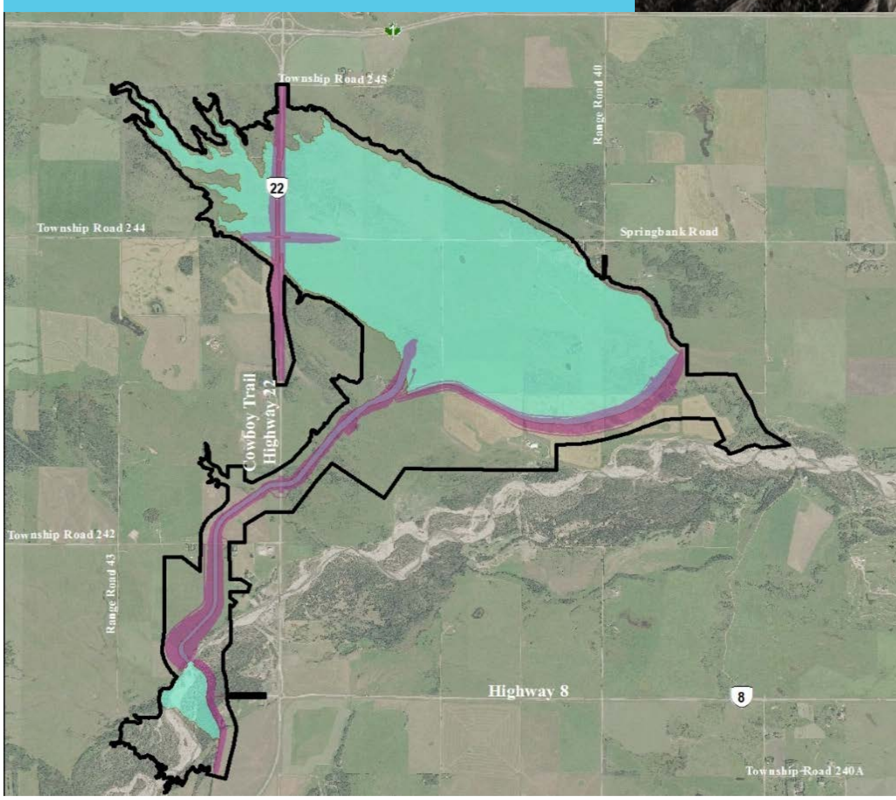
Springbank Off-stream Reservoir Project



Response to CEAA Information Request Package 3 August 31, 2018

May 2019

Alberta Transportation

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Abbreviations

2,4-D	2,4-dichlorophenoxyacetic acid
2D	two-dimensional
3D	three-dimensional
3Q10	3-day, 10-year daily mean flows
AAAQO	Alberta Ambient Air Quality Objectives
ACT	Alberta Culture and Tourism
AEP	Alberta Environment and Parks
CEAA Agency	Canadian Environmental Assessment Agency
APEGA	Association of Professional Engineers and Geoscientists Alberta
AQMS	Air Quality Management System
BLIERS	industrial emission limits for significant emission sources
BOD	biochemical oxygen demand
BSP	biologically sensitive time periods
CAAQS	Canadian Ambient Air Quality Standards
CAC	criteria air contaminant
CCME	Canadian Council of Ministers of the Environment
CDA	Canadian Dam Association
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
CEAA	*Canadian Environmental Assessment Act*
CEAR	Canadian Environmental Assessment Registry
CEPA	*Canadian Environmental Protection Act*
CIE	Commission Internationale de L'Éclairage (also known as the International Commission on Illumination)
COPC	contaminants of potential concern
Cr III	trivalent chromium
Cr VI	hexavalent chromium
CRA	commercial, recreational, or aboriginal
CRCM	Canadian Regional Climate Model
DEP	diesel emission particulate

DFO	Fisheries and Oceans Canada
EBAM	environmental beta attenuation monitor
EC_{50}	effect concentration
ECCC	Environment and Climate Change Canada
ECO Plan	Environmental Construction Operations Plan
EGBC	Engineers and Geoscientists BC
EIA	environmental impact assessment
EIS	environmental impact statement
EIS Guidelines	Environmental Impact Statement Guidelines
EL	elevation
ER	exposure ratio
ERWQO	Elbow River Water Quality Objective
FN	First Nations
FSL	full service level
GHG	greenhouse gases
HC	Health Canada
HD	hydrodynamic
IR	information request
LAA	local assessment area
L_{dn}	day-night average sound level
LOAEL	lowest observed adverse effect level
MC1	McLean Creek
MNL	mitigated noise level
MPM	Meyer-Peter and Müller
MPOI	maximum point of impingement
MT	mud transport
NRC	National Research Council
NRCB	Natural Resources Conservation Board
OAQPS	Office of Air Quality Planning and Standards
PAH	polycyclic aromatic hydrocarbon

PDA	Project development area
PDC	Planned Development Case
PM	particulate matter
$PM_{2.5}$	particulate matter with a diameter of less than 2.5 micrometers
PMF	probable maximum flood
PMP	probable maximum precipitation
POD_{HEC}	human equivalent concentration point of departure
PoE	pathways of effect
Project	Springbank Off-stream Reservoir Project
QAES	qualified aquatic environmental specialist
RAA	regional assessment area
SARA	*Species at Risk Act*
SOD	sediment oxygen demand
SSARR	streamflow synthesis and reservoir regulation
SSRP	South Saskatchewan Regional Plan
ST	sand transport
TCEQ	Texas Commission on Environmental Quality
TF	transportable fraction
TKU	Traditional Knowledge and Use
TLRU	traditional land and resource use
TRJR	Tri-River Joint Reservoir
TRV	toxicological reference value
TSP	trisodium phosphate
TSS	total suspended solids
TUS	Traditional Use Study
US EPA	United States Environmental Protection Agency
VC	valued component
VOC	volatile organic compound

CLIMATE CHANGE

Question IR3-01: Climate Change

Sources:

EIS Guidelines Part 2, Sections 6.2.2; 6.6.2

EIS Volume 1, Section 1

Tsuut'ina First Nation, Ermineskin Cree Nation, and Kainai First Nation – Technical Review of the EIS - Annexes – Combined (CEAR # 46, 47, 50)

Environment and Climate Change Canada Technical Review, June 18, 2018 (CEAR # 32)

Context and Rationale

The EIS Guidelines require the proponent to describe multiple components of hydrology of the Elbow River watershed, and the effects of the environment on the Project.

ECCC indicated that atmospheric moisture content is expected to increase as the atmosphere warms. This in turn would result in an increase in extreme precipitation in the future, though precise projection of future changes in extreme precipitation at the regional and local scales is difficult to obtain (IPCC, 2012, 2013; Kharin et al., 2013; Zhang et al., 2017). ECCC indicated that while there is not yet clear evidence of influence of human-induced climate change on observed floods, studies suggest human influence may have increased the likelihood of extreme precipitation that led to the 2013 Alberta flood (Teufel et al. 2017). Probable Maximum Precipitation (PMP) is projected to increase in the future with continued anthropogenic warming (Kunkel et al, 2013), affecting the Probable Maximum Flood (PMF). Additionally, because of the ongoing change in climate, there is growing uncertainty in the reliability of any return-period analysis of flood flows.

Consideration of climate change forecasts from an ensemble of models with low to high forcing allows for better prediction of potential effects of climate change on the Project. Tsuut'ina Nation noted that the Engineers and Geoscientists BC (EGBC) have specific guidance on how to incorporate effects of climate change into flood hazard and/or risk assessment.

If the frequency and size of future flooding, size of diversions, and/or likelihood of reservoir exceedance are underestimated, direct and cumulative effects to valued components including federal lands from the loss of upstream flood protection integrity may be greater than predicted. Clarity is required to understand whether change in climate, climate uncertainty, and

the magnitude of effects in the context of climate change were considered when determining the design flood to understand the potential effects of the environment on the Project.

Information Requests:

a) Indicate whether, and why or why not, events with a return period similar to the 2013 flood event would likely be of greater magnitude as a result of climate change.

b) Provide information on projected future changes in the regional climate and evaluate potential future climate change related effects on the Project. Include:

- **A flood frequency and size analysis.**
- **Where possible, climate change information based on projections from a range of climate models with low to high plausible future global emission scenarios.**
- **Consideration of the capacity of the diversion and reservoir in the context of climate change, climate uncertainty, and magnitude of effects.**
- **An assessment of how any adverse effects on the Project due to extreme events as a result of climate change in turn could result in potential effects to VCs.**
- **Consideration of the guidance provided by EGBC and a rationale of why it was or was not applied.**

Response IR3-01

a) Climate change may cause floods with a return period similar to the 2013 flood to be of greater magnitude due to many complex inter-related factors, such as those identified in the above Context and Rationale. However, the design basis for the Project is to size the retention volume of the reservoir and diversion capacity to the flood of record (i.e., the 2013 flood) and not to its associated return period. In Alberta, the flood standard is the 1:100 year flood or the flood of record, whichever is greater. The Project is designed to the flood of record, which happens to have an estimated return period of approximately 1:200 year, in both peak flow and volume.

b) i) A flood frequency and size analysis was completed as part of the Project design. Table IR1-1 lists the relevant parameters.

Table IR1-1 Summary of Flood Frequency and Size Analysis Completed for Project Design

Return Period (years)	Instantaneous Peak Discharge (m^3/s)	7-day Volume (dam^3)	56-day Volume (dam^3)
500	1,800	174,000	371,000
200	1,110	132,000	322,000
100	765	107,000	290,000
50	530	86,600	260,000
20	330	65,600	226,000
10	200	53,100	203,000
5	140	38,100	172,000
2	70	20,000	105,000

ii) The impacts of climate change on spring flooding in the Elbow River watershed have been studied using statistical analysis of historical hydro-climatological data and a modelling analysis using the Canadian Regional Climate Model (CRCM) and Valeo et al. (2007). These analyses revealed that there are predicted to be increasing trends in annual mean temperature. The months showing these trends were February and March for the eastern-most part of the watershed and January, March, April, July, and August for the western-most part of the watershed. In the eastern part of the watershed, observations showed decreases in snowfall but no trends in total annual precipitation. Conversely, increases in snowfall were observed in the western portion near the foothills. No significant trends were observed in flow rates within the watershed but modelling of spring freshet flooding showed that spring-time flooding, due to expected increases in precipitation during the month of May, can nearly double flood peaks.

The hydrological regime of the Elbow River watershed in Alberta was studied to determine how climate change might affect it (Marceau et al. 2014). This was investigated using an integrated modelling system, including a cellular automata and spatially-distributed hydrological based model (MIKE SHE/MIKE 11) for scenario simulation. The study concluded that climate change might cause a decrease in average annual overland flow, baseflow, and streamflow. There may be an increase in evapotranspiration, creating conditions for water scarcity. In addition, an increase in temperature during winter and spring will increase snowmelt and peak river flow, creating an increased flood risk from April to June (Marceau et al. 2014). This highlights the need for the Project as flood mitigation on Elbow River.

In another study, previous flood frequency analyses conducted in Alberta from the late 1960s to the late 1990s were evaluated to better define the problem of inconsistency regarding flood frequency analyses prepared for water management projects (Niel and

Watt 2001). The study found that many flood records in Alberta exhibit a high degree of statistical variability or high degree of irregularity in their time series.

iii) The required diversion capacity to achieve the design basis is 480 m^3/s but 25% capacity was added to account for debris and sediment, for a flow rate capacity of 600 m^3/s. This additional diversion capacity can also serve as provision for the effects that climate change could have on peak flood magnitudes. The 25% added capacity is larger than that which is provided in the EGBC guidelines (EGBC 2018).

The required retention capacity of the off-stream reservoir is 77,771 dam^3, which is 10% larger than needed to achieve the design basis of managing a flood with the magnitude of the 2013 Calgary flood. This additional volume can also serve as provision for the effects that climate change could have on flood volumes. This 10% provision is the same as that recommended by EGBC (2018).

iv) The adoption of the 2013 flood as the design flood for this assessment, given the extreme nature of that event meteorologically and in its environmental and socio-economic effects, is reflective that an extreme climate change event is assessed.

v) The guidance provided by EGBC was not explicitly applied because the Project is in Alberta and outside the jurisdictional boundaries of EGBC. The Association of Professional Engineers and Geoscientists Alberta (APEGA) does not provide such guidance. The implementation of the additional diversion rate capacity and volume capacity (in (b) (iii)) is reflective of design modification, representative of safety factors, as recommended by EGBC (2018).

REFERENCES

EGBc (Engineers and Geoscientists BC). 2018. Legislated Flood Assessments In a Changing Climate in BC. Available at: https://www.egbc.ca/getmedia/f5c2d7e9-26ad-4cb3-b528-940b3aaa9069/Legislated-Flood-Assessments-in-BC.pdf.aspx

Marceau, D. J., N. Wijesekara, and B. Farjad. 2014. Impact of land-use and Icimae change on the hydrology of the Elbow River Watershed. *Alberta Flood Mitigation Workshop.* Calgary: University of Calgary .

Niel, C., and W. Watt. 2001. *Report on Six Case Studies of Flood Frequency Analyses. Prepared for Alberta Transportation, Transportation and Civil Engineering Division, Civil Projects Branch.*

Valeo, C., Z. Xiang, F. Bouchart, P. Yeung, and M. Ryan. 2007. Climate Change Impacts in the Elbow River Watershed. *Canadian Water Resources Journal*.

PROBABLE MAXIMUM PRECIPITATION

Question IR3-02: Probable Maximum Precipitation

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.2.2; 6.6.2

EIS Volume 3A, Section 6.2.2.4

EIS Volume 3B, Section 6.4.4.4

EIS Volume 4, Appendix J

Stantec 2015b. Springbank Off-Stream Reservoir Project Probable Maximum Flood Analysis. Memo, Aug 7, 2015.

Rocky View County – Comments on the EIS, June 15, 2018 (CEAR #571)

Environment and Climate Change Canada Technical Review, June 18, 2018 (CEAR # 32)

Context and Rationale:

The EIS Guidelines require the proponent to present information on multiple components of hydrology of the Elbow River watershed as well as relevant meteorological information. The EIS Guidelines also require the proponent to present information on the effects of the environment on the Project.

The EIS presents four PMP scenarios based on the 2013 flood (Stantec 2015b). These scenarios consider general (synoptic, large scale) storms, orographic precipitation, and local (convective) storms. However, the EIS does not include a scenario which starts with convective storms near the foothills then supplanted by a synoptic-scale storm which is the type of event that occurred during the 2013 flooding event (Kochtubajda et al., 2016; Liu et al., 2016). A combination of initial convective rainfall over the foothills and subsequent synoptic-scale rainfall with upslope flow and orographic rainfall may lead to even stronger peak flow and this PMP scenario should be evaluated.

The EIS indicated that the 100-year rainfall amounts from the Pincher Creek Airport meteorological station were used to estimate PMP, due to it being in closest proximity and the physiographic characteristics to the Elbow River Basin, and having a long period of record. This is inconsistent with the EIS watershed analysis, which used data from the Climate WNA website and suggested differences of temperature and precipitation between the upper and lower

watersheds. It is unclear whether the Pincher Creek station (300 km south of the Elbow River basin) is more representative for the upper or lower watershed. ECCC indicated that there are a number of weather stations operated by the provincial and federal government agencies in the area.

Additional information on precipitation, including storm scenarios associated with the PMP and appropriate meteorological data, is necessary understand the rationale for the design flood and potential effects of the environment on the Project.

Information Requests:

a) Analyse an additional PMP scenario, keeping the volume equivalent to scenarios 1 and 2, and reflecting both convective and synoptic characteristics as observed in the 2013 flood event, to better model the severity of a PMP scenario associated with the design flood.

b) Identify two separate monitoring stations to represent the upper and lower basins and differentiate precipitation between the upper and lower watersheds in order to better characterize the PMP. If data is not available, describe how the 100-year rainfall amount from the Pincher Creek station is representative in the PMP scenario.

Response IR3-02

a) Spatial and temporal distribution of the probable maximum precipitation (PMP) values within the watershed were completed using the specific characteristics of the June 2013 flood. As a result, the convective and synoptic characteristics as observed in the 2013 flood are represented in Scenario 1 and Scenario 2 (see Appendix IR2-1, Section 4.2, Table 18); therefore, additional analysis is not warranted.

b) The Context and Rationale summary contains a misunderstanding of the provided information. The assessment does not rely on "the 100-year rainfall amounts from the Pincher Creek Airport meteorological station were used to estimate PMP." Rather, the PMP estimate is based on a comprehensive review of past storms within the region, transposition of past events to the region considering moisture availability and topographic effects, and then maximization based on moisture availability. Rainfall patterns, including spatial and temporal distribution, were modelled using the June 2013 rain characteristics. Therefore, the requested analysis is not necessary.

DESIGN FLOOD

Question IR3-03: Design Flood

Sources:

EIS Guidelines Part 2, Sections 6.2.2; 6.6.2

EIS Volume 1, Section 3.1

Rocky View County – Comments on the EIS, June 15, 2018 (CEAR #571)

Tsuut'ina First Nation, Ermineskin Cree Nation, and Kainai First Nation – Technical Review of the EIS - Annexes – Combined (CEAR # 46, 47, 50)

Environment and Climate Change Canada Technical Review, June 18, 2018 (CEAR # 32)

Context and Rationale:

The EIS Guidelines require the proponent to describe multiple components of hydrology of the Elbow River watershed, and the effects of the environment on the Project.

The EIS notes that the Project is designed to mitigate floods up to the design flood level corresponding to the 2013 flood event; however, the rationale supporting the choice of this design flood level is not provided.

The assessment of potential effects in the EIS is based on the flows recorded in the Elbow River at Bragg Creek, whereas the Project design is based on the 2013 flood hydrograph recorded at Glenmore Reservoir's level gauge and select hydrometric station data within the basin. In the EIS, the PMF analysis indicated that the PMF at the diversion site would be approximately 2.3 times bigger than the peak flow during the 2013 analysis. This introduces uncertainty into the assessment.

The EIS notes that the off-stream dam is classified as an "extreme" consequence dam and the floodplain berm is classified as a "very high" consequence dam. Rocky View County indicated that if the floodplain berm is a "very high" class, the design flood should be 2/3 between the 1000-year flood and PMF, and not 1/3 between the 1:1000-year flood and PMF as described in the EIS. This suggests that the flood frequency estimates and/or the PMF estimate may not be appropriate. If the PMF is underestimated, the emergency spillway and auxiliary spillway may be undersized.

Information on the rationale for the selection of the design flood and capacity of the spillway components is required to understand the effects of the environment on the Project.

Information Request:

a) Provide a rationale for the selection of the design flood level. The response should include:

- **Consideration as to whether designing for the 2013 flood is suitable considering climate change.**
- **A description of implications on the Project of projected changes from climate change in the estimations of the design values (such as 1:100 year flood, PMF and PMP).**
- **A rationale for the use of 1/3 between the 1:1000 year and PMF for the floodplain berm. Provide the 1:1000-year flood peak value for clarity.**
- **A description, considering climate change, of the ability of the emergency spillway and auxiliary spillway to handle a higher PMF and PMP.**

Response IR3-03

a) The design basis for the Project is to provide flood protection to the City of Calgary for a flood equal to or less severe than the 2013 flood; the design is not based on a specific flood recurrence interval. Climate change, and its effects on flood frequency, would not impact the design selection of the reservoir retention volume and diversion rates. The Project will still meet its design objectives if the 2013 flood were to occur more frequently than predicted. Its design and operational parameters would not be affected by a change in frequency of rainfall.

Research suggests that PMP values may increase in the future with a warming climate due to higher levels of atmospheric moisture content (Kunkel et al. 2013). However, the degree of PMP change is uncertain due to the potential climatic effects on storm convergence. Should the PMP increase due to climate change, the PMF would increase, although it may be offset somewhat from reduced contribution from snowmelt.

The floodplain berm is classified as a “High” consequence structure and, therefore, utilizes an inflow design flood of 1/3 between the 1:1,000 year flood and PMF, based on CDA (2007). The 1:1,000 year flood is estimated to generate a peak flow of 1,930 m^3/s in Elbow River.

The implications of an increase of the PMF would likely require an expansion of the auxiliary spillway at the diversion structure and the emergency spillway for the dam. By extending the length of the spillways, the design water levels and freeboard requirements could be maintained and would, therefore, not affect the stability of the dam and hydraulic structures. Both spillway weirs could be extended at their current locations to increase their capacity and limit effects on the diversion structure and off-stream dam.

REFERENCES

CDA (Canadian Dam Association). 2007. Dam Safety Guidelines (Revised 2013). Canadian Dam Association. Toronto, Ontario

Kunkel, K. E., T. R. Karl, D. R. Easterling, K. Redmond, J. Young, X. Yin, and P. Hennon. 2013. Probable maximum precipitation and climate change, Geophys. Res.Lett., 40,1402–1408

HYDROLOGY

Question IR3-04: Hydrology – Local and Regional Assessment Areas

Sources:

EIS Guidelines Part 2, Section 6.1.4

EIS Volume 2, Section 5.3.1

EIS Volume 3A, Section 6.1.4.1

Tsuut'ina First Nation, Ermineskin Cree Nation, and Kainai First Nation – Technical Review of the EIS - Annexes – Combined (CEAR # 46, 47, 50)

Rocky View County – Comments on the EIS, June 15, 2018 (CEAR #571)

Context and Rationale:

The EIS Guidelines require the proponent to present information on multiple components of hydrology of the Elbow River watershed.

The EIS states that the LAA includes the project footprint in addition to "adjacent areas where environmental effects may reasonably be expected to occur" specific to each VC. The EIS also states that the RAA is the area within which the Project's environmental effects may interact or accumulate with the environmental effects of other projects of activities that have been or will be carried out such that cumulative effects may potentially occur.

The LAA for the hydrological assessment extends downstream of the PDA but appears to exclude consideration of the backwater effects of the diversion gates upstream. Potential effects upstream (e.g. backwater effects) due to high reservoir levels during the retention time should be assessed. Given the boundaries of the LAA, it is unclear whether the potential effects of local runoff draining into the reservoir and potential effects upstream of the Project are adequately characterized.

The RAA for hydrology extends only to the headwaters of the Glenmore Reservoir. Potential downstream effects due to reduced flood peaks past the Glenmore Reservoir or in the Bow River are not assessed. It is unclear whether the RAA adequately captures the full extent of potential effects downstream of the Project.

The limited rationale presented for the selection of LAA and RAA for the hydrological assessment does not allow for a full understanding of the potential environmental effects resulting from changes to hydrology.

Information Requests:

a) **List and provide rationale for the criteria used to determine the LAA and RAA for hydrology.**

b) **Describe whether the LAA extends far enough upstream to evaluate potential effects from backwatering, local runoff, and sediment deposition.**

c) **Discuss whether the RAA extends far enough downstream of the Project to account for potential effects from reduced flood peaks.**

Response IR3-04

a) The location and rationale for the hydrology LAA and RAA are as follows:

LAA

The LAA boundary to the west begins in a catchment basin immediately surrounding the Project (i.e., area within a height of land within which overland flow of water, such as from precipitation and streams, flows towards or near the Project), continues eastward along the perimeter of the Elbow River valley, with the eastern extent at the inlet to the Glenmore Reservoir.

The rationale for this boundary is to capture potential local interaction with overland water in the Elbow River until meeting the Glenmore Reservoir where water levels are controlled by the City of Calgary; that control is independent of the Project.

RAA

The RAA boundary to the west is the upper headwaters of Elbow River watershed in the Rocky Mountains and to the east is the eastern extent the Glenmore Dam located at the eastern boundary of the Glenmore Reservoir.

The rationale for this boundary is to include the full catchment basin for Elbow River, hence the maximum extent of overland water inflow to Elbow River and includes Glenmore Reservoir to the extent of its the dam. The Glenmore Reservoir is the downstream extent of the RAA because it is a managed water body subject to operational control by the City of Calgary.

The purpose of the Project is to mitigate floods by diverting flow in the Elbow River greater than 160 m^3/s. By diverting flow greater than 160 m^3/s, the operational parameters of Glenmore Dam will be maintained and hydrology downstream of Glenmore Dam will not be affected by the Project. As such, Glenmore Dam is the extent of influence by the Project on flows in Elbow River.

b) The LAA extends far enough upstream to evaluate potential effects from backwatering from Project activities, local runoff, and sediment deposition. The western extent of the PDA boundary is based on a likely maximum spatial extent of floodwater during Project operations upstream of the floodplain berm. The PDA is within the LAA.

c) As stated above for a), the RAA extends to the outlet of Glenmore Dam. As the purpose of the Project is to mitigate floods by diverting flow in the Elbow River greater than 160 m^3/s to allow for functionality of the Glenmore Dam to be maintained, the RAA does not extend downstream of Glenmore Dam in which the positive effects (i.e., reduced flood peaks) from both the Project and the Glenmore Reservoir operations occur during a flood.

Question IR3-05: Hydrology – Emergency Spillway and Freeboard

Sources:

EIS Guidelines Part 2, Sections 3.1; 6.2.2

EIS Volume 1, Section 3.2.3

Rocky View County – Comments on the EIS, June 15, 2018 (CEAR #571)

Context and Rationale:

The EIS Guidelines require the proponent to present information on changes to surface water, including changes to water quality and quantity and sediment quality and quantity in the event that flood event(s) exceed the capacity of the reservoir system. The EIS Guidelines also require the proponent to describe project components and operations including a detailed water management plan.

According to the CDA 2007 Dam Safety Guidelines, the initial reservoir level needs to be specified when assessing the PMF, and the level should correspond to the higher bracket of the range of reservoir level that may be expected at the commencement of the PMF. The EIS adopts a 100-year storm as the antecedent condition prior to the PMF, but it is not clear whether an initial reservoir level is considered, or how it is considered, when determining the capacity of the emergency spillway. The CDA Guidelines also require the consideration of wave run up when assessing the adequacy of the freeboard. Understanding of the initial reservoir level is required

to assess the capacity of the emergency spillway and determine whether an adequate freeboard would be maintained.

The EIS states that since the reservoir will not have a permanent pool, wave wash protection will not be necessary. Although the off-stream reservoir will not have a permanent pool during dry operations, it will store water for a certain amount of time during flooding. Floods are often accompanied with relatively strong winds, which were not considered and could cause waves that affect the structures of the reservoir. The dam design shown in Figure 3-8 has a freeboard of 1.5 m from the inflow design flood pool elevation to crest. It is unclear whether this freeboard is adequate for design wave run-up as required by the CDA Dam Safety Guidelines.

Information Requests:

a) **Provide a rationale for the capacity of the emergency spillway, taking into account the PMF and a range of initial reservoir levels that could occur.**

b) **Discuss whether the emergency spillway capacity would maintain an adequate freeboard (distance between the maximum water level and top of the dam) as required by the CDA 2007 Dam Safety Guidelines.**

c) **Provide a rationale for the freeboard in the reservoir considering the potential for waves due to strong winds that accompany floods.**

Response IR3-05

a) The capacity of the emergency spillway was determined through hydrologic and hydraulic model simulations of flood operations during a probable maximum flood (PMF) and assuming failure of the diversion inlet gates to close once the full service level of the reservoir is reached.

During a flood, the diversion inlet structure gates will be opened to partially divert flood flows into the off-stream reservoir. After the reservoir full service level is reached, the diversion gates will be closed and flood water will continue downstream through the service and auxiliary spillways.

The emergency spillway design assumes the following:

- 1:100 year antecedent storm precedes the probable maximum precipitation (PMP), increasing baseflow and runoff potential, but it is not diverted to the reservoir.
- The initial reservoir level is at El. 1,196.6 m, which is equivalent to 7,561 dam^3 of initial volume. This incorporates both potential sedimentation and inflow from a 1:100 year, 6-hour storm in the local drainage basin.

Because the scenario assumes an equipment failure, inclusion of an antecedent diversion plus a low probability failure scenario plus a very low probability flood (PMF) is not warranted.

b) The emergency spillway capacity maintains adequate freeboard as required by the CDA (2007) through consideration of wind generated wave setup and runup for the reservoir at its peak water surface elevation. Details of this analysis are presented in the response to c).

c) Freeboard criteria for the reservoir and dam were determined based on the CDA Dam Safety Guidelines (2007). Freeboard was determined based on an evaluation of wind generated wave height, setup and run-up.

Two wind-generated wave scenarios were evaluated. First, normal freeboard assumes the reservoir is at its FSL and the freeboard should prevent overtopping by 95% of the waves caused by the most critical wind with a frequency of 1:1,000 year. Second, minimum freeboard assumes the reservoir is at its maximum elevation during passage of the PMF and the freeboard should prevent overtopping by 95% of the waves caused by the most critical wind with a frequency of 1:2 year.

Calculations for wind and wave run-up were performed using the methods in USBR (2012). Table IR5-1 provides a summary of calculation parameters and results.

Table IR5-1 Normal and Minimum Freeboard Calculations Summary

	Normal Freeboard	Minimum Freeboard
Wind velocity return interval	1:1,000 year	1:2 year
Design wind velocity (m/s)	29.0	24.5
Fetch length (km)	4.80	4.80
Calculated wave runup (m)	2.12	1.42
Calculated wave setup (m)	0.13	0.04
Total freeboard required above pool elevation (m)	2.25	1.46
Pool elevation (water height in the reservoir) (m)	1,210.75	1,212.00
Required crest height (m)	1,213.00	1,213.46

REFERENCES

CDA (Canadian Dam Association). 2007. Dam Safety Guidelines (Revised 2013). Canadian Dam Association. Toronto, Ontario

USBR (U.S. Bureau of Reclamation). 2012. Embankment Dams, Chapter 6, Freeboard. Available at: https://www.usbr.gov/tsc/techreferences/designstandards-datacollectionguides/finalds-pdfs/DS13-6.pdf

Question IR3-06: Hydrology – Suspended Sediment

Sources:

EIS Guidelines Part 2, Section 6.1.4; 6.2.2

EIS Volume 3B, Sections 6.4.1; 6.4.3

EIS Volume 4, Appendix J, Figure 3-12

Rocky View County – Comments on the EIS, June 15, 2018 (CEAR #571)

Context and Rationale:

The EIS Guidelines require the proponent to present information on baseline conditions and assess changes to hydrology and water quality of the Elbow River watershed, including sediment transport characteristics and sediment quality and quantity. The EIS Guidelines direct the proponent to carry out modelling as required to present and substantiate anticipated changes.

The EIS indicates that suspended sediment concentration decreases as discharge decreases. Some of the decrease is due to the reduction in supply as runoff decreases and the decreased turbulence of the lower discharge downstream of the diversion inlet. The largest size fraction of the suspended sediment would drop out of suspension at the lower discharge once the normal flow is established downstream of the service spillway, and suspended sediment concentrations may be reduced by more what is demonstrated.

It is unclear whether the estimated peak suspended sediment concentration at Highway 22 is representative of the entire downstream reach of the Elbow River, or is reduced due to its proximity to the service spillway where turbulence is high. Additionally, the curves in Figure 3-12 appear to be skewed due to the inclusion of local effects. It is unclear whether conclusions regarding sediment transport would change if the local effects were eliminated and therefore slopes were increased.

Clarity on the meaning of the figures and associated predictions of effects is needed in order to assess potential effects to hydrology.

Modelling

The EIS states that sediment transport for the three flood scenarios was modelled based off a hydrodynamic numerical model (MIKE21), and the mud/bedload transport (MT) and sediment transport (ST) modules. The morphological changes to the bed reported by the MIKE21 model seem to be in four small areas and not in a critical area at the Diversion Inlet. Additionally, it is

not clear how the MT and ST modules were combined to accurately stimulate sediment transport.

Rocky View County indicated that the equation used to evaluate suspended sediment, the Meyer-Peter and Muller equation, is most suitable for estimating gravel transport and may underestimate sediment transport with fine sediments or high current speeds. Therefore, it may not be suitable for evaluating the fate of suspended sediment released from the reservoir and the high velocities associated with flows released into the tributary downstream of the low level outlet.

Interactions between suspended sediment and bedload transport are important in assessing effects to the morphology of the river, including degradation and aggradation in the river channel. Clarity of the modelling of fine sediment transport is needed.

Shear Stress

The EIS notes that once the flow goes below160 m^3/s, the shear stress required to mobilize sediment "with diversion" is higher than with "no diversion." Rocky View County indicated that the shear stress should be the same unless the flow is deeper or steeper, which could be caused if hydraulic conditions at the site are affected by turbulence and not representative of downstream conditions. Clarity is required regarding the shear stress, in order to understand the figures and assess potential effects to suspended sediment concentrations.

<u>Information Requests:</u>

a) Provide a rationale for the estimated peak suspended sediment concentration reduction at Highway 22.

b) Discuss whether increased slopes would change conclusions regarding sediment transport.

c) Provide additional details on the sediment transport model. Include how the results for the MT and ST modules were combined and a description of what areas were reported by the MIKE21 model.

d) Provide rationale for using the Meyer-Peter and Muller equation to estimate sediment transport and discuss whether the results on the sediment transport model were validated against a total load formula.

e) Provide a rationale for why the shear stress “with diversion” is higher than with “no diversion.”

Response IR3-06

a) The peak flow is reduced due to the partial diversion of flood water, which leads to a reduction in water velocity in the river at Highway 22. The subsequent reduction in flow velocity will reduce shear stress in the river and thus reduce the carrying capacity of sediment in the river. With lower carrying capacity of sediment, the peak suspended sediment concentration will be reduced at that location.

b) Volume 4, Appendix J, Figure 3-12 shows the features of suspended sediment concentration in the hydrology LAA and hydrology RAA, based on the available data from pre-project conditions. The reference to “local effects” in the Context and Rationale does not apply because the service spillway has not been constructed. The sediment transport modelling compares conditions with and without the Project and, therefore, evaluates the change in slope on sediment transport.

c) In the modelling study of sediment transport, the mud transport (MT) and sand transport (ST) modules are used. Although the MT module considers fine-grained non-cohesive material (sand/gravel), the main focus of this module is to simulate cohesive sediment (silts and clays) finer than sand. The ST module simulates the sediment transport of non-cohesive sediment (sand and gravels) only. In execution of the modelling, the MT and ST modules are each individually coupled with the hydrodynamic (HD) module, which is the basic computational component of the MIKE21 modelling system. There is no direct integration or information exchange between the MT and ST modules.

   The MIKE21 model produces results across the full model domain. Three representative locations are reported in the hydrology assessment (Volume 3B, Section 6):

   - Location 1 is 1.3 km downstream of Highway 22
   - Location 2 is 1.9 km upstream of Twin Bridges
   - Location 3 is 0.9 km upstream of Sarcee Bridge

d) The Meyer-Peter and Müller (1948) bedload formula in the ST module is used to simulate the transport and bed level changes of non-cohesive sand and gravel sediments. A comparison between the sediment transport model and a total load formula has not been performed.

e) Volume 3B, Section 6, Figure 6-13, Figure 6-18 and Figure 6-22 present results of the MIKE21 at Highway 22, including shear stress for the design flood, 1:100 year flood and 1:10 year flood, respectively. In summary, during active diversion of flood flows, the shear stress is lower with diversion than without, as is expected from the reduction of flow in the river. Each of those figures exhibits a small increase in shear stress prior to and after diversion of the flood flows. These minor hydraulic effects have no bearing on the interpretation of the results and overall effects of the Project on sediment transport.

REFERENCES

Meyer-Peter and Muller. 1948. Formulas for Bed-Load Transport. International Association of Hydraulic Research, 2nd Congressional Proceeding, Stockholm, pp. 39-64.

Question IR3-07: Hydrology – Unnamed Tributary

Sources:

EIS Guidelines Part 2, Section 6.1.4

EIS Volume 1, Section 3.2, Figure 3-1

EIS Volume 4, Appendix J, Section 3.3.1.2

Environment and Climate Change Canada Technical Review, June 18, 2018 (CEAR #32)

Context and Rationale:

The EIS Guidelines require the proponent to present information on hydrology and water quality of the Elbow River watershed, including the delineation of drainage basins at appropriate scales (water bodies and watercourses) overlaid by key project components.

The EIS states that the LAA contains several tributaries to the Elbow River that contribute flow from the plains. The tributaries inside the reservoir area will drain through the low level outlet. The EIS describes and depicts a tributary that crosses Highway 22 near Township Road 242; however, no information is provided about the tributary between the proposed new bridges shown in Figure 3-1.

Clarity is required on the project interactions with and effects on this tributary as it may have potential effects to VCs.

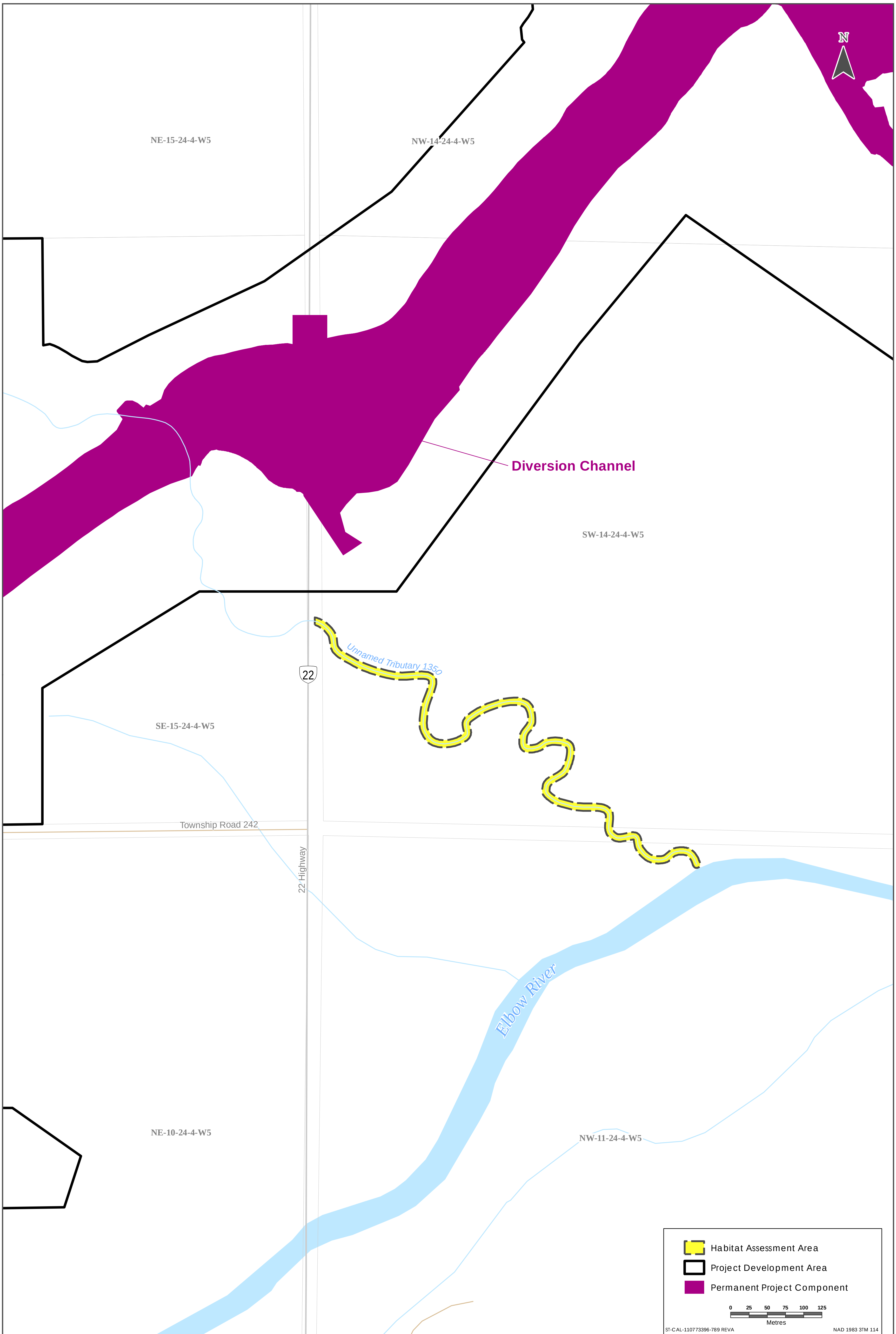
Information Request:

a) Clarify the disposition of the unnamed tributary that currently crosses Highway 22 near Township Road 242 before joining the Elbow River.

b) Describe the project interactions and effects of any changes to the unnamed tributary on VCs.

Response IR3-07

a) The unnamed tributary (Tributary 1350) is located on legal land sections NW-11-24-W5M and SW 14-24-24-W5M (see Figure IR7-1). The field data sheet for the tributary is provided in Appendix IR7-1.



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Fish Habitat Assessment Area for Tributary 1350

Figure IR7-1

b) Tributary 1350 was a sinuous, low-gradient creek with minimal flow at the time of assessment (September 2016). Approximately 250 m upstream from the confluence with the Elbow River, the area becomes a flat wetland with no defined channel and evidence of cattle use (i.e., hummocks). The tributary is likely seasonally connected to the Elbow River during rain or snowmelt. The lower portion of the tributary may provide seasonal, but poor habitat for fish when water is present.

During construction of the diversion structure, Tributary 1350 will be permanently altered. Approximately 1,200 m of the tributary will be lost; the lowest 250 m being seasonal fish habitat. Due to the intermittent nature of the tributary, the contribution of flow into the Elbow River is minimal.

PROJECT OPERATION

Question IR3-08: Project Operation – Flood Frequency

Sources:

EIS Guidelines Part 2, Section 3.1; 3.2.2; 6.1.4

EIS Volume 1, Section 3.1 and 7.4

EIS Volume 3B, Section 3.2.8

Rocky View County – Comments on the EIS, June 15, 2018 (CEAR #571)

Piikani Nation – Technical Review of EIS, June 15, 2018 (CEAR #48)

Context and Rationale:

The EIS Guidelines require the proponent to describe the operation of key Project components and a schedule for all Project activities including a water management plan for Project operation. The EIS Guidelines also require the proponent to present information on multiple components of hydrology of the Elbow River watershed.

There are conflicting statements in the EIS regarding when the Project will operate. In Volume 1, Section 3.1, the EIS states that the diversion of flood waters begin when flows in the river exceed 160 m^3/s (approximately a 1:7 year flood). However, Volume 1, Section 7.4, Table 7-3 of the EIS indicates that during floods, flows of approximately 160 m^3/s (approximately a 1:10 year flood) will continue in the Elbow River downstream of the low level outlet, and Volume 1, Section 3.1, Table 3-1 of the EIS shows that a 1:10 year flood is estimated to have a peak discharge of 200 m^3/s. Further, Stantec noted to the Piikani Nation that the minimum streamflow for the Project to operate is a 1:10 year return period flood.

Throughout the EIS, the 1:10 year flood is used to estimate potential effects. For example, in Volume 3B, Section 3.2.8, the EIS indicates that dust emissions would only be a concern for a flood event that exceeds a 1:10 year flood. There is concern that dust emissions would be present any time the Project is in operation. There is also concern that in a wet cycle, the flood operation of the Project could be more frequent, which may lead to additional environmental effects that have not been assessed.

Understanding the frequency of Project operation and when water management practices will be implemented is critical to the assessment of environmental effects.

Information Requests:

a) **Clarify at what flow volumes and what flood frequency the Project will be in operation.**

b) **Anytime potential effects are assessed based on the Project operating at the 1:10 year flood ratio, reassess the potential effects to each VC based on the highest frequency of Project operation.**

Response IR3-08

a) The Project will activate when flow rates in Elbow River are above 160 m^3/s. The assessment of potential effects required hydrodynamic and sediment transport modelling, which required recurrence intervals that represent an increasing probability of occurrence in any given year (i.e., the probability of a 1:10 year flood occurring in any given year is 10%). As a result, a 1:10 year interval (200 m^3/s) was the closest flow volume to the activation flow volume of 160 m^3/s and was used in the assessment.

b) The assessment of effects during the flood and post-flood phases addresses three floods: 1:10 year, 1:100 year and design (Volume 2, Section 7.1.1.2). The rationale for selection of these floods, for both engineering design and assessment of effects, is provided in Volume 1, Section 3.1. In that section, Table 3-1 provides an itemization of different return periods and peak discharge. The frequency of Project operation is correlated to Elbow River flood flow rates at and above 160 m^3/s. As such, the appropriate frequencies of Project operation have been assessed.

Question IR3-09: Project Operation – Effects from changes in Flood Frequency and Sediment Load and Transport on the Elbow River

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.1.5; 6.2.2; 6.3.1; 6.3.3

EIS Volume 1, Sections 3.1; 7.4

EIS Volume 3A, Section 8.4.4

EIS Volume 3B, Sections 6.2; 6.4; 6.7; 8.2

EIS Volume 4, Appendix J, Table 3-4

Rocky View County – Comments on the EIS, June 15, 2018 (CEAR #571)

Piikani Nation – Technical Review of EIS, June 15, 2018 (CEAR #48)Samson Cree Nation – Springbank Off-Stream Reservoir Project Written Submission – June 25, 2018 (CEAR #52)

Montana First Nation – Review of Springbank Off-Stream Reservoir EIA, June 2018 (CEAR #51)

Alberta Transportation Responses to CEAA Annex 2: A) Early Technical Issues, May 11, 2018

Fisheries and Oceans Canada – Comments on the EIS, June 19, 2018 (CEAR #28)

Context and Rationale:

The EIS Guidelines require the proponent to present information on multiple components of hydrology of the Elbow River watershed, including those that affect water quality and quantity, sediment quality and quantity, and fish and fish habitat. Flows and associated sediment transport within river systems affect water quality as well as fish and fish habitat.

Flood Frequency

Based on the current diversion rate, the Elbow River below the diversion may not flood except in extreme circumstances, which could have potential effects to the larger gravel bars downstream of the diversion channel. This could also affect river morphology, vegetation types and sizes growing on the gravel bars, wetlands and other sensitive areas, which are vital for river health and flood/drought management.

For example, during Project operations, up to 600 m^3/s will be diverted from the Elbow River to maintain a flow of 160 m^3/s. Therefore, the minimum 500 m^3/s threshold to mobilize the thalweg armour layer (coarse sediment) would only occur for floods at a recurrence interval of 200 years or longer, instead of the current expected 50 year interval. This suggests that general bed motion in the Elbow River downstream of the inlet will occur less frequently as a result of the Project.

Sediment Transport

The EIS stated that Project magnitude of effects to suspended sediment concentrations or yields were not determined because they are a direct consequence of the intent of the Project, which is flow diversion. The EIS notes that the change in suspended sediment transport during the diversion would be limited to the local assessment area. This assessment may be incorrect if the proportion of sediment mass removed from the Elbow River during diversion is sizeable compared to the total annual yield in the Elbow River. Rationale or clarification is required, as reducing sediment concentrations or yields is not the intent of the Project. These changes may have implications for the downstream morphology of the Elbow River channel, the sustainability of the deltaic area around the mouth of the Elbow River where it enters the Glenmore Reservoir, and fish habitat, riparian areas, vegetation, and wildlife habitat.

Fish and Fish Habitat

The EIS indicated that no significant changes in sediment transport are anticipated; therefore there would be no alterations to the quality of fish habitat. The EIS also indicates that erosion in the outlet channel and the potential requirement for maintenance could result in alterations to fish habitat, increased turbidity, and the deposition of sediment in substrates in the outlet channel and in the Elbow River downstream of the low level outlet. DFO indicated that when sediment is released from the reservoir, it will likely be deposited downstream on areas that contain fish habitat.

In its responses to CEAA Annex 2: A) Early Technical Issues Question 5, the proponent commits to implementing adaptive management for TSS if levels are significantly greater than predicted. This qualitative description does not allow for a conceptualization of when TSS adaptive management measures would be implemented.

Additional information is required on sediment deposition (fine and coarse) and mitigation measures in order to understand potential effects to fish and fish habitat.

<u>Information Requests:</u>

a) Assess the environmental effects of a reduced frequency of inundation of the Elbow River downstream of the Project.

b) Clarify how coarse sediment and bedload transport downstream will be maintained if discharges greater than 160m^3/s will no longer occur, or will occur on a limited basis, in the Elbow River downstream of the diversion channel.

c) Assess the environmental effects from changes in sediment yields. Include:

- **Discussion on the importance of and Project effects to sediment deposition and resuspension dynamics within the diversion channel and Elbow River downstream of the low level outlet.**
- **Data on expected sediment mass that would be removed from the Elbow River under each flood scenario and a comparison to the annual sediment yield of the Elbow River.**
- **Explanation of whether the corresponding loss of sediment supply was accounted for in modelling potential changes in channel degradation/aggradation downstream of the diversion channel as a result of flood operations.**
- **Discussion on how sediment yields in the Elbow River may or may not be reduced over several decades, taking into account the probability of each flood scenario and the corresponding loss of sediment yield.**

d) Explanation of why effects of a 30% decrease in sediment yield in the Elbow River would be expected to be restricted to the local assessment area. Provide an assessment of potential effects to fish and fish habitat from the changes (regardless of significance) in sediment deposition from the Project, including:

- **An assessment of where sediment would be deposited downstream of the low level outlet channel, and on the type(s) of fish habitat it is predicted to settle on.**
- **A description of how the deposition of sediment on substrates could affect the quality of fish habitat in the low level outlet channel and in Elbow River downstream of the low level outlet.**

e) Provide a follow-up and monitoring plan for TSS, including:

- **A description of what adaptive management measures would be implemented for high levels of TSS and when they would be implemented.**

Response IR3-09

Background Information

The following statement is from the Context and Rationale: "The EIS stated that Project magnitude of effects to suspended sediment concentrations or yields were not determined because they are a direct consequence of the intent of the Project, which is flow diversion." This is a misunderstanding of the information presented. The relevant quote (Volume 3B Section 6.5) is the following:

"Determination of significance is not relevant for changes in hydrology because the purpose of the Project is to actively modify the hydrology of the Elbow River. However, as the hydrology is being intentionally modified and this modification would also change sediment transport, the significance of any resulting changes is assessed by other VCs."

a-b) The Project does not alter the frequency of floods, but the Project does alter the magnitude of peak floods up to the unlikely condition of the off-stream reservoir reaching full-service level. The Project is designed to alter flood-related environmental conditions in the river between the Project and Glenmore Reservoir. This includes preventing destructive effects associated with flood water flows and mass mobilization of bed sediments. The Project design does not alter the more frequent flows below 160 m^3/s, which are not diverted.

The environmental effects from diversion are primarily related to the forces that affect bed sediment transport (e.g., reduced shear stress during the larger floods) and, subsequently, the morphology and bed sediment composition of Elbow River. Stream flows below 1:2 year frequency (i.e., bankfull flood frequency) are primarily the flood frequencies that are responsible for maintaining channel shape (e.g., has the energy to form channel unit, gravel bars and maintain pool depths) and will be maintained for all flood diversions. Therefore, Elbow River channel morphology will maintain its baseline nature. Any potential changes in channel morphology that occur during a flood diversion are expected to be reversed during the next bankfull flow in the river.

Volume 3B, Section 6.4.4, page 6.52 provides a detailed discussion on the environmental effects of eliminating peak flood flows above 160 m^3/s. A summary of effects on morphology is described in Table IR9-1 (reproduced from Volume 3B, Section 6, Table 6-10, but with clarifying edits in red text).

Table IR9-1 Net Change in the Geomorphology of the Elbow River and Low-level Outlet (Unnamed Creek)

Flood	Location	Operation	Maximum Degradation (m)	Maximum Aggradation (m)	Range (m)	Change in Range with Diversion (%)
Design	Elbow River	without diversion	-2.55	2.66	5.21	-17
		with diversion	-2.44	1.89	4.33	
1:100 year	Elbow River	without diversion	-2.25	1.86	4.11	3
		with diversion	-2.20	2.03	4.23	
1:10 year	Elbow River	without diversion	-2.01	2.28	4.29	-24
		with diversion	-1.97	1.29	3.27	
Design	Low-level outlet (unnamed creek)	release	-0.56	0.40	0.96	NA
1:100 year	Low-level outlet (unnamed creek)	release	-0.56	0.46	1.02	NA
1:10 year	Low-level outlet (unnamed creek)	release	NC (-0.01)	NC (0.01)	(NC (0.01)	NA

NOTES:
NA: Not applicable
NC: No change

The only effect on fish habitat associated with eliminating peak flows greater than 160 m^3/s will be reduced mobilization on gravel bar heads and subsequent decrease in the magnitude of degradation and aggradation of those gravel bars. For all floods, erosion and deposition of bar heads will be maintained, although the reduction in magnitude of erosion and deposition will be as follows (Volume 3B, Section 8.2.2, Page 8.10):

- design flood will decrease 65% compared to without the Project
- 1:100 year flood will decrease 5% compared to without the Project
- 1:10 year flood will decrease 24% compared to without the Project

This quote is from Volume 3B, Section 8.2.2, page 8.11:

> "During floods, flows of approximately 160 m^3/s, which are close to the 1:10 year flood would continue in Elbow River downstream of the diversion structure. These flows are considered channel forming and would shift bed materials which would maintain overwintering and spawning habitat and shallow side-channel and nearshore rearing habitats. Given the low probability of the design flood and the 1:100 year flood, the reduction in magnitude of erosion and deposition is unlikely to occur at a frequency to negatively affect overwintering habitat, such as the scouring of pools and deeper runs for trout species, nor negatively affect spawning habitat in Elbow River. Sediment removal is likely to be an ongoing maintenance concern in the diversion channel and in the Elbow River immediately upstream from the auxiliary spillway and diversion structure.
>
> The reduction in floods over 160 m_3/s may cause a stabilization of banks and a corresponding increase in directly overhanging vegetation, However, due to the limited nature of this interaction and the presence of channel forming flows up to the 1:10 flood (160 m^3/s), the effect is likely to be not significant."

The force of water released from the reservoir will mobilize bed sediments and change the morphology of the unnamed creek. However, bed material is predicted to remain in the unnamed creek and minimal interaction with the Elbow River is expected (Volume 3B, Section 8.2.2, page 7.10). The transport and deposition of sediments from the release of water will result in a localized gravel fan at the confluence of the unnamed creek with Elbow River associated with three assessed floods:

- design flood gravel fan will be approximately 500 m^2 and approximately 0.05 m to 1.0 m deep.
- 1:100 year flood gravel fan will be approximately 150 m^2 and approximately 0.05 m to 0.17 m deep.
- l:10 year flood will not result in a gravel fan.

The predicted gravel fan size in each flood, as a result of diversion, is well within the expected range of aggradation and degradation of Elbow River. Any resulting gravel fan would interact with flow in the river and temporarily modify the location of the active channel of the river. However, the fan's extent and depth are unlikely to result in permanent alteration. As a result, any fan deposited at the confluence is transient in nature and subsequent higher flows in the Elbow River would remobilize the deposited material downstream. Based on the model results, no long-term effect is expected in Elbow River.

Increased suspended sediment concentrations and the deposition of sediment on substrates could affect the quality of fish habitat in the unnamed creek and in Elbow River downstream of its confluence with the unnamed creek. Given the low probability of diversion occurrence (less than once in ten years) and with the implementation of mitigation measures, the potential change in sediment and turbidity that may result downstream is not anticipated to result in residual effects on aquatic ecology, given the slow rate of draining water from the reservoir (Volume 3B, Section 8.3.2, page 8.12).

c) For the aquatic ecology LAA, the average annual yield ranges from 28,700 t to 39,700 t (Volume 4, Appendix J, Section 3, Figure 3-21).

   Changes in sediment yield are provided in Volume 3B, Section 6, Table 6-6. In summary, a 1:10 year flood has the probability of occurring of 10% each year. For this flood, 24,000 t of sediment yield would occur; 1,300 t would be diverted and 1,100 t returned to the river. This is about 4% of the average annual sediment diverted and about 3.5% of average annual returned amount for this 10% flood. The total change would be 0.5% x 10% or about 0.05% change on an annual basis. Over several decades, there would be expected to be little change in annual average sediment yield. The changes in aggradation and degradation with and without the Project is assessed by modelling and compared to the 1:10 year flood and is discussed in Volume 3B, Section 6.4.4.

   1:100 year and design floods have sediment yields in the range of 1,900,000 t to 4,800,000 t, respectively; however, these floods are rare (with a probability of occurring of less than 1% each year). The Project reduces the sediment yield by 50-65%, as shown in Volume 3B, Section 6, Table 6-6 (see Table IR9-2), compared to the sediment yield without the Project. These floods would not be expected to occur for over a several-decade time frame, so they would not be expected to change typical river morphology. When they do occur, they have a large effect on river morphology. The corresponding loss of sediment supply is accounted for in modelling potential changes in river channel degradation/aggradation downstream of the diversion channel as a result of floods. The changes in aggradation and degradation with and without the Project are listed in Table IR9-1.

Table IR9-2 Estimated Suspended Sediment Concentrations and Yields in the Elbow River, With and Without Diversion

Flood	Elbow River Peak Suspended Sediment Conc. Non-Diversion (g/m^3)	Diversion Channel Average Suspended Sediment Conc. (g/m^3)	Diversion Channel Peak Suspended Sediment Conc. (g/m^3)	Diversion Time (days)	Elbow River Suspended Sediment Mass Non-Diversion (kt)	Diversion Suspended Sediment Mass (kt)	Elbow River Suspended Sediment Mass Reduction (%)	Suspended Sediment Mass Released into the Low-level Outlet (kt)	Loss of Retention Volume Due to Sediment Remaining In Reservoir[4] (%)
Design[1]	139,682	18,709	89,166	3.75	4,819	2,389	50	90	1.1
1:100 Year[2]	77,649	19,228	74,715	1.80	1,943	1,268	65	220	0.5
1:10 Year[3]	4,818	1,258	2,064	0.38	24	1.3	5	1.1	0.0

NOTES:
[1] Period of diversion: 06/20/2013 04:00 h to 06/23/2013 22:00 h; Residence time: 06/24/2013 to 07/14/2013
[2] Period of diversion: 05/31/2100 05:00 h to 06/02/2100 02:00 h: Residence time: 06/02/2100 to 07/15/2100
[3] Period of diversion: 05/24/2008 15:00 h to 05/24/2008 23:00 h; Residence time: 05/25/2008 to 07/07/2008
[4] Based on full service volume of 77,771 dam^3 and assuming a sediment density of 2,650 kg/m^3

d) As discussed in a), a gravel fan may form at the confluence of the unnamed creek with Elbow River. Habitat for this section of the river is discussed in Volume 4, (Appendix M, Section 3.1.8, page 3.20 [Reach 6: Elbow River]). The Elbow River channel at this location is approximately 25 m to 38 m wide; in September 1016, it had a wetted width between 15 m and 22 m with depths up to 1.0 m. Fish habitat is comprised primarily of run habitat (i.e., R2 and R3 category types at 39% and 33% of total wetted area), riffles (i.e., at 20%) and pools (8%). A small side channel was present in this section of river.

Fish habitat is considered good for all resident fish in this section of the river (see Table IR9-3).

Table IR9-3 Fish Habitat in Elbow River in the Vicinity of the Confluence with the Unnamed Creek (Low-Level Outlet Channel)

Habitat Type	Forage Fish	Coarse Fish	Sport Fish
Spawning habitat	good	good	good
Overwintering habitat	good	good	good
Rearing habitat	good	good	good
Migration habitat	good	good	good

As discussed in a), deposited sediment resulting in a gravel fan would interact with flow in the river and potentially modify its morphology in the active channel. This would temporarily cover fish habitat within the extent of the gravel fan; however, the fan's extent and depth are unlikely to result in permanent habitat alteration. Any gravel fan deposited at the confluence will be transient in nature; subsequent higher flows in Elbow River would remobilize the deposited material downstream and reform the river channel to pre-flood conditions. Based on the model results, no long-term effect is expected in the river.

e) Water quality monitoring will be done in the reservoir prior to discharge and in the unnamed creek. Details of the monitoring plan are provided in the response to CEAA IR1-2, Appendix IR2-1; see Section 9.5.3 (Turbidity and Suspended Solids).

Suspended sediment concentrations being released from the reservoir will be controlled by adjusting or closing the outlet gate at the base of the reservoir to alter the flow rate.

AEP will manage the release rate in a manner that mitigates effects to water quality in the Elbow River. Operational flexibility provides AEP with the ability to manage how water is returned to the Elbow River while controlling factors such as sediment release.

Question IR3-10: Project Operation – Water Retention in the Reservoir

Sources:

EIS Guidelines Part 2, Sections 3.1; 3.2.2; 6.1.4

EIS Volume 1, Section 6.3

EIS Volume 3B, Section 6.4

Rocky View County – Comments on the EIS, June 15, 2018 (CEAR #571)

Context and Rationale:

The EIS Guidelines require the proponent to describe the operation of key Project components and a schedule for all Project activities including a water management plan for Project operation. Further, the EIS Guidelines require the proponent to present information on multiple components of hydrology of the Elbow River watershed and describe any changes from the Project to water quality and quantity.

The EIS states that water from the reservoir will be tested prior to draining and concentrations will need to meet the Alberta Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines prior to release back into the Elbow River. However, if the residence time increases to mitigate potential effects to water quality, this could have additional effects associated with seasonality, post-flood maintenance, and future flood capacity.

Table 6-4 of the EIS indicates that in the design for 1:100 year and 1:10 year floods, there will be a percentage of the volume of water remaining in the reservoir after release. Figures 6-11 and 6-16 in the EIS suggest that the reservoir levels for the 2013 design flood and 100-year floods were nearly the same at the end of release, and the steep ends of the drawdown curves suggest that the low-level outlet would have been closed before the reservoir is empty. The EIS also indicates that the low-level outlet will remain open to allow the unnamed creek to flood through during the dry and post-flood operation. Details of the routing analysis are needed to understand the reservoir release curves as they may not be representative of the actual operation and it is not clear what release decisions were applied in the model to produce those curves.

Additionally, the EIS notes that there are some depressions in the reservoir area. If those depressions cannot be drained, resulting limitations to storage capacity should be considered, as they would be filled with local runoff before the flow diversion operation.

Understanding retention within the reservoir is required to accurately assess potential effects, including effects to water quality, fish and fish habitat, land use, physical and cultural heritage, and impacts to rights.

Information Requests:

a) **For each flood scenario, provide details on how long the proponent intends on retaining water within the reservoir in order to meet the CCME Water Quality Guidelines, and the potential effects to VCs from doing so.**

b) **Provide the volumes, depths, and surface area of water expected to be pre-existing in depressions in the reservoir pre-diversion and remaining in the reservoir post-release for each flood scenario. Describe where this water would be stored, the time will take for this water to dry out or be released, and the potential effects to VCs.**

c) **Given the information requested above, provide a table with values demonstrating the total retention time for each flood scenario (including retention during flooding, draw down time, and additional time needed for any water left in the reservoir after release to dry out or be released).**

Response IR3-10

a) The water quality assessment is based on the maximum reservoir residence time (including time to release water to empty reservoir) for each flood, as listed in Table IR3-10 (Volume 3B, Section 6, Table 6-4). The actual release rate, however, will be dependent on a variety of factors, including conditions in the river at the time of release.

b) There is no permanent water pre-existing in depressions in the reservoir and there is generally positive drainage (i.e., water flow from higher to lower elevations) through the unnamed creek. There are some wetlands that may hold shallow water seasonally or semi-permanently, and some human-made dugouts that are likely permanently flooded. It is expected that the wetlands would hold water post-release, which would be similar to conditions without the Project following a flood. Other depressions may hold a very small amount of water post-release, but that water would be shallow and would evaporate quickly. Water retention in wetland communities depends on a variety of factors and cannot be easily calculated; however, wetland communities are expected to persist post-flood (i.e., they will continue to retain some amount of water) as described in Volume 3B, Section 10.2.2. Effects on vegetation and wetlands from inundation during flooding are described in Volume 3B, Section 10.2.2, and Project residual effects on vegetation community diversity, traditional plant use and wetland functions are not anticipated because plant communities are expected to recover post-flood.

c) Table IR10-1 is updated from Volume 3B, Section 6, Table 6-4, with clarifying edits in red text provides information (a clarifying edit has been added to the last column in red text) on the retention time and release time for each flood. It does not include additional time needed for water left in the reservoir after release to dry out because this amount of water is expected to be negligible and has no expected effects on valued components (VCs).

Table IR10-1 Volumes Diverted, Retained in the Reservoir and Released back to the Elbow River (updated Volume 3B, Section 6, Table 6-4)

Flood	Elbow River Volume Non-Diversion (dam³)	Volume Diverted (dam³)	Elbow River Volume Reduction During Diversion (%)	Diverted Volume / Annual Volume[4] (%)	Diversion Time (days)	Residence Time in Reservoir (days)	Modelled Release Rate (m³/s)	Release Time (days)	Volume Released[5] (dam³)	Diverted Volume Remaining In the Reservoir (%)
Design[1]	113,985	55,138	48	11.2	3.75	20	20.01	38	54,380	1.4
1:100[2]	58,933	33,014	56	5.4	1.8	43	11.31	39	32,680	1.0
1:10[3]	6,017	790	14	0.2	0.38	43	0.27	30	654	17

NOTES:

[1] Period of diversion: 06/20/2013 04:00 h to 06/23/2013 22:00 h; Residence time: 06/24/2013 to 07/14/2013

[2] Period of diversion: 05/31/2100 05:00 h to 06/02/2100 02:00 h: Residence time: 06/02/2100 to 07/15/2100

[3] Period of diversion: 05/24/2008 15:00 h to 05/24/2008 23:00 h; Residence time: 05/25/2008 to 07/07/2008

[4] Based on actual WSC Record at Sarcee Bridge for design flood and 1:10 flood; modelled annual data for 1:100 flood. Calculated annual flow volumes are 2013 flood, 490,136 dam³; 1:100 year flood, 613,411 dam³; and 1:10 year flood, 380,797 dam³

[5] Does not include evaporated volume

PROJECT COMPONENTS

Question IR3-11: Project Components – Channel Improvements

Sources:

EIS Guidelines Part 2, Section 3.2; 6.1.4; 6.1.5; 6.2.2; 6.3.1

EIS Volume 1 Section 2.2.5

EIS Volume 3A Section 6.5.2

Rocky View County – Comments on the EIS, June 15, 2018

Fisheries and Oceans Canada – Comments on the EIS, June 19, 2018

Context and Rationale:

The EIS Guidelines require the proponent to describe Project activities for the different phases of the Project. Further, the EIS Guidelines require the proponent to present information on multiple components of hydrology of the Elbow River watershed, including those that affect water quality and quantity and fish and fish habitat.

The EIS states that two alternatives were considered for construction and operation of the low level outlet channel (to drain water from the reservoir back into the Elbow River): upsizing the existing unnamed creek to convey peak design flow to the Elbow River and delaying reshaping the unnamed creek channel until it is necessary.

Due to the design discharge from the low level outlet (27 m^3/s) and the current capacity of the unnamed creek (approximately 1 m^3/s), improvement and restoration of the unnamed creek and the Elbow River downstream of the low level outlet would be required as soon as a major flood occurs. The EIS states that most maintenance on the unnamed creek will occur after a large flood event so that the effects to the unnamed creek can be evaluated for damage. This is because there may be the possibility of less extensive damage to the unnamed creek and adjacent environment from the flood than would occur when upsizing to a design flood. Currently, only regrading on the unnamed creek to convey flows away from critical infrastructure is planned.

The release of large flows into the unnamed creek and Elbow River is expected to produce significant degradation (erosion, sediment loading, etc). The highest sediment depths are expected to occur close to the low level outlet (up and downstream of the outlet). The unnamed creek will have limited or no flow again until the sediment has been removed from its channel

upstream of the low level outlet. If the sediment is not removed, what flow does occur through the unnamed creek will deliver high concentrations of fine sediment to the Elbow River each time it rains. As the Project does not include the improvement of the unnamed creek and Elbow River up and downstream of the low level outlet until after a flood, the increased flow may affect morphology and sediment loading.

Additional information is required to understand effects on hydrology, water quality and quantity, and fish and fish habitat associated with the construction and operation of the low level outlet channel.

<u>Information Requests:</u>

a) **Provide a rationale for not conducting maintenance on the unnamed creek to enable the accommodation of flood flows prior to a flood event.**

b) **Assess the potential environmental effects from the release of large flows into the unnamed creek and the Elbow River channel downstream of the low level outlet, particularly from bedload transport.**

c) **Describe the potential improvement and restorations (design and costs) needed, proposed timing of the works, and the potential environmental effects from any channel improvements or restorations within the unnamed creek and the Elbow River up and downstream of the low level outlet.**

Response IR3-11

a) Volume 1, Section 2.2., page 2.26 provides the rationale for the recommended approach:

> "Upsizing the existing stream during construction would result in reshaping the channel, likely to the size of a design flood. This would include the addition of armouring of the channel and would affect the aquatic ecosystem of the stream. The riparian conditions along the stream would be altered with the likely removal of vegetation paralleling the stream. The upsizing would involve instream work and offer the potential for erosion of sediment into the stream and downstream to the Elbow River.
>
> If stream maintenance were to be postponed until a large flood had occurred and the extent of stream damage following reservoir draining had been evaluated, effects to the stream and adjacent environment may be less extensive that those for a design flood."

The alternative, wherein the unnamed creek would be engineered by reshaping and armouring, is not described or characterized in the assessment, but it is provided as follows.

In order to convey and control the release of water from the reservoir for the maximum designed release rate of 27 m^3/s, the design of an engineered channel would be approximately 15 m wide and 1.5 m deep. This 1,800 m channel would require approximately 40,000 m^3 of excavation and 9,000 m^3 of riprap channel protection. To provide construction access, an estimated six hectares of area would need to be cleared and grubbed.

By contrast, maintenance of the unnamed creek (low-level outlet channel), following the release of water from the reservoir after a flood, would be more limited. The existing creek channel is undersized for the expected design flood discharge; therefore, within this section there could be erosion of the beds and shores. However, the existing channel is nested within a larger floodplain valley that is vegetated with forest and shrub. Overbank flows within the floodplain has lower shear stress and erosive power as shown in Figures IR11-1 to IR11-3. Root mass from the vegetation may provide erosion protection within the floodplain area. Maintenance may be provided by smaller equipment that can access the stream banks without wide-scale vegetation removal. This will reduce impacts to the creek.

b) Changes in morphology in the Elbow River would likely take the form of reduced mobilization on bar heads, decreases in degradation and aggradation and potentially changes in channel planform. During release, high magnitude changes to geomorphology are expected in the unnamed creek. However, most of the mobilized bed material is predicted to remain within the unnamed creek and minimal interaction with Elbow River would occur.

The net change in aggradation and degradation for the unnamed creek and for Elbow River (from the location of the diversion inlet to Glenmore Reservoir) for each flood is summarized in the response to IR3-09, Table 9-1. The net change in aggradation and degradation in the unnamed creek suggests that the geomorphological effect would be similar for both the design and 1:100 year flood. Although a higher release rate and volume is associated with the design flood, most of this flow would be overbank and not in the active channel. As a result, the actual flows contained in the unnamed creek would be at bankfull for the same period for the design flood and 1:100 year flood, hence the similarity in net change. For the 1:10 year flood release, there is a much lower net change. The net change in aggradation and degradation in the unnamed creek suggests that the geomorphological effect would be similar for both the design and 1:100 year floods. Although a higher release rate and volume is associated with the design flood, most of this flow would be overbank and not in the unnamed creek. Given that the floodplain is heavily vegetated with high roughness values, the reduction is a result of less than bankfull flow reducing degradation/aggradation during release.

c) Proposed maintenance measures for the unnamed creek following a flood may include a variety of bank stabilization and vegetation restoration strategies, such as:

- bank grading that reduces the steepness of channel slopes
- bio-engineered bank stabilization with erosion blankets and live branch layering
- rock toe and bank armouring
- grade control riffle or rock structure

These strategies typically range in cost from $1,000/metre to $3,000/metre for streams of this size and dependent upon location in the profile (e.g. riffle versus rock toe).

Maintenance measures would occur during post-flood operations and at a period when the outlet structure is closed and no water is flowing within the unnamed creek. There is expected to be few environmental effects but may include temporary loss of ephemeral riparian and wildlife habitat. It is not expected that any of these measures would need to extend into the Elbow River channel.

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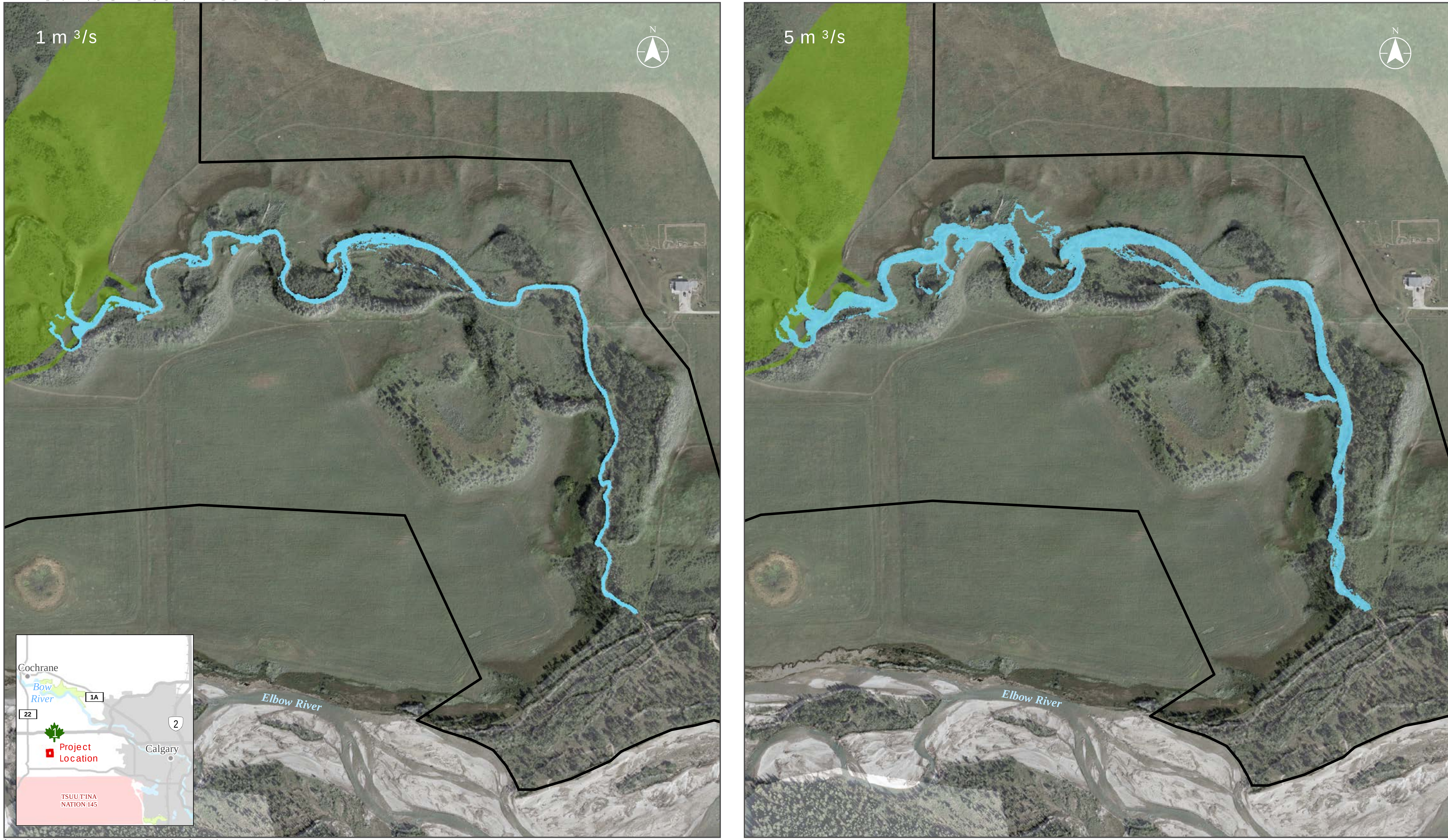

Sources: Base Dat & Imagery - Government of Alberta; Thematic Data - Stantec Ltd.

Flood Extent
Major Component of the Project
Project Development Area

Flood Extent Data Created: 20160912

0 75 150 225 300
metres

110773396-770 REVA

NAD 1983 3TM 114

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Flood Extents at the Outlet Channel for $1\ m^3/s$ and $5\ m^3/s$

Figure IR11-1

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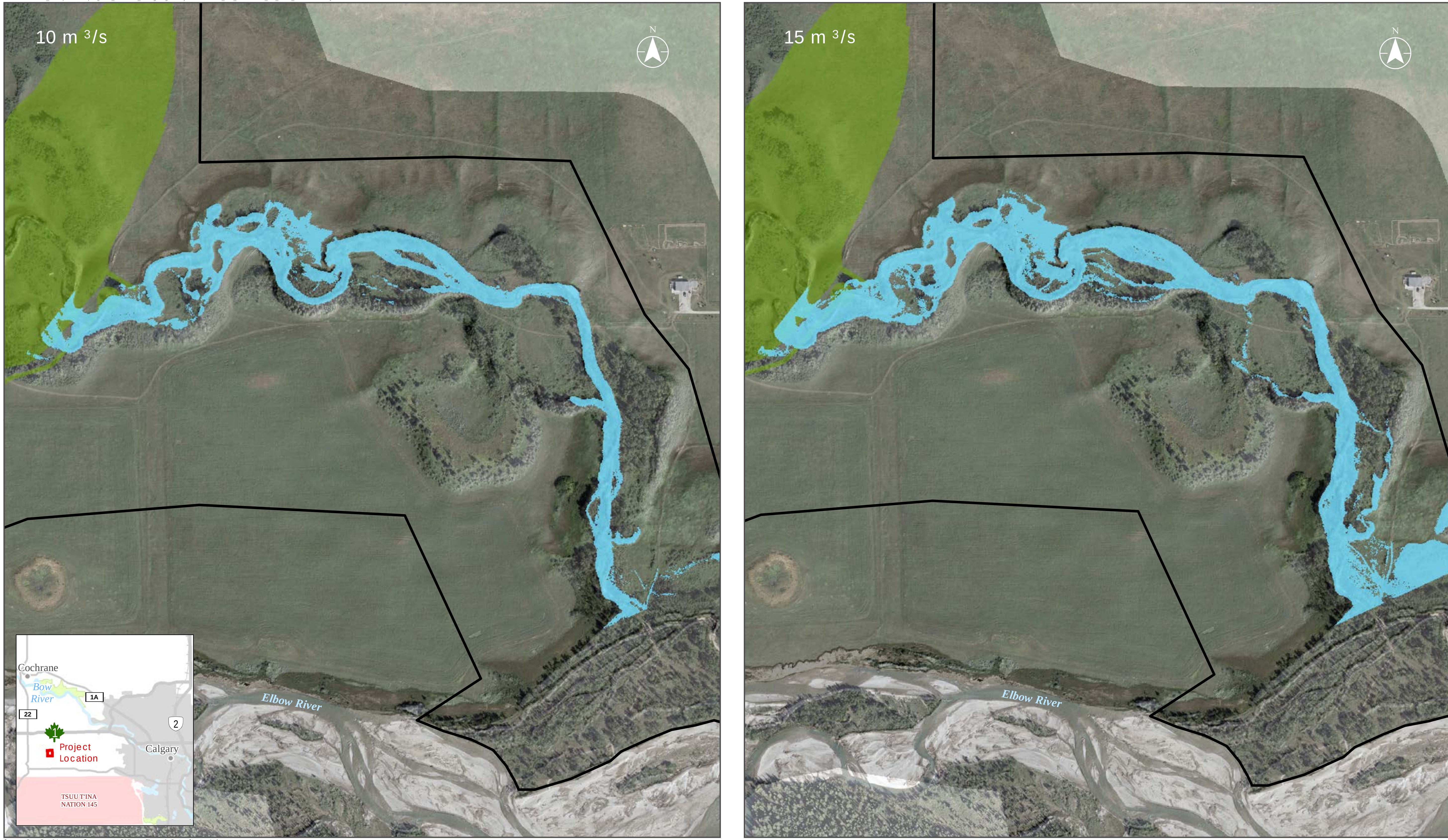

Sources: Base Dat & Imagery - Government of Alberta; Thematic Data - Stantec Ltd.

Flood Extent
Major Component of the Project
Project Development Area

Flood Extent Data Created: 20160912

0 75 150 225 300
metres

110773396-771 REVA NAD 1983 3TM 114

Flood Extents at the Outlet Channel for 10 m^3/s and 15 m^3/s

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Figure IR11-2

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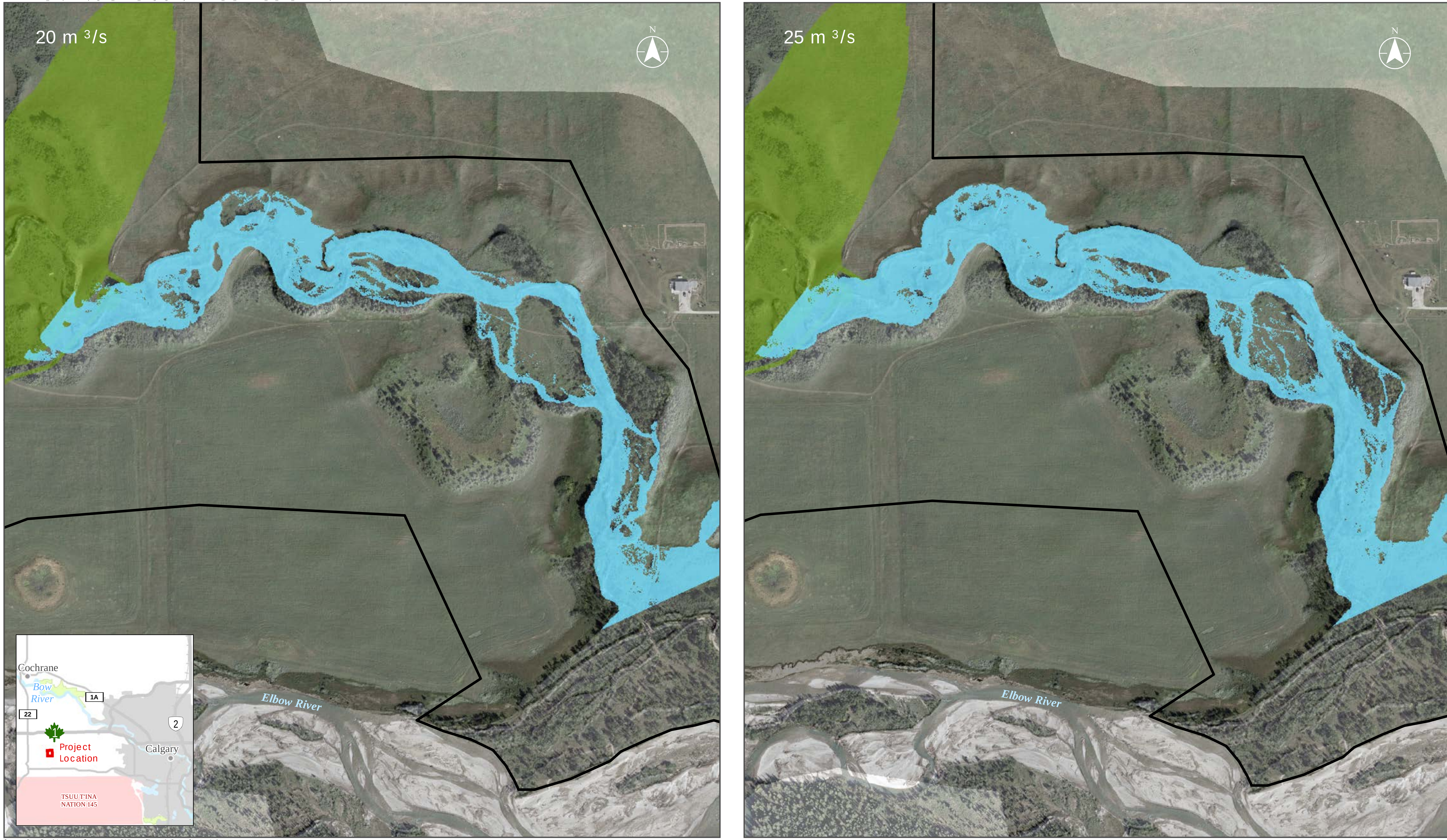


Sources: Base Dat & Imagery - Government of Alberta; Thematic Data - Stantec Ltd.

Flood Extent
Major Component of the Project
Project Development Area

Flood Extent Data Created: 20160912

0 75 150 225 300
metres

110773396-772 REVA

NAD 1983 3TM 114

Flood Extents at the Outlet Channel for 20 m^3/s and 25 m^3/s

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Figure IR11-3

EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Question IR3-12: Effects of the Environment on the Project – Maintenance

Sources:

EIS Guidelines Part 2, Sections 3.2.2; 6.6.2; 8

EIS Volume 1 Attachment A, Table A-5, pp.A.30

EIS Volume 3C, Section 2

Rocky View County – Comments on the EIS, June 15, 2018 (CEAR #571)

Context and Rationale:

The EIS Guidelines require the proponent to describe ongoing and post-flood recovery and/or maintenance of each Project component and to provide details of planning, design, and construction strategies to minimize the potential effects of the environment on the Project.

These information requirements are interrelated as maintenance activities may serve to mitigate the effects of the environment on the Project. The EIS states that design mitigation measures were incorporated into the Project but provides limited details as to which features specifically mitigate effects of the environment on the Project. The EIS indicates that a Project-specific inspection and monitoring plan for geotechnical conditions will be developed and provides high level commitments to monitoring and adherence to standards. Post-flood repair and maintenance activities are generally described. Servicing the overflow gate structure and any in-stream components may require river flow management, including isolation of the site using cofferdam, dewatering, flow diversion, etc. Additional information is required on potential in-stream maintenance activities, the potential effects to valued components, and the associated regulatory requirements.

The future development of a Project-specific maintenance, inspection and monitoring plan does not allow for a conceptualization of potential effects from or mitigated by specific maintenance activities, such as removal of debris and sediment from the outlet components. Additional details are required in order to assess potential effects to valued components, specifically hydrology, hydrogeology, wildlife and biodiversity, and fish and fish habitat.

Information Requests:

a) **Provide details on dam integrity monitoring and ongoing maintenance activities for the floodplain berm, to account for potential effects of the environment on the Project..**

b) **Provide additional information on post-flood repair and maintenance activities including a list of any in-stream maintenance activities that may be required, the potential effects to valued components, and any associated regulatory requirements.**

Response IR3-12

a) The floodplain berm is an earthen embankment with riprap erosion protection on the upstream slope, gravel road on the crest and grass vegetation on the downstream side.

Dam integrity monitoring will consist of regular visual inspection of the embankment, including (at a minimum) once a year prior to flood season and after flood diversions. The visual inspection will identify signs of erosion, slope stability concerns, settlement, rodent burrows or other physical damage. Identified issues that could affect the operations of the structure will be corrected.

Ongoing maintenance will include grass cutting to prevent the development of woody vegetation on the embankment. Additional maintenance may include re-grading of the gravel access road, replacement of riprap and repairs to erosion rills on the surface.

b) Post-flood sediment and debris removal from the riverbed will only occur if the sediment or debris is affecting the operability of the Project, or if it impedes navigation, fish passage or aquatic connectivity. This activity is expected to occur in the post-flood period. As stated in Volume 1, Attachment A, Section A.5.2, post-flood repair and maintenance activities that require instream work will be isolated and completed in the 'dry' wherever possible. Instream isolations will be the responsibility of maintenance contractors and will follow mitigation measures such as those identified below (a detailed listed of mitigation during instream work is in Section A.5.2, Page A.31-A.40):

- Eroding or exposed areas will be stabilized with appropriately sized, clean rock. Rock will be installed at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment.
- The area of instream footprints of isolations will be reduced.
- The duration of all work done below the highwater mark of watercourses will be minimized.
- Appropriate isolation materials and designs will be used to reduce disturbance to the beds and shores of the watercourse or water body.

- Before isolation and dewatering works commence, applicable permits will be obtained for relocating fish and capture fish trapped within an isolated/enclosed area at the work site and safely relocate them to an appropriate location in the same waters.
- Accumulated sediment and excess spoil will be removed from the isolated area before removing the isolation.
- Pumping systems will be sized to accommodate any expected flows of the watercourse during the construction period.
- Pumps will be monitored at all times, and back-up pumps should be readily available on-site in case of pump failure.
- Pump discharge area(s) will be protected to prevent erosion and the release of suspended sediment downstream. This material will be removed when the works have been completed.
- When removing the isolation, the instream dams will be gradually removed first, to equalize water levels inside and outside of the isolated area and to allow suspended sediments to settle. During the final removal of isolation, the original channel shape, bottom gradient and substrate will be restored at these locations.

The nature of post-flood activities is similar to those of construction; therefore, similar pathways of effects have been assessed as part of Project construction. The mitigation provided for construction activities would also be applied for post-flood operations but would be less than those associated with construction because most maintenance activities occur in the dry. AEP would seek approvals under the *Water Act*, *Fisheries Act* and a Provincial Fish Research License, as required, and dependent on the nature of the removal. The duration of any clean up activity is expected to take up to one week for a heavy sediment and debris load. This activity would be completed following a diverted flood if it generates sufficient amount of sediment and debris to require cleanup.

BEDLOAD SEDIMENT ACCUMULATION

Question IR3-13: Bedload Sediment Accumulation

Sources:

EIS Guidelines Part 2, Section 6.2.2

EIS Volume 1 Attachment A, Section 2.2.2.2

Rocky View County – Comments on the EIS, June 15, 2018 (CEAR #571)

Context and Rationale:

The EIS Guidelines require the proponent to present information on changes to groundwater and surface water, including changes to sediment quality and quantity.

Rocky View County indicated that when the Obermeyer (overflow) crest gates are raised during the flood operation, there is the potential to stop bedload transport until sediment accumulates up to the top of the gates. This may affect the discharge capacities of the service spillway and diversion inlet and result in bedload entering and accumulating in the diversion channel. Accumulated sediment may also increase the structural load on the gates.

The Water Management Plan in the EIS indicates drawbacks to the Obermeyer crest gate which include its inability to pass bed load during floods; this would be partially mitigated with the addition of the adjacent sluiceway which passes flow and sediment. Additional detail regarding bedload sediment accumulation and continuity of bedload transport is required to understand potential environmental effects related to sediment accumulation, movement, and discharge.

Information Requests:

a) Discuss how bedload sediment accumulation in front of the Obermeyer crest gates would affect river morphology and the performance, capacity, and integrity of the service spillway, diversion inlet, and gate structure.

b) Discuss the effectiveness of the sluiceway in providing continuity of bedload transport.

Response IR3-13

a) Bedload sediment transport during flood operations was assessed using a 1:16 scale physical model and a 2D numerical hydraulic model. The model studies assessed the effectiveness of the design during a design flood under conservative assumptions (i.e., the high bedload transport rates). The physical model provided initial feedback on early design concepts and provided confirmation on the performance of the numerical model.

The 2D numerical model was utilized to evaluate the latest design layouts for longer simulation periods. The physical model provided validation of the numerical model.

BEDLOAD TRANSPORT RATES

An analysis of the bedload materials in the immediate vicinity of the diversion structure and bedload rating curves for the Elbow River were developed as inputs for the physical and numerical sediment transport modelling.

Four bar samples were collected from near the site of the diversion structure using methods described in Rosgen (2006). A composite grain size distribution of the four samples is presented in Table IR13-1. The estimated median particle size (D50) is 26 mm.

Table IR13-1 Composite Grain Size Distribution of Four Bar Samples

Grain Size (mm)	% of Particles by Weight Finer
2	7.5
4	10.5
8	16.5
16	37.4
31.5	56.9
63	85.8
120	100

Eight sediment transport equations were reviewed for developing bedload sediment rating curves. Three were selected as most applicable to the diversion structure site, based on site geology and hydrology and published literature. These selected methods for evaluation included the Meyer-Peter and Müller (1948) sediment transport equation, the Bagnold (1980) sediment transport equation, and the Wilcox and Crowe (2003) sediment transport equation. Figure IR13-1 shows the bedload sediment rating curves using an average channel roughness value (n) of 0.045 for each of these equations.

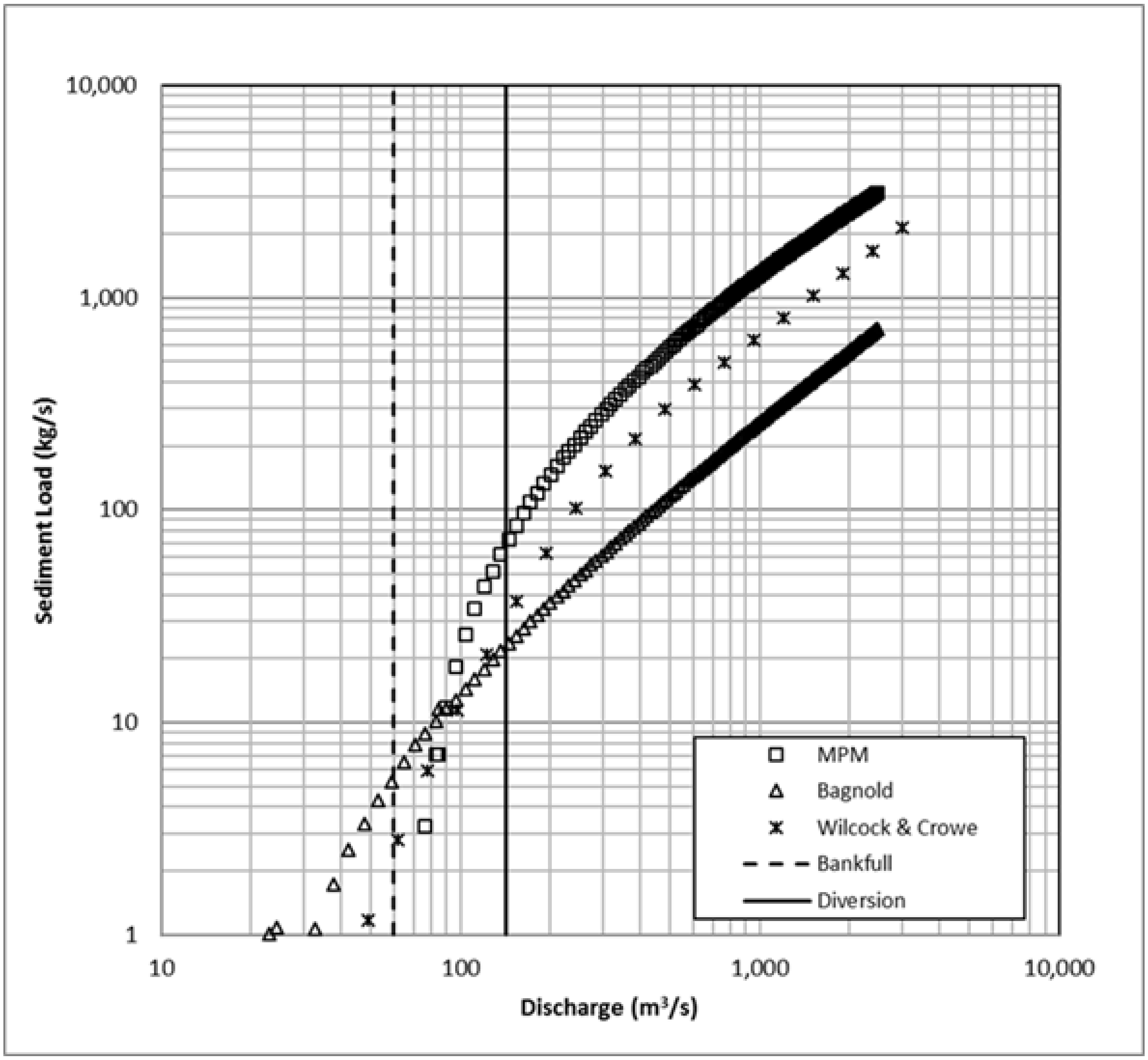


Figure IR13-1 Elbow River Predicted Sediment Rating Curve at the Diversion Structure

The Meyer-Peter and Müller (MPM) equation produced the most conservative estimates (i.e., highest bedload volume per flow rate) and was selected for use in the physical modelling and numerical modelling. Based on Figure IR13-1, the estimated loading rates are 300 kg/s at 320 m^3/s (approximately1:25 year flood), 950 kg/s at 760 m^3/s (approximately1:100 year flood), and 1,600 kg/s at 1,240 m^3/s (design flood).

Physical Hydraulic Model

The diversion structure physical hydraulic model was used to assess performance during a limited period of sediment loading. The Physical Model Study report by the National Research Council (NRC) Canada is provided as Appendix IR13-1. Due to the large predicted bedload volume and equipment limitations at the NRC laboratory, a long-term simulation of sediment performance in the physical hydraulic model was not possible. The short-term results were used as a check against the results of the numerical bedload transport model.

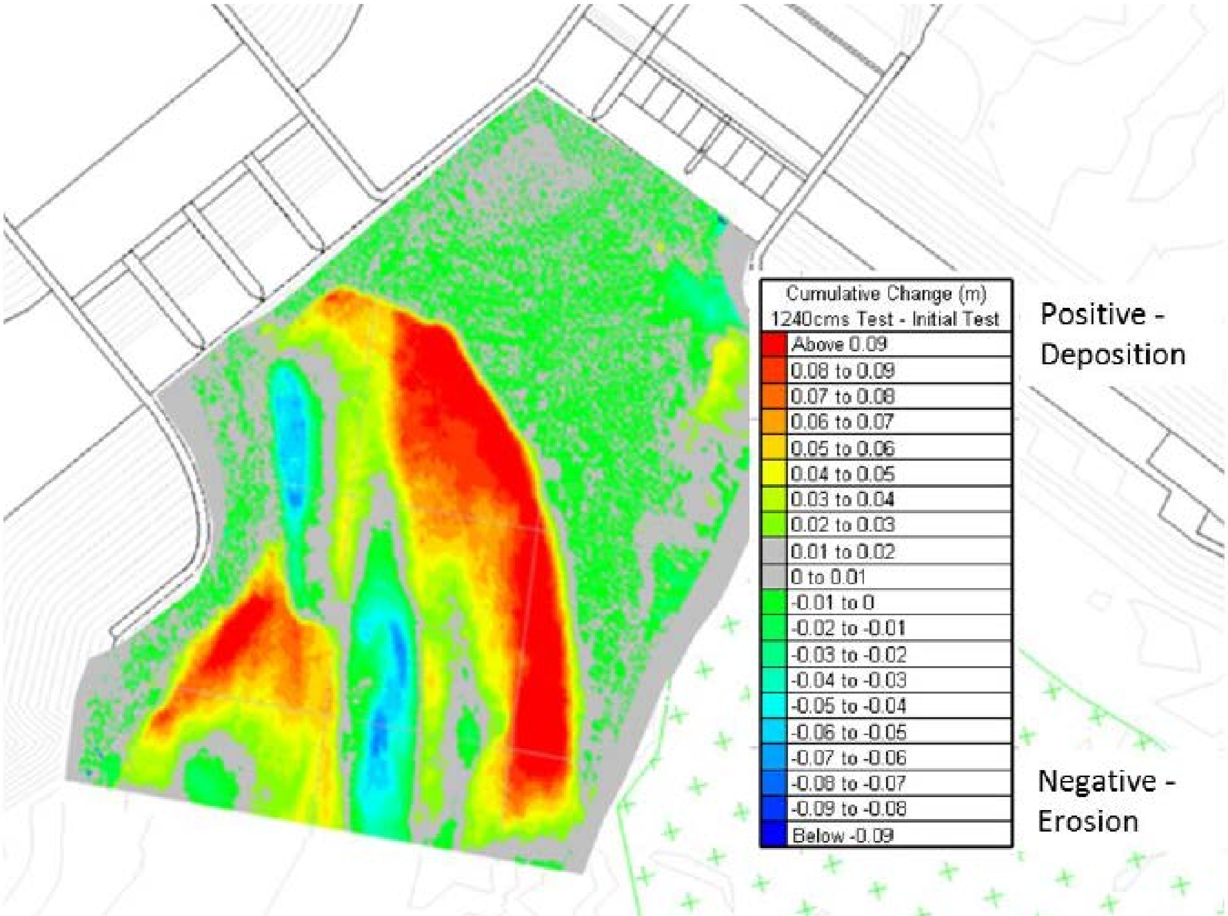
Grain size distribution and bedload feed rates for the model were developed based on the composite grain-size distribution and the MPM loading rates. Sediment particle sizes were scaled based on the model scale and Shields' equation for particle mobility. Due to the limitations of the model size and equipment at the laboratory, a truncated grain size distribution was selected for use in representing the upper 50 percent of the curve.

In the physical model, sediment was loaded at the upstream end using mechanical sediment spreaders. The river channels and forebay area upstream of the diversion structure were pre-loaded with sediment.

Sediment transport simulations were completed for discharges at 320 m^3/s, 760 m^3/s and 1,240 m^3/s. Sediment transport simulations were run until sediment spreaders were emptied. In full scale minutes (i.e., full scale means, the actual operation of the Project). Sediment transport simulations proceeded from the lowest flow rate to the highest flow rate in the river. Between each simulation, the physical model was drained and 3D laser scanning equipment was used to measure changes in the mobile bed before and after each sediment run.

The largest measured bed changes upstream of the diversion structure were observed during the 320 m^3/s simulation, which indicated deposition of sediment in the diversion structure forebay as a bar curving toward the diversion inlet. During the 760 m^3/s simulation, only minor changes to the bed geometry was observed because most of the sediment remained near the sediment loading locations. The 1,240 m^3/s simulation showed slight increases to the depositional bar feature in the forebay area. However, the development of scour holes were observed adjacent to the left and right abutments of the modelled diversion structure.

During the simulations, most of the bed sediment remained upstream of the diversion structure. Small quantities of bedload sediment that passed through the modelled diversion inlet deposited immediately downstream of the chute blocks. In summary, sediment is predicted to deposit upstream of the gates and in the pattern shown in Figure IR13-2 (i.e., the cumulative change in bed geometry after all simulations).



NOTE: cms = m^3/s

Figure IR13-2 Physical Model Mobile Bed Cumulative Change at the 1/16 Model Scale

2D NUMERICAL HYDRAULIC MODEL

The diversion structure 2D sediment transport numerical model is used to assess performance of the design during extended periods of sediment loading that are anticipated during the design flood.

2D numerical modelling was developed using RiverFlow2D Plus, version 5.1 model software developed by Hydronia, LLC.

Figure IR13-3 displays the model domain that includes portions of Elbow River, diversion structure, and the diversion channel. The downstream boundary of the diversion channel is at the entrance to the off-stream reservoir.

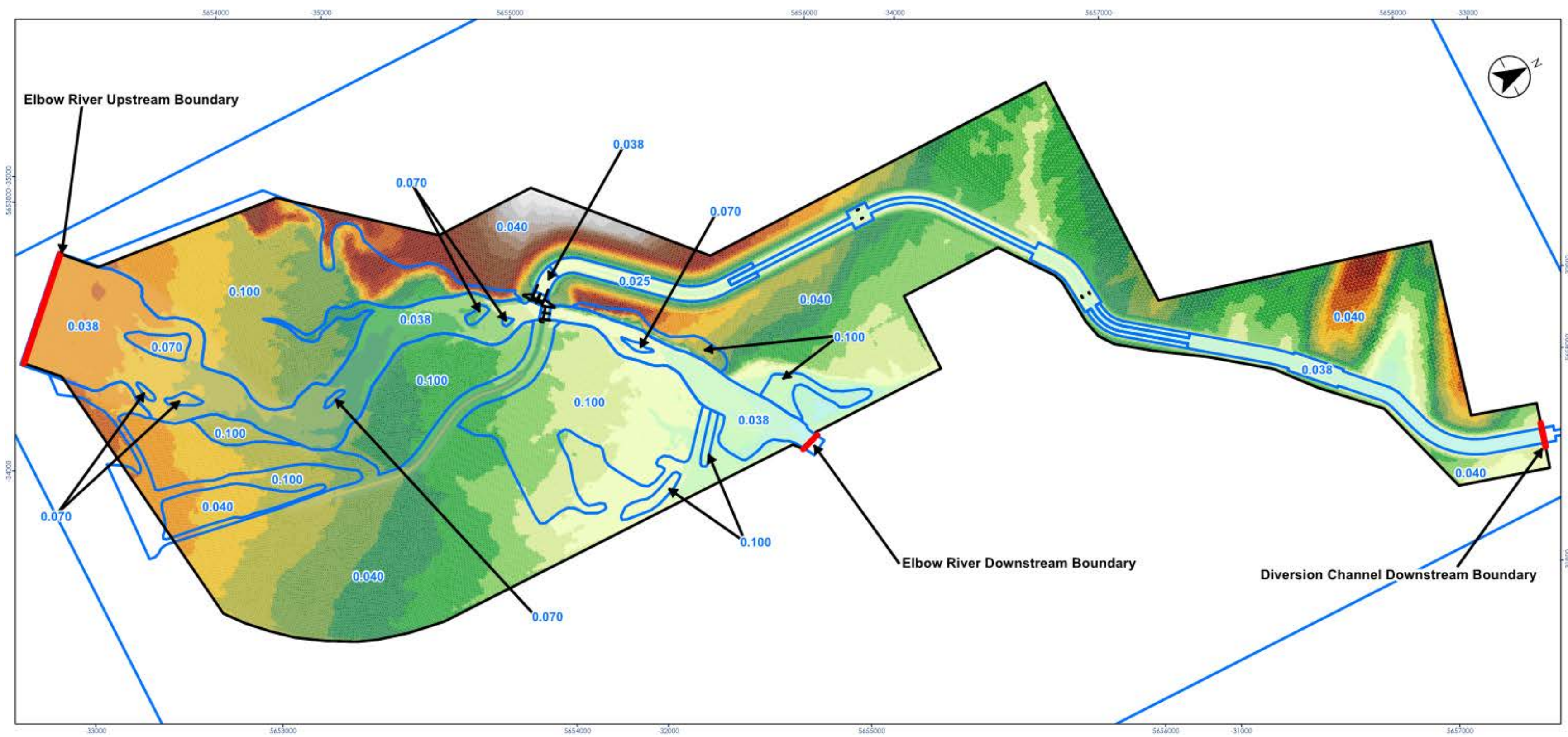


Figure IR13-3 Diversion Structure 2D Model Domain

The model domain comprises a triangular mesh with elevations assigned from a digital terrain model. Model mesh elements vary in size depending on the complexity of the terrain and detail of proposed Project features. The design mesh for the sediment transport modelling is composed of approximately 45,000 elements. Gate settings for both the diversion inlet and service spillway were selected based on the settings for the 1:100 year flood at the maximum diversion capacity of 600 m^3/s.

Sediment transport simulations were performed for a constant flow rate in the river of 760 m^3/s with a diversion rate of 600 m^3/s. This condition represents the greatest backwater effect during flood operations and represents the dominant flow rate in the June 2013 flood. Figure IR13-4 provides a comparison of water surface profiles for a range of peak flow rate values. Figure IR13-5 illustrates the proposed simulation flow rate and selected durations in comparison to the June 2013 flood hydrograph.

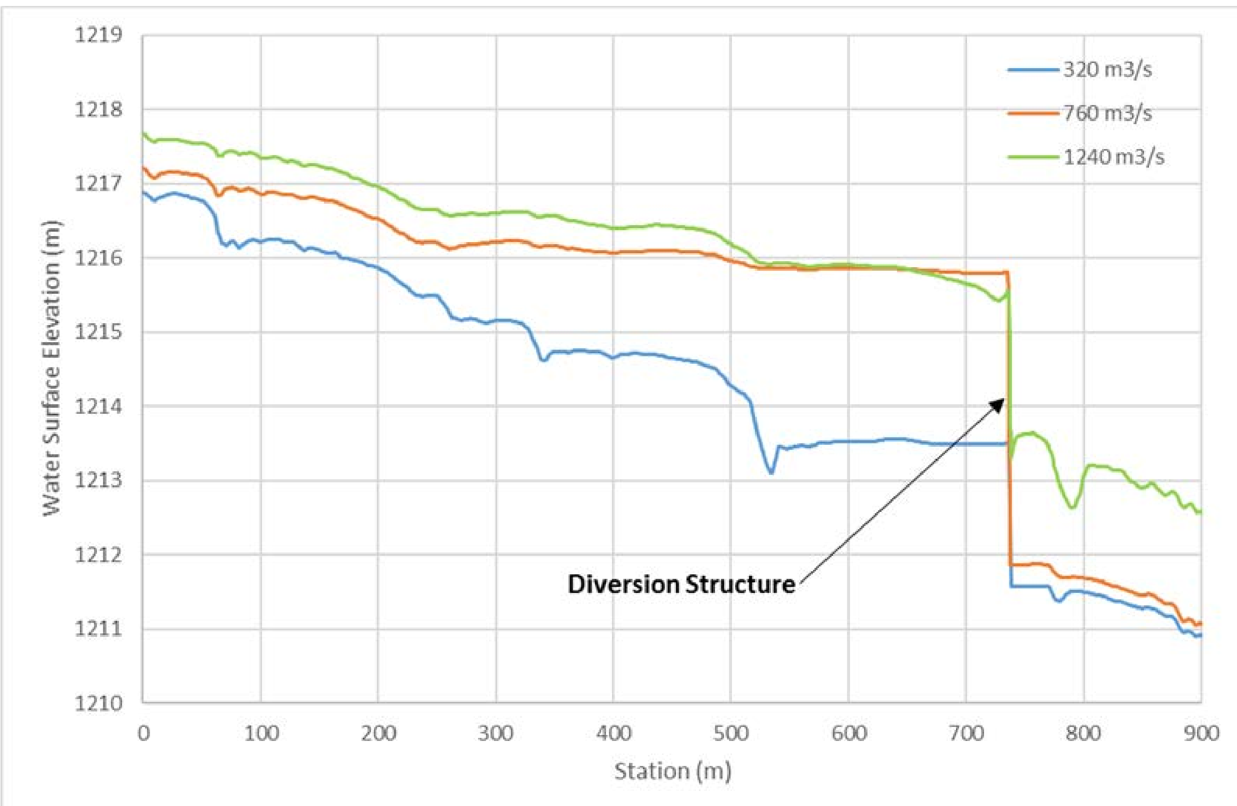
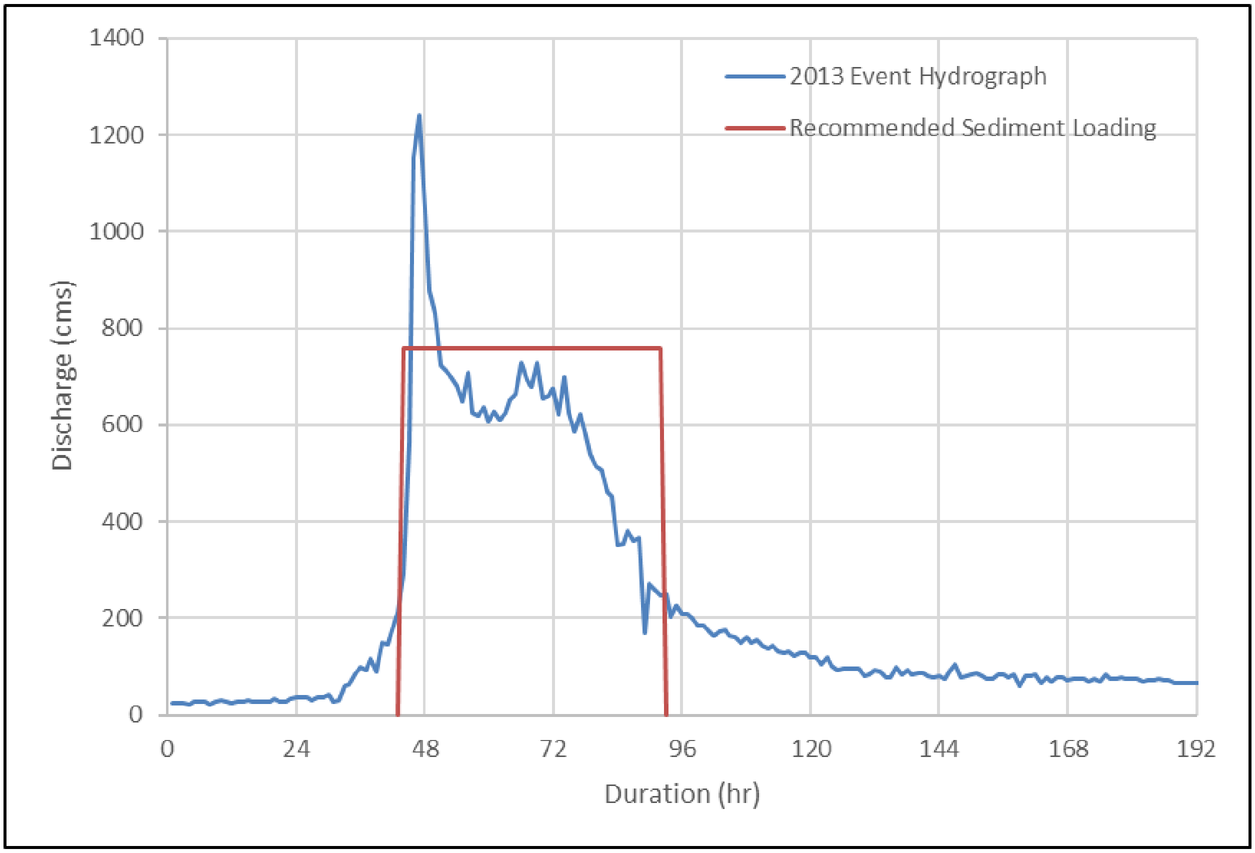


Figure IR13-4 Comparison of Diversion Structure Head Pond During Various Discharges



NOTE: cms = m^3/s

Figure IR13-5 Sediment Loading Simulation

The model was run for a total duration of seven days. The desired duration of sediment loading at the diversion structure is two days (as illustrated by the red box in Figure IR13-5); however, three days is required for the modelled sediment-load to travel from the upstream boundary of the model to the diversion structure because it represents a state of dynamic equilibrium in between. This means that the "true" sediment loading period occurs from Day 3 to Day 5 of the simulation. An additional two days were added to evaluate continued performance beyond the two-day duration.

Bedload sediment transport methods and inputs within the 2D hydraulic model are consistent with recommendations from the physical model. The MPM equation was selected as the transport function. A sediment loading rate of 949 kg/s (0.36 m^3/s) was selected corresponding to the 760 m^3/s flow rate in the river before the diversion inlet.

Sediment properties used in the MPM function included an assumed sediment density of 2,650 kg/m^3, mean sediment diameter of 26 mm, porosity of 0.4, and a Shields stress of 0.047.

The area upstream of the diversion structure has a design grade of 1,210.0 m; however, from the numerical modelling, it is anticipated that sediment will aggrade in this location prior to, and during, a large flood and create a more natural grade through the structure. To simulate this condition, the area upstream of the diversion structure was pre-loaded with sediment up to the elevation of the diversion inlet at 1,211.5 m.

Numerical model results were reviewed to assess the potential impacts of bedload sediment erosion and deposition on the performance of the diversion structure for the design flood. Table IR13-2 summarizes the results of the numerical model at various time steps.

Table IR13-2 Summary of 2D Sediment Transport Results

Time Steps	Headwater Elevation (m)	Flow rate into the Diversion Channel (m^3/s)
Base (Clearwater Model)	1,215.8	587
765 m^3/s, sediment transport simulation - Day 3	1,215.8	581
765 m^3/s, sediment transport simulation - Day 5	1,215.8	575
765 m^3/s, sediment transport simulation - Day 7	1,216.0	556

The following observations are noted for the numerical model:

- The design sediment loading reached the diversion structure within 72 hours (Day 3).
- The sediment reaching the diversion structure initially began aggrading upstream of the structure in the low velocity zones created by diversion operations.
- Depositional patterns grew during the simulation in a downstream direction, filling in the area upstream of the diversion structure until it reached the diversion inlet. The depositional area grew further to just downstream of the diversion inlet. However, deposition was not observed immediately upstream and/or against the service spillway gates.
- The sediment that was pre-loaded upstream of the diversion structure was partially mobilized into the diversion inlet, before settling out just downstream of the diversion inlet. This occurs within the first 12 hours.
- By the end of simulation Day 5, sediment deposition in the diversion channel downstream of the diversion inlet had a maximum depth of approximately 4.0 m, tapering to approximately 0.1 m of deposition after 800 m.

From the numerical model, and as presented in Table IR13-2, the diversion rate declines over the simulation period by 2% on Day 5 and 4% on Day 7. At completion of the model simulation, diversion rates remained 75 m^3/s greater than the diversion rate of 480 m^3/s, indicating that sufficient capacity is provided within the design to meet the performance criteria for diversion during the design flood. Because sediment deposition was not observed immediately upstream or against the service spillway gates, no impacts are expected to the structural integrity of the gates.

b) The sluiceway was considered in early iterations of the diversion structure's design but is no longer a component of the Project because the initial physical model simulations indicated that the sluiceway was ineffective at promoting bedload transport downstream, as sediment deposition occurred prior to reaching the structure. Subsequent designs and analysis, including the 2D numerical results presented above, removed the sluiceway from the design and instead incorporated asymmetrical operation of the service spillway gates.

Bedload transport through the service spillway is expected to reduce substantially during diversion operations. As operations cease, bedload transport will resume because the service spillway gates are lowered into the fully opened position and the backwater effect of the service spillway gate operations is negated.

REFERENCES

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Rosgen, D.L. 2006. Watershed Assessment of River Stability and Sediment Supply (WARSSS). Fort Collins, CO: Wildland Hydrology Books.

Wilcock, P., and J. Crowe. 2003. Surface-Based Transport Model of Mixed-Size Sediment. Journal of Hydraulic Engineering. February, 2003. Pp 121-128.

HYDROGEOLOGY

Question IR3-14: Hydrogeology – Potential Changes to Groundwater

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.2.2

EIS Volume 3A, Sections 5.3; 5.4.2; 5.4.2.2

EIS Volume 3B, Section 5.1

EIS Volume 4, Appendix I Hydrogeology Baseline Technical Data Report, Sections 2.3, 3.1 and 3.2

Tsuut'ina First Nation, Ermineskin Cree Nation, and Kainai First Nation – Technical Review of the EIS - Annexes - Combined (CEAR # 46, 47, 50)

Natural Resources Canada – Comments on the EIS, June 19, 2018 (CEAR #45)

Context and Rationale:

The EIS Guidelines require the proponent to present information regarding baseline conditions (such as delineation of stratigraphic boundaries) and changes to groundwater quality and quantity resulting from the Project. The EIS Guidelines direct the proponent to carry out modelling as required to present and substantiate anticipated changes.

Project Interactions with Groundwater

The EIS notes that road construction and reclamation activities during construction and dry operations, and reservoir sediment clean up, channel maintenance, and road and bridge maintenance during project flood and post-flood operations, are not expected to interact with hydrogeology. The EIS indicates that there will be no interaction as the activities will occur at or above the ground surface and above the water table. However, the EIS does note that lay down activities could potentially interact with groundwater such that groundwater quality is affected (e.g. incidental spills). No additional rationale is provided to describe why effects on groundwater quality may occur during lay down activities and not during road construction, reclamation, reservoir sediment clean up, channel maintenance, and road and bridge maintenance activities.

Additional information is required to understand the potential effects from all project activities on groundwater.

Diversion Channel and Construction Dewatering

The EIS states that the Project has the potential to change groundwater quantity in and near the PDA as a result of local, shallow and temporary subsurface dewatering that might be required to facilitate construction of various Project components. As construction of the diversion channel will lower groundwater levels, details of the hydrostratigraphic units encountered along the diversion channel are required in order to accurately assess the potential changes to groundwater levels.

The EIS indicates that groundwater that would seep into the diversion channel (when dry) would remain within the watershed and that regional-scale effects on groundwater quantity can be mitigated by allowing seepage in the dry diversion channel to infiltrate back into the subsurface, or flow back into the Elbow River via surface water drainage pathways. While construction dewatering is not a permanent process, the quantity of groundwater removed for construction dewatering may be greater than what will seep into the operating diversion channel.

The majority of the Tsuut'ina Nation's private water wells draw water from the upper weathered bedrock, it is possible construction dewatering could significantly affect available groundwater.

Additional details on the diversion channel and construction dewatering are required to understand potential changes to groundwater quantity and quality and the effects of those changes, including effects on federal lands and on Indigenous peoples.

Information Requests:

a) Provide rationale as to why effects on groundwater quality are not expected to occur during road construction, reclamation, reservoir sediment clean up, channel maintenance, and road and bridge maintenance activities. If pathways of effects are identified, revise the assessment of effects to groundwater accordingly.

b) Identify the hydrostratigraphic units that will be encountered by the diversion channel excavation.

c) Prepare a NW-SE cross section that intersects the diversion channel approximately 150 m west of Highway 22 for scenarios EE0 (Average Flow Condition Simulation Under Existing Conditions) and PP0 (Average Flow Condition Simulation with the Project) with the water table shown.

d) Provide a description of the dewatering activities (location, methods, timing) for the construction of the Project. Discuss aquifers requiring dewatering and their depth.

e) Provide a numerical groundwater model simulation that predicts potential effects on groundwater from construction dewatering.

f) Provide a description of the effects of construction dewatering on federal lands.

Response IR3-14

a) The listed Project activities occur on or above the land surface (and by extension above the groundwater table) and are not expected to lead to interactions with groundwater under normal circumstances (incidental spills during construction are not considered to be normal circumstance). Standard mitigation measures will be implemented and environmental protection plans developed prior to construction activities to prevent effects on groundwater quality potentially resulting from accidental events like spills. Standard mitigation measures to be implemented are summarized in the draft groundwater monitoring plan, which is presented as Appendix IR15-1 in the response to IR3-15.

b) The diversion channel will incise into the subsurface and encounter the glaciolacustrine clays/silt unit, the glacial till unit, the basal silt/sand unit, and bedrock. Updated geologic cross sections through the expanded RAA show the geologic units to be encountered by the diversion channel are included in the Hydrogeology TDR Update, Section 3.1 (see Appendix IR14-1, Figures 3-14 to 3-18).

c) Updated hydrogeologic cross sections through the diversion channel are presented in Section 5.5 of the Hydrogeology TDR Update. These cross sections show simulated water levels and are positioned to depict areas where Project effects may occur. A cross section specifically at 150 m west of Highway 22 has not been provided; however, cross sections B-B' and C-C' both cross the diversion channel near Highway 22.

d) The need for construction dewatering will be determined on a site-specific basis during pre-construction planning when the detailed construction schedule is finalized. The specific location, timing and method for dewatering is not known in detail at this point in time. Groundwater conditions at a given location will be assessed in consideration of the time of year and recent climactic conditions. For example, if excavations at a particular location are occurring during freezing temperatures, then dewatering may not be required to facilitate construction.

e) Given that the location, timing, and method for dewatering are not currently known it is not possible to prepare a numerical model simulation specific to a given dewatering event. However, the numerical model was used to simulate effects of excavation and long-term operation of the diversion channel (when dry), which can be used as a conservative surrogate for what the effects from construction dewatering would be (because the channel is essentially a long, open excavation that is in place indefinitely). These simulated effects are presented in Section 5 of the Hydrogeology TDR Update (Appendix IR14-1).

f) Construction dewatering is not expected to lead to effects on federal lands (see Appendix 14-1, Section 6) due to their limited extent and presence of Elbow River which acts as a regional flow divide.

Question IR3-15: Hydrogeology – Groundwater Sampling, Monitoring and Follow-up

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.2.2

EIS Volume 3A, Section 5.2

EIS Volume 3B, Section 5.2

EIS Volume 4, Appendix I Hydrogeology Baseline Technical Data Report, Sections 2.3, 3.1 and 3.2

Tsuut'ina First Nation, Ermineskin Cree Nation, and Kainai First Nation – Technical Review of the EIS - Annexes – Combined (CEAR # 46, 47, 50)

Natural Resources Canada – Comments on the EIS, June 19, 2018 (CEAR #45)

Context and Rationale:

The EIS Guidelines require the proponent to present information regarding groundwater, including baseline information such as location of monitoring wells, and changes to groundwater quality and quantity resulting from the Project. The EIS Guidelines direct the proponent to carry out modelling as required to present and substantiate anticipated changes.

The EIS does not clearly present where groundwater monitoring wells are located. The EIS indicates that shallower monitoring wells were installed within the first water-bearing unit encountered and the deeper (bedrock) monitoring wells were installed in the first water-bearing bedrock unit. Hydraulic conductivities and water levels were measured in these wells and used as input data to the numerical groundwater model. Wells were not installed in the weathered upper portion of the bedrock, suggesting that hydrogeological conditions in this layer were not evaluated or used as model inputs for calibration, and therefore, the numerical groundwater model does not predict effects in the upper weathered bedrock.

Water may be able to flow between the lower bedrock and the upper weathered bedrock; however, these two layers cannot be considered a single hydrostratigraphic unit as they may have different hydraulic properties, particularly in areas of the RAA where saturated till or clay overlies the weathered bedrock.

Tsuut'ina Nation's private water wells are installed in the upper weathered bedrock. It is important to include data from wells in the upper weathered bedrock in order to accurately predict hydrogeological conditions for Tsuut'ina IR 145.

The EIS indicates that the field sampling program identified bedrock with varying permeabilities (heterogeneities, sandstone vs. claystone); however, the conceptual model did not consider the complexity of fractured flow in bedrock as bedrock was conceptualized as a single mass without heterogeneities. The uncertainty of groundwater flow direction and velocity in bedrock environments needs to be considered to assess potential implications on private water wells within the fractured bedrock. Inclusion of bedrock heterogeneities is required in order to accurately predict potential effects to groundwater quantity and quality.

Additionally, the EIS only discusses the use of domestic water wells in follow-up and monitoring. The purpose of the follow-up program is to validate the results of hydrogeological modelling and domestic wells on their own are of limited value to evaluate water level predictions. The use of dedicated monitoring wells to allow groundwater head monitoring for both dry operations and flood/post-flood response should be considered.

The EIS indicates that landowners and the Tsuut'ina Nation identified concerns with potential project effects on groundwater and local water wells. A follow-up and monitoring program will validate the results of the hydrogeological modelling and monitor the effects of a flood on groundwater in the LAA; however, the LAA is not inclusive of Tsuut'ina Nation IR 145. Therefore, there is uncertainty regarding effects to reserve lands.

Additional information is required to understand the potential changes to groundwater and the effects of those changes, including effects on federal lands and on Indigenous peoples.

<u>Information Requests:</u>

a) Clearly identify and label the groundwater monitoring well locations and depths.

b) Install or use monitoring wells on Tsuut'ina IR 145 that are representative of Tsuut'ina Nation's private water wells and use the hydraulic head data from these monitoring wells to calibrate the numerical groundwater model.

c) Include bedrock heterogeneities and fractured bedrock in the Conceptual Hydrostratigraphic Framework.

d) With regards to monitoring and follow-up:

- **Discuss the potential for use of dedicated monitoring wells (current or new) to allow groundwater head monitoring (i.e. with dataloggers) for both dry operations (along diversion channel) and flood/post-flood response (near reservoir).**
- **Describe how high detection limits will affect follow-up and monitoring actions.**
- **Confirm whether any of the current monitoring wells will be maintained for use in follow-up and monitoring.**

- **Detail a follow-up and monitoring program for groundwater on Tsuut'ina IR 145. Include surveys and monitoring of Tsuut'ina's private water wells for water levels, prior to and during construction and during dry operations until groundwater under Project conditions reaches static conditions and well interference can be assessed.**

e) Provide details on initial sampling of domestic wells prior to construction in order to establish pre-project baseline conditions.

Response IR3-15

a) The hydrogeology RAA has been expanded to include areas south of Elbow River and on Tsuut'ina Nation Reserve lands. Accordingly, the 3D CSM for the RAA has also been expanded to include additional information from south of Elbow River, including areas within the Elbow River watershed. Revised maps of the geologic/hydrogeologic information used (including monitoring wells, geotechnical boreholes, and domestic well information) in the expanded RAA are in Section 3 of the Hydrogeology TDR Update (see the response to IR3-14, Appendix IR14-1). Attachment A of the Hydrogeology TDR update presents borehole logs for all Project-specific wells installed in the PDA.

b) The numerical groundwater model has also been revised in accordance with the expanded RAA. Additional data from the Tsuut'ina Nation Reserve have been incorporated into the model, including water levels from wells that were used to calibrate the updated model. Section 4 of the Hydrogeology TDR Update describes the updated model and calibration.

c) Flow through secondary porosity such as fractures in bedrock generally increases the permeability or hydraulic conductivity relative to the permeability of similar, unfractured deposits. However, bedrock fractures are highly site-specific and are difficult to map at a regional scale, particularly in highly deformed areas with veneers of unconsolidated material, as is the case in the expanded RAA. Bedrock fractures generally date back to the mountain building period millions of years ago and remineralization can occur in fractures, precluding the effects of secondary porosity. Implementing fractures explicitly in the 3D CSM framework is not feasible at the scale of the RAA. However, fracture patterns were implemented in the numerical model by means of creating an additional upper bedrock layer and isolating the upper 15 m of the bedrock volume. This layer was used to approximate the upper fractured zone of the bedrock where increased permeability is expected. Further, hydraulic conductivity estimates obtained through single-well response tests and packer isolation testing (see Section 3.2.1 of Appendix IR14-1) measure the bulk conductivity of the geologic materials including the influence of fractures.

d-e) Appendix IR15-1 is a draft groundwater monitoring plan. The overall scope and intent of the monitoring plan are presented therein, including potential locations of monitoring wells to be used, and the phased approach to the monitoring program including pre-construction baseline monitoring. Monitoring well locations will be selected using a tiered approach that includes multiple tiers of wells to be used during pre-construction and latter operating phases of the Project.

Question IR3-16: Hydrogeology – Regional Assessment Area Boundary

Sources:

EIS Guidelines Part 1, Section 3.3

EIS Guidelines Part 2, Sections 6.1.4; 6.2.2

EIS Volume 3A, Section 5

EIS Volume 4, Appendix I, Hydrogeology Baseline Technical Data Report, Sections 2.3; 3.1; 3.2

Tsuut'ina First Nation, Ermineskin Cree Nation, and Kainai First Nation – Technical Review of the EIS - Annexes - Combined (CEAR # 46, 47, 50)

Context and Rationale:

The EIS Guidelines require the proponent to present information regarding groundwater, including baseline information and changes to groundwater quality and quantity resulting from the Project. The EIS Guidelines direct the proponent to carry out modelling as required to present and substantiate anticipated changes. The EIS Guidelines also notes that spatial boundaries may vary dependent on VC and require a rationale for the selected boundaries.

The EIS indicates that the southern boundary of the RAA and numerical groundwater model is the floodplain and terrace of the Elbow River.

The EIS indicates that "the Elbow River valley is a hydraulic divide for shallow groundwater" and that groundwater on either side of the valley will be to the Elbow River. The EIS predicts that under the design flood, a 1:10 year flood, and 1:100 year flood, groundwater flows towards the Elbow River. However, the Elbow RiverWater Management Plan (May 2008) states that flow direction in the shallow groundwater near the Elbow River is from the river into the alluvial aquifer under flood conditions. As a result, it is unclear, under flood conditions, where groundwater will flow and whether the location of the south model boundary is reasonable.

Potential effects on Tsuut'ina IR 145 cannot be reliably estimated, as the numerical groundwater model in the EIS over-estimates the hydraulic heads and may not accurately predict flow under flood conditions along the southern model boundary, directly on and adjacent to Tsuut'ina IR 145.

Figure 5-16 of the EIS depicts a dramatic decrease in hydraulic head between the reservoir and the adjacent aquifer suggesting a base of low permeability engineered clay. However, the base of the reservoir is composed primarily of naturally occurring till and clay and a decrease in hydraulic head between the reservoir and adjacent aquifer would not likely occur. If times of high permeability occur at the reservoir base, the hydraulic head increase will result in greater changes to the groundwater system than predicted.

Additionally, the EIS demonstrates a discrepancy between the measured and modelled heads between Figures 5-6 and 5-10, causing further uncertainty in the model predictions.

Additional information is required to understand the potential changes to groundwater and the effects of those changes, including effects on federal lands and on Indigenous peoples.

Information Requests:

a) **Extend the RAA's southern boundary within the hydrogeological model to a location where the groundwater boundary conditions can be more reliably estimated. The new boundary should include a portion of Tsuut'ina IR 145. It has been suggested by Tsuut'ina Nation that the Elbow River watershed boundary be used as the southern boundary. Include a robust prediction of potential effects to Tsuut'ina IR 145.**

b) **Update relevant sections of the EIS to account for the new southern boundary: • Reconstruct and recalibrate the numerical groundwater model to adequately model the hydrogeology of the Elbow River and shallow aquifer and to assess potential effects to groundwater.**

- **Re-simulate the flood scenarios once the numerical groundwater model has been reconstructed and update relevant figures.**
- **Conduct a sensitivity analysis on the model including introducing high permeability windows into the reservoir base.**
- **Conduct and report the particle tracking simulation and conduct sensitivity analyses using high permeable windows.**
- **Reassess the potential effects to groundwater on Tsuut'ina IR 145.**

c) **Natural Resources Canada noted a possible error in Section 5.1.4.1 of the EIS, which states "a boundary to the northwest to encompass the subwatershed of three small tributaries to the Elbow River". Clarify if this is supposed to be northeast. If it is the northeast, describe any changes made to the analysis.**

Response IR3-16

a) The RAA for the hydrogeology assessment has now been expanded to include areas south of Elbow River, including areas of the Tsuut'ina Nation Reserve that fall within the Elbow River watershed. The Hydrogeology TDR Update (see the response to IR3-14, Appendix 14-1) describes the baseline conditions in the expanded RAA.

b) The numerical groundwater model has been updated in accordance with the expansion of the RAA. The model now includes areas of the Tsuut'ina Nation Reserve that fall within the Elbow River watershed. Updated model simulations have been prepared and are presented in the Hydrogeology TDR Update.

   Particle tracking was not completed because it was considered not necessary for understanding effects on groundwater from the reservoir: the modelling provides sufficient information regarding groundwater flow and the fate of the groundwater behind the dam. From the conceptual model and the numerical model, groundwater will flow and discharge to the river. Particle tracking will not add to that understanding.

c) The original statement should have referred to the boundary to the northeast. The boundary of the RAA has now been changed and now extends further south across Elbow River and further east to the edge of a subwatershed near the Glenmore Reservoir. A description of the expanded RAA boundaries is presented in Section 2 of the Hydrogeology TDR Update.

Question IR3-17: Hydrogeology – Groundwater Modelling

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.2.2

EIS Volume 3B, Section 5

EIS Volume 4, Appendix I, Hydrogeology Baseline Technical Data Report, Section 3

EIS Volume 4, Appendix I, Groundwater Numerical Modelling Technical Data Report, Sections 2.2; 3; 4.1; 4.2; 5, 5.1; 6

Tsuut'ina First Nation, Ermineskin Cree Nation, and Kainai First Nation – Technical Review of the EIS - Annexes – Combined (CEAR #46, 47, 50)

Natural Resources Canada – Comments on the EIS, June 19, 2018 (CEAR #45)

Context and Rationale:

The EIS Guidelines require the proponent to present information regarding groundwater, including baseline information and changes to groundwater quality and quantity resulting from the Project. The EIS Guidelines direct the proponent to carry out modelling as required to present and substantiate anticipated changes.

Boundary Conditions

Several details of the boundary conditions used for hydrogeological modelling need additional description and/or justification as boundary conditions can have a significant influence on model results and the interpretation of project-related effects.

Although potential evapotranspiration (evaporation and plant transpiration) may exceed annual precipitation, a small distributed groundwater recharge is possible due to seasonal or short term excess precipitation/melt. In the current numerical groundwater model, water inputs are mostly limited to locations of prescribed head boundary conditions (i.e. mostly at model edges).

As most of the tributaries to the Elbow River within the hydrogeological modelling domain are intermittent, it is unclear why the numerical groundwater model uses prescribed (fixed) boundary conditions along intermittent streams. Additionally, several of these streams have isolated locations of prescribed boundary conditions.

As time varying hydraulic heads are not provided for locations other than those presented in Figure 4-5, it appears that the specified-head boundary conditions on the exterior boundary are time invariant, or else the time variations that have been implemented are not described.

Additionally, there is no specified recharge boundary condition. Consequently, there appears to be no time-variable boundary conditions for water input to the model.

Set-up and Calibration

Multiple details of the hydrogeological model settings, parameters and calibration, including the transient model setup, are required to understand model results.

The model boundary conditions include prescribed heads at both the top and bottom of the groundwater flow system and not a range of possible heads, which may hinder the calibration of model parameters. Additionally, the locations of most calibration targets are in close proximity to locations of prescribed head boundary conditions, which may limit the calibration of model parameters. Identification of all locations used as calibration targets is needed.

The EIS indicates that there was no need to differentiate among the bedrock formations due to the similarities in lithologies. The numerical groundwater model shows that the calibrated hydraulic conductivity values for the shallow bedrock range over almost three orders of magnitude. Information to understand the range of calibrated values is needed.

Hydraulic conductivities (K) are presented for various monitoring wells, borehole intervals, and as preliminary model estimates although final calibrated hydraulic conductivities values are not provided. Maps and cross-sections of final calibrated values would be beneficial to understand the hydraulic conductivities.

Additional information is required to understand the potential changes to groundwater and the effects of those changes, including effects on federal lands and on Indigenous peoples.

Information Request:

a) Apply distributed groundwater recharge across the hydrogeological model domain, or provide a rationale as to why it does not need to be considered.

b) Provide additional details on boundary conditions:

- **Provide rationale for the use of prescribed boundary conditions as the main boundary condition along the model exterior and along intermittent streams.**
- **Document the use of any constraints on prescribed head boundary conditions (e.g. the use of "seepage face" boundary conditions).**
- **Indicate why several of the intermittent streams have isolated locations of prescribed boundary conditions.**

c) Provide additional detail on the time variant conditions applied:

- **Describe the boundary conditions used along the diversion channel for steady-state simulation PP0 (Average Flow Condition Simulation with the Project).**
- **Discuss how boundary conditions were applied along the rest of the diversion channel, reservoir and Elbow River.**
- **Include time-varying boundary condition data for the perimeter boundary for each layer of the model domain and describe how this data was collected or inferred. Clarify what time variations have been implemented.**
- **Discuss how the model accommodates variable water inputs from precipitation during flood simulations. Specify the time-variable boundary conditions that control the water inputs to the model.**

d) Provide additional detail on the model set-up and calibration. Include:

- **The number of model layers, which hydrostratigraphic units are assigned to which layers, and how hydraulic conditions are treated in each layer (free, phreatic, confined or dependent);**
- **All locations used as calibration targets;**
- **Whether groundwater flow rates or discharge were used to constrain model calibrations;**
- **The full range of model parameters (e.g. hydraulic conductivity) that may produce reasonable model calibrations; and**
- **Whether any attempts were made to calibrate specific storage values in transient models.**

e) Provide additional detail on hydraulic conductivities. Include:

- **A table that shows the initial and final (calibrated) hydraulic conductivities value for each hydrostratigraphic unit and report the anisotropy ratio;**
- **Maps and cross-sections of final calibrated hydraulic conductivities values, and the three zones of calibrated bedrock hydraulic conductivity; and**
- **A rationale for the range in calibrated hydraulic conductivity values for the shallow bedrock and compare them with the measured values.**

f) Describe the following aspects of the transient model setup: • Report the specific storage (Ss) values for each hydrostratigraphic unit (and specific yield for any unconfined layers). Describe how these values were obtained and estimate an appropriate range of values.

- **Indicate the time step used and justify why a fixed time step was used for a model in which rapid water level changes are modelled.**

g) Describe any changes to the outcome of the numerical groundwater model and in turn to the assessment of changes to groundwater, including effects on federal lands and Indigenous peoples.

Response IR3-17

a) The numerical groundwater model has been updated in accordance with the expanded RAA. Distributed recharge has now been added over the model domain. Section 4 of the Hydrogeology TDR Update (see the response to 3-14, Appendix IR14-1) describes setup and calibration of the updated numerical model.

b) Section 4 of the Hydrogeology TDR Update describes setup and calibration of the updated numerical model, including the implementation of various boundary conditions.

c) Section 5.3 of the Hydrogeology TDR Update describes setup and implementation of time varying boundary conditions for transient simulations. Time varying specified head nodes are established in the model for Elbow River, diversion channel, and off-stream reservoir. These boundary condition nodes were set to variable head conditions based on outputs from the surface water modelling were used to define the time variation of water levels in these features. In the off-stream reservoir, time varying boundary conditions were activated to represent the variation in water level as the reservoir is filled and then emptied. A constant, distributed is applied as a boundary condition on the top layer of the model. Given the intent of the model is to examine potential Project effects, it is not necessary to apply a variable recharge rate since it would not materially affect the net change in head when comparing pre-Project to post-Project conditions.

d-e) The numerical groundwater model is updated in accordance with the expanded RAA. Distributed recharge is added over the model domain. Section 4 of the Hydrogeology TDR Update describes setup and calibration of the updated numerical model. Initial hydraulic conductivity values for each of the hydrostratigraphic units represented were assigned based on estimates of hydraulic conductivities yielded from the geotechnical and hydrogeologic field programs, which are summarized in Section 3.2.1

f) Specific storage and specific yield estimates were based on literature values for similar geologic materials and are presented in Table 4-3 of the Hydrogeology TDR Update. The updated numerical model used a 0.5 hour timestep to increase the numerical stability during periods of rapid water level change.

g) The updated numerical model simulations are presented in Section 5 of the Hydrogeology TDR Update. In general, the simulation results show that effects on groundwater are limited to areas near Project components, such as the diversion channel, off-stream reservoir and dam. The simulation results from the updated model, while expanded in extent, show that effects on groundwater levels do not extend south across the Elbow River valley.

Question IR3-18: Hydrogeology – Groundwater Baseline and Model Sensitivity

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.2.2

EIS Volume 3A, Section 5

EIS Volume 3B, Section 5

EIS Volume 4, Appendix I, Groundwater Numerical Modelling Technical Data Report

Tsuut'ina First Nation, Ermineskin Cree Nation, and Kainai First Nation – Technical Review of the EIS - Annexes – Combined

Natural Resources Canada – Comments on the EIS, June 19, 2018 (CEAR #45)

Context and Rationale:

The EIS Guidelines require the proponent to present information regarding groundwater, including baseline information and changes to groundwater quality and quantity resulting from the Project. The EIS Guidelines direct the proponent to carry out modelling as required to present and substantiate anticipated changes.

Clarifications and additional information are required regarding the groundwater baseline studies and hydrogeological modelling in order to understand the potential changes to groundwater and the effects of those changes, including effects on federal lands and on Indigenous peoples.

For example, it is not clear what model or hydrostratigraphic layer(s) are represented in the potentiometric head maps of hydrogeological modelling. Clarity is needed because the water table crosses hydrostratigraphic units and vertical gradients are present.

The cross section figures in the EIS indicate that the unconsolidated deposits may be unsaturated along many ridges and hillslopes. The potentiometric maps for unconsolidated deposits should only indicate contours for areas where unconsolidated deposits are saturated. Areas where the water table is below the unconsolidated deposits should be clearly indicated.

The hydrogeological units represented by control points CP4 and CP5 (bedrock or unconsolidated deposits) are not indicated. Natural Resources Canada noted that, given the lack of hydraulic response at these locations, additional locations closer to the reservoir (in which there is a response) would help demonstrate how the response of piezometric heads varies with distance from the reservoir in response to reservoir flooding.

The simulation times of the various hydraulic head maps shown in Figure 6-6 are not clearly indicated. Natural Resources Canada indicated it might be more useful to indicate the time with respect to the boundary condition hydrograph.

Hydrogeological modelling should include a sensitivity analysis to consider the potential effects of model uncertainty on transient model results and predicted effects. Uncertainties in specific storage and hydraulic conductivity can have a significant influence on piezometric head propagation. The sensitivity to specific storage values is of particular significance since the model was calibrated to hydraulic conductivity under steady state conditions.

Information Requests:

a) Specify what units/layers are represented in the potentiometric head maps and discuss how these maps were produced.

b) Identify all water level measurement locations used to map the potentiometric surface of unconsolidated deposits and clearly identify areas where the water table is below the unconsolidated deposits.

c) Provide contour maps of the surface topography and bedrock surface topography to allow for a comparison with piezometric head maps.

d) Indicate the hydrogeological units represented by control points CP4 and CP5.

e) Clearly identify the simulation times of the various hydraulic head maps shown in Figure 6-6 (Volume 4, Appendix I) or indicate the time with respect to the boundary condition hydrograph (e.g. arrows showing simulation times on Figure 5-1 (Volume 3B, Section 5)).

f) Provide a sensitivity analysis to demonstrate the influence of uncertainty in hydrogeological model parameters on the distance of piezometric head propagation resulting from the PP1 scenario (Design Flood with Project Operation).

Response IR3-18

a-b) The hydrogeology RAA is expanded and new data has been incorporated into an updated assessment. Groundwater levels and flow regimes within the expanded RAA are presented in Section 3.2 of the Hydrogeology TDR Update (see the response to IR 3-14, Appendix IR14-1).

c) The conceptual hydrostratigraphic framework of the expanded RAA (including surface topography and bedrock topography) is presented in Section 3.1 of the Hydrogeology TDR Update. Additional maps of depth to water and recharge/discharge maps are included in Section 3.2.

d) Because the hydrogeologic system in the RAA is modelled as an unconfined system, the points of interest represent hydrostatic head conditions. Updated hydraulic head maps are in Section 5 of the Hydrogeology TDR Update.

e) Updated numerical model simulation results for the design flood are presented in Section 5 of the Hydrogeology TDR Update. Transient simulation results for the design flood are presented for timestep 650, which represents the point in time at which the off-stream reservoir is full.

f) A sensitivity analysis for the updated numerical model is presented in Appendix E of the Hydrogeology TDR Update. The sensitivity analysis considers higher permeability of all units within the domain to understand the potential influence on the lateral extent of effects on groundwater levels.

GROUNDWATER

Question IR3-19: Groundwater – Culturally Sensitive Groundwater Resources

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.1.9; 6.2.2; 6.3.4

Piikani Nation – Technical Review of EIS, June 15, 2018 (CEAR #48)

Context and Rationale:

The EIS Guidelines require the proponent to present information regarding groundwater, including baseline information and changes to groundwater quality and quantity resulting from the Project. The EIS Guidelines also require the proponent to assess the effects of changes to the environment on Indigenous peoples, including on physical and cultural heritage.

The EIS does not assess the potential existence of groundwater-dependent, traditionally used and culturally sensitive areas, such as cabins, recreational sites, fishing, hunting, and plant gathering areas within the RAA, LAA or PDA. Pathways of effects for groundwater-dependent traditional uses could be indirect through plant gathering (e.g. medicinal plants) or direct (accessing shallow groundwater or springs near cabins, fishing or hunting sites). These pathways are often related to the considerable potential for surface water/groundwater interaction in the project area.

Additional information is required to understand the potential changes to groundwater and effects of those changes on Indigenous peoples, including effects on physical and cultural heritage.

Information Requests:

a) Identify groundwater dependent traditional uses and culturally sensitive areas and describe potential pathways of effects. These pathways should consider the potential for any project impacts to groundwater to affect traditional use and culturally sensitive areas, regardless of whether the groundwater effects are considered significant.

b) Identify mitigation measures, and associated monitoring and follow-up, related to groundwater to protect traditional use and culturally sensitive areas. Consider and describe protection related to the contribution of natural groundwater flow.

Response IR3-19

a) Alberta Transportation recognizes that the information regarding traditional land and resource use, including groundwater dependent traditional uses and culturally sensitive areas, are best identified by Indigenous groups themselves. To that end, Alberta Transportation commenced consultation with Treaty 7 First Nations in August 2014 and with the additional Indigenous groups identified in the Canadian Environmental Assessment Agency (CEA Agency) Guidelines for the Project in October 2016 concerning the Project, including the context and setting for traditional uses in the Project area. Alberta Transportation has been conducting Indigenous engagement prior to and throughout the assessment process, which includes sharing of Project information and updates, on-going communication about the Project, face-to-face meetings, facilitation of site visits, and funding for Project-specific Traditional Use Studies (TUS). Alberta Transportation's response to this information request relies on both the material filed in the EIA and any supplemental information received since then. However, Alberta Transportation understands that the provision of this information is at the priority and discretion of the participating Indigenous group.

Refer to Alberta Transportation's response to CEAA IR2-1 for a summary of:

- The engagement activities facilitated by Alberta Transportation to inform Project planning.
- Any feedback and material from Indigenous groups received prior to and following the filing of the EIA to inform Project planning.

Refer to the response to CEAA IR2-01, Appendix IR1-1 for an updated summary of the engagement process to February 28, 2019 for additional Indigenous groups that CEAA requested to include. That Appendix has three parts: updated engagement summaries, record of consultation, and the consolidated SCRT.

As noted in Volume 3A, Section 14.1.7, Alberta Transportation is aware that current use of lands and resources for traditional purposes by Indigenous groups may occur within the PDA by permission of the landowner, and potential Project effects on such current use have been assessed in Volume 3A, Section 14.3. The assessment of potential Project effects on TLRU includes analysis, discussion and conclusions of the Project's residual effects on groundwater dependent traditional uses and culturally sensitive areas, as identified through engagement with each Indigenous group. The description of groundwater dependent traditional uses and culturally sensitive areas, and the potential pathways of effects are described in Volume 3A, Sections 14.2.4 and 14.3.2. These pathways are further described in Volume 3A, Section 5.4 and Volume 3B, Section 5.2. Assessment of effects on vegetation species diversity is provided in Volume 3A, Section 10.4.4.2 and Volume 3B, Section 10.2.3 and effects on vegetation community diversity is presented in Volume 3A, Section 10.4.3 and Volume 3B, Section 10.2.2, including communities that may be associated with groundwater (i.e., wetlands).

Table IR19-1 summarizes groundwater dependent traditional uses and culturally sensitive areas, as identified by each of the Indigenous groups listed in the EIS Guidelines, that were either previously included in the assessment or subsequently shared with Alberta Transportation. Location information is provided in this table, where available.

The pathways for potential impacts of the Project identified by Indigenous groups are aligned with the potential effects and effects pathways described in Volume 3A, Section 14, Table 14-1. To date, no new pathways for potential effects of the Project on groundwater dependent traditional uses and culturally sensitive areas were identified through the information shared by Indigenous groups.

Table IR19-1 Groundwater Dependent Traditional Uses and Culturally Sensitive Areas as Identified by each Indigenous Group

Groundwater Dependent Traditional Uses and Culturally Sensitive Areas, including Medicinal Plants, Shallow Groundwater or Springs near Cabins, Fishing or Hunting Sites	Source	EIA Reference (if applicable)[1]
Kainai First Nation		
Kainai First Nation identified a natural spring within the PDA (at approximately Alt=1224m Lat=51.0185° Lon=-114.4907°) and noted "disruptions to natural springs such as this one and the potential for interaction between reservoir/flood water and groundwater were identified as concerns of the BT/K related to the construction of the Project and in the event of a flood."	Kainai First Nation 2018 (CEAR #47), p. 86	Volume 3A, Section 14.1.2
In comments to CEAA, Kainai First Nation requested "a water well survey of Tsuut'ina private water wells and monitor water levels" and noted, "since the majority of Tsuut'ina private water wells draw water from the upper weathered bedrock, it is possible construction dewatering could significantly affect available groundwater." Kainai First Nation also noted that "Tsuut'ina First Nation have stated they are concerned about the project's effect on their groundwater. Please require the proponent to adequately assess potential effects on Tsuut'ina Nation's groundwater."	PGL 2018a (CEAR #47), p. 3, 5	--

[1] -- indicates the referenced information was received following the submission of the EIA.

Table IR19-1 Groundwater Dependent Traditional Uses and Culturally Sensitive Areas as Identified by each Indigenous Group

Groundwater Dependent Traditional Uses and Culturally Sensitive Areas, including Medicinal Plants, Shallow Groundwater or Springs near Cabins, Fishing or Hunting Sites	Source	EIA Reference (if applicable)[1]
Siksika Nation		
Siksika Nation observed that in 2013, and previous floods, High River and Elbow River flow into the Bow River and asked whether the communities along the Bow River have proper sewage facilities for containing sewage in flood events. Siksika Nation is concerned about the impact on drinking water. In 2013 raw sewage was coming into the stream and affecting Sisika Nation drinking water. Siksika Nation wanted to know if there was mitigation to address effects of sewage effluent on drinking water. Siksika Nation also expressed concerns about agricultural pesticides and herbicides, which end up in the river. How is this project going to help avoid those impacts	Engagement Meeting, April 26, 2018	--
Tsuut'ina Nation		
"The Elbow River is also an important source of drinking water for our community as it is connect[ed] to the groundwater on our reserve." "For drinking and other household uses, we depend on the groundwater in the Elbow River Alluvial Aquifer, which flows back and forth from the Elbow River. Any potential contamination or change to the flow of the Elbow River is therefore likely to contaminate our aquifer." "Should the water stored in the reservoir become contaminated in any way (which is a possibility in any flood event), this could lead to the contamination of the groundwater used on our reserve." "We already see groundwater bubbling up on our reserve lands, including around the Redwood Meadows area as it flows back from the Elbow River. Should the water in either the surface or the groundwater system become contaminated as a result of a flood event, there is a real risk that the Project's infrastructure will facilitate the spread of these materials onto our reserve."	Tsuut'ina Nation May 2016, p. 7, 8	Volume 3A, Section 14.1.2 Volume 3A, Section 14.8.5
Tsuut'ina Nation expressed concern about potential effects of flood water on natural springs, specifically effects to ground water when a spring is flooded and covered up.	Engagement Meeting, May 14-15, 2018, p. 4	--
Tsuut'ina Nation identified Elbow River as a source of drinking water and noted the importance of the river's connection to groundwater. Tsuut'ina Nation also indicated that they depend on the groundwater in the Elbow River Alluvial Aquifer for the reserves' domestic drinking water. The Tsuut'ina noted that there are over 1500 wells on the reserve.	Engagement Meeting, May 14-15, 2018, p. 53	--

Table IR19-1 Groundwater Dependent Traditional Uses and Culturally Sensitive Areas as Identified by each Indigenous Group

Groundwater Dependent Traditional Uses and Culturally Sensitive Areas, including Medicinal Plants, Shallow Groundwater or Springs near Cabins, Fishing or Hunting Sites	Source	EIA Reference (if applicable)[1]
Tsuut'ina Nation stated that they do not have confidence that the model is making accurate predictions for groundwater on the reserve. Tsuut'ina Nation commented that there is a 48 m vertical difference adjacent to the reserve. The groundwater model cannot accurately predict groundwater levels on Tsuut'ina. Using private water wells is not satisfactory. Tsuut'ina Nation requested that the watershed be used as the boundary for the groundwater model. Tsuut'ina Nation stated that springs are more important than flows. There is potential for springs to be plugged up during construction. If there is no monitoring plan, no baseline, people will get sick.	Engagement Meeting, October 11, 2018, p. 4, 5	--
"The Elbow River is an important source of drinking water for our community as it is connected to the groundwater on our reserve. We regularly see groundwater bubbling up on our reserve lands, including around the Red Meadows areas as it flows back from the Elbow River." "…the EIS does not evaluate groundwater or aquifer use on Tsuut'ina lands. The revised EIS also does not consider which aquifers are used by Tsuut'ina for potable water and how these aquifers interact with the Elbow River. The result is that potential impacts to Tsuut'ina's rights and interests, including those briefly toughed on above, remain unknown." Tsuut'ina Nation requested "a water well survey of Tsuut'ina private water wells and monitor water levels" and noted, "since the majority of Tsuut'ina private water wells draw water from the upper weathered bedrock, it is possible construction dewatering could significantly effect available groundwater." "Tsuut'ina First Nation have stated they are concerned about the project's effect on their groundwater. Please require the proponent to adequately assess potential effects on Tsuut'ina Nation's groundwater."	Mandell Pinder LLP 2018 (CEAR #50), p. 2, 4, 10	--

Table IR19-1 Groundwater Dependent Traditional Uses and Culturally Sensitive Areas as Identified by each Indigenous Group

Groundwater Dependent Traditional Uses and Culturally Sensitive Areas, including Medicinal Plants, Shallow Groundwater or Springs near Cabins, Fishing or Hunting Sites	Source	EIA Reference (if applicable)[1]
"As the Project would not be decommissioned, it would mean a permanent change to the flow of the Elbow River, some of it's tributaries, and the connected groundwater. The Elbow River is an important source of drinking water for our community as it is connected to the groundwater on our reserve. We regularly see groundwater bubbling up on our reserve lands, including around the Red Meadows areas as it flows back from the Elbow River. This aspect of the Project is particularly concerning to us as water is a sacred element given to us by the Creator. It sustains life and is considered medicine and pivotal to our ceremonies and as Tsuut'ina we have an obligation to protect it." "We also advised Alberta Transportation that additional information needs to be collected to update Tsuut'ina Nation's Traditional Use Study and to prepare a more details assessment of impacts to groundwater and surface water from the Project." "Tsuut'ina's current understanding when it comes to impacts to groundwater and surface water is that the original model is a poor predictor of Project impacts, especially for Tsuut'ina lands, and so cannot be relied on to conclude that our wells and surface water will not be impacted by the Project and that we are not at risk of increase[d] flooding….Tsuut'ina has made it clear to Alberta Transportation over the course of several meetings that additional data also needs to be collected, including from dedicated monitoring wells on Tsuut'ina reserve, to properly calibrate the model."	Tsuut'ina Nation. February 2019. p 1, 3	--

Table IR19-1 Groundwater Dependent Traditional Uses and Culturally Sensitive Areas as Identified by each Indigenous Group

Groundwater Dependent Traditional Uses and Culturally Sensitive Areas, including Medicinal Plants, Shallow Groundwater or Springs near Cabins, Fishing or Hunting Sites	Source	EIA Reference (if applicable)[1]
"Tsuut'ina has repeatedly stated they are concerned about how SR1 could affect their water resources. The EIS didn't evaluate groundwater/aquifer use on Tsuut'ina lands. The EIS doesn't discuss which aquifers are used by Tsuut'ina or nearby landowners for potable water and how these aquifers interact with the Elbow River." "The aquifer from which Tsuut'ina draws groundwater has not been delineated. Without this delineation, it is not possible to predict potential project effects on Tsuut'ina's interests." "By forcing the solution at the south boundary adjacent to Tsuut'ina land to match the static groundwater heads measured in the baseline study, and running only the steady state solution, you prevent the model from assessing potential impacts adjacent to Tsuut'ina lands." "The Groundwater model must be improved to be capable of predicting effects on Tsuut'ina and adjacent private lands. There are potable water wells on Tsuut'ina land immediately south of the proposed diversion channel where the groundwater model predicts a permanent decrease in hydraulic head of 5.5 m during dry conditions (it is not clear in the EIS if this hydraulic head decrease is in the shallow unconsolidated sediments or the bedrock or both). The groundwater model as designed, fails to adequately predict potential changes to groundwater in Tsuut'ina wells due to the presence of the diversion structure." "Groundwater data gaps identifies in Vol 4, Sec 5 prevent a fulsome assessment of effects on bull trout spawning (see EIS p.9.19 "bull trout spawning usually occurs…over coarse substrates in areas influenced by groundwater")."	PGL 2018, p. 2, 5, 6	--
"Tsuut'ina has repeatedly stated they are concerned about how the Project could affect their water resources. The revised EIS does not evaluate groundwater/aquifer use on Tsuut'ina lands. The revised EIS also does not discuss which aquifers are used by Tsuut'ina for potable water and how these aquifers interact with the Elbow River."	Mandell Pinder LLP 2018, p. 2	--
Questioning the ability of the model to account for groundwater impacts to Tsuut'ina: "… we have concluded that the hydrogeological impact assessment does not assess potential groundwater impacts to IR145… Except for a small portion of land at the north end of IR 145 around Highway 22, the Regional Assessment Area (RAA), which coincide[s] with the boundaries of the Groundwater model, does not encompass IR 145… any predictions presented in the EIA that are based on this groundwater model do not predict potential groundwater impacts on IR145."	PGL Additional Assessment and Modeling Request, p. 1	--

Table IR19-1 Groundwater Dependent Traditional Uses and Culturally Sensitive Areas as Identified by each Indigenous Group

Groundwater Dependent Traditional Uses and Culturally Sensitive Areas, including Medicinal Plants, Shallow Groundwater or Springs near Cabins, Fishing or Hunting Sites	Source	EIA Reference (if applicable)[1]
"The Elbow River is an important source of drinking water for our community as it is connected to the groundwater on our reserve. We regularly see groundwater bubbling up on our reserve lands, including around the Redwood Meadows area as it flows back from the Elbow River. This aspect of the project is particularly concerning to us as water is a sacred element given to us by the Creator. It sustains life and is considered medicine and pivotal to our ceremonies and as Tsuut'ina we have an obligation to protect it". "Tsuut'ina's current understanding when it comes to impacts to groundwater and surface water is that the original model is a poor predictor of Project impacts, especially for Tsuut'ina's lands, and so cannot be relied on to conclude that our wells and surface water will not be impacted by the Project and that we are not at risk of increased flooding". "In addition to the new modelling, Tsuut'ina has made it clear to Alberta Transportation over the course of several meetings that additional data also needs to be collected, including from dedicated monitoring wells on Tsuut'ina's reserve, to properly calibrate the model".	Tsuut'ina Nation 2019, p. 1, 3	--
Piikani Nation		
"Long-term effects on groundwater resources downgradient of the Project did not appear to have been explicitly addressed in the numerical groundwater flow model. No sensitivity analysis or assessment of the model imitations and uncertainties appeared to have been performed on the model" "… the application did not appear to have assessed potential existence of groundwater-dependent, traditionally used culturally sensitive areas, such as cabins, recreational sites, fishing, hunting, and plant gathering areas within the LAA that could be impacted by the Project".	Piikani Nation Consultation 2018 (CEAR #48), p. 3, 4	--

Table IR19-1 Groundwater Dependent Traditional Uses and Culturally Sensitive Areas as Identified by each Indigenous Group

Groundwater Dependent Traditional Uses and Culturally Sensitive Areas, including Medicinal Plants, Shallow Groundwater or Springs near Cabins, Fishing or Hunting Sites	Source	EIA Reference (if applicable)[1]
"Piikani Nation requests that Alberta Transportation: i. conducts additional water quality sampling, from more wells, and through all seasons to establish a more robust Baseline, before or during construction of the Project to confirm the validity of the EIA assessment results; ii. engages in long-term monitoring of more than ten domestic wells within the RAA and conducts additional well surveys to acquire further pertinent information for the long-term monitoring program; iii. provides Piikani Nation with updates regarding additional investigations of the Project and seasonal characterization of groundwater quality; and consults with Piikani Nation about its mitigation plans in the event of unexpected effects on groundwater quality and quantity in the RAA". "Piikani Nation requests that Alberta Transportation: i. confirms that it has considered potential traditional groundwater use in any culturally sensitive areas; ii. if it identifies or is informed through the TLRU study about traditionally used, culturally sensitive areas within the Project impact area, develops mitigative measures to protect these sensitive areas including the contribution of natural groundwater flow to such areas; and iii. consults with community members to inform and participate in monitoring activities related to culturally sensitive areas and considers incorporating the role groundwater plays in sustaining identified areas for monitoring and mitigation".	Piikani Nation 2018, p. 17-18, 24	--
Piikani Nation expressed concern for groundwater and the stated that Project doesn't plan to line the reservoir, so any contaminants would likely seep into the groundwater system. Piikani Nation noted that Tsuut'ina Nation relies on the Elbow River and on the groundwater in the Elbow River Alluvial Aquifer for the reserve's drinking water.	Piikani Nation 2018, p. 14	--
Stoney Nakoda Nations		
"… Stoney Nakoda Nations wanted to understand impacts from SR1 to groundwater as well as surface water". Stoney Nakoda Nations, in referencing water issues stated that "the Stoney have a historical and legal stance on water" and "wanted to acknowledge that point as part of the work on SR1".	Engagement Meeting, September 14, 2017, p. 3, 4	Volume 3A, Section 5.1.2 Volume 3A, Section 14.1.2
Ermineskin Cree Nation		
Ermineskin Cree Nation did not identify any groundwater dependent traditional uses and culturally sensitive areas.	--	--

Table IR19-1 Groundwater Dependent Traditional Uses and Culturally Sensitive Areas as Identified by each Indigenous Group

Groundwater Dependent Traditional Uses and Culturally Sensitive Areas, including Medicinal Plants, Shallow Groundwater or Springs near Cabins, Fishing or Hunting Sites	Source	EIA Reference (if applicable)[1]
Louis Bull Tribe		
Louis Bull Tribe did not identify any groundwater dependent traditional uses and culturally sensitive areas.	--	--
Montana First Nation		
Montana First Nation did not identify any groundwater dependent traditional uses and culturally sensitive areas.	--	--
Samson Cree Nation		
Samson Cree Nation did not identify any groundwater dependent traditional uses and culturally sensitive areas.	--	--
Métis Nation of Alberta, Region 3		
Métis Nation of Alberta, Region 3 did not identify any groundwater dependent traditional uses and culturally sensitive areas.	--	--
Foothills Ojibway		
As reported in Volume 3A, Section 14.8.7, Foothills Ojibway undertakes current use activities such as hunting, plant harvesting, habitation, as well as spiritual and ceremonial practices. However, no additional information regarding groundwater-dependent traditional uses and culturally sensitive areas has been received from Foothills Ojibway to date. Alberta Transportation has continued to provide Foothills Ojibway with Project information and updates.		
Ktunaxa Nation		
As reported in Volume 3A, Section 14.8.8, Ktunaxa Nation has informed Alberta Transportation that they have no interest in the Project. Alberta Transportation has continued to provide Ktunaxa Nation with Project information and updates.		
Métis Nation British Columbia		
Métis Nation British Columbia has not engaged with Alberta Transportation on the Project. Alberta Transportation has continued to provide Métis Nation British Columbia with Project information and updates.		

b) As described in Volume 4, Appendix C, page C.4, C.5 and C.26, measures to mitigate potential effects on groundwater dependent traditional uses and culturally sensitive areas and those that also contribute to natural groundwater flow include:

- Water will be discharged in a manner to avoid erosion using turbidity barriers, containment berms and settling ponds. Dewatering-will be in accordance with the terms and conditions of the *Environmental Protection and Enhancement Act* approval conditions, and *Water Act* approval and the federal *Fisheries Act* and *Navigable Waters Protection Act.*
- A care of water plan will include the use of cofferdams, pumping systems, sumps, pipelines, channels, flumes, drains, and other dewatering works to permit construction of the work in the dry.
- At locations where flows from care of water operations are discharged into waterbodies, test the water quality at discharge locations and monitor the TSS to ensure the water quality is made equal to or better than the initial water source.
- Total suspended solids (TSS) levels will be controlled and reduced using silt fences and turbidity barriers to ensure the water quality from care of water system discharges is made equal to or better than the initial water quality. TSS levels will be monitored by carrying out frequent water quality testing.
- Construction dewatering will be minimized through construction planning.
- Existing water wells within the reservoir footprint will be decommissioned and plugged off to prevent groundwater contamination.
- Regional-scale effects on groundwater quantity can be mitigated by allowing seepage in the dry diversion channel to infiltrate back into the subsurface, or flow back into the Elbow River by surface water drainage pathways. Silt fences and turbidity barriers will be used to control TSS and to ensure the water quality discharges is made equal to or better than the initial water quality by carrying out frequent water quality testing.

Volume 3C, Section 2.4.1 describes the hydrogeological monitoring program, which reflects concerns related to the effects of the Project on groundwater and local water wells raised by landowners in the area and by potentially affected Indigenous groups. As described, a follow-up and monitoring program will validate the results of the hydrogeological modelling and monitor the effects of a flood on groundwater in the LAA. Final follow-up and monitoring plans will incorporate any requirements in approval conditions for the Project.

The use of groundwater dependent traditional uses and culturally sensitive areas, as indicated by the outcomes of the engagement program to date, are consistent with the activities that were assessed for effects on TLRU and for which the suite of mitigation measures were developed.

Alberta Transportation has determined that the significance conclusions ("not significant") of effects on groundwater are unchanged.

Alberta Transportation emphasizes that the EIA conforms to CEAA 2012 and the CEA Agency Guidelines for the Project and reflects standard environmental assessment practice appropriate for the scope and nature of the Project.[2]

Alberta anticipates building upon engagement efforts to date to continue to strengthen relationships with potentially affected Indigenous groups. Information provided throughout the regulatory phase will be used to inform Project plans and mitigation, as appropriate.

REFERENCES

Kainai First Nation. June 2018. Blood Tribe/Káínai Traditional Knowledge, Land, and Resource Use Study. Springbank Off-Stream Reservoir Project. Prepared for the Blood Tribe/Káínai. Prepared by Dermot O'Connor, Oak Road Concepts Inc. Available on the Canadian Environmental Assessment Registry (CEAR #47) at: https://www.ceaa-acee.gc.ca/050/evaluations/document/123631?culture=en-CA

PGL. Springbank Off-Stream Reservoir Project – EIS Technical Review and Information Requests, Kainai First Nation. Available on the Canadian Environmental Assessment Registry (CEAR #47) at: https://www.ceaa-acee.gc.ca/050/evaluations/document/123631?culture=en-CA

PGL. Springbank Off-Stream Reservoir Project – EIS Technical Review and Information Requests, Selected Sections: Second Sufficiency Review. Tsuut'ina Nation. Available on the Canadian Environmental Assessment Registry (CEAR #47) at: https://www.ceaa-acee.gc.ca/050/evaluations/document/123631?culture=en-CA

PGL. Springbank Off-Stream Reservoir Project –2nd EIS Sufficiency Review. Tsuut'ina Nation. April 18, 2018, 2018.

PGL. Springbank Off-Stream Reservoir Project –Additional Hydrogeological Assessment and Modeling Request. Tsuut'ina Nation. May 25, 2018.

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[2] Standard assessment methods have been developed with reference to federal guidance material for the conduct of federal environmental assessment, including CEAA 2012; the CEA Agency's Draft Technical Guidelines for assessing the Current Use of Lands and Resources for Traditional Purposes under CEAA 2012 (December 2015); the CEA Agency's Considering Aboriginal traditional knowledge in environmental assessments conducted under CEAA -- Interim Principles (2016); the CEA Agency Environmental Impact Statement Guidelines for the Springbank Off Stream Reservoir Project (2016); CEA Agency's Assessing Cumulative Environmental Effects under the CEAA, 2012, Interim Technical Guidance (March 2018); CEA Agency's Assessing Cumulative Environmental Effects under the CEAA, 2012, Operational Policy Statement (March 2015); CEA Agency's Cumulative Effects Assessment Practitioners' Guide (1999); and Table A-3 of the National Energy Board Filing Manual (2017).

Mandell Pinder LLP. April 16, 2018. Letter to Canadian Environmental Assessment Agency Re: Springbank Off-Stream Reservoir Project (the Project) Technical Review of Revised Environmental Impact Statement (EIS).

Mandell Pinder LLP. June 20, 2018. Letter to Canadian Environmental Assessment Agency Re: Springbank Off-Stream Reservoir Project (the Project) Technical Review of Revised Environmental Impact Statement (EIS). Available on the Canadian Environmental Assessment Registry (CEAR #50) at: https://www.ceaa-acee.gc.ca/050/documents/p80123/123695E.pdf

Piikani Nation. June 2018. Alberta Transportation Springbank Off-Stream Reservoir Project Environmental Impact Study. Review prepared for Piikani Nation by Schaldemose & Associates Inc.

Piikani Nation Consultation. June 15, 2018. Letter to Alberta Transportation and Canadian Environmental Assessment Agency RE: Piikani Nation Statement of Concern for Alberta Transportation Springbank Off-Stream Reservoir Project. Available on the Canadian Environmental Assessment Registry (CEAR #48) at: https://www.ceaa-acee.gc.ca/050/evaluations/document/123693?culture=en-CA

Tsuut'ina Nation. May 30, 2016. Letter to Canadian Environmental Assessment Agency Re: Springbank Off-Stream Reservoir Project.

Tsuut'ina Nation. February 28, 2019. Letter to Alberta Transportation Re: Canadian Environmental Assessment Agency Information Requests for the Springbank Off-Stream Reservoir Project (the Project) – Request for Tsuut'ina Input.

ICE REGIME

Question IR3-20: Ice Regime

Sources:

EIS Guidelines Part 2, Section 6.2.2

EIS Volume 3A, Section 6.2

EIS Volume 3B, Section 6, Table A-2

Context and Rationale:

The EIS Guidelines require the proponent to assess changes to groundwater and surface water, including changes to ice regime.

The EIS notes that ice regime effects are assessed in Volume 3B, Section 6 (Hydrology). However, no discussion of ice regime is present in Volume 3B. Although the existing conditions of ice dynamics are discussed in Volume 3A, Section 6.2 of the EIS, information is not provided on consideration of changes to ice regime as a result of the Project.

Additional information is required to understand changes to ice regime that could result from the Project, and effects of those changes on valued components.

Information Requests:

a) Describe potential changes to ice regime as a result of the Project. Include a discussion the potential for Project components to affect ice jamming, particularly during flooding, and the potential effects from this on relevant valued components.

b) If necessary, update the Concordance Table (Volume 4, Appendix A, Table A-2) based on the sections that discuss ice regime effects.

Response IR3-20

a) The ice observations described in Volume 3A, Section 6.2.2.5 were made at the Highway 22 Bridge. As for the service spillway in the diversion structure, the bridge spans the bankfull width and has a mid-channel pier. Because of its geometry and location close to the diversion structure, the bridge was selected as a surrogate for how the diversion structure may affect flow and ice in dry operations. The ice observations show that the bridge does not influence the river's ice regime and, therefore, it is inferred that the diversion structure will not either. In addition to these observations the following is noted.

The diversion structure's diversion inlet has a sill that is at bankfull elevation and ice from mid-winter ice processes will not reach the diversion inlet.

Elbow River does not currently experience ice jamming from either frazil (ice crystals formed in turbulent waters) or break-up because the flow in winter is too low and most of the channel freezes to bed. Because of the low flow rates, open water leads are not maintained during cold periods, and the lack of open water leads prevents the formation of frazil.

At the diversion structure, the river channel nearly freezes to bed with flow passing through superimposed lenses in the ice. This same phenomenon was observed throughout this reach of the Elbow River including under the Highway 22 bridge and at all points in the river between the bridge and the diversion structure. As for the bridge, the diversion structure service spillway spans the bankfull channel and is not expected to have any impact on frazil or other mid-winter ice processes.

Break-up on Elbow River is staged, wherein ice at the Project site thermally degrade weeks, or months, before the freshet in the upper parts of the watershed (alpine). This scenario is not conducive to mechanical break-up that could cause jamming. There is no geomorphic or anecdotal evidence of ice jamming on Elbow River from mechanical breakup. Because mechanical break-up does not typically occur on Elbow River, there is limited risk that the Project could impact this characteristic of the regime.

Should a mechanical ice break-up occur, because the diversion structure spans the bankfulll channel, no impact on ice floes (e.g., such that it could induce large jams) is expected and the structure would behave similar to the Highway 22 bridge in such an event. The diversion structure will, therefore, not change the break-up characteristics of the ice regime on Elbow River.

Floods on the Elbow River occur in June and do not occur at the same time as the thermal degradation of the ice cover (typically April). As such, floods occur after complete ice melt. Ice will not be present during flood operations and cannot affect the operation of the service spillway, or the diversion inlet, or the diversion structure.

In conclusion, because the Project does not affect the ice regime of the Elbow River, it will not have any effect on any valued components (VCs).

b) Given the response to (a), no updates to the concordance table are required.

WATER QUALITY

Question IR3-21: Water Quality – Nutrients

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.2.2

EIS Volume 3A, Section 8

EIS Volume 3B, Section 8

EIS Volume 4, Appendix K

Piikani Nation – Technical Review of EIS, June 15, 2018 (CEAR #48)

Context and Rationale:

The EIS Guidelines require baseline data and assessment of potential effects to water quality associated with nutrients.

The EIS considers select nutrients of concern and risks for eutrophication. The detection limits selected may not a support a full understanding of how the Project may contribute to eutrophication. For example, some detection limits reported are within the hypereutrophic range. Further, the EIS does not provide information on the potential for cyanobacterial blooms or microcystin toxin release in the reserve or downstream.

Additional information is required regarding nutrient detection limits and potential eutrophication and toxin production, to understand potential changes to water quality and the environmental effects of those changes.

Information Requests:

a) For each nutrient, compare detection limits listed in the EIS with standard detection limits in federal and/or provincial water quality guidelines. If detection limits are higher than guidelines, provide a rationale for the selection of detection limits, describe associated limitations, and identify how these limitations will be addressed. Identify the water quality guidelines used in the assessment.

b) Describe how low-level detection limits for nutrients will be integrated into water quality monitoring and follow-up programs to ensure that trophic categories can be assessed and guidelines adhered to.

c) Provide an assessment of the potential for the off-stream reservoir to develop cyanobacterial blooms and the associated potential for the production of microcystin toxins. Include an analysis of the potential introduction and dispersion of these toxins in the Elbow River and drinking water supplies, such as the Glenmore Reservoir. Describe associated mitigation measures and contingency plans should cyanobacterial blooms develop in the reservoir.

Response IR3-21

a) The number of nutrient concentrations below detection limits and/or above regulatory (provincial and federal) guidelines are presented in Volume 4, Appendix K, Section 3.2.3, Table 3-2. Table IR21-1 compares relevant guidelines and detection limits for nutrient water quality analysis.

Nutrient levels were rarely above regulatory guideline levels except for a few instances where nitrate was greater than guidelines at Sarcee Bridge (n = 9 or 4.3 % of all observations) and at Weaslehead Bridge (n = 2 or 0.8% of all observations). The number of nutrient concentrations below detection limits or above Elbow River Water Quality Objectives (ERWQOs) are presented in Volume 4, Appendix K, Section 3, Table 3-3.

Table IR21-2 summarizes the number of nutrient analysis (i.e., nitrate+nitrite, ammonia and dissolved phosphorus) below guideline levels and Table IR21-3 summarizes the percentage of nutrient sample analysis that exceeded ERWQO in each of the Elbow River stations.

Detection limits were rarely greater than guideline levels or regulatory thresholds. It is possible ammonia guidelines are lower than detection limits; however, conditions permitting this to occur are expected to be rare (i.e., elevated water temperatures and pH levels). Even though several ammonia values were below detection limits, they were not greater than the relevant guideline level. The Project is not predicted to result in changes to nutrients or alter aquatic trophic levels (Volume 3B, Section 7.5, page 7.34). The guidelines for total phosphorus and total nitrogen are predicted to be not exceeded.

Table IR21-1 Relevant Guidelines and Detection Limits for Elbow River Used in this Assessment.

Parameter	Unit	CWQG[1] Acute	CWQG[1] Chronic	ASWQG[2] Short term	ASWQG[2] Long term	ERWQO[3]	Detection Limit
Nitrate (as (N)	mg/L	124	3	124	3	--	0.02 - 0.1
Nitrite (as N)	mg/L	--	0.06	Varies[4]	Varies[4]	--	0.01 - 0.05
Nitrate+Nitirite	mg/L	--	--	--	--	0.267	0.003 - 0.11
Total Nitrogen	mg/L	--	Narrative[5]	--	--	Narrative[5]	calculated
Ammonia (as N)	mg/L	--	Equation[6]	--	Equation[6]	0.04	0.005 – 0.1[7]
Total Kjeldahl Nitrogen	mg/L	--	--	--	--	--	0.02 - 0.2
Total Phosphorus	mg/L	--	Narrative[5]	--	Narrative[5]	--	0.001 - 0.02
Total Dissolved Phosphorus	mg/L	--	--	--	--	0.009	0.001 - 0.01

NOTES:

-- no guideline or detection limit

1 Canadian Water Quality Guidelines (CCME 2019)

2 Alberta Surface Water Quality Guidelines (GoA 2018)

3 Elbow River Water Quality Objectives

4- Varies with chloride – When chloride is less than 2 mg/L, the 30-day average for nitrate is 0.02 mg/L and the lowest instantaneous concentration is 0.06 mg/L

5 Nutrient guidelines for rivers – nitrogen and phosphorus to be maintained as to prevent detrimental changes or trophic changes

6 Lowest guideline level (0.021 mg/L NH_3) is above most analytical detection limits

7 three samples were analyzed for ammonia using a detection limit of 0.01 mg/L in 2013, all other detection limits were at or greater than 0.01 mg/L

Table IR21-2 The Number of Elbow River Water Sample Nutrient Concentrations Below Analytical Detection Limits

Parameter	Bragg Creek (number of samples below detection limit)	Highway 22 (number of samples below detection limit)	Twin Bridge (number of samples below detection limit)	Sarcee Bridge (number of samples below detection limit)	Weaslehead Bridge (number of samples below detection limit)
Nitrate+Nitrite	220 (2)	460 (0)	672 (21)	206 (0)	320 (0)
Ammonia	7 (79)	12 (114)	103 (112)	1 (83)	24 (62)
Dissolved Phosphorus	102 (111)	183 (240)	301 (455)	114 (62)	239 (166)
Total Organic Carbon	172 (0)	386 (16)	739 (18)	82 (0)	344 (0)

Table IR21-3 Percentage of Elbow River Water Sample Nutrient Concentrations Greater than Elbow River Water Quality Objectives (ERWQOs)

Parameter	Bragg Creek.	Highway 22	Twin Bridge	Sarcee Bridge	Weaslehead Bridge
Nitrate+Nitrite	0.5	0.0	1.3	2.4	0.6
Ammonia	0.0	0.0	0.0	0.0	0.0
Dissolved Phosphorus	4.2	4.2	6.2	9.7	12.3
Total Organic Carbon	0.0	0.0	0.0	0.0	0.0

b) Water quality sample analysis for nutrients from the Project monitoring programs will use analytical methods with detection limits less than relevant regulatory guideline levels. For instance, the detection limit for nitrate is 0.02 to 0.1 mg/L which is lower than relevant provincial and federal guidelines for the protection of aquatic life (see Table IR21-1).

The off-stream reservoir will be engaged only when flows in the river are greater than 160 m^3/s). During these infrequent floods (less often than once in ten years), nutrients associated with suspended sediments will largely settle in the off-stream reservoir and reduce overall downstream nutrient loading (as stated in Volume 4, Appendix K, Section 7.4.2, page 7.23). The off-stream reservoir will have no effect on dissolved nutrients. Therefore, the Project will not result in increased nutrient loading to Elbow River or Glenmore Reservoir, nor will it affect trophic levels.

c) Cyanobacteria comprise a diverse group of microorganisms with functional traits allowing them to inhabit many habitats. A number of freshwater planktonic groups are known to affect drinking water and recreational resources. Several environmental factors are involved in the development of these communities in aquatic habitats including water, temperature, light attenuation, nutrient levels and nutrient ratios (nitrogen, phosphorus and carbon), water mixing, turbidity, and waterbody residence time (Mantzoui et al 2016; Stroom and Kardinaal 2016; Komarek 2003; Gkelis et al. 2017). The potential for cyanobacteria to bloom in the off-stream reservoir is low and the reasons are discussed in the five points below.

1. Nutrient availability and eutrophication are the most important factors leading to nuisance cyanobacterial blooms; nitrogen, phosphorus and carbon are needed to varying degrees for growth.

   Several functional groups are known nitrogen fixers and, therefore, can sequester N_2 (nitrogen as gas or dissolved phase in the water column) for their nitrogen needs. However, phosphorus may not be as readily available for uptake and, thus, becomes the limiting factor for continued growth. In some cases, cyanobacteria can be controlled by regulating phosphorus entering a waterbody.

   Carbon is used by cyanobacteria in photosynthesis to produce sugar. Atmospheric carbon dioxide will diffuse into the water column from the surface; if it is depleted, it can also be a limiting factor for growth. Volume 3B, Section 7.4.2, page 7.23 predicts that nutrients will settle with suspended sediments in the reservoir and will have no effect on dissolved nutrients. Nutrients will generally be unavailable for phytoplankton growth; this includes cyanobacteria growth.

Trophic status is discussed in Volume 4, Appendix K, Section 2.2.4.6 page 2-29: the productivity or trophic status of an aquatic system is based on total phosphorus concentrations as follows (CCME 2019):

- ultra-oligotrophic: less than 0.004 mg/L
- oligotrophic: 0.004-0.010 mg/L
- mesotrophic: 0.010-0.020 mg/L
- meso-eutrophic: 0.020-0.035 mg/L
- eutrophic: 0.035-0.100 mg/L
- hyper-eutrophic: greater than 0.100 mg/L

Based on reported median total phosphorus concentrations, Elbow River is considered oligotrophic (see Volume 4 Appendix K, Section 3, Figure 3.5). Low total phosphorus concentrations correspond with low productivity (CCME 2004). The trophic status will not change due to the Project; therefore, the water quality parameters that depend on the trophic status will not be changed.

Water quality in Elbow River upstream of Calgary is considered oligotrophic (as stated above) and occasionally mesotrophic; nutrient levels tend to be low. The median total phosphorus levels, for example, in the spring and summer at Bragg Creek and Highway 22 generally ranged between 0.002 and 0.003 mg/L; however, the June median level was 0.0055 mg/L. The median total nitrogen levels were between 0.1 mg/L and 0.3 mg/L. Guideline exceedances at these two locations for total phosphorus and total nitrogen between from 2010 to 2014 occurred in less than 3% of samples collected and reported by the City of Calgary (2012). Cyanobacterial blooms are associated with total phosphorus concentrations between 0.020 mg/L and 0.030 mg/L (greater by a factor of 10) when other favorable conditions are present (e.g., stratification, water temperature, available carbon); thus, the risk for cyanobacteria to bloom is low.

2. Nutrients entering the off-stream reservoir will largely be particle-bound and associated with suspended sediments; these concentrations will settle out and be unavailable for biological uptake. Because the reservoir is shallow and aeration of water from wind action, water is predicted to remain well oxygenated. Thus, nutrients will stay in particulate form; they will not dissolve and diffuse into the water column and, thereby, not be available for biological uptake.

3. Cyanobacteria compete with algae for resources in aquatic habitats including nutrients and light. In the unlikely event conditions changed and cyanobacteria were to bloom (as suggested in the IR question) pioneer algae species will take advantage of limited resources including nutrients, preventing cyanobacteria from establishing at nuisance levels. Downing et al. (2001) showed that cyanobacteria did not become the dominant phytoplankton until total phosphorus concentrations were above 0.08 mg/L to 0.09 mg/L. Algae typically use resources quickly and out-compete slower developing

cyanobacteria in the short term. Low concentrations nutrients, particularly phosphorus, will be taken up by algae, thus leaving cyanobacteria colonies with fewer resources.

4. Waterbodies may be subject to the development of nuisance cyanobacteria colonies because of environmental conditions that developed in previous seasons. This includes favorable overwintering or resting conditions in benthic sediments that support recruitment of cyanobacterial colonies. Because of the short term, temporary and infrequent nature of operating the off-stream reservoir and given the low likelihood of a major flood (requiring diversion) during the spring season, there will not be any overwintering or resting habitat or populations in the off-stream reservoir; therefore, a nuisance bloom will not occur.

5. Cyanobacteria have sets of functional traits allowing them to respond to multiple environmental conditions happening simultaneously. This allows them to be competitive and successful in stable habitats.

   For instance, under stratified water conditions such as in a deep lake, vertical mixing is limited; cyanobacteria have gas vesicles allowing them to regulate their position in the water column. This allows them to rise and take advantage of higher light levels required for photosynthesis and dissolved carbon dioxide concentrations. Additionally, during periods of heavy growth, blooms can attenuate available light, thus limiting the growth of planktonic algae at lower levels in the water. Conversely, in shallow reservoirs and waterbodies, such as the off-stream reservoir, environmental conditions tend to be less stable. Wind action will cause mixing through the reservoir that prevents cyanobacteria from taking advantage of a position in the upper water column. Thus, cyanobacteria will not be able to effectively use their functional traits to outcompete algae.

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Question IR3-22: Water Quality - Modelling of Post-Flood Parameters

<u>Sources:</u>

EIS Guidelines Part 2, Section 6.2.2 and 6.3.1

EIS Volume 3B, Section 7.1.1.1

EIS Volume 4, Appendix K

Piikani Nation – Technical Review of EIS, June 15, 2018

Context and Rationale:

The EIS Guidelines require that any changes to TSS, turbidity, oxygen levels, water temperature, pH, dissolved oxygen, ice regime, water quality including metals, methyl mercury, nutrients, dissolved/total organic carbon, biological oxygen demand, carbonaceous biochemical oxygen demand, pesticides, aquatic indicators, and sediment quality be included in the EIS.

The EIS provides a quantitative assessment of Project effects to TSS and uses TSS as a surrogate to qualitatively examine the effects of the Project during flood and post-flood on other parameters, such as nutrients, metals, and coliforms. The EIS explains that such an approach reduces duplicative efforts and addresses the core processes that produce water quality patterns in Elbow River. However, further rationale is needed to determine whether effects to TSS is an appropriate surrogate for each of the other water quality parameters. Potential effects to nutrients, metals, and coliforms may be underestimated if TSS does not act similarly to these parameters.

Indigenous groups raised concerns with water quality changes associated with chemicals found within the reservoir area. The EIS lists a few best management practices from the Environmental Code of Practice for Pesticides to prevent introducing herbicides to surface water. Some of these included maintaining a distance between mixing/application of products and open bodies of water. However, the soil chemistry results for hydrocarbons (F3-F4) shown in Table A-4 of the technical report (Appendix K) suggested that it was likely that some of the flooded reservoir pasture lands might have had herbicides applied or are otherwise contaminated with hydrocarbons.

Additional information is required to understand changes to water quality from the project and environmental effects of those changes.

Information Requests:

a) **Provide evidence that TSS is an appropriate surrogate for other water quality parameters not assessed and listed in the EIS Guidelines Part 2, sections 6.2.2 and 6.3.1. If TSS is found to be not suitable as a proxy for any water quality parameters, provide an assessment of the potential effects to that parameter and associated potential changed to water quality.**

b) **With regards to pesticides and hydrocarbon contamination:**

   i. **Assess effects related to herbicides applied to control vegetation during Project operations, and also to any existing hydrocarbons including herbicides that are on lands within the full project footprint;**

   ii. **Provide a project footprint map at a larger scale than shown in Figure 2 (EIA, Volume 4, Appendix K) that more clearly depicts the locations of the sediment and soil quality sampling sites;**

iii. **Clarify how adequate setbacks for stored fuels, lubricant from vehicles and herbicide applications on the Project footprint will be maintained before an extreme flood event occurs, to prevent introducing hydrocarbons or other contaminants to water during a flood event.**

Response IR3-22

a) The literature evidence is strong (as presented in Volume 3B, Section 7 and In Volume 4, Appendix K) that total suspended solids (TSS) is a valid indicator for water quality parameters, based on chemistry and physics of how metals, organics and other substances adhere to suspended sediment.

Water quality patterns in Elbow River are driven by flow and the sediment it transports (Volume 4, Appendix J, Section 3.3.2; Appendix, K, Section 2.4.4; Sosiak and Dixon 2004). As stated in Volume 4, Appendix, K, Section 2.4.4:

> "Parameters that behave similarly to TSS are likely either directly associated with suspended sediment transport or related processes that contribute to high flows (e.g., overland flow during precipitation; Han et al. 2006). Parameters that behave in contrast to TSS are likely associated with processes unrelated to suspended sediment transport or the drivers that contribute to it (e.g., groundwater contribution to baseflow)."

Many water quality parameters have been shown to be directly or indirectly related to suspended sediments, in both literature and the Elbow River dataset used for the assessment. Therefore, using the results of a pathway analysis approach for how suspended sediments may change can be used to predict how other water quality constituents will respond to the Project. The connection between suspended sediments and water quality constituents is further discussed in Volume 3B, Section 7.1, page 7.2:

> "Many water quality parameters behave similarly to suspended sediment. They are either directly associated with suspended sediment transport (e.g., Foster and Charlesworth 1996) or indirectly associated with suspended sediment (e.g., Han et al. 2006). Direct associations are when suspended sediment is at least partially composed of a parameter (e.g., a nutrient or metal). In this case, the parameter suspends and settles with suspended sediment because it is a part of that sediment. Indirect associations are when suspended sediment is not composed of a parameter (e.g., a nutrient or metal), but the parameter behaves in a manner similar to suspended sediment (e.g., settling in low velocity water and suspending in high velocity water). The following parameters are often associated with suspended sediment concentrations:
>
> - nutrients (including dissolved and total organic carbon, phosphorus, and nitrogen species); Owens and Walling 2002, Walling et al. 2005, López-Tarazón et al. 2016

- metals; Meybeck et al. 2004, Horowitz 2008, Beck and Birch 2012
- coliforms; Crane et al. 1983, Tyrrel and Quinton 2003"

These processes are further explained in Volume 4, Appendix K, Section 3.2:

"Ion exchange processes occur between positively charged matter (such as metals and nutrients) and negatively charged particle surfaces, binding positively charged matter to particle surfaces. The majority (over 70%) of aluminum, arsenic, barium, chromium, copper, iron, manganese, nickel, zinc, and phosphorus have been found to be associated with suspended sediment particles in major United States (US) rivers (Horowitz 2004). In contrast, strontium was generally found in the dissolved phase, whereas lithium as divided equally between both phases (Horowitz 2004). In urban runoff, 70-80% of phosphorus and 50-80% of nitrogen have been reported to be particle-bound, with higher adherence to smaller particles (Vaze and Chiew 2004)."

b) The following discusses pesticide and hydrocarbon contaminants.

i) Baseline pesticide and herbicide levels in Elbow River are assessed in Volume 4 (Section 3.4, page 3.60). Of 63 analytes tested, two broad leaf weed herbicides were detected during the summer months between 2005 and 2010. 2,4-D (2,4-dichlorophenoxyacetic acid) was detected in 4 of 29 analysis and MCPP (2-methyl-4-chlorophenoxyacetic acid) was detected in 2 of 29 analysis. Concentrations above detection limits were from samples collected in Elbow River at Twin Bridges or Weaslehead Bridge.

2,4-D has a half life of 1-14 days in soil and MCPP has a half life of 21 days in soil (National Pesticide Information Center 2019a). Residual pesticide concentrations from 2,4-D and MCPP historic pesticide use (within the proposed off-stream reservoir) are predicted to degrade rapidly within the first season of dry operations.

Herbicides used to control weeds during construction and operations will be used in accordance with regulatory codes of practice (GoA 2010) that are designed to allow low risk activities to proceed without having an environmental effect. 2,4-D has a half life of 186 days in sediments (National Pesticide Information Center 2019b). Volume 3A, Section 7.5, page 7.18 states that effects from herbicide application will be not significant. Mitigation applied during herbicide use will include (Volume 3A, Section 7.4.2, Page 7.15) the following:

"Herbicides would be applied according to Environmental Code of Practice for Pesticides:

- restrict herbicide mixing and loading within 30 m of an open body of water

- identify open bodies of water within the application sites
- mark or flag of open bodies of water that will not be clearly visible to the applicator

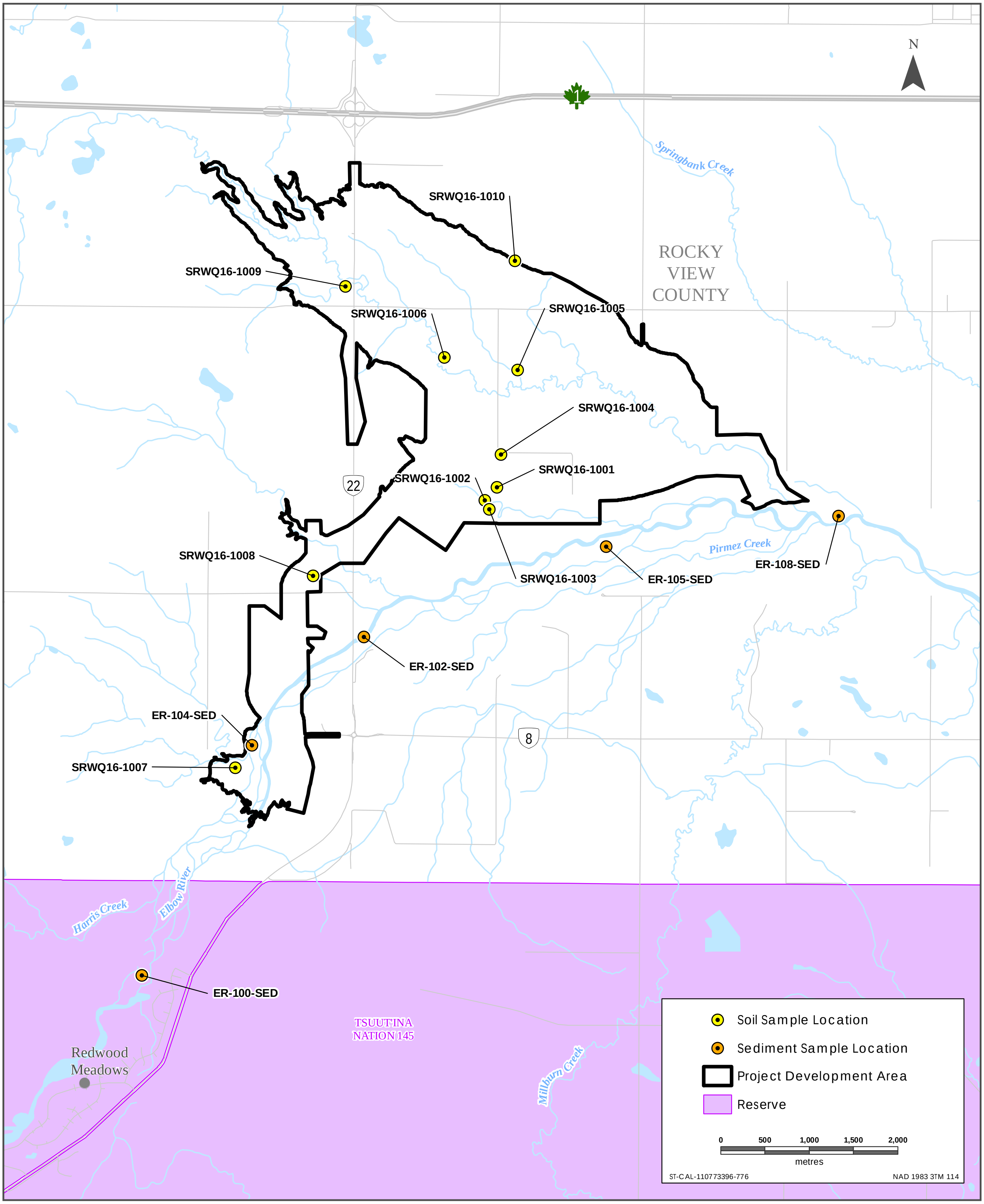
The Code of Practice specifies minimum distances that need to be maintained from open bodies of water, depending on the type of herbicide used."

Hydrocarbon analysis in soil samples collected within the off-stream reservoir were below detection limits (Volume 4, Appendix K, Attachment A, Table A-3, page A.8). Baseline hydrocarbon levels are not anticipated to have an effect on the off-stream reservoir water quality.

Hydrocarbons will be controlled during construction activities and potential effects on water quality are not expected. Mitigation to control hydrocarbons include (Volume 3B, Section 7.4.2, page 7.16):

- transport of hazardous materials to and from the Project site, storage, use and disposal will be in accordance with regulatory requirements
- construction equipment will be mechanically sound with no oil leaks, fuel or fluid leaks. Inspect equipment daily and immediately repair any leaks
- employ persons qualified to handle construction equipment fuels and lubricants to perform repairs
- service vehicles to carry fuel spill clean-up materials
- use of containment berms and impermeable liners around fuel and lubricant storage tanks
- maintain a minimum 100 m setback between stored fuels and lubricants and rivers, streams and surface water bodies

ii) See Figure IR22-1.



Sources: Base Data - ESRI, Natural Earth, Government of Alberta, Government of Canada
Thematic Data - ERBC, Government of Alberta, Stantec Ltd

Sediment and Soil Quality Sampling Sites

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Figure IR22-1

iii) Stored fuels and lubricants will be located above potential flood zone areas to prevent these materials from entering Elbow River or the off-stream reservoir. These facilities will be designed to contain stored fuels and lubricants and to control spills, should they occur. Spill kits and spill cleanup materials will be on hand to clean onsite leaks and spillage to prevent runoff from the localized area.

Herbicides will be used as per regulatory codes of practice (GoA 2010) to control and manage environmental changes to nearby waterbodies and prevent effects to water quality. Application rates will be according to manufacturers' recommendations to prevent overuse and runoff to sensitive environmental areas.

Additionally, Volume 3B, Section 8.2.2 states:

> "Potential contaminant-related effects will be mitigated through project design (e.g., road water runoff management), implementing a spill containment and response plan, using appropriate sediment and erosion control measures, limiting the use of and following best management practices for herbicides and fertilizers in the dry reservoir or near waterbodies, and using nontoxic biodegradable hydraulic fluids in equipment for any required instream works.
>
> Activities near water will be planned and completed in the dry and isolated from watercourses to prevent materials such as paint, primers, blasting abrasives, rust solvents, degreasers, grout, other chemicals or other deleterious materials do not enter the watercourse."

For clarification, "in the dry" means any activities near water will be isolated from the water in the river. This may include building a cofferdam to construct the service spill way, using drape cloths to capture paint and solvent overspray from the diversion inlet, or placing gas powered pumps within containment to capture oil, grease and fuel.

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FISH AND FISH HABITAT

Question IR3-23: Fish and Fish Habitat – Effects of Noise

Sources:

EIS Guidelines Part 2, Sections 6.1.5; 6.2.1; 6.3.1

EIS Volume 3A, Section 4; 11

EIS Volume 3B, Section 4; 11

Context and Rationale:

The EIS Guidelines require that the assessment include consideration of changes in ambient noise levels as a result of the Project. The EIS Guidelines require the proponent to provide baseline information on and assess the effects of changes to the environment on fish and fish habitat.

Several studies (Smith et al. 2004; Hastings and Popper 2005; Popper and Hastings 2009; Voellmy et al. 2014) indicate that an increase in anthropogenic noises and associated vibrations could have a potential effect on fish, such as behavioural changes that can result in decreased fitness; temporary or permanent damage to sound receptors; avoidance of areas with elevated sound levels; and changes in anti-predator behaviours of prey species.

The EIS does not consider noise and vibration effects on fish and fish habitat.

Information Requests:

a) Provide an assessment of the effects of noise and vibration to fish and fish habitat during construction.

b) Describe mitigation measures to reduce or eliminate the effects of noise and vibration on fish and fish habitat.

Response IR3-23

a) The assessment of effects does not consider noise and vibration on fish and fish habitat. Construction of the flood structures will be conducted in dry conditions outside aquatic and wetted fisheries habitats. The reference material cited discusses noise and vibration usually associated with impact pile driving in marine or connected aquatic environments with fisheries resources in proximity to the construction works. These conditions are not applicable to the Project.

b) Mitigation during construction includes construction of the diversion structure in isolated dry conditions outside aquatic fisheries habitats. During dry operations, instream Project components will not create noise and vibration.

Question IR3-24: Fish and Fish Habitat – Habitat Destruction

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.1.5; 6.2.2; 6.3.1

EIS Volume 3A, Sections 8.3; 8.4; 8.7

EIS Volume 3B, Section 8.2.5

Fisheries and Oceans Canada – Comments on the EIS, June 19, 2018 (CEAR #28)

Context and Rationale:

The EIS Guidelines require the proponent to provide baseline information on and assess the effects of changes to the environment on fish and fish habitat.

The EIS indicates that there would be temporary and permanent areas of disturbance within the bankfull of the Elbow River. For instance, the permanent diversion structure footprint is 1,854 m2 on class 2 and class 3 run type fish habitat. A characterization of the type and extent of fish habitat affected is important in determining residual impacts, and extent of offsetting required.

The EIS lists bridge construction as resulting in the permanent alteration of fish habitat, destruction of fish habitat, and death of fish. However, the details of the bridge construction are not provided. Additionally, the EIS states that during construction, the footprint within the bankfull water level may result in a temporary infill of habitat for the area that is not submerged during flows at the 1:2 flood level. This temporary infill is not explained or included as one of the Project components.

Throughout the EIS, it is not clear what areas and type of fish habitat will be affected by Project components and the type of disturbance that will occur (destruction or permanent alteration). To clearly understand the potential effects to fish and fish habitat, a summary of this information and figures should be provided.

Additionally, the EIS states that the characterization of the residual effects from the destruction of fish habitat is anticipated to be neutral in direction and short-term in duration. It is unclear how these characterizations were determined. A rationale for the characterization of residual effects is important to understand if there may be potential effects to fish and fish habitat.

Information Requests:

a) Provide a detailed breakdown of areas to be affected by the Project and the areas of each temporary or permanent structure, including:

- **The extent, type and cause of fish habitat destruction resulting from bridge construction.**
- **Additional details on the temporary infill of habitat, including an explanation of how this infill would result in destruction of fish habitat, and the type and area of habitat destruction.**
- **A table listing and summarizing all destruction and permanent alteration to fish habitat.**
- **A figure which illustrates the area to be affected and the type of disturbance (i.e., destruction vs. permanent alteration) and relate it to the type of habitat affected.**

b Provide a rationale for the characterization of residual effects from the destruction of fish habitat.

Response IR3-24

a) A detailed design for the planned diversion structure, and Highway 22 bridge has not been completed at this time; an analysis of the habitat footprint associated with these works (i.e., temporary and permanent infill of habitat) will be generated in advance of submitting an application for authorization to DFO. Temporary infill of habitat includes the temporary placement of material or structures in water to support construction activities (e.g., instream isolations) and will be removed upon completion of the works. This results in a temporary alteration of habitat during the time these materials or structures are in the water, but habitat is restored after the materials are removed. Permanent infill of habitat includes materials and structures that remain in place and will not be removed upon the completion of construction activities and results in the permanent alteration of fish habitat. A portion (300 m^2) of Tributary 1350 to the Elbow River will be lost due to the construction of the diversion channel. Length of construction for each Project component is not known at this time, given that the detailed design has not been completed. However, best management and mitigation measures will be used to reduce impacts to fish habitat, such as staggering isolations.

Figure IR25-2 and Figure IR25-3 of the habitat mapbook provided in the response to IR3-25, as Appendix IR25-1, presents the surveyed fish habitat delineated in the area of the planned diversion structure. Field survey results indicate that the diversion structure will affect a portion of Class 3 run and riffle habitats within the thalweg of Elbow River, which has moderate spawning habitat for sport fish. Immature brown and brook trout were captured in Reach 3 within the planned diversion structure footprint. Table IR24-1 lists the Project sources that will change fish habitat.

Table IR24-1 Project-related Change in Fish Habitat

Project Components and Physical Activities	Permanent Alteration of Fish Habitat	Destruction of Fish Habitat
Water diversion structures	1,854 m^2 of Class 2 and Class 3 run habitat within Elbow River channel will be permanently altered	None
Diversion channel	No changes resulting in "permanent alteration" to existing channel and fish habitat	300 m^2 of Tributary 1350 will be lost due to the construction of the diversion channel
Bridge construction	Unknown- at this time, planned two T-piers in proposed diversion channel to support Highway 22 bridge. An analysis of potential interaction with fish habitat footprint will be generated upon advancement of the design.	Unknown

b) The reservoir and Highway 22 bridge will be constructed above the high-water mark; therefore, the footprint of these works is not considered fish habitat. The diversion structure footprint will be constructed within existing fish habitat, and there will be a residual effect on fisheries habitats. As stated in Volume 3A, Section 8.4, page 8.61:

"The residual effect of construction on causing a permanent alteration to fish habitat is adverse in direction, low in magnitude, restricted to the PDA, permanent in duration, and a single event in frequency. Due to the permanence of the project structures in the river, the effect is irreversible.

The residual effect of construction on causing the destruction of fish habitat is adverse in direction, low in magnitude, restricted to the PDA, permanent in duration, and as a single event in frequency. Due to the permanence of the structure in the river, the effect is irreversible.

The residual effect of construction causing death of fish is adverse in direction, low in magnitude, restricted to the PDA, and an irregular event in frequency. Given the low potential and the small portion of the fish population that could be affected, the effect is not significant and reversible.

The effect of dry operation on aquatic ecology through a destruction of fish habitat, considering passage mitigation measures and monitoring, is adverse in direction, low in magnitude, extends to Elbow River through the LAA, permanent in duration, and would occur during spawning migrations at an irregular, but continuous frequency. Due to the permanence of the structure in the river, the effect is irreversible."

However, engineered design mitigations to accommodate fish movement will allow fish passage to continue to occur.

Question IR3-25: Fish and Fish Habitat – Mapping

Sources:

EIS Guidelines Part 2, Sections 6.1.5; 6.3.1.

EIS Volume 3A Section 8, Figure 8.2-2; Table 8-5

Louis Bull Tribe – EIS Review Submission, July 18, 2018 (CEAR #49)

Fisheries and Oceans Canada – Comments on the EIS, June 19, 2018 (CEAR #28)

Context and Rationale:

The EIS Guidelines require the proponent to provide baseline information on and assess the effects of changes to the environment on fish and fish habitat, and require maps indicating the surface area of potential or confirmed fish habitat for spawning, nursery, feeding, overwintering, migration routes, etc.

The EIS includes a map of fish habitat that classifies fish habitat at the proposed diversion site as features (class 2 and class 3 runs, class 3 pools, rapids, riffles, and snyes). However, fish habitat is defined in the EIS as spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes. The fish habitat mapping in the EIS is not consistent with the definition of fish habitat in both the EIS and EIS Guidelines. Additionally, the EIS does not include mapping for habitat downstream of the low-level outlet.

The EIS provides an overview of the features that make up the habitat of selected fish in the Elbow River. The features noted in Table 8-5 are different than those noted in Figure 8.2-2. It is not clear whether Table 8-5 is meant to correspond with Figure 8.2-2.

Thorough characterization of fish habitat is important for understanding the effects of the Project on fish and fish habitat.

Information Requests:

a) **For all areas already mapped, provide a map of fish habitat that is consistent with the definition of fish habitat provided in the EIS and the requirements in the EIS Guidelines.**

b) **Provide a Fish Habitat Map for the Elbow River at the low level outlet channel, consistent with the requirements in the EIS Guidelines.**

c) **Clarify whether Table 8-5 is meant to correspond with Figure 8.2-2, and explain the differences between the information provided.**

Response IR3-25

a) Additional habitat mapping is presented in Appendix IR25-1 in accordance with the guidelines by Alberta Transportation (2009). The habitat units within these habitat maps align with habitat criteria that is defined in Volume 3A, Section 8, Table 8-5 and presented in Table IR25-1.

Life histories and the habitat used is variable between fish species and, in some cases, may overlap (e.g., one species may spawn in a habitat where another species feeds or rears). Locations for life history activities (e.g., spawning) can change over time within the river because:

- Elbow River is a dynamic system
- fish migrate along the entire reach of the river

It is most efficient to map the reach using the habitat features as defined in Alberta Transportation (2009) and compare these features to the life history strategies of the species historically present in Elbow River (Table IR25-1). By this method, as the river evolves, the life history strategies can still be compared to habitat features identified through desktop mapping or during field assessments of a given species potential habitat use. It is more efficient and is appropriate to provide the habitat features in the mapped area than to provide a map for each species in the river and where certain life histories might be occurring. In general, habitat throughout the mapped area of the aquatic ecology LAA (which extends from Reach 1 to Reach 12 and includes the PDA) was comprised of run (Class 2 and Class 3) and riffle transitions, large cobble and gravel bars. Cover was available in the form of woody debris, depth and pools. Woody debris jams along the margins of the river offered nearshore complexity.

Table IR25-1 Migration and Spawning Period and Habitat of Selected Fish in Elbow River[1] (from Volume 3A, Section 8.2.2, Table 8-5)

Species	Upstream Migration Times	Spawning Period	Riverine Spawning Habitats	Rearing Habitats	Overwintering Habitats
Burbot	Dec – Jan	Jan – Feb	Deep pools	Large coarse substrates, undercuts, woody debris, and vegetation mats (Langhorne et al. 2001)	Deep low velocity areas
Northern pike	April	April - May	Emergent and submergent vegetation	Nearshore areas of lakes and rivers, but generally require vegetation and cover, and are almost always found near either emergent vegetation or boulders (Langhorne et al 2001)	Deep low velocity areas (Inskip 1982)
Rainbow trout	March – May	April - June	Riffles and runs with gravel and cobble substrates	Roots, boulders, logjams, riffles, undercuts, Prefer pool margins, interstitial space between rocks, shallow rocky substrate, margins of river (Nelson and Paetz 1992)	Deeper pools, upwellings
Cutthroat trout (hybrids)	April – June	April - July	Riffles and runs with gravel and cobble substrates	Slower backwaters with woody debris, boulders, or overhanging vegetation for cover	Pools, upwellings
Sucker species	May – June	May – July	Broadcast spawning within shallow, gravel-bottom sections of streams, such as riffles. Runs with gravel and cobble substrates, inlet and outlet of pools, shoals.	Large coarse substrates and submergent and emergent vegetation	Large, deep pools
Bull trout	July – Aug	Sept - Oct	Riffles and runs with gravel and cobble substrates	Shallow, slower water with interstitial cover, moving to deeper water as they age	Larger pools and deeper water

Table IR25-1 Migration and Spawning Period and Habitat of Selected Fish in Elbow River[1] (from Volume 3A, Section 8.2.2, Table 8-5)

Species	Upstream Migration Times	Spawning Period	Riverine Spawning Habitats	Rearing Habitats	Overwintering Habitats
Brook trout	Sept	Sept - Oct	Riffles and runs with small gravel substrates, most likely in tributaries	Prefer extensive overhead cover and woody debris in shallow areas (Roberge et al. 2002)	Pools and areas of upwellings
Mountain whitefish	Sept	Sept – Oct	Runs with coarse substrates, inlet and outlet of pools, shoals.	Shallow backwaters and side channel, and near large woody debris cover in shallow areas (R.L. & L. Environmental Services Ltd. 1996)	Well oxygenated deep, larger pools
Brown trout	October	Oct – Nov	Riffles and runs with gravel and cobble substrates	Large woody debris, undercut banks in slower water	Deeper pools and larger water

NOTE:
[1] This table shows the preferred habitats for selected fish species in the Elbow River. It is a generalized overview of the habitats that the fish prefer for their various life stages. Their occupancy of this habitat type will depend on the time of year and the particular species' presence. It is expected these habitats would be used by the fish species, but given the dynamic nature of the Elbow River, it is not possible to confirm without direct observation or appropriate surveys (e.g., redd survey).

b) Habitat mapping in the unnamed creek channel is in Figure IR25-1, Reach 6 of the mapbook provided in a. However, the imagery showed the channel as dry, so there are no habitat units shown (only visible water was mapped for the desktop review).

c) Volume 3A, Section 8, Figure 8.2-2 (duplicated here as Figure IR25-2) identifies the habitat units noted at the location of the diversion structure. The habitat described in the figure provides an overview of habitat types that some fisheries species in the Elbow River tend to utilize to spawn, rear, and overwinter. While some of those habitats may be present in Figure IR25-2, the life processes described in Volume 3A, Section 8.2.2, Table 8-5 (duplicated here as Table IR25-1) have the potential to occur in these areas but were not confirmed during field assessments conducted in 2016.

REFERENCES

Alberta Transportation. 2009. Fish Habitat Manual Guidelines and Procedures for Watercourse Crossings in Alberta.

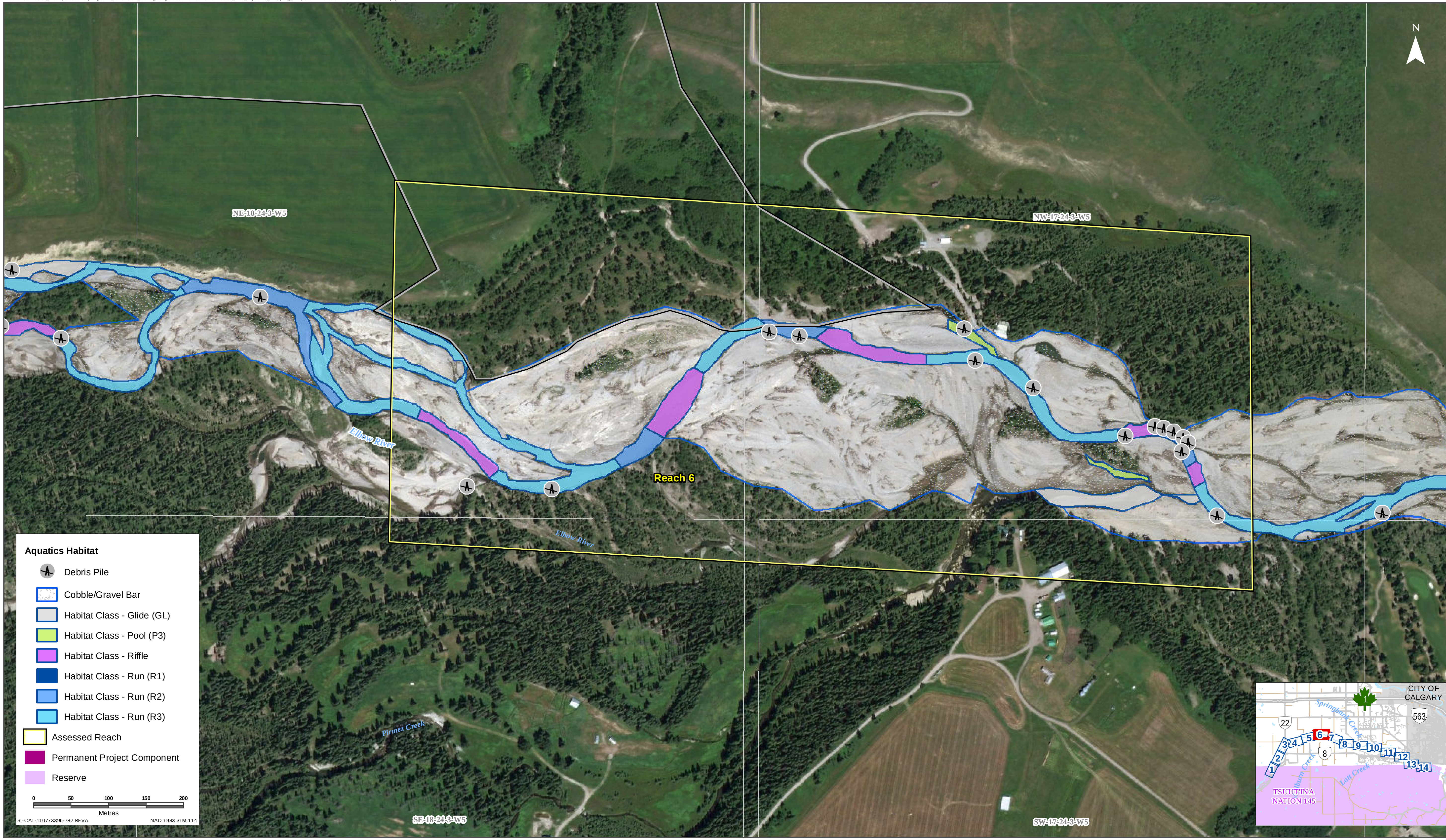
Inskip, P.D. 1982. Habitat suitability index models: northern pike. United Stated Department of the Interior. Fish and Wildlife Service. FWS/OBS-82/10.17. 40 pp.

Langhorne, A.L., M. Neufeld, G. Hoar, V. Bourhis, D.A. Fernet, and C.K. Minns. 2001. Life history characteristics of freshwater fishes occurring in Manitoba, Saskatchewan, and Alberta, with major emphasis on lake habitat requirements. Can. MS Rpt. Fish. Aquat. Sci. 2579: xii+170p.

Nelson, S.N, and M.J. Paetz. 1992. *The Fishes of Alberta*. 2nd Edition. Edmonton: University of Alberta Press.

R.L. & L. Environmental Services Ltd. 1996. An information review of four native Sportfish species in west-central Alberta. Prepared for Foothills Model Forest and the Fisheries Management and Enhancement Program. R.L. & L. Report No. 489F: 88 p. + 2 app.

Roberge, M., J.M.B. Hume, C.K. Minns, and T. Slaney. 2002. Life history characteristics of freshwater fishes occurring in British Columbia and the Yukon, with major emphasis on stream habitat characteristics. Can. Manuscr. Rep. Fish. Aquat. Sci. 2611: xiv + 248 p.



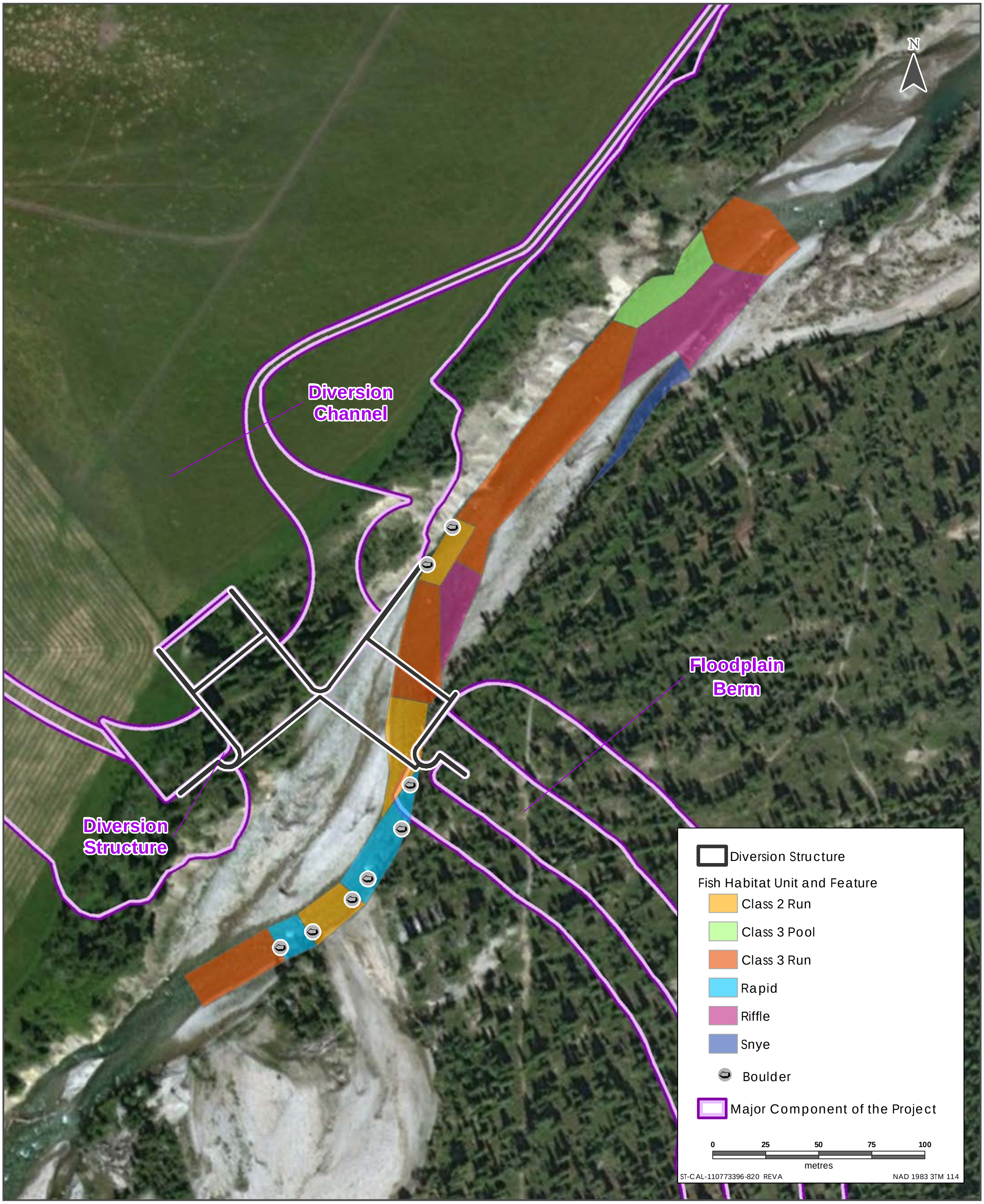
Sources: Base Data- Government of Alberta, Government of Canada. Thematic Data - Stantec Ltd.
Imagery: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESEVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Habitat Mapping of the Elbow River and Associated Reaches within Proximity to the PDA

Figure IR25-1



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Fish Habitat Map for the Elbow River at the Proposed Diversion Site

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESEVOIR PROJECT ENVIRONMENTAL ASSESSMENT

Figure IR25-2

Question IR3-26: Fish and Fish Habitat – Upstream Migration

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.1.5; 6.2.2; 6.3.1

EIS Volume 3A, Section 8.4.4.2

Fisheries and Oceans Canada – Comments on the EIS, June 19, 2018 (CEAR #28)

Context and Rationale:

The EIS Guidelines require the proponent to provide baseline information on and assess the effects of changes to the environment on fish and fish habitat.

The EIS indicates that downstream burbot movements should not be impeded, although upstream movements at this time might be to low velocity areas along the channel margin. This does not allow for a full understanding of potential effects of the project on fish migration and fish habitat.

Information Request:

a) Clarify and provide an explanation of current and Project related potential barriers and restrictions to migration for burbot.

Response IR3-26

a) An analysis of fish passage capabilities through the instream structure was completed for anguilliform species (including burbot) at a range of flows. The passage criteria considered burst and sustained swimming speeds at different sizes and life stages of the fish. Assessed flows are based on estimates of 3-day, 10-year daily mean flows (3Q10) during four biologically sensitive time periods (BSP). The results of these analyses were used to design a series of engineered mitigations to maintain flow depths and velocities through the service spillway and downstream of the stilling basin. A detailed discussion is provided in Appendix IR26-1.

The flows and mitigation measures were included in a 2D hydraulic model to demonstrate their ability to preserve upstream and downstream migration of burbot through the instream works. At river flows as low as 0.8 m^3/s, burbot passage will not be restricted through the service spillway and stilling basin.

Question IR3-27: Fish and Fish Habitat – Water Quality

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.1.5; 6.2.2; 6.3.1

EIS Volume 3B, Sections 7.4.3; 8.2.2.3

Fisheries and Oceans Canada – Comments on the EIS, June 19, 2018 (CEAR #28)

Context and Rationale:

The EIS Guidelines require the proponent to provide baseline information on and assess changes to water quality including temperature and dissolved oxygen and to provide baseline information on and assess the effects of changes to the environment on fish and fish habitat.

The EIS limits the assessment of effects of changes in water temperature and dissolved oxygen to a comparison of these parameters with the Project to these parameters in a flood event.

Fisheries and Oceans Canada indicated the comparison of Project effects to flood event effects is not suitable for determining potential effects to fish and fish habitat from changes in water temperatures and dissolved oxygen.

Information Request:

a) Provide a revised assessment of effects to fish and fish habitat from changes in temperature and dissolved oxygen. Compare potential effects to fish and fish habitat from Project changes to water temperature and dissolved oxygen at the point of discharge to existing conditions downstream of the outlet channel and in the Glenmore Reservoir.

Response IR3-27

a) Median summer dissolved oxygen concentrations in Elbow River were just above and below aquatic life guideline levels (9.5 mg/L CCME 2018) at Highway 22 and Twin Bridges, respectively (Volume 4, Appendix K, Section 3.3.1, page 3.53, Table 3-32).

Substantial changes to water quality in the off-stream reservoir due to temperature and dissolved oxygen are predicted to not occur; however, the following qualitative analysis indicates that a quantitative analysis would not yield a more precise assessment.

Due to low biochemical oxygen demand (BOD), low sediment oxygen demand (SOD) and the influence of wind mixing and shallow water levels, oxygen concentrations in the off-stream reservoir are not predicted to become anoxic. Changes to dissolved oxygen in the off-stream reservoir "are expected to be smaller than currently observed in Glenmore Reservoir" (Volume 3B, Section 7.4.3, page 7.24).

If low oxygen conditions in the off-stream reservoir occur prior to release of water, turbulence during release will aerate the water and oxygen levels will be attenuated; the unnamed creek channel has a gradient of greater than 0.8% over the lower 2 km before the confluence with Elbow River (Volume 4, Appendix J, Section 3.3, page 3.5). Turbulence generated by energy dissipation blocks and channel roughness (the natural textures of the unnamed creek) are predicted to aerate water as energy is dissipated before it enters the river. Therefore, dissolved oxygen concentrations in Elbow River downstream of the unnamed creek are predicted to be similar to concentrations in Elbow River upstream of the unnamed creek. Effects in Elbow River from low oxygen are predicted to be localized and temporary because of rapid aeration of released water.

As discussed in Volume 3B, Section 7.4.3, page 7.24 and page 7.25, water temperature in the reservoir can increase if the air temperature is sufficiently warm. However, the water temperatures in Elbow River are expected to similarly rise during the summer months. Thus, any changes in river water temperatures originating from mixing with water released from the reservoir would be temporary and localized due to rapid mixing.

Because changes to dissolved oxygen in the reservoir will be ameliorated and temperature in the reservoir and Elbow River will similarly be affected by seasonal conditions, effects on fish and fish habitat in the river are not predicted.

REFERENCES

CCME (Canadian Council of Ministers of the Environment). 2018. Canadian Environmental Quality Guidelines website. Accessed September 2018 at http://ceqg-rcqe.ccme.ca/en/index.html

Question IR3-28: Fish and Fish Habitat – Spawning Assessment

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.1.5; 6.2.2; 6.3.1

EIS Volume 3B, Section 8.2.4

Fisheries and Oceans Canada – Comments on the EIS, June 19, 2018 (CEAR #28)

Context and Rationale:

The EIS Guidelines require the proponent to provide baseline information and assess the effects of changes to the environment on fish and fish habitat.

The EIS describes spawning periods for various fish species throughout the spring and summer months, and high level information about typical flows during those times for the Elbow River.

It is not clear whether a spawning assessment was conducted for the low level outlet and the potential effects of draw down from the reservoir are not considered.

Information Request:

a) Assess potential effects to spawning within the low level outlet channel including, including a discussion of the consequences of reservoir draw down on potential spawning activity in the low level outlet.

Response IR3-28

a) A field survey was completed on September 19, 2016 at the unnamed creek; it is a low-value habitat with limited rearing potential and no existing spawning habitats (Volume 4, Appendix M, Attachment A.2, pdf page 77). Based on desktop data and the field observations, there is no evidence of existing spawning habitats in the unnamed creek.

The planned water release from the reservoir will not coincide with spring spawning periods for salmonids that may use habitats in Elbow River downstream of the unnamed creek and, therefore, this water release will not affect spring spawning fish. Water retained in the reservoir and released in late summer or early fall may coincide with fall spawning fish species; this assumes a late June flood and an 84-day filling-residence-release time in the reservoir, which could result in the reservoir being emptied by mid-September.

Release of water from the reservoir would coincide with Biologically Significant Period (BSP) 2 (June 16 to September 25), which corresponds with the incubation period of rainbow trout. It should be noted that a small variation in timing or temperature of a given year could increase the likelihood that water release from the reservoir coincides with BSP 3 (September 26 to December 01), which corresponds with mountain whitefish adult spawning period. Due to poor spawning habitat and normal flow conditions within the unnamed creek channel, it is not anticipated that fall spawning fish would utilize the channel for spawning and, therefore, release of water from the reservoir would have no effect on this component of fish life history.

Question IR3-29: Fish and Fish Habitat – Fish Stranding

Sources:

EIS Guidelines Part 2, Sections 6.1.5; 6.3.1

EIS Volume 3B, Section 8.2.4

EIS Volume 3C, Section 1.3.5.1

Samson Cree Nation – Springbank Off-Stream Reservoir Project Written Submission – June 25, 2018 (CEAR #52)

Piikani Nation – Technical Review of EIS, June 15, 2018 (CEAR #48)

Fisheries and Oceans Canada – Comments on the EIS, June 19, 2018 (CEAR #28)

Context and Rationale:

The EIS Guidelines require the proponent to provide baseline information on and assess the effects of changes to the environment on fish and fish habitat. The EIS Guidelines also require the proponent to assess the effects of changes in the environment on Indigenous peoples.

Fish entrainment and stranding has been identified as a potential effect on fish, with associated effects on Indigenous peoples. The EIS indicates that if potential fish stranding is identified, further action will be taken to reduce the potential mortality of fish, and notes that entrainment of fish into the reservoir during active diversion may cause bodily harm to fish as they are transported along the canal. It is not clear when and what actions will be taken to reduce areas of fish stranding. Physical works to reduce areas of potential stranding, such as further grading, should be considered and additional mitigation measures should be provided.

The EIS states that the change in water quality is not anticipated to cause acute or chronic toxicity or change the trophic status of the Elbow River or Glenmore Reservoir. However, lower water quality in the reservoir as a result of warming of the water (i.e., thermal stress), lower dissolved oxygen, or increased susceptibility and/or prevalence of disease amongst fish trapped within the reservoir could result in impaired health and death to fish. Threats of predation may be elevated in the reservoir, especially during drawdown. These pathways of effects are not considered in the assessment of effects to fish.

Indigenous groups have raised concerns with the entrainment and stranding of fish from a spiritual and cultural perspective. The proposed treatment of fish has been described as antithetical to natural law that governs interspecies relationships. The assessment of associated effects and appropriate mitigations must take this into account.

Additional detail on potential effects and proposed mitigation associated with fish entrainment and stranding is required to understand potential effects to fish and potential effects to Indigenous peoples.

Information Requests:

a) **Assess potential effects to fish trapped in the reservoir, specifically sensitive salmonid species, due to changes in water quality and threats of predation.**

b) **Provide additional mitigations that will be undertaken to reduce potential effects to fish, including mortality, should stranding occur. Describe the timing for implementation of mitigations and the associated thresholds for when mitigations would be applied.**

c) **Consider and discuss the natural law implications of the proposed Project relative to the treatment of fish and potential effects to Indigenous peoples. Identify related mitigation.**

d) **Provide the details of a monitoring and follow-up program for fish entrainment and stranding.**

Response IR3-29

a) Activation of the diversion channel and possible displacement and entrainment of fish into the reservoir should not affect fish as a result of water quality in the off-stream reservoir (suspended sediment, temperature, and dissolved oxygen). Suspended sediment levels in water entering the reservoir would be from the water diverted from the Elbow River into the reservoir. As stated in Volume 3B, Section 6.4.3, page 6.26:

> "During retention of water in the reservoir, a portion of the suspended sediment would permanently settle at the bottom of the reservoir. The locations of sedimentation are determined by circulatory patterns within the reservoir during active water inflow and retention, as influenced by existing topography. Sedimentation depths would be determined, in part, by concentration, water depth, the effects of the underlying

> topography and residence time in the reservoir. The longer the residence time, the greater the deposition."

This deposition of sediment in the reservoir would reduce the effects on fish from suspended sediment when they are entrained in the reservoir.

Water temperature in the reservoir can increase if air temperatures are sufficiently warm. However, water temperature is unlikely to reach levels causing fish mortality. Typically, when warm air temperatures occur, water temperatures in the Elbow River, especially in pools, also increases.

Potential loss of dissolved oxygen may occur due to low water velocity and increased temperature within the reservoir. However, wind mixing is anticipated to replenish loss of dissolved oxygen within the reservoir (Volume 3B, Section 7.4.3, page 7.2.4). Therefore, there should be no residual effects on fish in the reservoir due to dissolved oxygen concentrations.

Entrainment of fish within the reservoir could make them more vulnerable to predation from such species as piscivorous fish, raptors and waterfowl (Price and Nickum 1995), which are likely to be the primary predators of fish in the reservoir. During the early period of fish entrainment, reservoir water will be turbid from the inflow of flood waters, which will provide cover and, therefore, limiting predation of fish in the reservoir during this period. It is difficult to predict the effect of predation on fish entrained in the reservoir because it is dependent on the number of predators feeding in the area.

b,d) Post-flood operations will include monitoring fish in the off-stream reservoir during the release of water. The outlet structure at the base of the reservoir will be designed and operated in a manner that allows fish egress from the reservoir.

Monitoring for fish rescue activities will include the following:

- During water release, isolated pools in the reservoir will be identified and the potential for fish to become stranded will be assessed.
- Monitoring in and around the off-stream reservoir outlet structure will be done to observe if and how fish congregate around the outlet and if conditions permit their movement out of the reservoir. Monitoring will also include assessing for potential harm or mortality of fish caused by movement through the outlet structure.
- Water quality in the reservoir will be monitored using hand held meters to assess water temperature and dissolved oxygen to inform fish capture and handling methods. This data can be used if additional mitigation is required in the future.
- When the water has been fully drained, the unnamed creek channel will also be surveyed to identify isolated pools where fish might be stranded.

- Monitoring will be undertaken at a frequency that allows for successful fish rescue that is based on environmental conditions, including ambient air temperature and the rate of the receding water level.
- Visual monitoring of Elbow River will be periodically done to identify if translocated fish show signs of stress or mortality. Adjustments in returning fish to Elbow River will be made as needed to mitigate stress to fish (e.g., increase acclimation time).

c) Alberta Transportation is unable to speak to "natural law" implications and their application in the context of information associated with this regulatory application. All reasonable efforts have been made through Project design and environmental effects mitigation to reduce effects on fish during floods for a Project intended to minimize highly damaging effects downstream of the Project on Indigenous groups, their land and possessions, downstream communities, and the natural environment.

REFERENCES

Price, I.M., and John G. Nickum. 1995. Aquaculture and Birds: the Context for Controversy. *Colonial Waterbirds* Vol. 18, Special Publication 1: The Double-Crested Cormorant: Biology, Conservation and Management, pp. 33-45

Question IR3-30: Fish and Fish Habitat - Westslope Cutthroat Trout

Sources:

EIS Guidelines Part 2, Sections 6.1.5; 6.3.1

EIS Volume 3A, Section 8.2.2.3

Métis Nation British Columbia – Technical Review (CEAR #1153)

Samson Cree Nation – Springbank Off-Stream Reservoir Project Written Submission – June 25, 2018 (CEAR #52)

Context and Rationale:

The EIS Guidelines require the proponent to provide baseline information on and assess the effects of changes to the environment on fish and fish habitat. The EIS Guidelines also require the proponent to assess the effects of changes in the environment on Indigenous peoples.

The EIS presents information on westslope cutthroat trout and its habitat, and indicates that pure-strain westslope cutthroat trout are not present within the RAA and LAA. Evidence for this conclusion is not presented in the EIS.

Westslope cutthroat trout are a species of interest to Indigenous groups. Samson Cree Nation noted that the PDA has historically provided habitat for westslope cutthroat trout and they remain present in the upper Elbow River and its tributaries, outside of the PDA. Additional information is required to assess effects on fish and effects on Indigenous peoples.

Information Requests:

a) Provide evidence of the historic and current presence of westslope cutthroat trout (pure and hybrid) within the PDA.

b) Provide evidence for claims of hybridization of westslope cutthroat trout in the RAA and LAA.

c) Describe how the Project and proposed mitigation measures for fish and fish habitat fits with and/or could contribute to overall goals of the Recovery Strategy for the Alberta populations of westslope cutthroat trout in Canada.

Response IR3-30

a) Westslope cutthroat hybridization has been defined through the DFO recovery strategy (DFO 2014) and has been reported by the Alberta Westslope Cutthroat Trout Recovery Team (2013). Pure westslope cutthroat have only been observed in a few streams in southern Alberta and isolated to extreme headwaters; they are considered functionally extirpated within the LAA for aquatic ecology (AEP 2018; DFO 2014) and, therefore, are not expected to be present.

b) The upper reaches of the Elbow River within the RAA for aquatic ecology where westslope cutthroat trout may be found, will not be affected by the Project. Fish species, such as rainbow trout, which may hybridize with westslope cutthroat trout (McKelvey et al. 2016; DFO 2014), are prevented from migrating past Elbow Falls in the upstream area, a natural barrier to upstream fish passage. Therefore, the Project will not facilitate further hybridization of these stocks in the upper reaches of the aquatic ecology RAA.

c) There are no pure strains of westlope cutthroat trout known to occur within the LAA and effects on fish and fish habitat due to the Project will not occur in the upper reaches of the RAA where westlope cutthroat trout are present. Project effects will be neutral with respect to the Recovery Strategy. Fishery offsets have not been identified, but they may include improving habitat for westslope cutthroat trout upstream of the Project, which then could contribute to the westslope cutthroat trout Recovery Strategy.

REFERENCES

AEP (Alberta Environment and Parks). 2018. Current adult density fish sustainability index (FSI) for Westslope cutthroat trout. http://aep.alberta.ca/fish-wildlife/fisheries-management/fish-sustainability-index/fsi- species_maps/documents/Westslope Current_Density. Accessed March 11, 2018.

DFO (Fisheries and Oceans Canada). 2014. Recovery Strategy for the Alberta populations of Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) in Canada [Final]. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. iv + 28 pp + Appendices.

Mckelvey, K., M. Young, T. wilcox, D. Bingham, K. Pilgrim and M. Schwartz. 2016. Patterns of hybridization among cutthroat trout and rainbow trout in northern Rocky Mountain streams. Ecology and Evolution: 6(3) 688-706.

The Alberta Westslope Cutthroat Trout Recovery Team. 2013. Alberta Westslope Cutthroat Trout Recovery Plan: 2012-2017. Alberta Environment and Sustainable Resource Development, Alberta Species at Risk Recovery Plan No. 28. Edmonton, AB. 77 pp.

Question IR3-31: Fish and Fish Habitat – Assessment of Effects

Sources:

EIS Guidelines Part 2, Sections 6.1.5; 6.3.1; 6.6.3

EIS Volume 3C, Section 1.3.5.1

EIS Volume 4, Appendix M, Section 2.2.2

Fisheries and Oceans Canada – Comments on the EIS, June 19, 2018 (CEAR #28)

Context and Rationale:

The EIS Guidelines require the proponent to provide baseline information on and assess the effects of changes to the environment on fish and fish habitat. The EIS guidelines also require the proponent to identify and assess the Project's cumulative effects.

CRA Fisheries

Throughout the EIS, it is unclear how the proponent defines or understands the prohibition against serious harm to fish as it applies to fish and fish habitat that are part of or support commercial, recreational or Aboriginal (CRA) fisheries as defined in the *Fisheries Act*. Should the proponent

be interpreting this definition incorrectly, potential effects to fish and fish habitat may be underestimated.

The EIS states that forage fish species are species that are below the top of an aquatic food chain, are an important source of food for at least some predators, and experience high predation mortality. Additionally, the EIS assumes that the presence of higher trophic feeders indicates suitable habitats for forage fish. DFO indicated that fish that support CRA fisheries are those that contribute to the productivity of a fishery (often as prey species) and also may reside in waterbodies that contain CRA fisheries or are connected by a watercourse to such waterbodies. The description of fish and fish habitat in the EIS is not consistent with interpretations practiced by the DFO Fisheries Protection Program. Accurate interpretations of the *Fisheries Act* are necessary in order to assess the potential for effects to fish and fish habitat.

Significance Determinations

The cumulative effects assessment in the EIS states that changes to aquatic ecology, bedload, and fish habitat are not expected to affect the abundance or distribution of bull trout or cutthroat trout in the Elbow River, nor affect fish species that support CRA fisheries and species at risk. On this basis, the EIS concludes that permanent alteration of fish habitat from the Project is not significant. However, consideration of effects to fish under section 5 of CEAA 2012 should not be limited to these species. Further, rationale for the conclusion in the EIS that adverse residual effects on aquatic ecology due to the permanent alteration of fish habitat and death of fish would not affect the abundance or distribution of fish species that support CRA fisheries is not provided.

DFO indicated that there is potential spawning habitat for all fish species, including those that are a part of or support CRA fisheries downstream of the low level outlet channel that has not been considered. Additional information is required to understand potential cumulative effects to fish and fish habitat.

<u>Information Requests:</u>

a) Describe potential effects to fish that support CRA fisheries considering fish species that contribute to the productivity of CRA fisheries.

b) Revise the cumulative effects assessment for effects to fish and fish habitat to:

- **Demonstrate how fish spawning habitat has been considered in the cumulative effects assessment;**
- **Consider effects to all potentially affected fish species or provide a rationale for the use of bull trout, cutthroat trout, fish species that support CRA fisheries, and species at risk in determining significance.**

- **Provide a rationale for the conclusion that adverse residual effects on aquatic ecology due to the permanent alteration of fish habitat and death of fish would not affect the abundance or distribution of fish species.**
- **Clarify how potential effects to fish were determined to be not significant given the permanent, high magnitude residual effects.**

Response IR3-31

a) As stated in Volume 3A, Section 8.4.2, Table 8.4-1 (Table IR31-1), the aquatic ecology assessment identified and assessed 10 pathways of effects (DFO 2014) for land and water-based activities associated with the Project during construction and dry operations, which included those fish species supporting commercial, recreational, or Aboriginal (CRA) fisheries (Table IR31-2).

Table IR31-1 Pathways of Effects for the Proposed Work (Construction and Dry Operations) (from Volume 3A, Section 8.4.2, Table 8.4-1)

Pathways of Effects	Potential Effects
Land Based Activities	
Cleaning or maintenance of bridges or other structures	• Change in sediment concentration • Change in contaminant concentration
Excavation	• Change in baseflow • Change in water temperature • Change in sediment concentrations
Grading	• Change in sediment concentration • Change in habitat structure and cover
Use of industrial equipment	• Change in sediment concentration • Potential mortality of fish/eggs/ova from equipment • Change in contaminant concentrations
Vegetation Clearing	• Change in sediment concentration • Change in habitat structure and cover • Change in nutrient concentration • Change in food supply • Change in water temperature • Change in contaminant concentration

Table IR31-1 Pathways of Effects for the Proposed Work (Construction and Dry Operations) (from Volume 3A, Section 8.4.2, Table 8.4-1)

Pathways of Effects	Potential Effects
In Water Activities	
Change in Timing, Duration and Frequency of Flow	• Change in migration patterns • Displacement or stranding of fish • Change in sediment concentration • Change in habitat structure and cover • Change in nutrient concentration • Change in food supply • Change in water temperature • Change in contaminant concentration
Fish Passage Issues	• Incidental entrainment, impingement or mortality of resident species • Change in thermal cues or temperature barriers • Change in access to habitats/migration
Organic Debris Management	• Change in nutrient concentration • Change in habitat structure and cover • Change in food supply • Change in contaminant concentration • Change in sediment concentration
Placement of Materials or Structures in Water	• Change in habitat structure and cover • Change in nutrient concentration • Change in food supply • Change in sediment concentration • Change in baseflow and hydrodynamics • Change in contaminant concentration

Table IR31-2 List of Supporting CRA Fish Species

Family	Common Name[1]	Scientific Name
Catostomidae (suckers)	longnose sucker	*Catostomus catostomus*
	mountain sucker (Saskatchewan River populations)	*Catostomus platyrhynchus*
	white sucker	*Catostomus commersonii*
Cyprinidae (carps and minnows)	fathead minnow	*Pimephales promelas*
	lake chub	*Couesius plumbeus*
	longnose dace	*Rhinichthys cataractae*
	pearl dace	*Margariscus margarita*
	spottail shiner	*Notropis hudsonius*
Gasterosteidae (sticklebacks)	brook stickleback	*Culaea inconstans*
Percopsidae (trout-perches)	trout-perch	*Percopsis omiscomaycus*

As stated in Volume 3B, Section 8.2.1, Table 8.2-1 (reproduced here as Table IR31-3), the aquatic ecology assessment identified and assessed 10 pathways of effects for land and water-based activities associated with the Project during flood and post-flood operations, which included those fish species supporting CRA fisheries.

Table IR31-3 Pathways of Effects for the Proposed Work (Flood and Post Flood Operations) (from Volume 3B, Section 8.2.1, Table 8.2-1)

Pathways of Effects	Potential Effects (i.e., endpoints)
Land Based Activities	
Cleaning or maintenance of bridges or other structures	• Change in sediment concentration • Change in contaminant concentration
Excavation*	• Change in baseflow** • Change in water temperature • Change in sediment concentrations
Use of industrial equipment	• Change in sediment concentration • Potential mortality of fish/eggs/ova from equipment • Change in contaminant concentrations

Table IR31-3 Pathways of Effects for the Proposed Work (Flood and Post Flood Operations) (from Volume 3B, Section 8.2.1, Table 8.2-1)

Pathways of Effects	Potential Effects (i.e., endpoints)
In Water Activities	
Water Extraction	• Direct or indirect mortality of fish
Change in Timing, Duration and Frequency of Flow	• Change in migration patterns • Displacement or stranding of fish • Change in sediment concentration • Change in habitat structure and cover • Change in nutrient concentration • Change in food supply • Change in water temperature • Change in contaminant concentration
Dredging*	• Change in food supply • Change in habitat structure and cover • Change in sediment concentration • Change in contaminant concentration • Change in nutrient concentration
Fish Passage Issues	• Incidental entrainment, impingement, or mortality of fish • Change in thermal cues or temperature barriers • Change in access to habitats/migration
Organic Debris Management	• Change in nutrient concentration • Change in habitat structure and cover • Change in food supply • Change in contaminant concentration • Change in sediment concentration
NOTES: * Excavation and dredging refer to the potential moving of accumulated sediments and debris in upland areas and from within the normal highwater mark of watercourses following a flood. ** The change in baseflow from land-based excavation is not applicable to this phase of the project where excavation will focus on the potential moving of accumulated sediment away from infrastructure following a flood.	

b) The assessment of potential cumulative effects remains adequate because:

- the response to a) confirms adequate consideration of fish species that contribute to the productivity of CRA fisheries
- two other incrementally acting projects (Bragg Creek Flood Mitigation and Southwest Calgary Ring Road) occur during construction and dry operations phase but with minor effects contribution (Volume 3C, Section 1.2.4)
- no other interacting projects occur during the flood and post-flood phase (Volume 3C, Section 1.3.5)

This assessment includes all life history stages (e.g., spawning) of all fish species in the aquatic ecology RAA. This assessment followed guidance under the Canadian Environmental Assessment Agency, *Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012*.

Regarding significance, the "high magnitude" conclusion is in reference to the earlier conclusion for hydrology effects (Volume 3C, Section 1.3.3.1) and the "permanent" is reflective of the in-stream physical works diversion structure. The conclusion of not significant is based on, as stated (Volume 3C, Section 1.2.4.3 and 1.2.4.4), the minor proportion of habitat loss relative to that available in the watershed.

HUMAN HEALTH RISK ASSESSMENT

Question IR3-32: Human Health Risk Assessment

Sources:

EIS Guidelines Part 2, Section 6.3.4

EIS Volume 4, Appendix O, Section 6.2.4; 6.2.5

Health Canada Comments on the EIS – June 15, 2018 (CEAR # 30)

Context and Rationale:

The EIS Guidelines require the proponent to assess the effects of changes to the environment on Indigenous peoples, including on health.

The EIS makes the assumption that all chromium emissions were hexavalent chromium and does not demonstrate negligible. Health Canada indicated that the risk associated with hexavalent and trivalent chromium needs to be assessed separately as these chemicals have different effects to health. Additionally, both hexavalent and trivalent chromium may be present in soils as a result of airborne deposition post-construction. Estimates of risk associated with airborne exposure to chromium (both hexavalent and trivalent) is important to ensure that potential short duration exposure effects are not overlooked and are adequately characterized.

Information Requests:

a) **Provide quantitative risk estimates for hexavalent chromium and trivalent chromium separately and provide estimates of risk associated with anticipated airborne exposure during the construction phase.**

b) **Describe whether elevated levels of hexavalent and trivalent chromium may be present in soils as a result of airborne deposition post-construction.**

Response IR3-32

a) To provide quantitative risk estimates for hexavalent and trivalent chromium separate, chromium emissions were first separated and remodelled. Specifically:

- Modelled sources of trivalent chromium emissions during construction were diesel exhaust and fugitive dust (i.e., from soils). Trivalent chromium emissions from diesel exhaust were scaled from hexavalent chromium emissions from diesel exhaust based on guidance from United States Environmental Protection Agency (US EPA 2016a).
- Modelled sources of hexavalent chromium during construction were limited to diesel exhaust. As noted in CCME (1999), although chromium can exist in nine different valence states, trivalent and hexavalent chromium are the two most common species. Trivalent chromium occurs naturally, is ubiquitous in the environment, and stable in soil. The principal source of hexavalent chromium in the environment is anthropogenic pollution from activities such as metal finishing, wood treatment, and production of pigments (CCME 1999). Because the PDA is not a contaminated site, fugitive dust (soil) is not expected to be a source of hexavalent chromium.

Predicted concentrations of hexavalent chromium (Cr VI) and trivalent chromium (Cr III) at the maximum point of impingement (MPOI) within the LAA, and the predicted concentrations at the sensitive receptors, are provided in Table IR32-1 to Table IR32-4.

TOXICOLOGICAL REFERENCE VALUES

The discussion of chromium toxicity in Volume 4, Appendix O, Section 4.2.4 is primarily limited to Cr VI. The following presents updated text that clearly distinguishes between Cr III toxicity and Cr VI toxicity. No changes to the TRVs selected for Cr VI have been made.

Gastrointestinal and neurological effects have also been observed at very high acute inhalation exposures associated with industrial accidental exposures (US EPA 2016b). The Texas Commission on Environmental Quality (TCEQ 2014) derived an acute exposure limit of 1.3 µg/m^3 based on the increase in relative lung weight in rats following a 30-day (subacute) exposure to Cr VI particulate (Glaser et al. 1990). This value was selected as the acute TRV for Cr VI.

The International Agency for Research on Cancer classifies Cr VI as a Group 1 substance (i.e., carcinogenic to humans), and epidemiological studies on workers clearly establish that inhaled Cr VI is a human carcinogen, resulting in an increased risk of lung cancer. Mancuso (1975) followed new employees of a chromate production plant in Painesville, Ohio, hired between 1931 and 1937. Data from an industrial hygiene study of the plant performed in 1949 was used to derive chromium exposure concentrations. Increased lung cancer rates were associated with increased exposure to chromium. Mancuso (1975) is the key study used by Health Canada (2010) and US EPA IRIS (1998) to derive inhalation unit risk factors of

0.076 $(\mu g/m^3)^{-1}$ and 0.012 $(\mu g/m^3)^{-1}$, respectively. Neither Health Canada nor US EPA IRIS updated their assessments to incorporate more recent studies of the Painesville, Ohio cohort, or studies of other chromate production workers, such as those related to a Baltimore, Maryland chromate production plant. TCEQ (2014) re-calculated an inhalation unit risk factor for inhalation of particulate hexavalent chromium based on more recent studies of the Painesville, Ohio cohort (Crump et al. 2003) and the Baltimore, Maryland cohort (Gibb et al. 2000). The TCEQ (2014) inhalation unit risk value of 0.0023 $(\mu g/m^3)^{-1}$, which equates to a risk-specific concentration of 0.0043 µg/m³ at the 1-in-100,000 risk level, was selected for this HHRA.

The public is exposed to Cr III from eating food, drinking water, and inhaling air that contains the chemical. Trivalent chromium (Cr III) is an essential element in the human body, required for the metabolism of glucose, protein and fat. At higher doses, Cr III is toxic. However, Cr III is much less toxic than Cr VI (US EPA 2016b). The International Agency for Research on Cancer classifies Cr III as a Group 3 substance (i.e., not classifiable as to its carcinogenicity to humans).

In their assessment, the TCEQ (2009) noted that human inhalation studies on the short-term (i.e., acute, subacute) effects of elemental, trivalent, or other valence states of chromium were not identified. The TCEQ (2009) relied on an acute inhalation study conducted by Henderson et al. (1979) on Syrian hamsters. The identified critical effects were increased precursor enzymes that are considered early indicators of lung damage (i.e., precursors to adverse effects). TCEQ (2009) applied a total uncertainty factor of 300 (3 for interspecies uncertainty, 10 for intraspecies uncertainty, and 10 for incomplete database) to a human equivalent concentration point of departure (POD_{HEC}) of 3.6 mg/m³ (as Cr III) to derive an acute (1 hour) TRV of 12 µg/m³. This value was selected as the acute TRV for Cr III.

The primary target for noncarcinogenic chromium toxicity following subchronic inhalation is the respiratory tract (US EPA 1998). A subchronic study that evaluated inhalation exposures to Cr III was conducted by Derelanko et al. (1999) was identified as the key study for the evaluation of chronic noncarcinogenic toxicity of Cr III by TCEQ (2009). This study was also selected by ATSDR (2009) to derive intermediate duration inhalation. The Derelanko et al. (1999) study identified a lowest observed adverse effect level of 3.0 mg/m³ (as Cr III). The critical effect was increased total lung and trachea weights related to body weights in rats. Based on a calculated human equivalent concentration point of departure of 0.14 mg/m³ (as Cr III), and a total uncertainty factor of 1000 (3 for interspecies uncertainty, 10 for intraspecies uncertainty, 10 for subchronic to chronic uncertainty, and 3 for incomplete database), the TCEQ (2009) derived a chronic TRV of 0.14 µg/m³. This value was selected as the chronic TRV for Cr III.

These TRVs were used to calculate revised exposure ratios (ERs), as provided in Table IR32-1 to Table IR32-4. The ERs for Cr VI and Cr III are less than 1.0 for both 1-hour and annual exposures, indicating that there are no unacceptable risks to human health from chromium inhalation.

b) Elevated levels of hexavalent and trivalent chromium will not be present in soils as a result of airborne deposition post-construction. Based on the revised modelling for chromium, which differentiated Cr VI emissions from Cr III emissions, revised deposition rates were obtained for the LAA as well as each of the special receptor locations. These deposition rates, which reflect the Project-related deposition of metals from diesel exhaust during construction, are provided in Table IR32-5.

Potential changes in soil concentrations associated with metals deposition during the three-year construction period were calculated using the equation provided in Drivas et al. (2011). A sample calculation is provided in Volume 4, Appendix O, Attachment C.

During the remodelling of metals deposition, an error was found in the original metals deposition data. The rates previously reported in Volume 4, Appendix O, Attachment B, Table B-2 are 100 times higher than model predictions. The corrected values are provided in Table IR32-5.

The resulting predicted changes in soil metal concentrations after the three-year construction period are shown in Table IR32-6. Background soil concentrations are provided in the table for comparison. As indicated in the table, metals deposition is negligible (predicted changes less than 1 millionth of background concentrations).

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Table IR32-1 Exposure Concentrations and Exposure Ratios for 1-hour Cr VIII (Construction)

Human Receptor Location	1-hour Cr VI (TRV = 1.3 $\mu g/m^3$)					
	Exposure Concentration ($\mu g/m^3$)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	2.6E-06	9.5E-06	1.0E-05	2.0E-06	7.3E-06	7.8E-06
SR01	3.3E-07	1.8E-06	2.0E-06	2.5E-07	1.4E-06	1.5E-06
SR02	5.9E-07	1.1E-06	1.3E-06	4.6E-07	8.4E-07	1.0E-06
SR03	4.7E-07	7.7E-07	9.4E-07	3.6E-07	5.9E-07	7.3E-07
SR04	2.0E-07	5.6E-07	6.6E-07	1.5E-07	4.3E-07	5.1E-07
SR05	2.4E-07	7.0E-07	7.8E-07	1.8E-07	5.4E-07	6.0E-07
SR06	2.2E-07	3.7E-07	4.9E-07	1.7E-07	2.9E-07	3.8E-07
SR07	2.1E-07	3.1E-07	4.4E-07	1.6E-07	2.4E-07	3.4E-07
SR08	2.1E-07	3.0E-07	4.0E-07	1.6E-07	2.3E-07	3.1E-07
SR09	3.9E-07	2.0E-06	2.2E-06	3.0E-07	1.5E-06	1.7E-06
SR10	3.1E-07	8.6E-07	1.0E-06	2.4E-07	6.6E-07	7.8E-07
SR11	8.9E-07	1.0E-06	1.7E-06	6.9E-07	8.0E-07	1.3E-06
SR12	2.0E-07	1.0E-06	1.1E-06	1.5E-07	8.0E-07	8.5E-07
SR13	2.4E-07	9.8E-07	1.1E-06	1.9E-07	7.5E-07	8.1E-07
SR14	2.2E-07	1.3E-06	1.4E-06	1.7E-07	1.0E-06	1.1E-06
SR15	2.1E-07	1.1E-06	1.2E-06	1.6E-07	8.1E-07	9.0E-07
SR16	1.2E-07	8.1E-07	8.7E-07	9.1E-08	6.2E-07	6.7E-07
SR17	1.5E-07	3.1E-07	3.6E-07	1.2E-07	2.4E-07	2.8E-07
SR18	4.7E-07	1.2E-06	1.4E-06	3.6E-07	8.8E-07	1.1E-06
SR19	3.6E-07	1.4E-06	1.6E-06	2.8E-07	1.1E-06	1.3E-06
SR20	4.5E-07	9.9E-07	1.2E-06	3.5E-07	7.6E-07	9.4E-07
SR21	1.3E-07	3.9E-07	4.4E-07	1.0E-07	3.0E-07	3.4E-07
SR22	9.8E-08	4.0E-07	4.4E-07	7.5E-08	3.1E-07	3.4E-07
SR23	9.1E-08	3.4E-07	3.9E-07	7.0E-08	2.6E-07	3.0E-07
SR24	8.9E-08	2.7E-07	3.2E-07	6.8E-08	2.1E-07	2.5E-07
SR25	5.4E-07	1.3E-06	1.6E-06	4.1E-07	9.7E-07	1.2E-06
SR26	4.0E-07	4.7E-07	5.8E-07	3.0E-07	3.6E-07	4.5E-07
SR27	5.2E-07	3.8E-07	7.6E-07	4.0E-07	2.9E-07	5.8E-07
SR28	5.2E-07	3.8E-07	7.6E-07	4.0E-07	2.9E-07	5.8E-07
SR29	5.4E-07	4.1E-07	8.2E-07	4.2E-07	3.1E-07	6.3E-07
SR30	8.8E-07	4.3E-07	1.2E-06	6.8E-07	3.3E-07	8.9E-07
SR31	8.8E-07	4.3E-07	1.2E-06	6.8E-07	3.3E-07	8.9E-07
SR32	5.7E-07	3.9E-07	8.6E-07	4.4E-07	3.0E-07	6.6E-07
SR33	3.7E-07	3.8E-07	6.7E-07	2.9E-07	2.9E-07	5.1E-07
SR34	3.0E-07	3.7E-07	6.2E-07	2.3E-07	2.8E-07	4.8E-07
SR35	3.0E-07	3.7E-07	6.2E-07	2.3E-07	2.8E-07	4.8E-07
SR36	1.4E-07	7.9E-07	8.8E-07	1.1E-07	6.1E-07	6.8E-07
SR37	9.0E-08	3.5E-07	4.1E-07	6.9E-08	2.7E-07	3.1E-07
SR38	4.5E-07	5.6E-07	8.7E-07	3.5E-07	4.3E-07	6.7E-07
SR39	4.9E-07	4.9E-07	7.5E-07	3.8E-07	3.8E-07	5.7E-07
SR40	2.3E-07	1.1E-06	1.2E-06	1.8E-07	8.2E-07	9.0E-07
SR41	2.6E-07	1.8E-06	2.0E-06	2.0E-07	1.4E-06	1.5E-06
SR42	7.6E-07	5.9E-07	1.1E-06	5.8E-07	4.5E-07	8.3E-07
SR43	1.5E-06	7.0E-07	1.9E-06	1.2E-06	5.4E-07	1.5E-06
SR44	2.4E-07	1.5E-07	3.1E-07	1.8E-07	1.1E-07	2.4E-07
SR45	2.5E-07	1.0E-07	2.6E-07	1.9E-07	7.9E-08	2.0E-07
SR46	3.8E-07	8.9E-08	3.9E-07	2.9E-07	6.9E-08	3.0E-07
SR47	4.4E-07	9.0E-08	4.4E-07	3.4E-07	6.9E-08	3.4E-07
SR48	3.5E-07	6.9E-08	3.6E-07	2.7E-07	5.3E-08	2.8E-07
SR49	6.2E-07	6.9E-08	6.4E-07	4.8E-07	5.3E-08	4.9E-07
SR50	6.8E-08	6.0E-08	1.1E-07	5.2E-08	4.6E-08	8.2E-08
SR51	8.2E-08	1.7E-07	2.2E-07	6.3E-08	1.3E-07	1.7E-07
SR52	4.4E-07	2.0E-07	4.7E-07	3.4E-07	1.6E-07	3.6E-07
SR53	2.2E-07	7.0E-08	2.2E-07	1.7E-07	5.4E-08	1.7E-07
SR54	3.6E-07	1.2E-07	3.7E-07	2.8E-07	9.0E-08	2.8E-07
SR55	4.0E-07	7.7E-08	4.1E-07	3.1E-07	5.9E-08	3.1E-07
SR56	9.3E-08	6.7E-08	1.2E-07	7.1E-08	5.1E-08	9.1E-08
SR57	5.7E-07	4.2E-07	8.0E-07	4.4E-07	3.2E-07	6.1E-07
SR58	8.5E-08	3.6E-08	9.6E-08	6.5E-08	2.7E-08	7.4E-08

Table IR32-2 Exposure Concentrations and Exposure Ratios for Annual Cr VI (Construction)

Human Receptor Location	Annual Cr VI (non-threshold TRV = 0.0043 µg/m³)					
	Exposure Concentration (µg/m³)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	6.0E-07	1.9E-07	6.1E-07	1.4E-04	4.5E-05	1.4E-04
SR01	3.1E-08	3.2E-08	6.3E-08	7.2E-06	7.5E-06	1.5E-05
SR02	5.7E-08	1.1E-08	6.8E-08	1.3E-05	2.5E-06	1.6E-05
SR03	4.8E-08	9.9E-09	5.8E-08	1.1E-05	2.3E-06	1.4E-05
SR04	2.3E-08	2.0E-08	4.3E-08	5.4E-06	4.6E-06	1.0E-05
SR05	3.0E-08	2.0E-08	5.0E-08	7.1E-06	4.5E-06	1.2E-05
SR06	3.5E-08	9.3E-09	4.4E-08	8.0E-06	2.2E-06	1.0E-05
SR07	3.2E-08	6.7E-09	3.9E-08	7.5E-06	1.6E-06	9.1E-06
SR08	3.1E-08	7.9E-09	3.9E-08	7.2E-06	1.8E-06	9.1E-06
SR09	3.0E-08	2.1E-08	5.2E-08	7.1E-06	5.0E-06	1.2E-05
SR10	2.4E-08	1.6E-08	4.0E-08	5.6E-06	3.8E-06	9.4E-06
SR11	1.0E-07	2.6E-08	1.3E-07	2.4E-05	6.1E-06	3.0E-05
SR12	2.3E-08	3.0E-08	5.3E-08	5.4E-06	7.0E-06	1.2E-05
SR13	2.6E-08	2.6E-08	5.2E-08	6.0E-06	6.2E-06	1.2E-05
SR14	2.3E-08	3.6E-08	5.9E-08	5.4E-06	8.3E-06	1.4E-05
SR15	2.2E-08	3.7E-08	5.8E-08	5.2E-06	8.6E-06	1.4E-05
SR16	1.3E-08	2.8E-08	4.0E-08	3.0E-06	6.5E-06	9.3E-06
SR17	1.6E-08	1.0E-08	2.6E-08	3.8E-06	2.4E-06	6.1E-06
SR18	3.1E-08	3.3E-08	6.4E-08	7.3E-06	7.6E-06	1.5E-05
SR19	2.6E-08	7.4E-08	9.9E-08	6.0E-06	1.7E-05	2.3E-05
SR20	3.2E-08	3.6E-08	6.8E-08	7.5E-06	8.4E-06	1.6E-05
SR21	1.5E-08	1.3E-08	2.8E-08	3.5E-06	3.0E-06	6.4E-06
SR22	1.1E-08	1.3E-08	2.5E-08	2.7E-06	3.1E-06	5.7E-06
SR23	1.0E-08	1.2E-08	2.2E-08	2.4E-06	2.8E-06	5.2E-06
SR24	1.1E-08	1.2E-08	2.2E-08	2.5E-06	2.8E-06	5.2E-06
SR25	4.4E-08	4.5E-08	8.9E-08	1.0E-05	1.0E-05	2.1E-05
SR26	2.5E-08	4.2E-09	2.9E-08	5.9E-06	9.8E-07	6.8E-06
SR27	3.6E-08	4.0E-09	4.0E-08	8.4E-06	9.2E-07	9.4E-06
SR28	3.6E-08	4.0E-09	4.0E-08	8.4E-06	9.2E-07	9.4E-06
SR29	3.4E-08	4.2E-09	3.8E-08	7.8E-06	9.8E-07	8.8E-06
SR30	1.3E-07	4.6E-09	1.3E-07	2.9E-05	1.1E-06	3.0E-05
SR31	1.3E-07	4.6E-09	1.3E-07	2.9E-05	1.1E-06	3.0E-05
SR32	6.8E-08	5.2E-09	7.2E-08	1.6E-05	1.2E-06	1.7E-05
SR33	3.4E-08	5.9E-09	3.9E-08	8.0E-06	1.4E-06	9.2E-06
SR34	2.7E-08	6.7E-09	3.3E-08	6.2E-06	1.6E-06	7.7E-06
SR35	2.7E-08	6.7E-09	3.3E-08	6.2E-06	1.6E-06	7.7E-06
SR36	1.6E-08	2.3E-08	3.7E-08	3.6E-06	5.3E-06	8.7E-06
SR37	1.0E-08	1.2E-08	2.2E-08	2.4E-06	2.8E-06	5.1E-06
SR38	4.9E-08	1.9E-08	6.6E-08	1.1E-05	4.3E-06	1.5E-05
SR39	3.2E-08	1.1E-08	4.3E-08	7.4E-06	2.6E-06	1.0E-05
SR40	1.5E-08	2.2E-08	3.7E-08	3.5E-06	5.0E-06	8.5E-06
SR41	1.8E-08	4.7E-08	6.5E-08	4.2E-06	1.1E-05	1.5E-05
SR42	7.5E-08	8.3E-09	8.3E-08	1.7E-05	1.9E-06	1.9E-05
SR43	2.3E-07	6.8E-09	2.4E-07	5.4E-05	1.6E-06	5.5E-05
SR44	4.6E-08	4.2E-09	5.1E-08	1.1E-05	9.7E-07	1.2E-05
SR45	2.7E-08	2.0E-09	2.9E-08	6.4E-06	4.6E-07	6.8E-06
SR46	4.2E-08	1.6E-09	4.4E-08	9.8E-06	3.7E-07	1.0E-05
SR47	4.6E-08	1.6E-09	4.8E-08	1.1E-05	3.8E-07	1.1E-05
SR48	3.1E-08	1.0E-09	3.2E-08	7.1E-06	2.4E-07	7.4E-06
SR49	5.9E-08	1.1E-09	6.0E-08	1.4E-05	2.6E-07	1.4E-05
SR50	7.1E-09	2.8E-09	9.8E-09	1.6E-06	6.4E-07	2.3E-06
SR51	9.5E-09	8.8E-09	1.8E-08	2.2E-06	2.0E-06	4.1E-06
SR52	1.7E-08	1.7E-09	1.9E-08	3.9E-06	4.0E-07	4.3E-06
SR53	1.7E-08	9.6E-10	1.8E-08	4.0E-06	2.2E-07	4.2E-06
SR54	1.2E-08	9.1E-10	1.3E-08	2.8E-06	2.1E-07	3.0E-06
SR55	2.6E-08	6.0E-10	2.7E-08	6.1E-06	1.4E-07	6.2E-06
SR56	2.6E-09	4.1E-10	3.0E-09	6.1E-07	9.5E-08	7.0E-07
SR57	6.5E-08	3.6E-09	6.8E-08	1.5E-05	8.3E-07	1.6E-05
SR58	5.2E-09	5.1E-10	5.7E-09	1.2E-06	1.2E-07	1.3E-06

Table IR32-3 Exposure Concentrations and Exposure Ratios for 1-hour Cr III (Construction)

Human Receptor Location	1-hour Cr III (TRV = 12 µg/m³)					
	Exposure Concentration (µg/m³)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	4.5E-03	1.5E-01	1.5E-01	3.7E-04	1.2E-02	1.2E-02
SR01	4.6E-04	1.1E-02	1.1E-02	3.8E-05	9.2E-04	9.3E-04
SR02	9.9E-04	7.3E-03	7.3E-03	8.2E-05	6.0E-04	6.1E-04
SR03	7.5E-04	7.8E-03	7.9E-03	6.3E-05	6.5E-04	6.5E-04
SR04	3.0E-04	2.6E-02	2.6E-02	2.5E-05	2.2E-03	2.2E-03
SR05	6.9E-04	2.9E-02	2.9E-02	5.8E-05	2.4E-03	2.4E-03
SR06	3.7E-04	1.8E-02	1.8E-02	3.1E-05	1.5E-03	1.5E-03
SR07	2.8E-04	1.6E-02	1.6E-02	2.3E-05	1.3E-03	1.3E-03
SR08	5.0E-04	1.9E-02	1.9E-02	4.1E-05	1.6E-03	1.6E-03
SR09	3.1E-04	1.6E-02	1.6E-02	2.6E-05	1.3E-03	1.3E-03
SR10	2.1E-04	2.1E-02	2.1E-02	1.7E-05	1.8E-03	1.8E-03
SR11	1.0E-03	4.3E-02	4.4E-02	8.5E-05	3.6E-03	3.7E-03
SR12	4.5E-04	3.7E-02	3.7E-02	3.8E-05	3.1E-03	3.1E-03
SR13	5.5E-04	3.4E-02	3.4E-02	4.6E-05	2.8E-03	2.8E-03
SR14	4.3E-04	4.1E-02	4.1E-02	3.6E-05	3.4E-03	3.4E-03
SR15	3.7E-04	4.2E-02	4.2E-02	3.1E-05	3.5E-03	3.5E-03
SR16	1.5E-04	4.7E-02	4.7E-02	1.3E-05	3.9E-03	3.9E-03
SR17	2.4E-04	2.1E-02	2.1E-02	2.0E-05	1.7E-03	1.7E-03
SR18	3.6E-04	5.2E-02	5.2E-02	3.0E-05	4.3E-03	4.3E-03
SR19	2.1E-04	8.7E-02	8.8E-02	1.8E-05	7.3E-03	7.3E-03
SR20	3.0E-04	5.9E-02	5.9E-02	2.5E-05	4.9E-03	4.9E-03
SR21	1.2E-04	1.7E-02	1.7E-02	1.0E-05	1.4E-03	1.4E-03
SR22	8.6E-05	2.1E-02	2.1E-02	7.2E-06	1.7E-03	1.7E-03
SR23	7.8E-05	1.8E-02	1.8E-02	6.5E-06	1.5E-03	1.5E-03
SR24	8.9E-05	1.6E-02	1.6E-02	7.4E-06	1.4E-03	1.4E-03
SR25	4.0E-04	6.3E-02	6.4E-02	3.4E-05	5.3E-03	5.3E-03
SR26	2.7E-04	1.2E-02	1.2E-02	2.3E-05	1.0E-03	1.0E-03
SR27	3.2E-04	8.8E-03	9.0E-03	2.7E-05	7.3E-04	7.5E-04
SR28	3.2E-04	8.8E-03	9.0E-03	2.7E-05	7.3E-04	7.5E-04
SR29	3.2E-04	8.5E-03	8.8E-03	2.7E-05	7.1E-04	7.3E-04
SR30	8.3E-04	9.3E-03	9.9E-03	6.9E-05	7.7E-04	8.3E-04
SR31	8.3E-04	9.3E-03	9.9E-03	6.9E-05	7.7E-04	8.3E-04
SR32	4.9E-04	9.0E-03	9.3E-03	4.1E-05	7.5E-04	7.8E-04
SR33	2.4E-04	9.2E-03	9.4E-03	2.0E-05	7.7E-04	7.8E-04
SR34	1.8E-04	9.0E-03	9.1E-03	1.5E-05	7.5E-04	7.6E-04
SR35	1.8E-04	9.0E-03	9.1E-03	1.5E-05	7.5E-04	7.6E-04
SR36	2.2E-04	5.1E-02	5.1E-02	1.9E-05	4.2E-03	4.2E-03
SR37	7.5E-05	1.8E-02	1.8E-02	6.3E-06	1.5E-03	1.5E-03
SR38	3.3E-04	1.8E-02	1.8E-02	2.8E-05	1.5E-03	1.5E-03
SR39	5.2E-04	1.8E-02	1.8E-02	4.3E-05	1.5E-03	1.5E-03
SR40	1.1E-04	4.2E-02	4.2E-02	9.2E-06	3.5E-03	3.5E-03
SR41	1.3E-04	9.1E-02	9.1E-02	1.1E-05	7.6E-03	7.6E-03
SR42	1.2E-03	4.7E-03	5.2E-03	1.0E-04	3.9E-04	4.3E-04
SR43	2.6E-03	5.4E-03	7.0E-03	2.2E-04	4.5E-04	5.8E-04
SR44	6.8E-04	7.8E-03	7.9E-03	5.7E-05	6.5E-04	6.6E-04
SR45	1.2E-04	5.2E-03	5.2E-03	9.7E-06	4.4E-04	4.4E-04
SR46	2.4E-04	4.1E-03	4.1E-03	2.0E-05	3.4E-04	3.4E-04
SR47	2.4E-04	4.1E-03	4.1E-03	2.0E-05	3.4E-04	3.4E-04
SR48	1.5E-04	2.4E-03	2.4E-03	1.2E-05	2.0E-04	2.0E-04
SR49	4.4E-04	2.7E-03	2.8E-03	3.7E-05	2.2E-04	2.3E-04
SR50	7.2E-05	3.6E-03	3.6E-03	6.0E-06	3.0E-04	3.0E-04
SR51	8.8E-05	1.2E-02	1.2E-02	7.4E-06	1.0E-03	1.0E-03
SR52	3.9E-04	4.5E-03	4.5E-03	3.2E-05	3.8E-04	3.8E-04
SR53	8.0E-05	2.1E-03	2.1E-03	6.7E-06	1.7E-04	1.8E-04
SR54	3.4E-04	2.2E-03	2.2E-03	2.9E-05	1.8E-04	1.9E-04
SR55	4.1E-04	1.4E-03	1.4E-03	3.4E-05	1.1E-04	1.2E-04
SR56	3.8E-05	9.5E-04	9.7E-04	3.2E-06	7.9E-05	8.1E-05
SR57	4.6E-04	9.9E-03	1.0E-02	3.9E-05	8.2E-04	8.6E-04
SR58	4.7E-05	1.5E-03	1.5E-03	3.9E-06	1.2E-04	1.3E-04

Table IR32-4 Exposure Concentrations and Exposure Ratios for Annual Cr III (Construction)

Human Receptor Location	Annual Cr III (TRV = 0.14 µg/m³)					
	Exposure Concentration (µg/m³)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.1E-03	8.1E-03	8.2E-03	7.7E-03	5.8E-02	5.8E-02
SR01	4.0E-05	4.1E-04	4.5E-04	2.9E-04	3.0E-03	3.2E-03
SR02	8.8E-05	2.5E-04	3.4E-04	6.3E-04	1.8E-03	2.4E-03
SR03	7.2E-05	2.8E-04	3.5E-04	5.2E-04	2.0E-03	2.5E-03
SR04	2.9E-05	9.5E-04	9.8E-04	2.1E-04	6.8E-03	7.0E-03
SR05	5.1E-05	1.0E-03	1.1E-03	3.6E-04	7.4E-03	7.7E-03
SR06	6.2E-05	4.3E-04	4.9E-04	4.4E-04	3.1E-03	3.5E-03
SR07	5.0E-05	2.9E-04	3.4E-04	3.6E-04	2.1E-03	2.4E-03
SR08	7.3E-05	4.3E-04	5.0E-04	5.2E-04	3.1E-03	3.6E-03
SR09	3.2E-05	5.8E-04	6.2E-04	2.3E-04	4.2E-03	4.4E-03
SR10	2.0E-05	7.2E-04	7.4E-04	1.5E-04	5.1E-03	5.3E-03
SR11	1.5E-04	1.6E-03	1.7E-03	1.1E-03	1.1E-02	1.2E-02
SR12	3.1E-05	1.8E-03	1.8E-03	2.2E-04	1.3E-02	1.3E-02
SR13	3.7E-05	1.6E-03	1.6E-03	2.7E-04	1.1E-02	1.1E-02
SR14	2.9E-05	2.3E-03	2.3E-03	2.1E-04	1.6E-02	1.6E-02
SR15	2.8E-05	2.3E-03	2.3E-03	2.0E-04	1.7E-02	1.7E-02
SR16	1.4E-05	2.3E-03	2.3E-03	1.0E-04	1.7E-02	1.7E-02
SR17	2.2E-05	6.2E-04	6.4E-04	1.6E-04	4.4E-03	4.6E-03
SR18	2.8E-05	2.0E-03	2.1E-03	2.0E-04	1.5E-02	1.5E-02
SR19	1.9E-05	5.6E-03	5.6E-03	1.3E-04	4.0E-02	4.0E-02
SR20	2.7E-05	3.0E-03	3.0E-03	1.9E-04	2.1E-02	2.2E-02
SR21	1.6E-05	9.1E-04	9.3E-04	1.1E-04	6.5E-03	6.6E-03
SR22	1.2E-05	1.1E-03	1.1E-03	8.7E-05	8.1E-03	8.2E-03
SR23	1.0E-05	9.4E-04	9.5E-04	7.5E-05	6.7E-03	6.8E-03
SR24	1.1E-05	1.0E-03	1.0E-03	8.1E-05	7.2E-03	7.3E-03
SR25	4.3E-05	3.2E-03	3.3E-03	3.1E-04	2.3E-02	2.4E-02
SR26	2.1E-05	1.4E-04	1.6E-04	1.5E-04	1.0E-03	1.2E-03
SR27	3.1E-05	1.2E-04	1.5E-04	2.2E-04	8.8E-04	1.1E-03
SR28	3.1E-05	1.2E-04	1.5E-04	2.2E-04	8.8E-04	1.1E-03
SR29	2.7E-05	1.3E-04	1.6E-04	1.9E-04	9.4E-04	1.1E-03
SR30	1.7E-04	1.5E-04	3.2E-04	1.2E-03	1.1E-03	2.3E-03
SR31	1.7E-04	1.5E-04	3.2E-04	1.2E-03	1.1E-03	2.3E-03
SR32	8.2E-05	1.8E-04	2.6E-04	5.9E-04	1.3E-03	1.9E-03
SR33	2.9E-05	2.2E-04	2.5E-04	2.1E-04	1.6E-03	1.8E-03
SR34	2.0E-05	2.6E-04	2.8E-04	1.4E-04	1.8E-03	2.0E-03
SR35	2.0E-05	2.6E-04	2.8E-04	1.4E-04	1.8E-03	2.0E-03
SR36	1.8E-05	1.6E-03	1.6E-03	1.3E-04	1.1E-02	1.1E-02
SR37	1.0E-05	9.2E-04	9.3E-04	7.3E-05	6.6E-03	6.7E-03
SR38	5.2E-05	1.3E-03	1.4E-03	3.7E-04	9.5E-03	9.9E-03
SR39	3.3E-05	6.6E-04	7.0E-04	2.4E-04	4.7E-03	5.0E-03
SR40	9.2E-06	1.3E-03	1.3E-03	6.6E-05	9.0E-03	9.0E-03
SR41	1.2E-05	3.6E-03	3.6E-03	8.3E-05	2.5E-02	2.6E-02
SR42	1.2E-04	1.5E-04	2.7E-04	8.3E-04	1.1E-03	1.9E-03
SR43	4.0E-04	1.9E-04	5.9E-04	2.9E-03	1.3E-03	4.2E-03
SR44	1.3E-04	2.1E-04	3.3E-04	9.2E-04	1.5E-03	2.4E-03
SR45	2.3E-05	7.2E-05	9.5E-05	1.6E-04	5.2E-04	6.8E-04
SR46	3.1E-05	5.3E-05	8.4E-05	2.2E-04	3.8E-04	6.0E-04
SR47	3.0E-05	5.4E-05	8.5E-05	2.2E-04	3.9E-04	6.0E-04
SR48	1.9E-05	2.9E-05	4.7E-05	1.3E-04	2.0E-04	3.4E-04
SR49	4.6E-05	3.2E-05	7.8E-05	3.3E-04	2.3E-04	5.6E-04
SR50	1.1E-05	1.7E-04	1.8E-04	7.7E-05	1.2E-03	1.3E-03
SR51	1.1E-05	7.5E-04	7.6E-04	7.8E-05	5.3E-03	5.4E-03
SR52	1.8E-05	4.5E-05	6.2E-05	1.3E-04	3.2E-04	4.4E-04
SR53	1.0E-05	2.8E-05	3.8E-05	7.2E-05	2.0E-04	2.7E-04
SR54	1.3E-05	2.0E-05	3.4E-05	9.4E-05	1.5E-04	2.4E-04
SR55	3.8E-05	1.2E-05	5.0E-05	2.7E-04	8.9E-05	3.6E-04
SR56	1.6E-06	8.4E-06	9.8E-06	1.1E-05	6.0E-05	7.0E-05
SR57	8.2E-05	1.1E-04	1.9E-04	5.8E-04	7.8E-04	1.3E-03
SR58	3.5E-06	1.6E-05	1.9E-05	2.5E-05	1.1E-04	1.4E-04

Table IR32-5 Maximum Predicted Annual Deposition for Project Case (Construction Phase)

Receptor Location	Arsenic	Cr VI	Cr III	Manganese	Mercury	Nickel
	Deposition Rate, Q (mg/100 cm²/yr)					
MPOI	5.57E-07	1.14E-08	5.18E-08	1.03E-06	1.11E-09	1.79E-06
SR1	1.44E-07	2.95E-09	1.34E-08	2.67E-07	2.87E-10	4.65E-07
SR2	4.68E-08	9.55E-10	4.35E-09	8.65E-08	9.28E-11	1.51E-07
SR3	4.30E-08	8.77E-10	4.00E-09	7.95E-08	8.53E-11	1.38E-07
SR4	7.67E-08	1.57E-09	7.13E-09	1.42E-07	1.52E-10	2.47E-07
SR5	7.30E-08	1.49E-09	6.79E-09	1.35E-07	1.45E-10	2.35E-07
SR6	3.88E-08	7.93E-10	3.61E-09	7.18E-08	7.71E-11	1.25E-07
SR7	2.81E-08	5.74E-10	2.61E-09	5.20E-08	5.58E-11	9.05E-08
SR8	3.14E-08	6.41E-10	2.92E-09	5.81E-08	6.24E-11	1.01E-07
SR9	1.35E-07	2.77E-09	1.26E-08	2.50E-07	2.69E-10	4.36E-07
SR10	1.08E-07	2.21E-09	1.01E-08	2.01E-07	2.15E-10	3.49E-07
SR11	1.48E-07	3.02E-09	1.38E-08	2.73E-07	2.94E-10	4.76E-07
SR12	1.07E-07	2.19E-09	9.98E-09	1.98E-07	2.13E-10	3.45E-07
SR13	9.65E-08	1.97E-09	8.98E-09	1.79E-07	1.92E-10	3.11E-07
SR14	1.26E-07	2.57E-09	1.17E-08	2.33E-07	2.50E-10	4.05E-07
SR15	1.20E-07	2.45E-09	1.12E-08	2.22E-07	2.38E-10	3.86E-07
SR16	9.53E-08	1.94E-09	8.86E-09	1.76E-07	1.89E-10	3.07E-07
SR17	3.63E-08	7.41E-10	3.38E-09	6.71E-08	7.21E-11	1.17E-07
SR18	1.65E-07	3.36E-09	1.53E-08	3.04E-07	3.27E-10	5.30E-07
SR19	3.48E-07	7.11E-09	3.24E-08	6.44E-07	6.91E-10	1.12E-06
SR20	2.13E-07	4.35E-09	1.98E-08	3.94E-07	4.23E-10	6.86E-07
SR21	1.02E-07	2.08E-09	9.48E-09	1.89E-07	2.02E-10	3.28E-07
SR22	1.15E-07	2.34E-09	1.07E-08	2.12E-07	2.28E-10	3.70E-07
SR23	1.09E-07	2.22E-09	1.01E-08	2.01E-07	2.16E-10	3.50E-07
SR24	5.72E-08	1.17E-09	5.32E-09	1.06E-07	1.14E-10	1.84E-07
SR25	2.39E-07	4.88E-09	2.22E-08	4.42E-07	4.74E-10	7.69E-07
SR26	5.99E-08	1.22E-09	5.57E-09	1.11E-07	1.19E-10	1.93E-07
SR27	5.94E-08	1.21E-09	5.52E-09	1.10E-07	1.18E-10	1.91E-07
SR28	5.94E-08	1.21E-09	5.52E-09	1.10E-07	1.18E-10	1.91E-07
SR29	6.08E-08	1.24E-09	5.65E-09	1.12E-07	1.21E-10	1.96E-07
SR30	6.47E-08	1.32E-09	6.02E-09	1.20E-07	1.28E-10	2.08E-07
SR31	6.47E-08	1.32E-09	6.02E-09	1.20E-07	1.28E-10	2.08E-07
SR32	6.83E-08	1.39E-09	6.35E-09	1.26E-07	1.35E-10	2.20E-07
SR33	6.94E-08	1.42E-09	6.45E-09	1.28E-07	1.38E-10	2.23E-07
SR34	7.07E-08	1.44E-09	6.57E-09	1.31E-07	1.40E-10	2.28E-07
SR35	7.07E-08	1.44E-09	6.57E-09	1.31E-07	1.40E-10	2.28E-07
SR36	7.26E-08	1.48E-09	6.75E-09	1.34E-07	1.44E-10	2.34E-07
SR37	1.06E-07	2.17E-09	9.90E-09	1.97E-07	2.11E-10	3.43E-07
SR38	1.38E-07	2.81E-09	1.28E-08	2.54E-07	2.73E-10	4.43E-07
SR39	1.20E-07	2.45E-09	1.12E-08	2.22E-07	2.38E-10	3.87E-07
SR40	1.41E-07	2.87E-09	1.31E-08	2.60E-07	2.79E-10	4.53E-07
SR41	2.50E-07	5.10E-09	2.32E-08	4.62E-07	4.95E-10	8.03E-07
SR42	4.56E-08	9.31E-10	4.24E-09	8.43E-08	9.05E-11	1.47E-07
SR43	3.45E-08	7.04E-10	3.21E-09	6.38E-08	6.85E-11	1.11E-07
SR44	1.73E-08	3.53E-10	1.61E-09	3.20E-08	3.43E-11	5.56E-08
SR45	1.06E-08	2.17E-10	9.88E-10	1.96E-08	2.11E-11	3.42E-08
SR46	9.17E-09	1.87E-10	8.52E-10	1.69E-08	1.82E-11	2.95E-08
SR47	9.16E-09	1.87E-10	8.51E-10	1.69E-08	1.82E-11	2.95E-08
SR48	7.05E-09	1.44E-10	6.56E-10	1.30E-08	1.40E-11	2.27E-08
SR49	7.31E-09	1.49E-10	6.80E-10	1.35E-08	1.45E-11	2.35E-08
SR50	1.56E-08	3.17E-10	1.45E-09	2.88E-08	3.09E-11	5.01E-08
SR51	4.41E-08	9.00E-10	4.10E-09	8.15E-08	8.75E-11	1.42E-07
SR52	3.80E-08	7.77E-10	3.54E-09	7.04E-08	7.55E-11	1.22E-07
SR53	7.66E-09	1.56E-10	7.12E-10	1.42E-08	1.52E-11	2.47E-08
SR54	2.90E-08	5.92E-10	2.70E-09	5.36E-08	5.76E-11	9.34E-08
SR55	2.31E-08	4.72E-10	2.15E-09	4.27E-08	4.59E-11	7.44E-08
SR56	1.73E-08	3.54E-10	1.61E-09	3.21E-08	3.44E-11	5.58E-08
SR57	5.37E-08	1.10E-09	4.99E-09	9.93E-08	1.07E-10	1.73E-07
SR58	4.33E-09	8.83E-11	4.02E-10	8.00E-09	8.59E-12	1.39E-08

Table IR32-6 Maximum Predicted Change in Soil Concentration

COPC	Maximum Predicted Change in Soil Concentration, Cs (mg/kg)		Background Concentration		Maximum Change	Health-based Screening Level	
	at MPOI	at Receptor	(mg/kg)	Reference	%	(mg/kg)	Reference
Metals							
Arsenic Compounds	3.3E-06	2.1E-06	6.93	c	0%	17	a
Chromium VI	6.8E-08	4.3E-08	<0.3	d	0%	0.4	a
Chromium III	3.1E-07	1.9E-07	26.1	c	0%	64	a
Manganese Compounds	6.2E-06	3.9E-06	1900	b	0%	-	-
Mercury	6.6E-09	4.1E-09	0.031	c	0%	6.6	a
Nickel Compounds	1.1E-05	6.7E-06	24.5	c	0%	45	a

References:

(a) Alberta Government. 2016. Tier I Soil and Groundwater Remediation Guidelines, Table A-2 (Health-based Screening Level) and Table C-9 (Background Concentration).

(b) Ontario Ministry of Environment. 2011. Rationale for the Development od Soil and Groundwater Standards for Use at Contaminated Sites in Ontario. Table 1, Agricultural (for PAHs) and Table 8.3b (Manganese)

(c) Maximum measured concentration in collected soil samples from PDA

(d) Millenium EMS Solutions. 2016. Best Practices - Evaluation of Background Metal Concentrations in Alberta Soil. Letter to Petroleum Technology Alliance Canada, dated August 16, 2016. File #15-00403.

COUNTRY FOODS

Question IR3-33: Country Foods

Sources:

EIS Guidelines Part 2, Sections 6.1.4; 6.1.9; 6.2.2; 6.3.4

EIS Volume 4, Appendix O, Section 6.3.2

Health Canada Comments on the EIS – June 15, 2018 (CEAR #30)

Piikani Nation – Technical Review of EIS, June 15, 2018 (CEAR #48)

Montana First Nation – Review of Springbank Off-Stream Reservoir EIA, June 2018 (CEAR #51)

Context and Rationale:

The EIS Guidelines require the proponent to assess the effects of changes to the environment on Indigenous peoples, including effects on current use and on health, both of which are related to the availability, quality, and accessibility of country foods.

The EIS notes that there is the potential for conversion of natural mercury to methylmercury during a flood. Flooding will occur over a short time period and may not be enough time to result in significant bioaccumulation or biomagnification in the food chain. However, there is uncertainty regarding retention and draw down times that may not have been considered.

The EIS indicates that the highest predicted methylmercury concentrations in the reservoir water after draining under both the 1:100 year and 1:10 year floods scenarios do not exceed the CCME guideline for the protection of aquatic life. However, the short-term (acute) provincial guideline for methylmercury is exceeded and not discussed in the EIS.

Indigenous users have identified that country foods are harvested from the Elbow River. The precautionary principle should be followed to be protective of human health.

Additional information is required to understand potential changes to country foods and effects on Indigenous peoples.

Information Request:

a) **Describe the potential effects to aquatic organisms in the reservoir that will result from methylmercury concentrations reaching the 0.002 µg/L short-term guideline and exceeding the long-term (chronic) guideline established by Alberta.**

b) Describe the spatial extent of potential effects that would result from the release of water containing 0.002 µg/L methylmercury, into the Elbow River, taking into account the frequency of the release of waters with this concentration.

c) Identify the country foods harvested from the Elbow River and for each describe the susceptibility to the uptake and biomagnification of methylmercury.

d) Include commitments for baseline methylmercury sampling of country foods along with a monitoring and follow-up program of methylmercury in these foods following reservoir flooding.

e) Incorporate the information from IR1-06 issued to Alberta Transportation by the Agency on June 29, 2018 into the response.

Response IR3-33

a) Effects of the Project related to methylation of mercury are related to two factors: 1) change in water quality concentrations of methylmercury related to inundation of soils within the reservoir and 2) change in structure of the food web in the downstream environment (Wiener and Suchanek 2008). Both of these factors are discussed below.

Based on predictions in Volume 3B, Section 7.4.4, page 7.29 regarding methylmercury flux between soil and reservoir water, and a revised starting water concentration of 0.0004 µg/L (derived as discussed in CEAA IR1-06), updated predictions for methylmercury concentrations for the three floods are as follows:

- design flood, 0.00068 to 0.0017 µg/L
- 1:100 year flood, 0.00080 to 0.0024 µg/L
- 1:10 year flood, 0.00085 to 0.0024 µg/L

These estimated low and high methylmercury concentrations are below CCME (2003) guideline (0.004 µg/L methylmercury), but the estimated high concentrations are greater than the guideline in (GoA 2018): 0.001 µg/L long-term level and 0.002 µg/L short-term level. Below describes (1) toxicity information related to exposure of aquatic organisms to methylmercury in water and (2) how the revised values are derived, and the conservatism incorporated in the assessment.

Toxicity Information

As indicated in CCME (2003), in chronic tests, the EC_{50} (effect concentration) for invertebrates ranged from 0.04 µg/L to 1.14 µg/L. For fish, the effects concentrations ranged from 0.93 µg/L to 63 µg/L. The LOAEL (lowest observed adverse effect level) of 0.04 µg/L (based on reproductive effects in *Daphnia magna*) was divided by a safety factor of 10 to derive the Canadian guideline of 0.004 µg/L. Based on these results, which suggest that the upper range of potential concentrations are less than the Canadian guideline and well below the LOAEL, significant effects on aquatic organisms in the reservoir due to direct exposure to methylmercury in water are not expected.

DERIVATION OF REVISED VALUES FOR METHYLMERCURY

The predicted methylmercury concentrations incorporate a number of conservative assumptions:

- The mercury and methylmercury assessment was derived using a number of conservative methods and assumptions to predict the minimum and maximum results. The predicted upper methylmercury concentrations are considered high for a number of reasons: Soil conditions are based on literature for sites with higher soil mercury and methylmercury than for the Project and in ecological zones expected to have higher soil carbon content (Hall et al. 2005).
- A range of predictions is provided, based on the literature for methylation flux rates (Hall et al. 2005).
- A methylmercury/mercury ratio in water is used at the upper end of the observed literature range (1% to 15% methylmercury), which is typical of wetland soils, not the arid soils of the PDA.
- Baseline mercury concentrations are likely overestimated because baseline values are below the detection limit. Reported concentrations from samples collected in 2016 were below analytical detection limit of 0.005 mg/L (Volume 4, Appendix K, Attachment A, Table A-1), making it challenging to calculate a baseline mercury concentration for the analysis. By assuming the distribution is somewhat symmetrical, arranged between zero and the reported detection limit, and assuming a lognormal distribution, a median concentration of 0.003 µg/L is estimated. This value is conservative because it assumes that the maximum concentration is near the detection limit.
- Based on work by Trudel and Rasmussen (2006), mercury uptake and accumulation from water exposure is only approximately 0.1% of the mercury accumulation from diet and water together (this included both elemental mercury and methylmercury).

As discussed above, methylmercury levels are predicted to be low, water released from the reservoir will occur infrequently, reservoir water will be diluted through mixing with Elbow River, and most of the reservoir water will be released to the river prior to methylmercury concentration reaching their higher predicted concentrations. Therefore, food webs in Elbow River are not predicted to be affected by methylmercury as a result of reservoir operations.

b) Methylmercury concentrations predicted in the reservoir and, subsequently, in Elbow River will be short term in nature (up to 84 days for inundation) and occurring infrequently: the predicted water quality concentrations that exceed the Alberta short-term guideline of 0.002 µg/L are associated with floods with return periods of 1:10 years or less frequent and would only occur towards the end of the impoundment (as concentrations are a function of mass flux rate and time).

The area of effects associated with the release of water with a methylmercury concentration of 0.002 µg/L will depend on conditions at the time of release (e.g., release rate, flow in the Elbow River at the time of release, and turbulence of flow). However, given the dilution that will occur in Elbow River, the expected area is expected to be small. Dilution rates in Elbow River (Volume 3B, Section 7.4.3, page 7.25) are predicted to be as follows:

- For the design flood, released water would contribute 29% to 59% of total flow in Elbow River (i.e., dilution would result in reduction of reservoir constituent concentrations of 40% to 70%).
- For the 1:100 year flood, released water would contribute 5% to 35% of total flow in Elbow River (i.e., dilution would result in reduction of reservoir constituent concentrations of 65% to 95%).
- For the 1:10 year flood, released water would contribute less than 5% of total flow in Elbow River (i.e., dilution would result in reduction of reservoir constituent concentrations greater than 95%).

c) Information regarding traditional land and resource use, including the harvest of country foods, are best identified by Indigenous groups themselves. To that end, Alberta Transportation commenced consultation with Treaty 7 First Nations in August 2014 and with the additional Indigenous groups identified in the Canadian Environmental Assessment Agency (CEA Agency) Guidelines for the Project in October 2016 concerning the Project, including the context and setting for traditional uses in the Project area. Alberta Transportation has been conducting Indigenous engagement prior to and throughout the assessment process, which includes sharing of Project information and updates, on-going communication about the Project, face-to-face meetings, facilitation of site visits, and funding for Project-specific Traditional Use Studies (TUS). Alberta Transportation's response to this information request relies on both the material filed in the EIA and any supplemental information received since the filing of the EIA. However, Alberta Transportation understands that the provision of this information is at the priority and discretion of the participating Indigenous group.

Refer to Alberta Transportation's response to CEAA IR2-01 for a summary of:

- The engagement activities facilitated by Alberta Transportation to inform Project planning.
- Feedback and material from Indigenous groups received prior to and following the filing of the EIA to inform Project planning.

Refer to the response to CEAA IR2-1, Appendix IR1-1 for an updated summary of the engagement process to February 28, 2019 for additional Indigenous groups that CEAA requested to include.

As noted in Volume 3A, Section 14.1.7, current use of lands and resources for traditional purposes by Indigenous groups may occur within the PDA by permission of the landowner, and potential Project effects on such current use have been assessed in Volume 3A, Section 14.3. The description of country foods harvested from the Elbow River, and the potential pathways of effects are described in Volume 3A, Sections 14.2.4 and 14.3.2.

Table IR33-1 summarizes the country foods harvested from Elbow River, as identified by each of the Indigenous groups listed in the EIS Guidelines, that were either previously included in the assessment or subsequently shared with Alberta Transportation. Species information is provided in this table, where available.

Table IR33-1 Country Foods Harvested from the Elbow River as Identified by each Indigenous Group

Country Foods Harvested from the Elbow River	Source	EIA Reference (if applicable)[3]
Kainai First Nation		
"Elders described the Elbow River as habitat for rainbow trout, cutthroat trout, brook trout, bull trout and rocky mountain whitefish".	Kainai First Nation 2018 (CEAR #47), p. 67	--
"Near the outlet of Val Vista Creek on the Elbow River, the field research team noted the presence of food plants including Saskatoon berries and chokecherries"	Kainai First Nation 2018 (CEAR #47), p. 72	--
"Some of the bird species in the PDA are of subsistence value… the group encountered ruffed grouse. There is potential to hunt these game birds along the wooded portions of the banks of the Elbow River. The field research team spotted, photographed and documented the presence of Canada Geese near the outlet of the Val Vista Creek (unnamed Creek) on the Elbow River. Merganser ducks were also spotted on the river".	Kainai First Nation 2018 (CEAR #47), p. 64	--

[3] -- indicates the referenced information was received following the submission of the EIA.

Table IR33-1 Country Foods Harvested from the Elbow River as Identified by each Indigenous Group

Country Foods Harvested from the Elbow River	Source	EIA Reference (if applicable)[3]
Siksika Nation		
"There are medicinal and ceremonial plants located on both sides of the Elbow River where the diversion inlet and service sluiceway are proposed to be constructed (see Figure Two). These plants will need to be protected or relocated to another spot nearby to ensure they are available in future for Blackfoot traditional people".	KCO & SCO 2017, p. 5	Volume 3A, Section 14.3.2.2 Volume 3A, Section 14.3.4.1
Tsuut'ina Nation		
Tsuut'ina Nation explained that medicinal plants are traditionally found in the areas adjacent to the Elbow River, because "medicine grows along the river".	Tsuut'ina Nation 2018, p. 53	--
"Tsuut'ina land users report fishing for char, suckers, pike, whitefish, cutties, rainbow, brown and bull trout on the Elbow River and its tributaries".	Tsuut'ina Nation 2018, p. 54	--
"[T]he sacred plants the Tsuut'ina rely upon grow along the shores of the Elbow River, which is one of the reasons the Tsuut'ina selected a site proximate to the river for their reserve".	Tsuut'ina Nation 2018, p. 65	--
Piikani Nation		
During the site visit to the Off-stream Storage Dam, Piikani Nation commented that "the low-lying area is presently covered by overgrowth of willows, cottonwood, poplar and various types of berry trees" "The area within the flood basin is the natural habit of the grizzly bear, moose, elk, deer, wolf, coyote, cougars and raptors, fur bearing animals, herbs and medicinal plants"	Piikani Nation, n.d., p. 9, 20	--
Ermineskin Cree Nation		
Subsistence harvesting was recorded around the Elbow River Recreation Area.	WSSS 2018 (CEAR #46), p. 22	--
"In addition to big game, ECN land users hunt for waterfowl (ducks and geese) and game birds (prairie chickens and wild turkeys) along the river to the south of the PDA".	WSSS 2018 (CEAR #46, p. 24	--
"The main species fished in the Elbow River were bull trout, rainbow trout, and cutthroat trout".	WSSS 2018 (CEAR #46), p. 26	--
Montana First Nation		
Montana First Nation has not identified any country foods harvested from the Elbow River.	--	--

Table IR33-1 Country Foods Harvested from the Elbow River as Identified by each Indigenous Group

Country Foods Harvested from the Elbow River	Source	EIA Reference (if applicable)[3]
Samson Cree Nation		
"The Project development area historically provided habitat for westslope cutthroat trout, which is a fish species of interest to Samson… westslope cutthroat trout remain present in the upper Elbow River and its tributaries".	Samson Cree Nation 2018 (CEAR #52), p. 12	--
Métis Nation of Alberta, Region 3		
"A preliminary survey indicated that many members of The Métis Nation of Alberta, Region 3 or their ancestors have harvested plants, both edible and medicinal, caught fish, and hunted/trapped in the project area. Several actively fish or harvest plants in the project area today, so the impacts to country foods by the construction of the reservoir has the potential to limit the access or have adverse effects on the ability of members of The Métis Nation of Alberta, Region 3 to access country foods that form an important part of expressing, maintaining, and passing on cultural values".	MNAR3 2019, p. 2	--
Foothills Ojibway		
As reported in Volume 3A, Section 14.8.7, Foothills Ojibway undertakes current use activities such as hunting, plant harvesting, habitation, as well as spiritual and ceremonial practices. However, no additional information regarding country foods has been received from Foothills Ojibway to date. Alberta Transportation has continued to provide Foothills Ojibway with Project information and updates.		
Ktunaxa Nation		
As reported in Volume 3A, Section 14.8.8, Ktunaxa Nation has informed Alberta Transportation that they have no interest in the Project. Alberta Transportation has continued to provide Ktunaxa Nation with Project information and updates.		
Métis Nation British Columbia		
Métis Nation British Columbia has not engaged with Alberta Transportation on the Project. Alberta Transportation has continued to provide Métis Nation British Columbia with Project information and updates.		

Water released from the off-stream reservoir is not expected to result in methylmercury levels in Elbow River high enough to affect food webs. As discussed above:

- Methylmercury levels are predicted to be low, as described in a), and conservative, as discussed in b).
- Based on work by Trudel and Rasmussen (2006), mercury uptake and accumulation from water exposure is only approximately 0.1% of the mercury accumulation from diet and water together (this included both elemental mercury and methylmercury), as discussed in b).
- Water released from the reservoir will occur infrequently, and most of the water will be released into the river prior to methylmercury concentration reaching their maximum predicted concentrations, as discussed in b).
- Water released from the reservoir will be diluted through mixing with Elbow River, as discussed in b).

Because of these reasons, food webs in Elbow River are not predicted to be affected by methylmercury as a result of the reservoir operations.

The harvest of country foods from Elbow River, as indicated by the outcomes of the engagement program to date, are consistent with the activities in the EIA and for which Alberta Transportation's suite of mitigation measures were developed.

The significance conclusions remain unchanged.

Alberta anticipates building upon engagement efforts to date to continue to strengthen relationships with potentially affected Indigenous groups. Information provided throughout the regulatory phase will be used to inform Project plans and mitigation, as appropriate.

d) Given the explanations in a) to c), no additional sampling of water, sediment, or fish tissue is required.

e) Information from CEAA IR1-06 has been incorporated into this response.

REFERENCES

CCME (Canadian Council of Ministers of the Environment). 2003. Canadian Water Quality Guidelines for the Protection of Aquatic Life, Mercury – Inorganic mercury and methylmercury.

GoA (Government of Alberta). 2018. Environmental Quality Guidelines for Alberta Surface Waters. Water Policy Branch, Alberta Environment and Parks, Edmonton.

KCO & SCO (Kainai Consultation Office and Siksika Consultation Office). 2017. Springbank Off-stream Reservoir (SR-1) KCO and SCO TUS Research Study. Joint Kainai & Siksika Interim Report.

Kainai First Nation. June 2018. Blood Tribe/Káínai Traditional Knowledge, Land, and Resource Use Study Springbank Off-Stream Reservoir Project. Prepared for the Blood Tribe/Káínai. Prepared by Dermot O'Connor, Oak Road Concepts Inc. Available on the Canadian Environmental Assessment Registry (CEAR #47) at: https://www.ceaa-acee.gc.ca/050/evaluations/document/123631?culture=en-CA

MNAR3 (Métis Nation of Alberta Region 3). March 13, 2019. Letter to Alberta Transportation Re: Canadian Environmental Assessment agency Information Request for the Springbank Off-Stream Reservoir Project, Metis Nation of Alberta Region 3 Input.

Piikani Nation. n.d. Piikani Report on Proposed Springbank Reservoir And Dam. Prepared by William Big Bull for Piikani Consultation.

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NOISE

Question IR3-34: Noise

Sources:

EIS Guidelines Part 2, Sections 6.1.1; 6.1.9; 6.2.1; 6.3.4

EIS Volume 3A, Sections 4.3; 4.4.2.2

Health Canada Comments on the EIS – June 15, 2018 (CEAR #30)

Context and Rationale:

The EIS Guidelines require a description of baseline noise levels and changes in ambient noise levels, as well as an assessment of the effects of changes to noise levels on Indigenous peoples.

The EIS indicates that blasting may occur during Project construction and the contractor would prepare a blasting safety plan and submit it to the proponent. However, blasting was not included in the assessment of potential effects from noise. The EIS also notes that mitigation will be developed for each of the identified noise assessment scenarios when the Project schedule is finalized.

Considering noise thresholds may be exceeded at several receptors, a noise follow-up and management plan, including mitigation, should be provided. Special consideration should be given to night construction noise mitigation measures to minimize potential effects to Indigenous people's health (i.e. sleep). Effects of blasting on the sensory environment and experience of the land by Indigenous peoples should also be considered.

Information Request:

a) Provide an updated assessment of effects of noise from the Project, including blasting noise. Include proposed mitigation measures for construction noise, any residual effects after the measures are implemented, and any follow-up programs.

Response IR3-34

a) Volume 3A, Section 4 assessed construction noise effects and concluded that noise mitigation is needed to adhere to Health Canada Guidance Limits.

The following are the conservative modelling assumptions:

- All receptors will be downwind from the Project at all times under atmospheric conditions that are highly conducive to noise propagation.
- Shielding effects from terrain and vegetation were not included.
- Noise emission estimates for construction equipment represent peak activity levels and construction hours.

Four of the forty-five receptors within LAA are Indigenous receptors. The model results indicate that the daytime and nighttime noise effect experienced at these four receptors will be below Health Canada's recommended threshold limits for annoyance and sleep disturbance for each of the modelled construction scenarios. The assessment shows that the noise threshold limits would be exceeded at other non-Indigenous receptors, indicating the need for a noise management plan (i.e., noise mitigation and monitoring program or follow-up program).

Administrative controls to mitigate noise involve ongoing planning, monitoring feedback, and decisions by the project manager, and cannot be pre-selected without constraining the project management process. The contractor's construction schedule, equipment selection, sequence of operations, and concurrent activities must be known in order to implement specific noise mitigation measures to adhere to the applicable mitigated noise level (MNL) thresholds and reduce noise disturbance to nearby residents.

Alberta Transportation, through its Environmental Construction Operations Plan (ECO Plan) Framework, will require the contractor to engage a qualified acoustic consultant and implement a construction noise management plan. The contractor's noise management plan, as approved by Alberta Transportation, will incorporate commitments made with respect to noise and possible conditions as part of regulatory approvals. Compliance with the noise management plan shall be monitored by contractor management and Alberta Transportation.

The noise management plan shall include the following activities on a weekly basis while construction and earthworks are performed:

- review planned construction activities, machinery locations, and mobile equipment movements on site and forecast Project noise levels at the most affected residence locations

- assess noise emission from individual pieces of equipment to ensure the best available noise controls are in place and functioning properly
- monitor actual noise levels near the affected residence locations and report trends or exceedances
- provide advance notification to sensitive receptors concerning construction duration, activities that are expected to be noisy and their expected duration, what noise mitigation measures are being applied, and when noise respite periods will occur. Facilitate contact through letterbox drops, meetings or individual consultation. Provide a means for direct feedback from residents and acknowledge specific concerns. A web site may be useful for sharing noise related information.
- regularly train workers and contractors (such as at toolbox talks) to use equipment in ways that minimize noise
- apply specific noise mitigation measures as needed to adhere to the MNL thresholds at nearby residences

Specific construction noise mitigation measures may include:

- avoiding metal/metal or rock/metal impulsive noises such as tailgate slams or dropping material from height
- using of portable enclosures or temporary noise barriers to reduce noise transmission towards sensitive receptors
- designing vehicle routes to maximize available topographic shielding towards nearby receptors
- implementing truck schedule and speed limits for material transport which reduce cumulative noise
- nominating off-site or screened waiting areas for trucks to avoid a congregation of idling vehicles
- using broadband back-up alarms in lieu of beepers
- scheduling non-critical path activities which generate noise during the daytime only
- reducing the equipment count or hours of noisy activity during the nighttime

Blasting air overpressure and vibration are short duration events that tend to have a negligible effect on the day-night average sound level (L_{dn}) used to evaluate the noise effect. Air overpressure effects commonly occur in the low frequency part of the audible frequency spectrum and may or may not be audible. Ground vibration may be perceptible but not audible. Therefore, noise thresholds such as MNL from Health Canada (2017) are not appropriate for assessing blast overpressure and ground vibration effects. Environment

Canada (2009) and Health Canada (2017) prescribe specific threshold limits for blasting air overpressure and vibration at sensitive receptors.

The possibility of blasting has been identified; however, the location, schedule, and proposed blast design must be known before specific mitigation measures can be applied as part of the blast design. For example, design factors such as the specific charge-weight per hole, number of holes, and spacing of holes will not be known until more detailed construction information is available. Alberta Transportation will require the blasting contractor to complete a blasting vibration and air overpressure assessment and adhere to the threshold limits for blasting air overpressure and vibration at sensitive receptors.

Blasting mitigation measures that may be used to meet these limits and reduce potential health effects such as sleep disturbance include:

- communicating with potentially impacted residents about blasting locations and schedule
- blasting during the daytime only at a specific time of day or predictable schedule
- adjusting charge-weight/hole, number of holes and delay based on prediction model or monitoring results consistent with the distance to the nearest sensitive receptor
- designing detonation patterns to progress away from nearest sensitive receptor and/or adjust delay time interval to reduce air pressure amplification
- maintaining good drilling and loading accuracy
- stemming boreholes with appropriate material
- covering exposed detonating cord trunk lines or use non-detonating initiation systems
- avoiding blasting during temperature inversions or unfavorable wind conditions
- using expansive chemical product for breaking bedrock in lieu of blasting

The available noise mitigation measures include options for substitution and curtailment of nighttime activities which can be progressively applied through a construction noise management plan to reduce residual noise effects during construction such that the Project is expected to meet Health Canada Guidelines for noise. With respect to blasting, Alberta Transportation will follow the specific threshold limits for blasting air overpressure and vibration at sensitive receptors specified by Environment Canada (2009) and Health Canada (2017). These calculations will be done when the blasting program is designed.

REFERENCES

Health Canada. 2017. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Environment Canada. 2009. Environmental Code of Practice for Metal Mines. Mining Section. Mining and Processing Division. Public and Resources Sectors Directorate. Environmental Stewardship Branch.

AIR QUALITY

Question IR3-35: Air Quality – Canadian Ambient Air Quality Standards (CAAQS)

Sources:

EIS Guidelines Part 2, Sections 6.1.1; 6.1.9; 6.2.1; 6.3.4; 8

EIS Volume 3A, Section 3; 15.4.4

EIS Volume 3B, Section 3; 15.4.2.3

EIS Volume 3C, Section 2.2

EIS Volume 4, Appendix E; Appendix O Table 4-1

Environment and Climate Change Canada Technical Review, June 18, 2018 (CEAR #32)

Health Canada Comments on the EIS – June 15, 2018 (CEAR #30)

Context and Rationale

The EIS Guidelines require a description of baseline air quality levels and changes in air quality, as well as an assessment of the effects of changes to air quality on Indigenous peoples. The EIS Guidelines require the proponent to compare anticipated air quality against the *Canadian Ambient Air Quality Standards* (CAAQS) for fine particulate matter.

In the EIS, the 2017 CAAQS for NO_2 are referenced and used in the health assessment but not in the air quality assessment. During the construction stage, if predicted NO_2 levels are expected to exceed the CAAQS levels, it is important to reference CAAQS NO_2 levels in the air quality and climate monitoring plan. Additionally, the EIS uses the 2015 CAAQS standards for $PM_{2.5}$ (as opposed to the 2020 standards). It is important to evaluate $PM_{2.5}$ concentrations to confirm concentrations are below the annual and 24-hour 2020 $PM_{2.5}$ CAAQS, as the Project stages are expected to occur during or after 2020.

The air quality assessment predicts exposure ratios (ER) greater than 1 for NO_2, $PM_{2.5}$, and diesel exhaust particulate at some receptors. To compare predicted concentrations for the Project with the 2020 CAAQS, the same metric should be used (i.e. the 3-year average of the 98th percentile), and applied to both $PM_{2.5}$ and NO_2.

Additional information is required to understand project changes to air quality, relative to applicable standards, and the effects of changes in air quality on Indigenous peoples.

<u>Information Requests:</u>

a) **Revise the air quality assessment to consider the 2017 CAAQS for NO_2:**

- **Describe the potential for the Project to contribute to ambient concentrations of NO_2 that exceed the CAAQS and provide a comparison of modelled ambient concentrations of NO_2 in the LAA and RAA.**
- **Assess the locations and frequency of NO_2 CAAQS exceedance that may occur as a result of the Project.**

b) **Compare predicted ambient and $PM_{2.5}$ concentrations with the appropriate 2020 CAAQS.**

- **Provide the potential for exceedance of these standards, and describe whether existing mitigation measures described in the EIS are adequate.**
- **Revise the $PM_{2.5}$ exposure limit and update the follow-up and monitoring plan to include the 2020 $PM_{2.5}$ CAAQS.**

c) **If CAAQS are exceeded, describe what mitigation measures would be employed and how follow-up and monitoring plans would be updated to consider monitoring with comparison to the CAAQS.**

- **Describe the criteria which trigger the air quality follow-up and monitoring plan, and the timing for when mitigation measures to reduce COPC concentrations would be implemented.**

d) **Provide specific measures to mitigate the potential risk for adverse health effects from air contaminants that have ERs of 1 or greater.**

Response IR3-35

BACKGROUND INFORMATION

At the time when the dispersion modelling was completed for the Project, the Government of Canada had not announced the final Canadian Ambient Air Quality Standards(CAAQS) for nitrogen dioxide (NO_2). As a result, the assessment of potential effects on air quality and climate only compared predicted NO_2 concentrations to the Alberta Ambient Air Quality Objectives (Volume 3A, Section 3.4.5.2). The Government of Canada announced finalization of the Canadian Ambient Air Quality Standards for NO_2 on December 9, 2017 (GoC 2017a). This response considers the CAAQS for NO_2.

The Air Quality Management System (AQMS) is a comprehensive approach for reducing air pollution in Canada and is the product of collaboration by the federal, provincial and territorial governments and stakeholders (CCME 2018). Federal, provincial and territorial governments all have roles and responsibilities in the implementation of the AQMS (CCME 2012a). The AQMS is a comprehensive framework that includes the CAAQS, industrial emission limits for significant emission sources (BLIERS), air zones for management of local air quality, initiatives to reduce emissions from the transportation sector, and requirements for monitoring and public reporting (CCME 2012a).

The CAAQS were developed as part of the AQMS considering both health and environmental impacts and were developed with the objective of driving continuous improvement of air quality in Canada. The CAAQS were developed collaboratively by Health Canada, Environment and Climate Change Canada (ECCC), provinces, territories, Indigenous peoples' representatives, and stakeholders from industry, health, and environmental organizations through the Canadian Council of Ministers of the Environment (CCME) (CCME 2012a). The CAAQS are established as objectives under the *Canadian Environmental Protection Act* (*CEPA*) 1999. The CAAQS for $PM_{2.5}$ and NO_2 are presented in Table IR35-1. Alberta Ambient Air Quality Objectives are also presented in Table IR35-1 for comparison purposes (GoC 2017a).

Table IR35-1 Canadian Ambient Air Quality Standards for $PM_{2.5}$ and NO_2

Contaminant	Units	Averaging Period	Canadian Ambient Air Quality Standard	Alberta Ambient Air Quality Objectives
$PM_{2.5}$	µg/m³	24-hour	28 (Effective in 2015)[1] 27 (Effective in 2020)[1]	29
		Annual	10 (Effective in 2015)[2] 8.8 (Effective in 2020)[2]	-
Nitrogen dioxide (NO_2)	µg/m³	1-hour	113 (60 ppb; Effective in 2020)[3] 79 (42 ppb; Effective 2025)[3]	300 (159 ppb)
		Annual	32 (17 ppb; Effective 2020)[4] 23 (12 ppb; Effective 2025)[4]	45 (24 ppb)

NOTES:
NO_2 = nitrogen dioxide; ppb = parts per billion $PM_{2.5}$ = particulate matter, 2.5 microns or less; µg/m³ = microgram per cubic meter.

1 The 24-hour $PM_{2.5}$ value is calculated from the 3-year average of the 98th percentile of the daily 24-hour average concentrations.

2 The annual average $PM_{2.5}$ value is calculated from the 3-year average of the annual average concentrations.

3 The 1-hour NO_2 value is calculated from the 3-year average of the 98th percentile of the daily maximum 1-hour average concentrations.

4 The annual NO_2 value is calculated from the arithmetic average over a single calendar year of all 1-hour average concentrations.

Under the AQMS, achievement of the CAAQS is determined in each air zone. Air zones are a place-based approach to manage local air quality. Provinces and territories have delineated their respective areas into individual air zones with the objective of driving continuous improvements in air quality and to prevent the CAAQS from being exceeded. Air management in each air zone is guided by the Air Zone Management Framework (CCME 2012b), another element of the AQMS. The Project is located within the South Saskatchewan Air Zone.

The CCME describes the process for selecting monitoring stations, measuring pollutant concentrations and determining achievement of the CAAQS (CCME 2012b, CCME 2012c). Determining achievement of the CAAQS is based upon using measured air quality concentrations at community monitoring stations and comparing the measured levels to the CAAQS and assigning air quality status to one of four management levels (2012b, GOC 2017a, GOC 2017b). The four air quality management levels require progressively more rigorous actions by jurisdictions as air quality approaches or exceeds the CAAQS, thereby ensuring proactive management actions are undertaken to reduce emissions and prevent exceedances of the CAAQS (CCME 2012b). The management levels under the AQMS for $PM_{2.5}$ and NO_2 are presented in Table IR35-2 (GoC 2017a, b).

Air zones such as the South Saskatchewan Zone cover broad geographical areas consisting of communities, rural areas with few permanent dwellings and areas of industrial development. The CCME guidance on determining achievement of the CAAQS states that the monitoring stations that are used to determine achievement and guiding air quality management efforts should be in areas that reflect air quality where people live (CCME 2012c). The CCME has developed guidance for $PM_{2.5}$ (CCME 2012c), however, has not yet released the Guidance on determining achievement of the NO_2 CAAQS. The guidance for $PM_{2.5}$ states that the monitoring sites should not, however, be sited near or unduly influenced by a nearby emission source (CCME 2012c); for example, Section 3.2 states that monitoring stations should not be in close proximity to the fence line of an industrial facility or next to a major roadway (CCME 2012c). The six ambient monitoring stations used by AEP to determine achievement of the CAAQS in the South Saskatchewan Air Zone for $PM_{2.5}$ are the Calgary Northwest, Calgary Central, Calgary Inglewood, Calgary Southeast, Medicine Hat Crescent Heights and Lethbridge monitoring stations. All six monitoring stations are located within the city limits of Calgary, Medicine and Lethbridge.

The Government of Alberta has implemented the Air Zone Management component of the AQMS into its provincial air quality management system. Specifically (AEP 2015) describes the Implementation of the air zone management framework for the $PM_{2.5}$ and ozone CAAQS. This policy describes Alberta's overall process for monitoring and reporting relative to the CAAQS under the AQMS. Alberta's policy states that monitoring and reporting focusses on populated areas and specifically excludes monitoring locations within areas of industrial activity where there is not a population centre (AEP 2015).

Table IR35-2 AQMS Air Quality Management Levels

Contaminant	Units	Averaging Period	AQMS 2020 Management Levels
$PM_{2.5}$	µg/m³	24-hour[1]	Red: > 27 µg/m³ Orange: > 19 and ≤ 27 µg/m³ Yellow: > 10 and ≤ 19 µg/m³ Green: ≤ 10 µg/m³
		Annual[2]	Red: > 8.8 µg/m³ Orange: > 6.4 and ≤ 8.8 µg/m³ Yellow: > 4.0 and ≤ 6.4 µg/m³ Green: ≤ 4.0 µg/m³
Nitrogen dioxide (NO_2)	ppb	1-hour[3]	Red: > 60 ppb Orange: > 31 and ≤ 60 ppb Yellow: > 20 and ≤ 31 ppb Green: ≤ 20 ppb
		Annual[4]	Red: > 17 ppb Orange: > 7 and ≤ 17 ppb Yellow: > 2 and ≤ 7 ppb Green: ≤ 2 ppb

NOTES:

NO_2 = nitrogen dioxide; ppb = parts per billion $PM_{2.5}$ = particulate matter, 2.5 microns or less; µg/m³ = microgram per cubic meter.

1 The 24-hour $PM_{2.5}$ value is calculated from the 3-year average of the 98th percentile of the daily 24-hour average concentrations.

2 The annual average $PM_{2.5}$ value is calculated from the 3-year average of the annual average concentrations.

3 The 1-hour NO_2 value under the AQMS is calculated from the 3-year average of the 98th percentile of the daily maximum 1-hour average concentrations.

4 The annual NO_2 value is calculated from the arithmetic average over a single calendar year of all 1-hour average concentrations.

Predicted NO_2 and $PM_{2.5}$ concentrations are presented for the entire RAA and at sensitive receptors in this response. However, the results are interpreted consistent with the Government of Canada's guidance and statements that describe that the CAAQS are intended to be used in conjunction with results from air quality modelling to predict the impact of a project on downwind locations such as communities and other sensitive receptors and were not intended to be used as standards to be achieved at a project fenceline (GoC 2018).

a) Maximum predicted NO_2 concentrations in the RAA are compared to the 2020 CAAQS for the Base Case, Project Case and Application Cases in Table IR35-3 to Table IR35-5, respectively. The tables also contain $PM_{2.5}$ concentration predictions as part of the response to part b. Predicted concentrations are presented using the same statistics as the CAAQS. Isopleths of maximum predicted NO_2 compared to the CAAQS for all assessment cases are provided in Figure IR35-1 to Figure IR35-6. The term "maximum 1-hour NO_2 concentration" used in this response refers to the 3-year average of the 98th percentile of the daily maximum 1-hour average concentrations for NO_2. Maximum predicted NO_2 concentrations compared to the CAAQS at sensitive receptors are presented in Table IR35-6.

The following summarizes the results:

BASE CASE

The maximum predicted 1-hour NO_2 concentration is 101 µg/m^3 and is predicted to occur near the intersection of Highway 1 and Highway 22. The maximum predicted 1-hour NO_2 concentration is less than the 2020 CAAQS of 113 µg/m^3.

The maximum predicted annual NO_2 concentration is 42.1 µg/m^3 and is also predicted to occur near the intersection of Highway 1 and Highway 22. The maximum predicted annual NO_2 concentration is greater than the 2020 CAAQS of 32 µg/m^3. The maximum predicted 1-hour and annual NO_2 concentrations occur on and near highways and are influenced by road traffic emissions. Predicted annual NO_2 concentrations greater than the CAAQS are limited to a small area at the intersection of Highway 1 and Highway 22.

Maximum predicted one-hour and annual NO_2 concentrations at the sensitive receptors (No. 1 to 58) are compared to the CAAQS in Table IR35-6. The maximum predicted one-hour and annual average NO_2 concentrations at any of the sensitive receptors for the Base Case are 90.0 µg/m^3 and 20.3 µg/m^3, respectively, and less than the CAAQS.

PROJECT CASE

The maximum predicted 1-hour NO_2 concentration during construction is 347 µg/m^3 and is predicted to occur along the north PDA boundary. The maximum predicted 1-hour NO_2 concentration is greater than the 2020 CAAQS of 113 µg/m^3. While the model predicts 1-hour NO_2 concentrations that are greater than the CAAQS, these values are limited to an area near the north end of the haul road that is parallel to Highway 22 and extend to approximately 300 m from the PDA boundary.

The maximum predicted annual NO_2 concentration is 21.9 µg/m^3 and is predicted to occur near the east PDA boundary. The maximum predicted annual NO_2 concentration is less than the 2020 CAAQS of 32 µg/m^3.

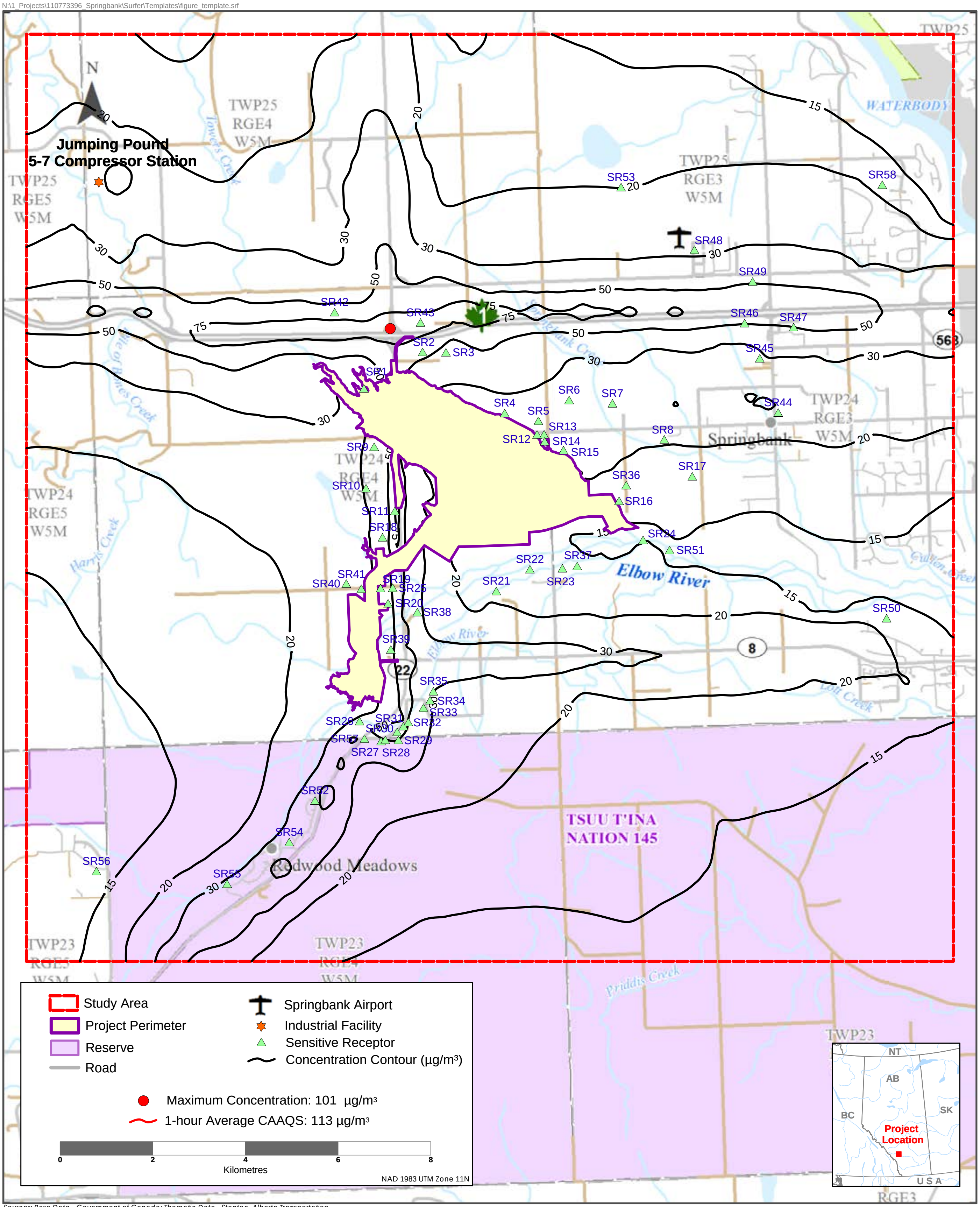
The maximum predicted 1-hour and annual average NO_2 concentrations at any of the sensitive receptors for the Project Case are 112 µg/m^3 and 17.1 µg/m^3, respectively, and are less than the CAAQS.

Application Case

The maximum predicted 1-hour NO_2 concentration is 361 µg/m^3 and is predicted to occur along the north PDA boundary. The maximum predicted 1-hour NO_2 concentration is greater than the 2020 CAAQS of 113 µg/m^3. As with the Project Case, NO_2 concentrations greater than the CAAQS are limited to an area near the north end of the haul road that is parallel to Highway 22 and is approximately 300 m from the PDA boundary.

The maximum predicted annual NO_2 concentration is 42.7 µg/m^3 and is also predicted to occur near the intersection of Highway 1 and Highway 22 in the same location as for the Base Case. The maximum predicted annual NO_2 concentration is greater than the 2020 CAAQS of 32 µg/m^3. Predicted annual NO_2 concentrations greater than the CAAQS are limited to a small area at the intersection of Highway 1 and Highway 22 and are influenced by traffic emissions.

The maximum predicted 1-hour and annual average NO_2 concentrations at any of the discrete receptors for the Application Case are 123 µg/m^3 and 22.5 µg/m^3, respectively. The maximum predicted one-hour NO_2 concentration is predicted to exceed the 2020 CAAQS of 113 µg/m^3 at discrete receptors at locations 1, 9 and 41 (see Table IR35-6). The maximum 1-hour NO_2 concentrations predicted to be exceeded at each of the indicated discrete receptors an average of 8, 6 and 11 days per year, respectively. The maximum predicted annual average NO_2 concentration at the discrete receptors is less than the CAAQS.



Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Maximum Predicted 98th Percentile Daily Maximum One-hour Average NO_2 Concentrations (µg/m³) (Base Case)

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure IR35-1

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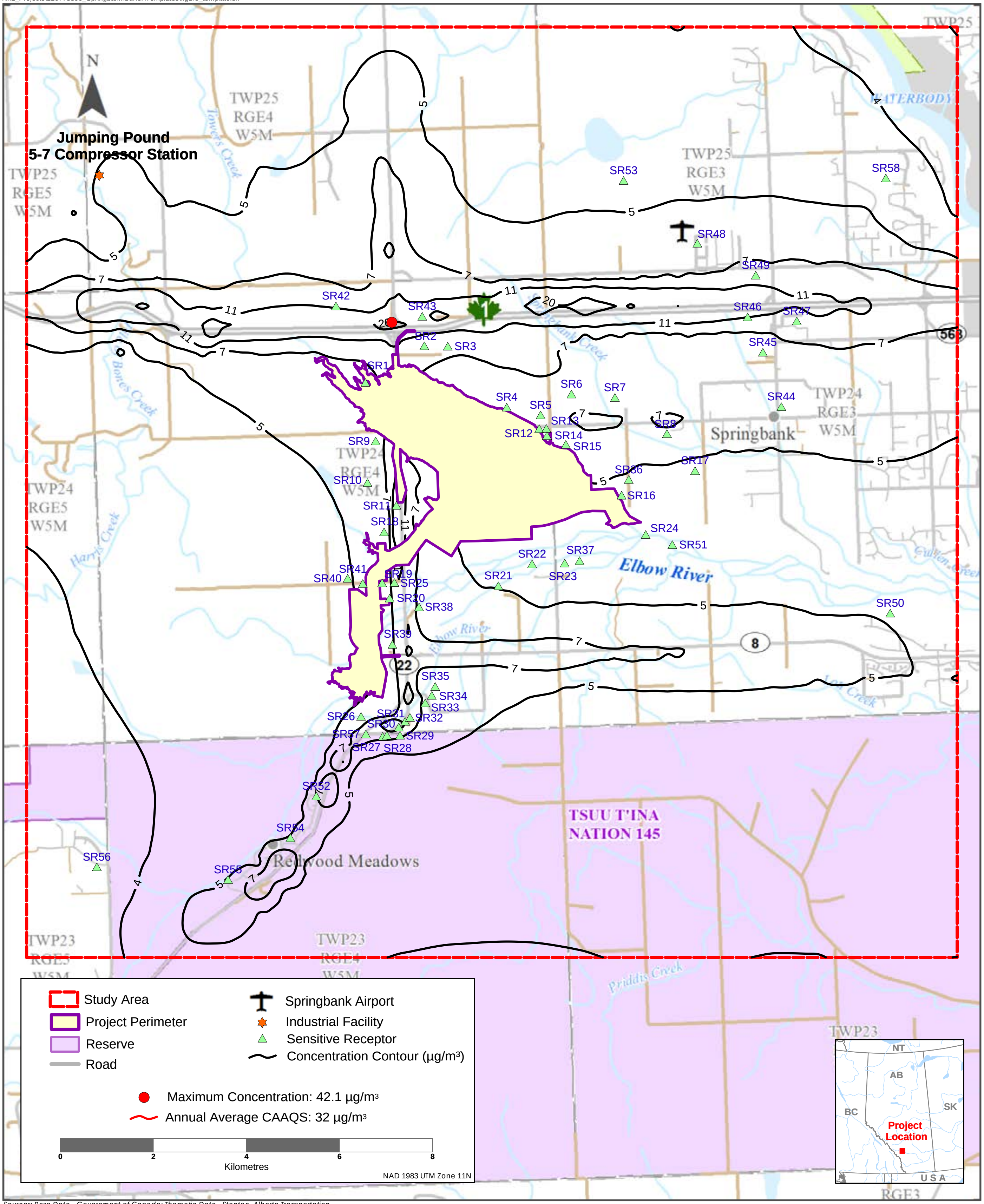


Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

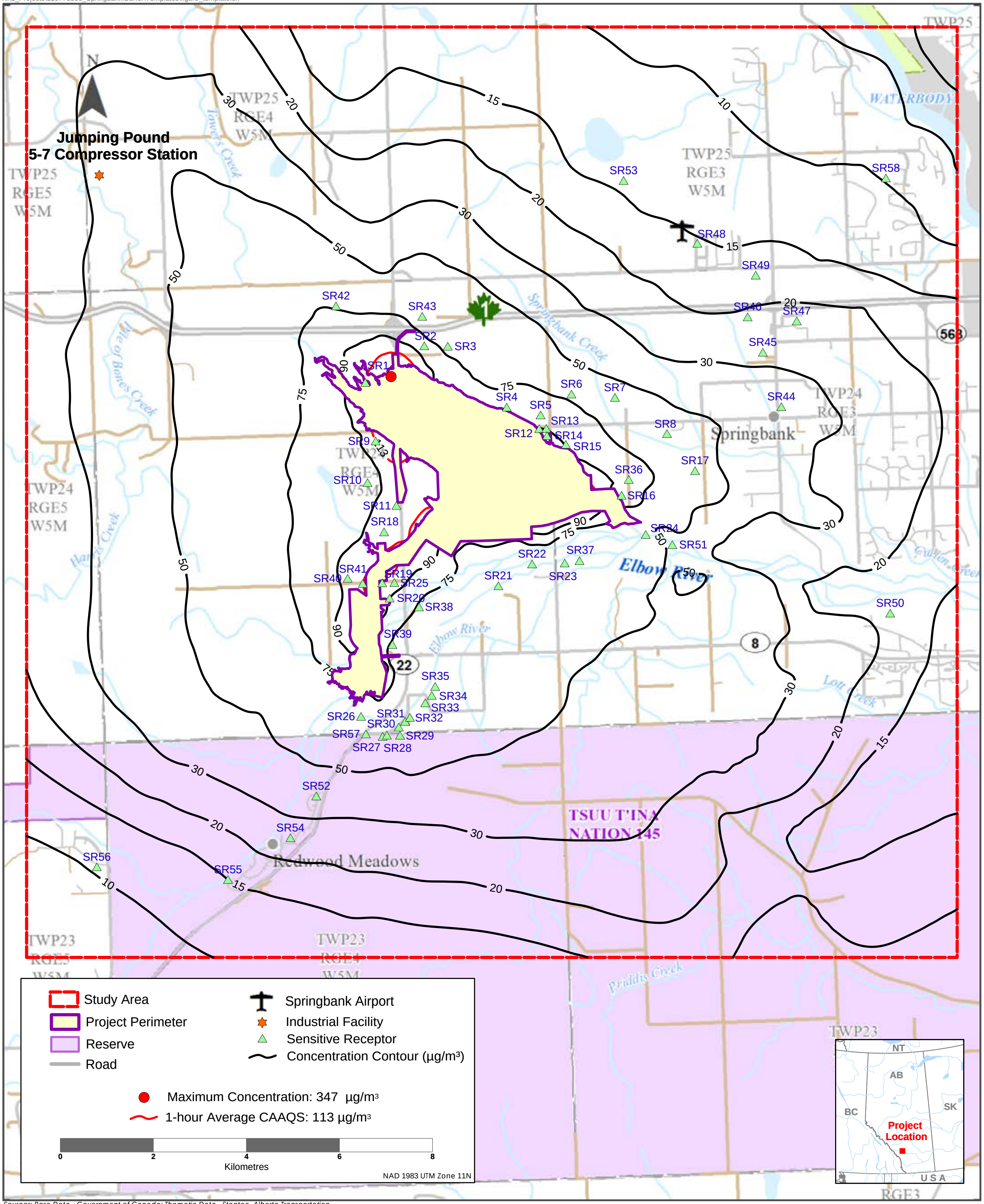
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Maximum Predicted Annual average NO_2 Concentration (Base Case)

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure IR35-2



Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

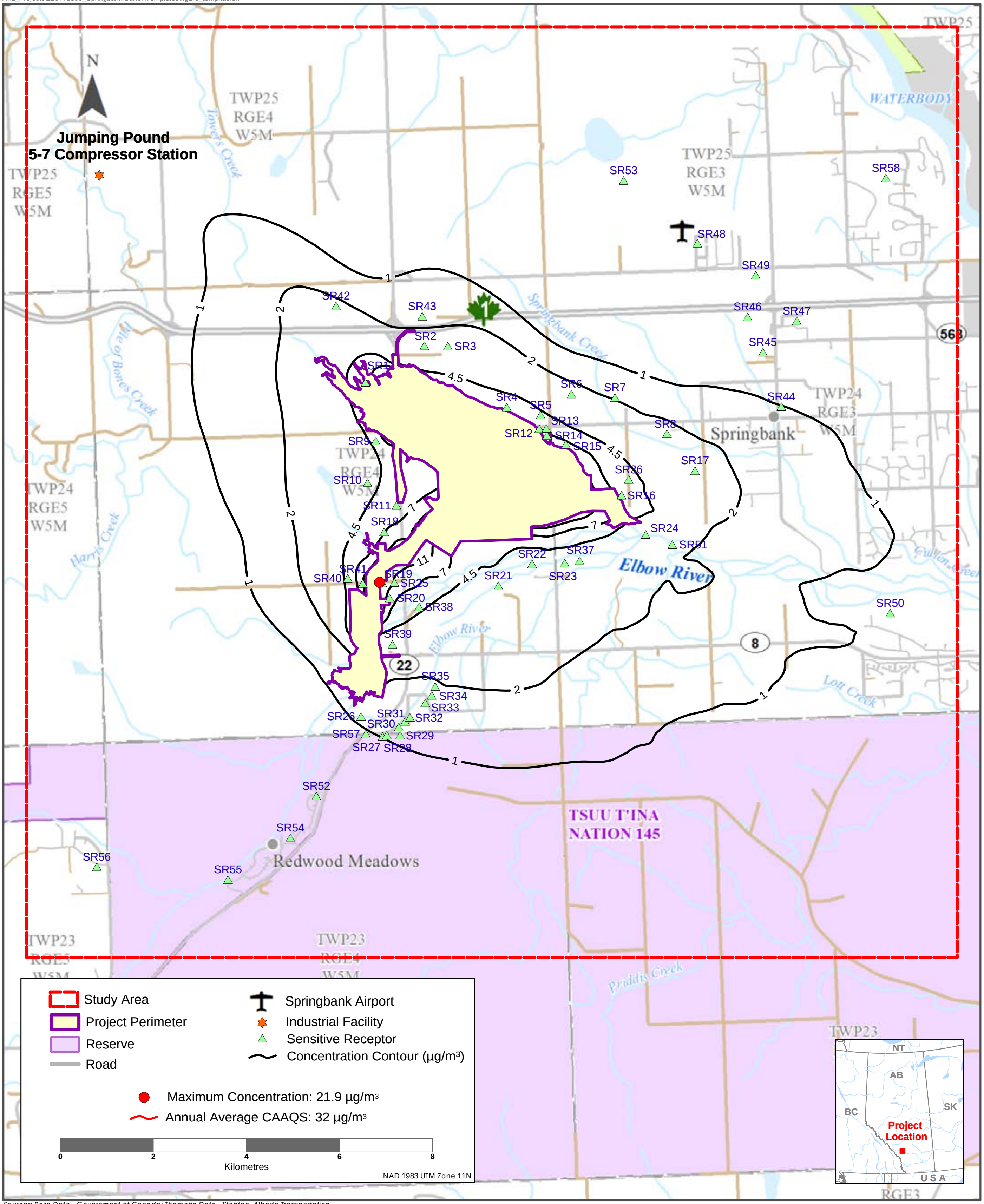
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Maximum Predicted 98th Percentile Daily Maximum One-hour Average NO_2 Concentrations (µg/m³) (Project Case)

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure IR35-3



Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

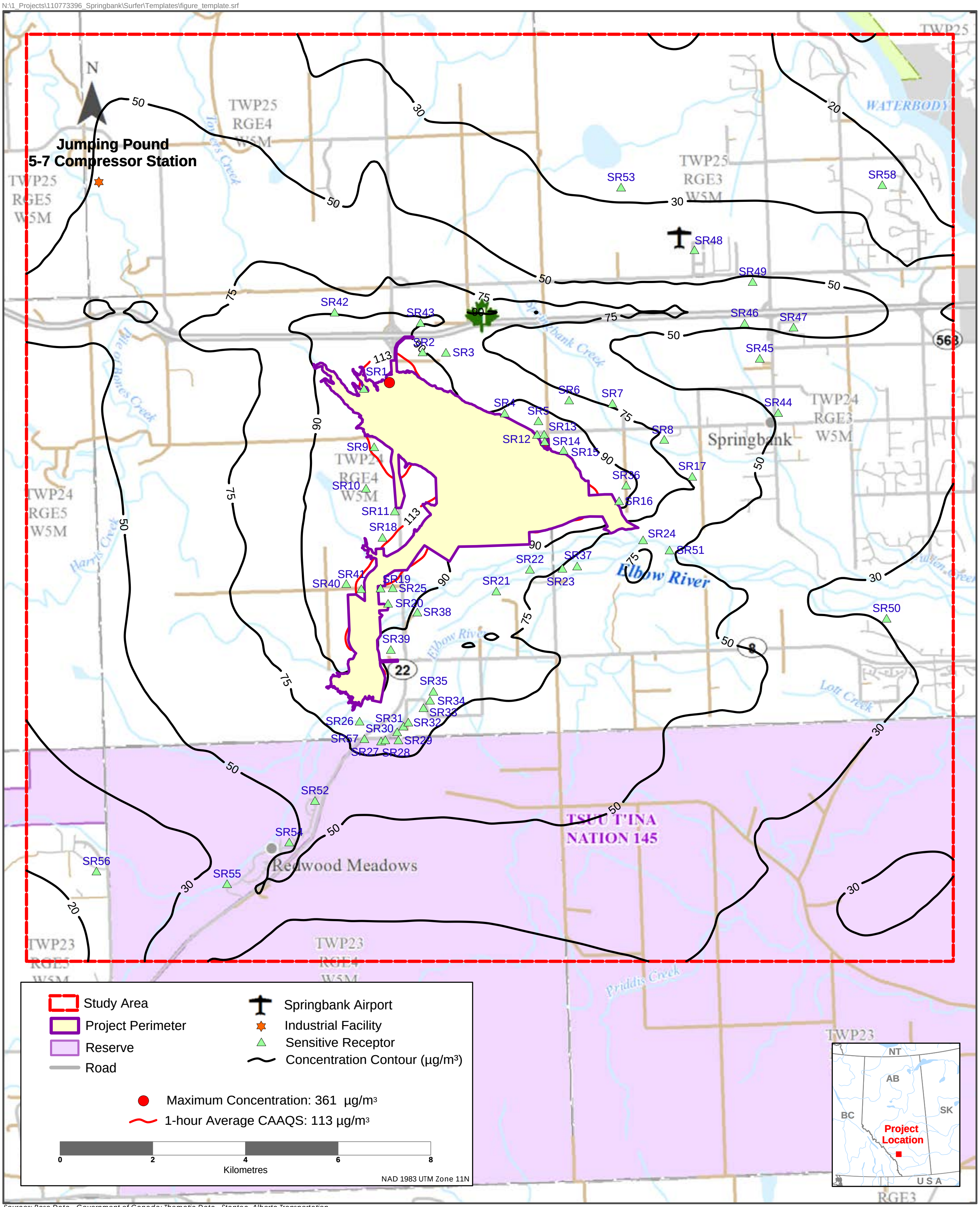
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Maximum Predicted Annual average NO_2 Concentration (Project Case)

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure IR35-4



Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

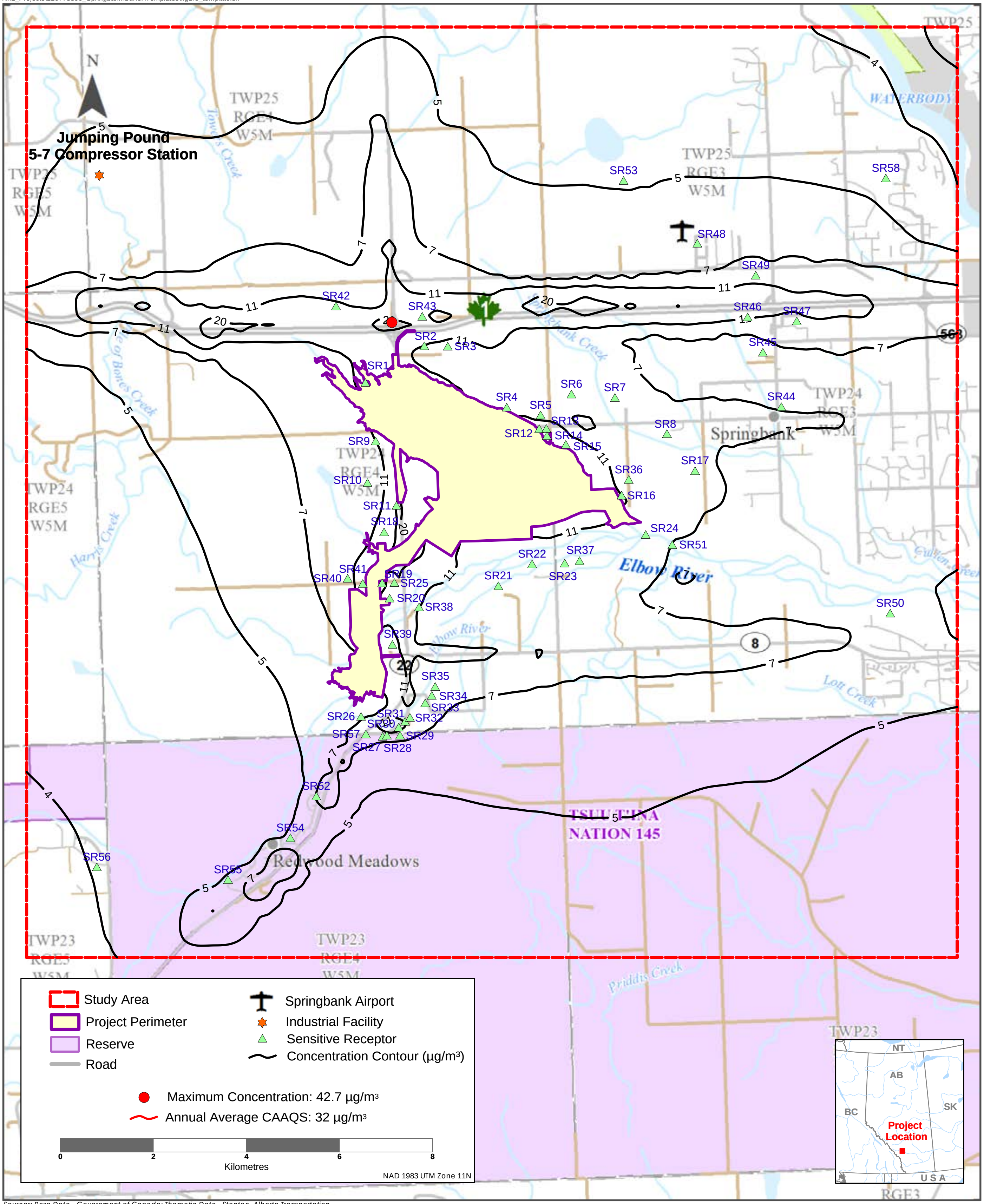
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Maximum Predicted 98th Percentile Daily Maximum One-hour Average NO_2 Concentrations (µg/m³) (Application Case)

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure IR35-5



Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Maximum Predicted Annual average NO_2 Concentration (Application Case)

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure IR35-6

Table IR35-3 Base Case Maximum Ground-Level NO_2 and $PM_{2.5}$ Concentrations

Substance	Averaging Period	Maximum Predicted Concentration	Background Concentration	Maximum Predicted Concentration with Background	Ambient Criteria [a]	Percent of Ambient Criteria
		(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(%)
NO_2	1-hour [b]	91.5	9.59	101	113	89.5
	Annual [c]	38.4	3.77	42.1	32	132
$PM_{2.5}$	24-hour [d]	7.47	11.0	18.5	27	68.4
	Annual [e]	3.73	3.50	7.23	8.8	82.2

NOTES:

[a] CAAQS: Canadian Ambient Air Quality Standards 2020 (ECCC 2013 and CCME 2014)

[b] Three-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations

[c] Average over a single calendar year of all 1-hour average concentrations

[d] Concentration represents the 3-year average of the annual 8th highest 24-hour average concentrations

[e] Concentration represents the 3-year average of the annual average concentrations

Stantec

Table IR35-4 Project Case Maximum Ground-Level NO_2 and $PM_{2.5}$ Concentrations

Substance	Averaging Period	Maximum Predicted Concentration (µg/m³)	Ambient Criteria [a] (µg/m³)	Percent of Ambient Criteria (%)
NO_2	1-hour [b]	347	113	307
	Annual [c]	21.9	32	68.5
$PM_{2.5}$	24-hour [d]	59.7	27	221
	Annual [e]	12.1	8.8	138

NOTES:
[a] CAAQS: Canadian Ambient Air Quality Standards 2020 (ECCC 2013 and CCME 2014)
[b] Three-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations
[c] Average over a single calendar year of all 1-hour average concentrations
[d] Concentration represents the 3-year average of the annual 8th highest 24-hour average concentrations
[e] Concentration represents the 3-year average of the annual average concentrations

Table IR35-5 Application Case Maximum Ground-Level NO_2 and $PM_{2.5}$ Concentrations

Substance	Averaging Period	Maximum Predicted Concentration (µg/m³)	Background Concentration (µg/m³)	Maximum Predicted Concentration with Background (µg/m³)	Ambient Criteria [a] (µg/m³)	Percent of Ambient Criteria (%)
NO_2	1-hour [b]	351	9.59	361	113	319
	Annual [c]	38.9	3.77	42.7	32	133
$PM_{2.5}$	24-hour [d]	61.0	11	72.0	27	267
	Annual [e]	12.4	3.5	15.9	8.8	181

NOTES:

[a] CAAQS: Canadian Ambient Air Quality Standards 2020 (ECCC 2013 and CCME 2014)

[b] Three-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations

[c] Average over a single calendar year of all 1-hour average concentrations

[d] Concentration represents the 3-year average of the annual 8th highest 24-hour average concentrations

[e] Concentration represents the 3-year average of the annual average concentrations

Table IR35-6 Maximum Ground-Level NO_2 Concentrations at Discrete Receptor Locations

No.	Model ID [a]	Description	UTM Easting (m)	UTM Northing (m)	Base Case [b]		Project Case		Application Case [b]	
					1-hour [c]	Annual [d]	1-hour [c]	Annual [d]	1-hour [c]	Annual [d]
					µg/m³					
1	11361	Residence	676781	5661331	33.5	6.29	109	6.35	**119**	12.3
2	11362	Residence	678048	5662119	55.1	8.42	80.1	2.54	91.1	10.8
3	11363	Residence	678552	5662110	44.5	7.68	72.1	2.63	82.6	10.2
4	11364	Residence	679819	5660800	23.5	5.55	81.8	5.21	92.2	10.6
5	11365	Residence	680547	5660633	24.8	5.92	84.8	4.89	94.8	10.7
6	11366	Residence	681210	5661081	24.4	6.27	71.1	2.64	83.0	8.84
7	11367	Residence	682145	5661009	23.9	6.15	61.5	1.96	73.3	8.06
8	11368	Residence	683263	5660232	20.8	5.70	61.0	2.31	72.6	7.97
9	11369	Residence	677002	5660073	37.1	6.23	112	4.95	**123**	10.8
10	11370	Residence	676827	5659178	30.8	5.68	87.0	4.07	97.6	9.50
11	11371	Residence	677449	5658687	72.8	11.9	94.0	5.85	107	16.2
12	11375	Residence	680518	5660338	22.3	5.48	91.3	6.88	101	12.2
13	11376	Residence	680670	5660342	23.9	5.64	88.8	6.25	98.5	11.7
14	11377	Residence	680684	5660189	22.9	5.49	96.4	8.01	106	13.3
15	11378	Residence	681089	5660000	22.5	5.42	89.1	8.18	99.1	13.3
16	11379	Residence	682288	5658906	16.6	4.73	82.6	6.63	92.4	11.2
17	11380	Residence	683867	5659434	18.5	4.92	62.8	2.90	73.6	7.7
18	11381	Residence	677183	5658119	42.6	6.26	97.9	7.01	109	12.6
19	11382	Residence	677141	5657023	33.1	5.77	101	17.1	111	22.5
20	11383	Residence	677303	5656695	40.0	6.32	89.8	8.93	100	14.9

Table IR35-6 Maximum Ground-Level NO_2 Concentrations at Discrete Receptor Locations

No.	Model ID [a]	Description	UTM Easting (m)	UTM Northing (m)	Base Case [b]		Project Case		Application Case [b]	
					1-hour [c]	Annual [d]	1-hour [c]	Annual [d]	1-hour [c]	Annual [d]
					µg/m³					
21	11384	Residence	679639	5656960	17.9	4.92	64.9	3.77	76.1	8.62
22	11385	Residence	680364	5657430	15.8	4.64	65.7	3.83	76.5	8.41
23	11386	Residence	681065	5657450	15.5	4.56	63.0	3.50	73.8	8.01
24	11387	Residence	682806	5658064	15.0	4.55	57.4	3.64	67.6	8.15
25	3901	Commercial	677404	5657030	47.0	7.28	96.5	10.6	108	17.3
26	2311	Residence	676688	5654153	35.1	5.70	68.9	1.08	80.4	6.73
27	9459	Residence	677153	5653723	45.3	6.61	62.1	1.04	79.4	7.50
28	9459	Entheos Conference and Retreat Centre	677243	5653750	45.3	6.61	62.1	1.04	79.4	7.50
29	9460	Residence	677526	5653748	48.2	6.39	61.7	1.10	82.4	7.34
30	9477	Residence	677499	5653923	65.4	13.9	63.3	1.22	86.8	14.6
31	9477	Residence	677635	5654046	65.4	13.9	63.3	1.22	86.8	14.6
32	9492	Residence	677739	5654132	50.9	9.18	64.1	1.39	84.3	10.2
33	9505	Residence	678067	5654443	35.1	6.44	63.9	1.58	78.9	7.83
34	9519	Residence	678209	5654605	30.1	5.81	63.2	1.82	79.2	7.48
35	9519	Residence	678281	5654797	30.1	5.81	63.2	1.82	79.2	7.48
36	6468	Residence	682441	5659245	18.2	4.91	83.4	5.21	93.2	9.94
37	9744	Residence	681384	5657499	15.4	4.54	61.4	3.46	71.9	7.95
38	3651	Camping Ground	677934	5656505	40.0	7.65	76.9	5.19	91.4	12.3

Table IR35-6 Maximum Ground-Level NO_2 Concentrations at Discrete Receptor Locations

No.	Model ID [a]	Description	UTM Easting (m)	UTM Northing (m)	Base Case [b]		Project Case		Application Case [b]	
					1-hour [c]	Annual [d]	1-hour [c]	Annual [d]	1-hour [c]	Annual [d]
					µg/m³					
39	3252	Camping Ground	677362	5655699	43.8	6.31	75.0	2.99	87.0	9.10
40	3922	Residence	676401	5657121	24.1	4.93	94.4	4.92	105	9.64
41	3861	Residence	676726	5657009	26.3	5.17	109	9.49	**120**	14.3
42	10119	Residence	676149	5662976	63.5	9.84	72.7	2.25	88.1	11.6
43	9322	Residence	678003	5662753	90.0	20.3	69.1	1.81	94.4	21.1
44	10555	School	685721	5660811	21.6	6.34	36.1	1.22	51.0	7.56
45	10600	School	685324	5661980	24.6	5.76	25.5	0.56	38.2	6.33
46	10617	Park	684997	5662740	34.0	6.91	21.6	0.44	40.7	7.35
47	10618	Commercial	686053	5662653	37.2	7.19	23.1	0.458	43.7	7.65
48	10673	Airport	683915	5664323	32.9	6.05	16.5	0.281	41.7	6.33
49	10654	School	685171	5663637	49.7	8.25	16.9	0.301	55.0	8.53
50	10467	Golf Club	688061	5656372	13.7	4.28	16.9	0.810	27.6	5.08
51	9787	Golf Club	683378	5657845	14.6	4.46	45.5	2.65	56.2	7.09
52	9394	Residence	675726	5652441	38.8	5.07	44.7	0.439	58.4	5.50
53	10719	Residence	682331	5665673	23.7	5.03	17.4	0.254	32.2	5.28
54	10262	Park	675169	5651545	35.9	4.71	23.1	0.222	42.9	4.92
55	10228	Golf Club	673829	5650646	39.3	5.88	14.9	0.141	43.1	6.02
56	10817	Golf Club	671010	5650919	14.8	3.97	11.5	0.098	23.8	4.06
57	9457	Park	676793	5653775	47.9	8.96	65.9	0.926	82.3	9.66

Table IR35-6 Maximum Ground-Level NO_2 Concentrations at Discrete Receptor Locations

No.	Model ID [a]	Description	UTM Easting (m)	UTM Northing (m)	Base Case [b]		Project Case		Application Case [b]	
					1-hour [c]	Annual [d]	1-hour [c]	Annual [d]	1-hour [c]	Annual [d]
					µg/m³					
58	10935	Golf Club	687967	5665726	14.8	4.14	7.88	0.132	20.1	4.27
CAAQS 2020 Ambient Criteria					113	32	113	32	113	32

NOTES:

[a] Model IDs of receptors 25 to 58 are based on nearest gridded receptor

[b] Base Case and Application Case predicted concentrations include background concentrations

[c] Three-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations

[d] Average over a single calendar year of all 1-hour average concentrations

Predicted concentrations greater than the CAAQS are bolded

b) Maximum predicted $PM_{2.5}$ concentrations during construction are compared to the 2020 CAAQS for the Base Case, Project Case and Application Cases in Table IR35-3, Table IR35-4 and Table IR35-5, respectively. Predicted concentrations are presented using the same statistics as the CAAQS. Isopleths of maximum predicted $PM_{2.5}$ compared to the CAAQS for all assessment cases are provided in Figure IR35-7 to Figure IR35-12. The term "maximum 24-hour $PM_{2.5}$ concentration" used in this response refers to the 3-year average of the 98th percentile of the daily 24-hour average concentrations. The term "maximum annual average $PM_{2.5}$ concentration" used in this response refers to the 3-year average based upon the CAAQS statistic for determining achievement for annual $PM_{2.5}$ concentrations. Maximum predicted $PM_{2.5}$ concentrations compared to the CAAQS at discrete receptors are presented in Table IR35-7.

A comprehensive list of mitigation measures to minimize emissions of fugitive dust and combustion emissions during Project construction is detailed in Volume 3A, Section 3.4.4.1. Alberta Transportation believes the proposed mitigation measures and adaptive management plans described in the EIS are adequate to minimize emissions and potential effects on air quality.

The following summarizes the results:

BASE CASE

The maximum predicted 24-hour $PM_{2.5}$ concentration is 18.5 µg/m³ and is predicted to occur near the intersection of Highway 1 and Highway 22. The maximum predicted 24-hour $PM_{2.5}$ concentration is less than the 2020 CAAQS of 27 µg/m³.

The maximum predicted annual $PM_{2.5}$ concentration is 7.23 µg/m³ and is also predicted to occur near the intersection of Highway 1 and Highway 22. The maximum predicted annual $PM_{2.5}$ concentration is less than the 2020 CAAQS of 8.8 µg/m³.

Maximum predicted 24-hour and annual $PM_{2.5}$ concentrations at the discrete receptors (No. 1 to 58) are compared to the CAAQS in Table IR35-7. The maximum predicted 24-hour and annual average $PM_{2.5}$ concentrations at any of the discrete receptors for the Base Case are 15.0 µg/m³ and 4.94 µg/m³, respectively, less than the CAAQS.

PROJECT CASE

The maximum predicted 24-hour $PM_{2.5}$ concentration is 59.7 µg/m³ and is predicted to occur along the north PDA boundary. The maximum predicted 24-hour $PM_{2.5}$ concentration is greater than the 2020 CAAQS of 27 µg/m³.

The maximum predicted annual $PM_{2.5}$ concentration is 12.1 µg/m³ and is predicted to occur near the east PDA boundary. The maximum predicted annual $PM_{2.5}$ concentration is greater than the 2020 CAAQS of 8.8 µg/m³.

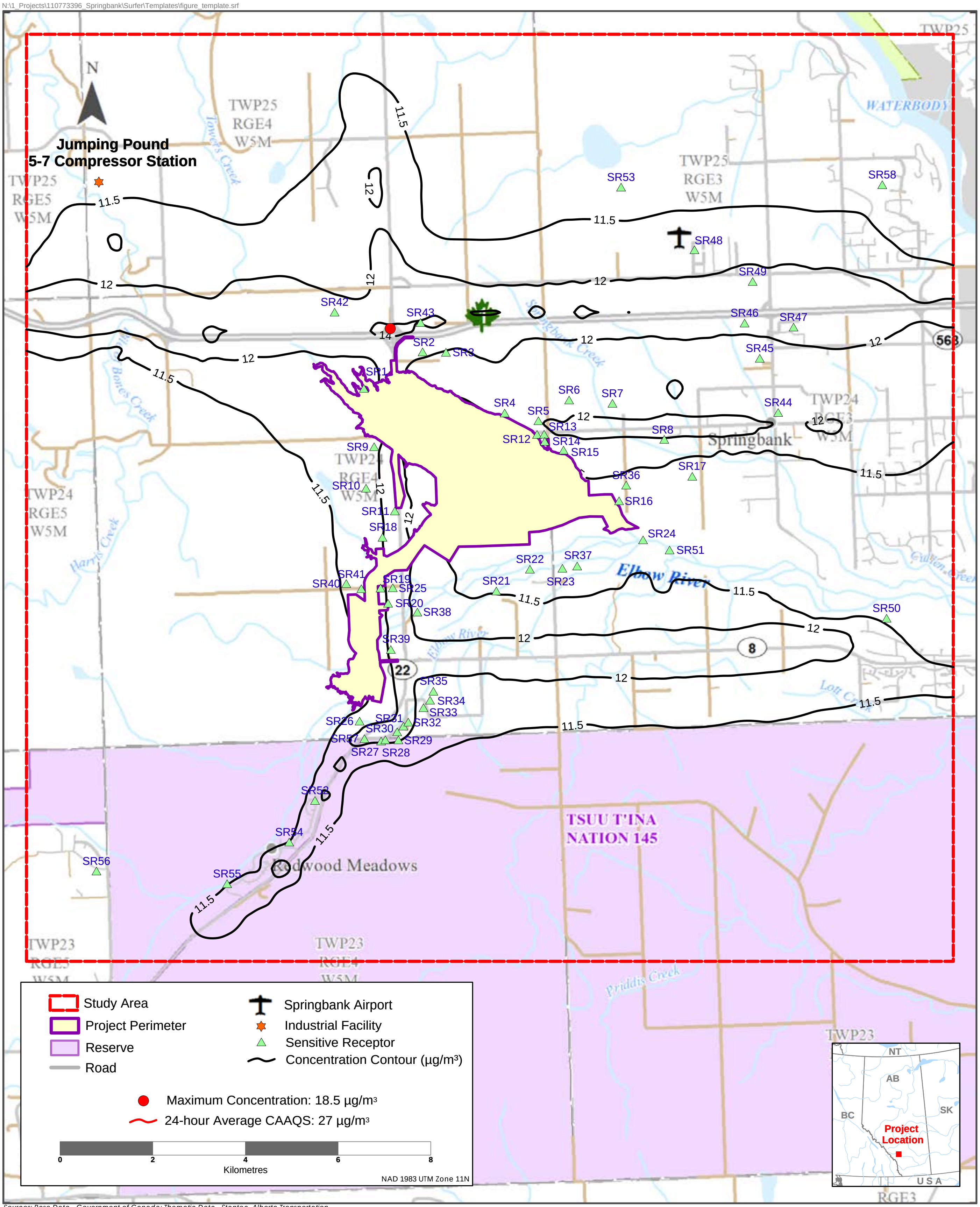
The maximum predicted 24-hour and annual average $PM_{2.5}$ concentrations at any of the discrete receptors for the Project Case are 42.4 µg/m³ and 9.27 µg/m³, respectively. The maximum predicted 24-hour $PM_{2.5}$ concentration is predicted to exceed the 2020 CAAQS of 27 µg/m³ at discrete receptors No. 18, 19, 25 and 41. The maximum 24-hour maximum $PM_{2.5}$ concentration is predicted to be exceeded at each the indicated discrete receptors an average of 1, 15, 3 and 20 days per year, respectively. The maximum predicted annual average $PM_{2.5}$ concentration is predicted to exceed the 2020 CAAQS 8.8 µg/m³ at sensitive receptor No. 19 for one of the three three-year average values predicted by the model.

APPLICATION CASE

The maximum predicted 24-hour $PM_{2.5}$ concentration is 72.0 µg/m³ and is predicted to occur along the north PDA boundary in the same location as for the Project Case. The maximum predicted 24-hour $PM_{2.5}$ concentration is greater than the 2020 CAAQS of 27 µg/m³.

The maximum predicted annual $PM_{2.5}$ concentration is 15.9 µg/m³ and is along the north PDA boundary in the same location as for the Project Case. The maximum predicted annual $PM_{2.5}$ concentration is greater than the 2020 CAAQS of 8.8 µg/m³.

The maximum predicted 24-hour and annual average $PM_{2.5}$ concentrations at any of the discrete receptors for the Application Case are 53.7 µg/m³ and 13.0 µg/m³, respectively. The maximum predicted 24-hour $PM_{2.5}$ concentration is predicted to exceed the 2020 CAAQS of 27 µg/m³ at 13 of the 58 discrete receptors (receptor No. 11–16, 18–20, 25, 36, 40–41). The maximum frequency of exceedance of the 24-hour CAAQS is an average of 76 days per year for $PM_{2.5}$ and is predicted to occur at sensitive receptor No. 19. The maximum predicted annual average $PM_{2.5}$ concentration is predicted to exceed the 2020 CAAQS 8.8 µg/m³ at discrete receptors No. 19, 20, 25 and 41 for each of the three three-year average values predicted by the model.



Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

8th Highest Predicted 24-hour average $PM_{2.5}$ Concentration (Base Case)

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure IR35-7

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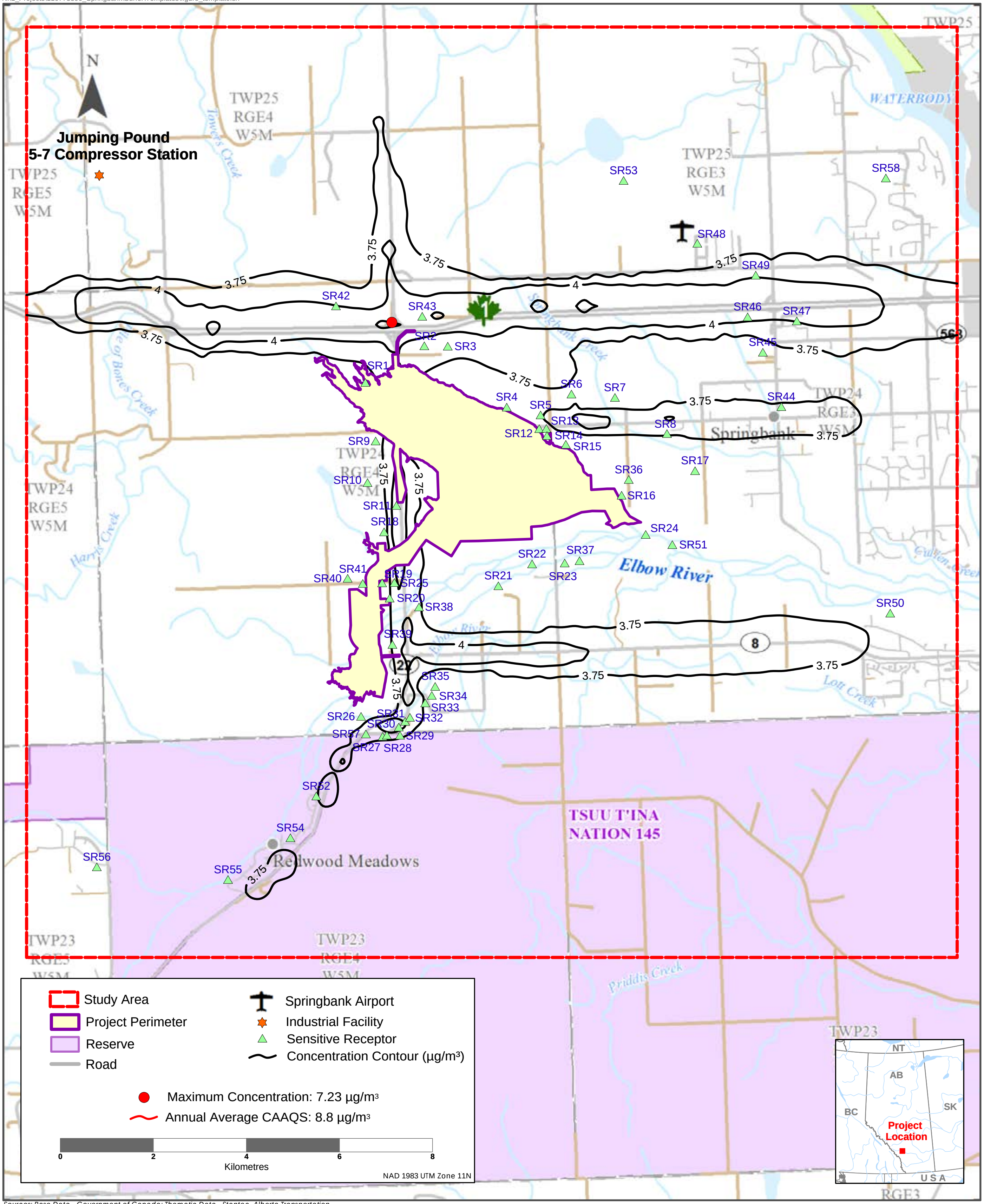

Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Maximum Predicted Annual average $PM_{2.5}$ Concentration (Base Case)

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure IR35-8

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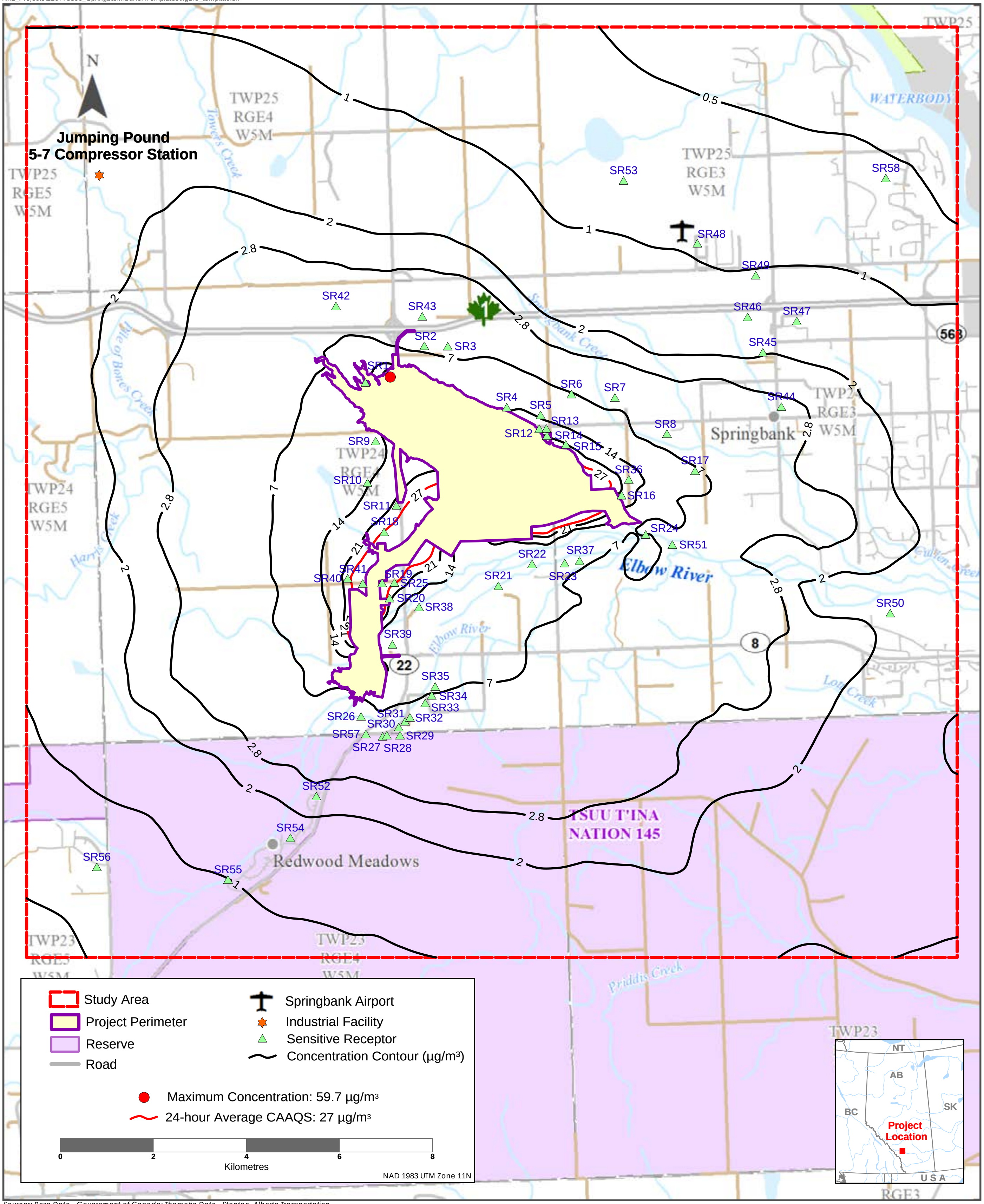

Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

8th Highest Predicted 24-hour average $PM_{2.5}$ Concentration (Project Case)

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure IR35-9

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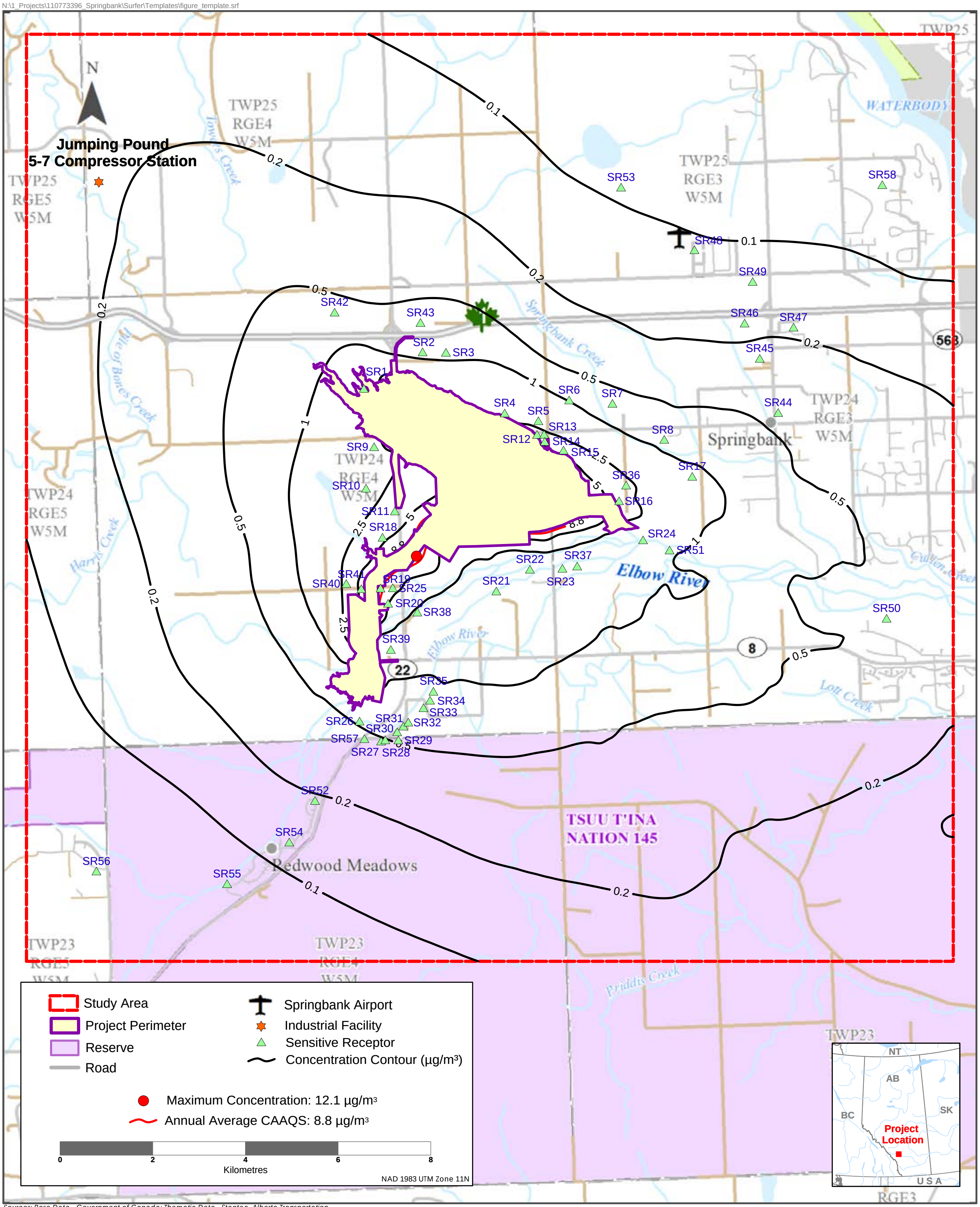

Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Maximum Predicted Annual average $PM_{2.5}$ Concentration (Project Case)

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure IR35-10

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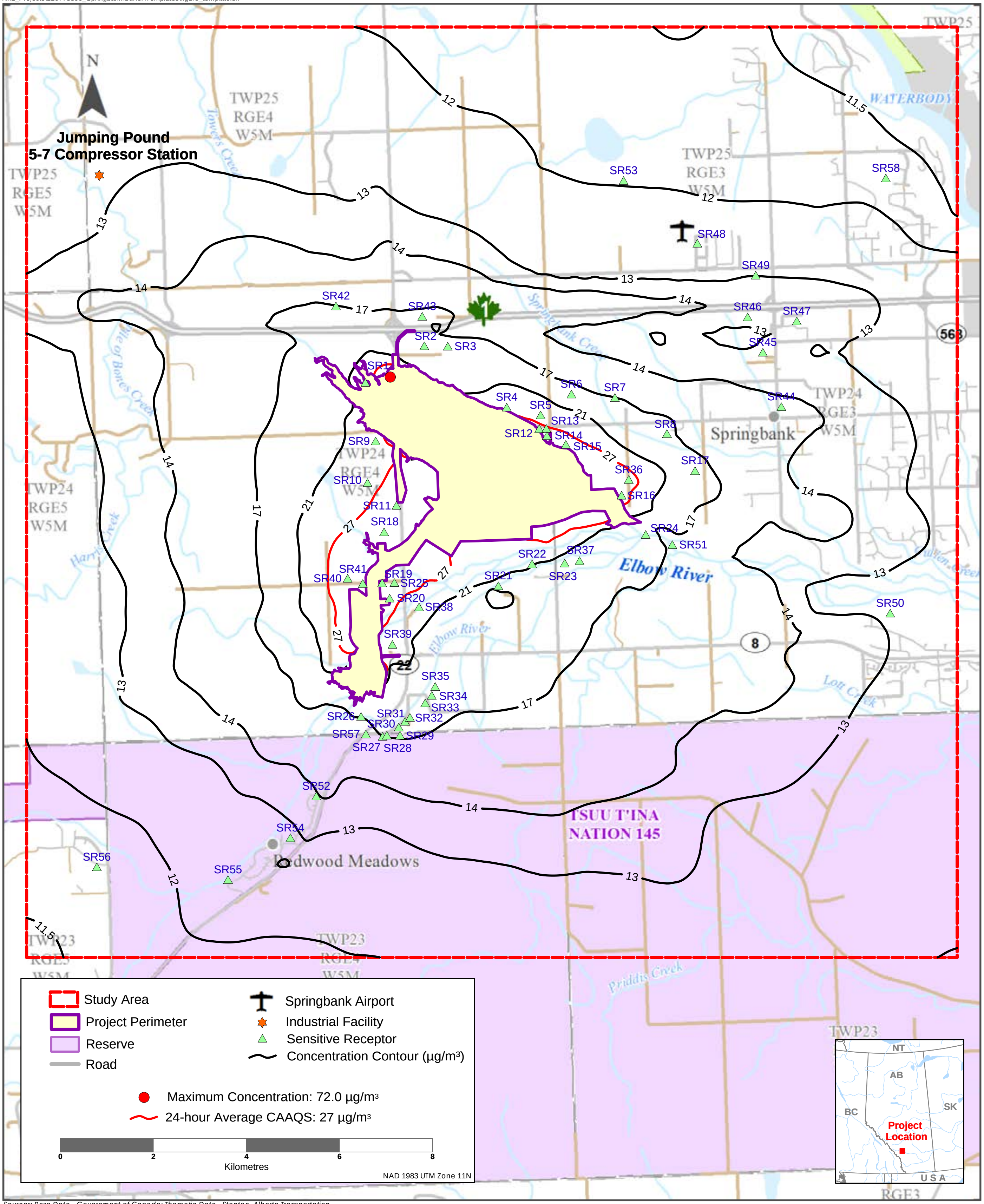

Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

8th Highest Predicted 24-hour average $PM_{2.5}$ Concentration (Application Case)

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure IR35-11

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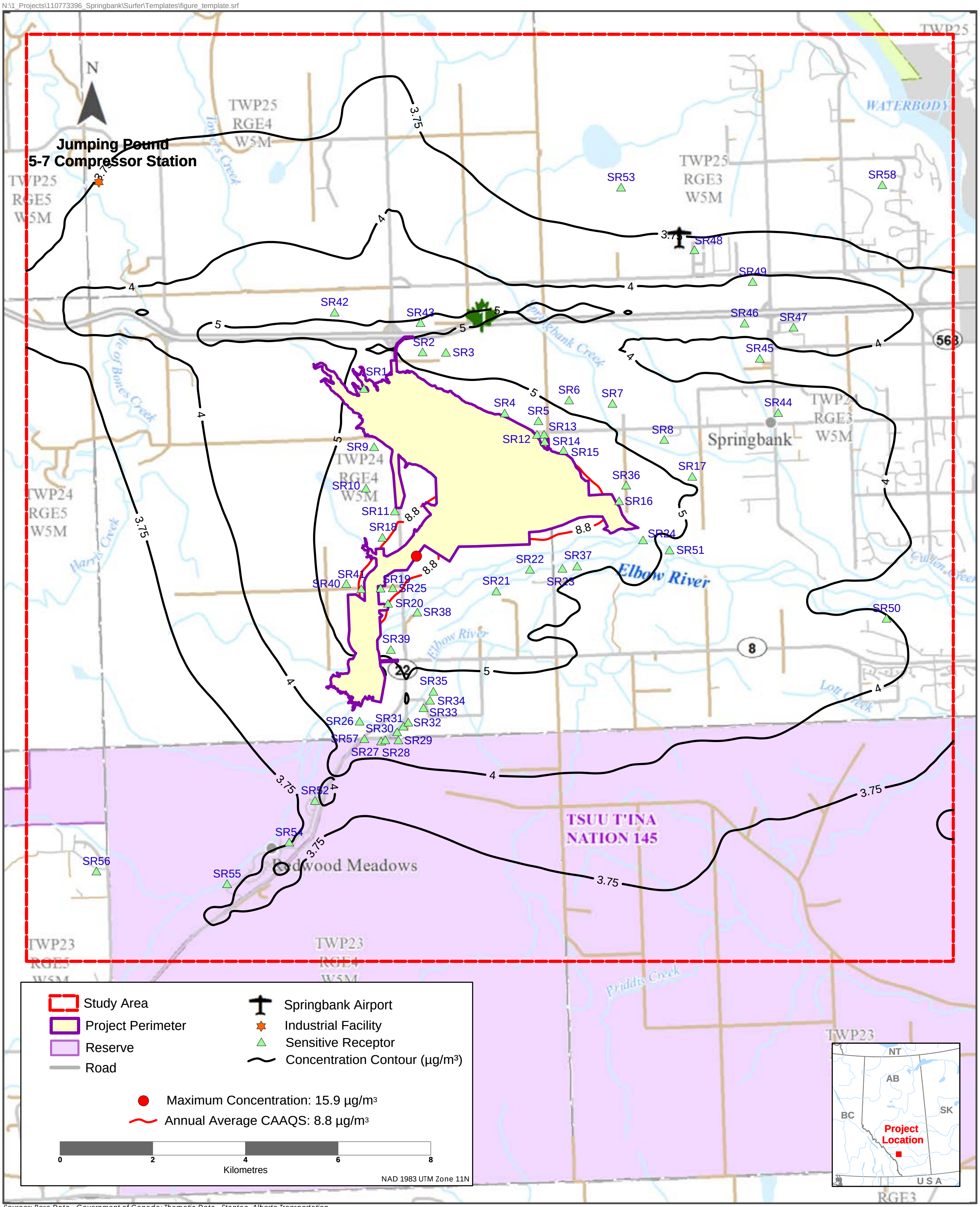

Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Maximum Predicted Annual average $PM_{2.5}$ Concentration (Application Case)

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure IR35-12

Table IR35-7 Maximum Ground-Level $PM_{2.5}$ Concentrations at Discrete Receptor Locations

No.	Model ID [a]	Description	UTM Easting (m)	UTM Northing (m)	Base Case [b]		Project Case		Application Case [b]	
					24-hour [c]	Annual [d]	24-hour [c]	Annual [d]	24-hour [c]	Annual [d]
					µg/m³					
1	11361	Residence	676781	5661331	11.8	3.71	12.2	1.77	23.8	5.47
2	11362	Residence	678048	5662119	12.1	3.86	6.32	0.918	17.9	4.78
3	11363	Residence	678552	5662110	11.9	3.81	6.28	0.910	17.6	4.72
4	11364	Residence	679819	5660800	11.5	3.66	13.3	2.08	24.5	5.74
5	11365	Residence	680547	5660633	11.8	3.72	13.3	2.11	24.5	5.83
6	11366	Residence	681210	5661081	11.8	3.75	7.35	1.00	18.6	4.74
7	11367	Residence	682145	5661009	11.7	3.73	5.96	0.731	17.1	4.46
8	11368	Residence	683263	5660232	11.7	3.74	5.99	0.906	17.2	4.65
9	11369	Residence	677002	5660073	11.9	3.70	12.5	1.92	23.9	5.62
10	11370	Residence	676827	5659178	11.7	3.67	13.7	2.03	25.3	5.69
11	11371	Residence	677449	5658687	13.3	4.14	22.7	3.49	**35.2**	7.62
12	11375	Residence	680518	5660338	11.6	3.67	18.4	3.23	**29.5**	6.90
13	11376	Residence	680670	5660342	11.7	3.69	17.1	2.91	**28.2**	6.60
14	11377	Residence	680684	5660189	11.6	3.67	20.9	3.88	**32.1**	7.55
15	11378	Residence	681089	5660000	11.6	3.66	22.0	3.97	**33.1**	7.64
16	11379	Residence	682288	5658906	11.4	3.61	19.6	3.85	**30.7**	7.45
17	11380	Residence	683867	5659434	11.5	3.63	7.51	1.26	18.7	4.89
18	11381	Residence	677183	5658119	12.0	3.72	**28.4**	4.39	**40.1**	8.10
19	11382	Residence	677141	5657023	11.8	3.69	**35.6**	**9.27**	**46.9**	**13.0**
20	11383	Residence	677303	5656695	12.1	3.73	22.6	5.13	**33.9**	**8.86**

Table IR35-7 Maximum Ground-Level $PM_{2.5}$ Concentrations at Discrete Receptor Locations

No.	Model ID [a]	Description	UTM Easting (m)	UTM Northing (m)	Base Case [b]		Project Case		Application Case [b]	
					24-hour [c]	Annual [d]	24-hour [c]	Annual [d]	24-hour [c]	Annual [d]
					µg/m³					
21	11384	Residence	679639	5656960	11.5	3.63	8.97	1.82	20.2	5.45
22	11385	Residence	680364	5657430	11.4	3.60	10.0	1.90	21.1	5.51
23	11386	Residence	681065	5657450	11.4	3.59	8.67	1.71	19.8	5.31
24	11387	Residence	682806	5658064	11.4	3.60	7.43	1.76	18.5	5.35
25	3901	Commercial	677404	5657030	12.3	3.80	**27.6**	6.07	**39.0**	**9.87**
26	2311	Residence	676688	5654153	11.7	3.67	5.71	0.521	17.0	4.19
27	9459	Residence	677153	5653723	11.9	3.73	5.50	0.488	17.0	4.22
28	9459	Entheos Conference and Retreat Centre	677243	5653750	11.9	3.73	5.50	0.488	17.0	4.22
29	9460	Residence	677526	5653748	11.9	3.72	5.65	0.513	17.1	4.23
30	9477	Residence	677499	5653923	13.0	4.27	6.15	0.568	18.1	4.84
31	9477	Residence	677635	5654046	13.0	4.27	6.15	0.568	18.1	4.84
32	9492	Residence	677739	5654132	12.3	3.92	6.44	0.643	18.1	4.57
33	9505	Residence	678067	5654443	11.8	3.73	6.74	0.725	18.1	4.45
34	9519	Residence	678209	5654605	11.7	3.69	7.11	0.826	18.5	4.52
35	9519	Residence	678281	5654797	11.7	3.69	7.11	0.826	18.5	4.52
36	6468	Residence	682441	5659245	11.4	3.62	18.5	2.91	**29.7**	6.53
37	9744	Residence	681384	5657499	11.4	3.59	8.5	1.70	19.6	5.29
38	3651	Camping Ground	677934	5656505	12.0	3.84	12.7	2.61	24.2	6.45

Table IR35-7 Maximum Ground-Level $PM_{2.5}$ Concentrations at Discrete Receptor Locations

No.	Model ID [a]	Description	UTM Easting (m)	UTM Northing (m)	Base Case [b]		Project Case		Application Case [b]	
					24-hour [c]	Annual [d]	24-hour [c]	Annual [d]	24-hour [c]	Annual [d]
					µg/m³					
39	3252	Camping Ground	677362	5655699	12.0	3.73	10.5	1.44	22.1	5.18
40	3922	Residence	676401	5657121	11.5	3.61	25.0	2.90	**36.2**	6.51
41	3861	Residence	676726	5657009	11.6	3.63	**42.4**	6.25	**53.7**	**9.89**
42	10119	Residence	676149	5662976	12.6	3.98	4.54	0.645	16.9	4.62
43	9322	Residence	678003	5662753	15.0	4.94	4.63	0.650	19.0	5.59
44	10555	School	685721	5660811	12.1	3.87	3.23	0.497	14.6	4.36
45	10600	School	685324	5661980	11.6	3.69	1.87	0.234	13.0	3.93
46	10617	Park	684997	5662740	11.8	3.78	1.46	0.188	12.9	3.97
47	10618	Commercial	686053	5662653	12.0	3.81	1.57	0.197	13.0	4.00
48	10673	Airport	683915	5664323	11.8	3.71	1.07	0.120	12.5	3.83
49	10654	School	685171	5663637	12.4	3.89	1.05	0.131	13.0	4.02
50	10467	Golf Club	688061	5656372	11.2	3.56	1.65	0.367	12.7	3.93
51	9787	Golf Club	683378	5657845	11.3	3.59	5.22	1.23	16.3	4.82
52	9394	Residence	675726	5652441	11.6	3.61	2.81	0.213	14.1	3.82
53	10719	Residence	682331	5665673	11.5	3.62	0.911	0.111	12.2	3.73
54	10262	Park	675169	5651545	11.4	3.57	1.50	0.115	12.6	3.69
55	10228	Golf Club	673829	5650646	11.7	3.66	0.98	0.077	12.3	3.74
56	10817	Golf Club	671010	5650919	11.1	3.52	0.702	0.055	11.8	3.57
57	9457	Park	676793	5653775	12.2	3.90	4.85	0.440	16.5	4.34

Table IR35-7 Maximum Ground-Level $PM_{2.5}$ Concentrations at Discrete Receptor Locations

No.	Model ID [a]	Description	UTM Easting (m)	UTM Northing (m)	Base Case [b]		Project Case		Application Case [b]	
					24-hour [c]	Annual [d]	24-hour [c]	Annual [d]	24-hour [c]	Annual [d]
					µg/m³					
58	10935	Golf Club	687967	5665726	11.2	3.54	0.507	0.0593	11.6	3.60
CAAQS 2020 Ambient Criteria					27	8.8	27	8.8	27	8.8

NOTES:
[a] Model IDs of receptors 25 to 58 are based on nearest gridded receptor
[b] Base Case and Application Case predicted concentrations include background concentrations
[c] Three-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations
[d] Average over a single calendar year of all 1-hour average concentrations
Predicted concentrations greater than the CAAQS are bolded

c) During Project construction, mitigation measures will be implemented to minimize emissions of NO_X and particulate matter. As a component of an adaptive management program, meteorological and ambient pollutant monitoring will be implemented in conjunction with emissions mitigation. A comprehensive list of mitigation is detailed in Volume 3A, Section 3.4.4.1. The proposed meteorological and ambient monitoring program as a component of the adaptive management is described in Volume 3C, Section 2.2.

Because the magnitude of fugitive dust emissions and effectiveness of dust control mitigation are influenced by variations in meteorological conditions such as temperature, wind speed, humidity, solar intensity, an adaptive management program is designed to minimize the generation of airborne dust and minimizing ambient concentrations of TSP and $PM_{2.5}$. The management techniques will include ambient air monitoring in conjunction with dust emission mitigation. Ambient air monitoring will be combined with review of weather data (from an onsite meteorological station), to evaluate the effectiveness of current mitigation and to assess the need for more rigorous dust mitigation. Monitoring will include the installation and operation of an anemometer to measure wind speed and wind direction, and an environmental beta attenuation monitor (EBAM) to measure ambient $PM_{2.5}$ and TSP concentrations. Monitoring will be continuous over 24 hours and extend throughout the construction period.

If the monitoring program indicates that the ground-level $PM_{2.5}$ and TSP concentrations are greater than Alberta ambient air quality objectives (AAAQO) (AEP 2019), additional mitigation to reduce dust emissions will be implemented. This mitigation could include increased watering of access roads, the spraying of surfactants, or the suspension of construction activity at the site. An Environmental Construction Operations Plan (ECO Plan) will be developed by the selected construction contractor using Alberta Transportation's ECO Plan framework (Volume 4, Supporting Documents, Document 4). The ECO Plan will identify the mitigation measures for the potential environmental effects of construction, including the ambient air monitoring program and adaptive management techniques to control the generation of airborne dust. The ECO Plan will follow the requirements in Alberta Transportation's *Civil Works Master Specifications for Construction of Provincial Water Management Projects* (Volume 4, Supporting Documents, Document 10). The ECO Plan will include the mitigation measures identified in Volume 4, Appendix C, Table C-1, page C.3 to page C.4. Key points related to the dust mitigation are as follows:

- Water will be applied to haul roads and disturbed areas for mitigating dust emissions. Watering could be repeated several times a day during dry periods with high wind conditions (Volume 4, Appendix C, Table C-1).
- Dust abatement brine solution will be applied on haul roads if particulate matter concentrations are in exceedance of the Alberta Ambient Air Quality Objectives and if an increase of watering is determined ineffective or unfeasible at the time (Volume 4, Appendix C, Table C-1).

- Dust generating construction activities will be suspended during periods of excessive winds when dust suppression measures might not be working adequately (Volume 4, Appendix C, Table C-1).
- In the event of a trackout and carryout of soils, road cleaning will be conducted by manually picking up and sweeping material or by using rotary or vacuum street cleaning vehicles (Volume 4, Appendix C, Table C-1).
- Disturbed surfaces will be revegetated promptly following construction to prevent wind erosion and to control dust (Volume 4, Appendix C, Table C-1).
- Surfaces of temporary soil and overburden stockpiles will be stabilized during extended periods between usage, by means of vegetating or covering the exposed surfaces (Volume 4, Appendix C, Table C-1).
- Silt fences and other (e.g., mulching and application of tackifiers) erosion control methods will be used to prevent soil loss from soil stockpiles due to wind erosion.

As noted in the air quality assessment (Volume 3A, Section 3.4.5), the highest fugitive dust emissions and highest predicted pollutant concentrations during construction are likely to be generated by the haul trucks transporting earth material from the diversion channel to the dam. Therefore, the monitoring equipment will be placed at two locations outside the PDA and between the haul road from the diversion channel excavation work to the dam construction site and nearby residences. Monitoring equipment will also be placed outside of the PDA between the borrow source area, if it is used, and nearby residences. The exact locations of the monitoring stations will be determined during the development of the ECO Plan by the construction contractor. The ambient monitoring results will be evaluated against the AAAQO rather than the CAAQS because the AAAQO for $PM_{2.5}$ of 29 $\mu g/m^3$ is numerically similar to the CAAQS of 27 $\mu g/m^3$; however, this will be applied to all measured concentrations (i.e., no exceedances permitted) rather than the 98th percentile metric associated with the CAAQS (which allows for periodic exceedances).

Based upon the model predictions and with consideration of the conservative assumptions, Alberta Transportation does not propose to include ambient NO_2 monitoring as a component of the adaptive management program. While maximum predicted NO_2 concentrations at several of the discrete receptors are predicted to exceed the CAAQS in the Application Case, the predicted exceedances are small (with a corresponding maximum sensitive receptor exposure ratio (ER) of 1.1 as presented in Volume 3A, Section 15, Table 15-12). Combustion emissions, such as NO_X, are conservatively estimated by assuming that all off-road diesel construction equipment was manufactured in the year 2012 with engines certified to meet Tier 3 Canadian off-road compression-ignition engine emission standards. More stringent Tier 4 standards for off-road diesel engines came into effect in 2014 with a transitional period for some engine categories starting in 2012. It is estimated that most of the actual construction equipment will have lower emissions and have engines that meet more stringent Tier 4 emission standards. As indicated in Volume 4, Appendix E, Attachment 3A, Table 3A-4, for diesel engines rated between 175 hp and 600 hp, which represents most of the engine sizes and emissions associated with the construction fleet, the Tier 4 emission standard represents an 89% reduction in NO_X emissions. Similarly, the Tier 4 engine standard represents a 93% reduction in diesel particulate matter emissions compared to Tier 3.

d) The Assessment of Potential Effects on Public Health presented in Volume 3A, Section 15, identifies the predicted concentrations of NO_2, $PM_{2.5}$, and diesel emission particulate (DEP) associated with Project construction with an ER of 1 or greater at discrete receptors. A comprehensive list of all mitigation is detailed in Volume 3A, Section 3.4.4.1, the implementation of which will minimize emissions of fugitive dust and combustion emissions associated with Project construction. An adaptive management program will also be implemented to minimize ambient concentrations of TSP and $PM_{2.5}$ associated with fugitive dust because the magnitude of fugitive dust emissions and effectiveness of dust control mitigation are influenced by meteorological conditions such as temperature, wind speed, humidity, solar intensity which can be highly variable. Alberta Transportation believes the proposed mitigation and adaptive management plans will effectively minimize emissions and potential effects on air quality and human health.

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GOC. 2018. Government of Canada Submission to the Joint Review Panel, Frontier Oil Sands Mine Project, CEAA Registry Document No. 489, August 31, 2018, pg. 160.

Question IR3-36: Air Quality – Dust

Sources:

EIS Guidelines Part 2, Sections 6.1.1; 6.1.9; 6.2.1; 6.3.4

EIS Volume 4 Appendix E, Attachment 3A

Environment and Climate Change Canada Technical Review, June 18, 2018 (CEAR #32)

Health Canada Comments on the EIS – June 15, 2018 (CEAR #30)

Context and Rationale:

The EIS Guidelines require a description of baseline air quality levels and changes in air quality, as well as an assessment of the effects of changes to air quality on Indigenous peoples.

The EIS uses a 90% natural mitigation efficiency for fugitive dust emissions on haul roads during winter months, which assumes almost complete snow and ice cover on the road to reduce the amount of dust generated. This value is based on a study on haul roads from two diamond mines (Northern Ontario and Northwest Territories). There is uncertainty in the assessment as the winter conditions at these mines may not be similar to the Project area, as it is not likely that the Project area experiences full snow cover during winter months. Additionally, the EIS indicates that the transportable fraction (TF) used to estimate fugitive dust emissions corresponds to grasslands and is used for both summer and winter. This assumes that any accumulated precipitation (i.e. snow) does not cover the grass.

By using a high natural control efficiency based on snow and ice cover together with a TF for grasslands, it is uncertain whether calculations of fugitive dust emissions are accurate. Empirical control efficiencies are not intended to be additive and if the results are extended to other sites, different conditions and potential changes need to be adequately taken into account.

Details on road dust mitigation and monitoring of the mitigation effectiveness have not been provided. It is unclear how the dust exceedances from the Project will be managed and how any effects from interactions with the nearby developments will be determined and managed.

Additional information is required to understand project changes to air quality and the effects of changes in air quality on Indigenous peoples.

Information Requests:

a) **Provide documentation that confirms that there would be enough snow cover in the Project area from November to February to achieve 90% dust control and an explanation as to why 90% natural control efficiency, derived from northern Canada, is applicable in the Project area.**

b) **Provide updated emission calculations, predicted concentrations, and isopleth maps with either a TF or a natural control efficiency applied in isolation.**

c) **Provide an analysis where both TF and natural control efficiency (in winter) is used in estimating road dust.**

d) **Provide details on how road dust mitigation will be applied and measured.**

e) **Given this information, update the environmental effects assessment for relevant VCs.**

Response IR3-36

a) The natural mitigation control factor (or efficiency) assumed for Project haul roads during winter conditions was derived from a study that measured the effectiveness of natural winter mitigation of road dust from two De Beers Canada Inc. diamond mining operations in northern Canada (Golder Associates 2012): The natural winter time mitigation control factor is intended to account for the reduction in fugitive dust that occurs during winter conditions due to both immobilization of dust particles bound in the frozen road surfaces and the capping effect of snow cover. The mechanisms that reduce fugitive emissions during winter conditions are not only snow cover. The study noted that due to snow, ice and sub-zero temperatures the silt fraction of a road, combined with ice, becomes bound to larger pieces of aggregate in the road and is unavailable for lofting by wheel entrainment.

The Golder Associates (2012) study involved measuring particulate concentrations in the plume generated by mine haul trucks using a pickup-truck mounted dust sampling system deployed in chase truck. The study measured the effectiveness of road watering, variations in night and day emissions and differences between summer and winter emissions. One of the conclusions of the study was that the observed 95th percentile values for wintertime road dust emissions were naturally reduced by 94% at the Victor Mine and by 96% at the Snap Lake Mine, compared to uncontrolled summer conditions.

Winter sampling was conducted from January 16 to 20, 2012 at the Victor Mine and from February 2 to 6, 2012 at the Snap Lake Mine (Golder Associates 2012). Temperature, wind speed and relative humidity at the Victor Mine during the measurement program ranged from -10.5 °C to -31.8 °C, 1.8 m/s to 5.2 m/s and 72.4% to 85.9%, respectively. Temperature, wind speed and relative humidity at the Snap Lake Mine during the measurement program ranged from -3.0 °C to -18.9 °C, 6.7 m/s to 9.5 m/s and 78.3% to 95.2%, respectively.

For purpose of the air quality modelling of the Project during construction, the winter time natural mitigation is assumed to be 90% (rather than 94% to 96% measured in the Golder Associates study) in order to be conservative and overestimate emissions. Climate normal data measured at the Springbank Airport summarizing monthly average temperature and snow depth from 1981 to 2010 are presented in Table IR36-1. Monthly average temperatures are below freezing for the November to February period. Monthly average snow depth is greater than 2 cm for the November to February period.

The natural mitigation control factor is intended to be representative of typical or average conditions. The application of this factor to the November to February winter period used in the modelling is reasonable because, on average, the temperature is below freezing and there is snow cover.

Table IR36-1 Climate Normals for the Springbank Airport (1981 to 2010)

Parameter	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily Average (°C)	-8.2	-6.7	-2.7	3.4	8.1	11.1	14.8	13.7	9.5	3.9	-3.8	-7.0
Average Snow Depth (cm)	8	7	6	1	0	0	0	0	0	0	4	6

However, most of the construction activity is expected to occur during non-winter periods when the ground is not frozen or covered with snow. A dust control efficiency of 75% is assumed for the March to October time period. The 75% is based upon the calculated dust control efficiency on haul roads during the summer based upon the application of water twice daily (US EPA 2006).

b) Updated emission calculations and model predictions are not warranted because it is reasonable to apply both a transportable fraction (TF) and a natural control efficiency adjustment; and, the values used are representative of environmental conditions in the region (as discussed above). The two factors account for two distinct, unrelated physical processes.

The natural mitigation control factor accounts for the measured reduction in fugitive dust emissions at the source due to the effect of snow cover and the combined effect of snow, ice and sub-zero temperatures on road materials.

The TF accounts for a reduction in particulate matter that is transportable beyond the PDA associated with particulate deposition processes that occur near a fugitive dust source, including impaction on land cover (vegetation and ground) and other processes that enhance deposition on a local scale.

The two adjustment factors are unrelated and, therefore, it is appropriate to apply them additively.

Winter Natural Mitigation Factor

As explained in a), the natural mitigation control factor accounts for reduced fugitive dust emissions due to snow cover and the combined effect of snow, ice and sub-zero temperatures that cause the silt fraction of road material to combine with ice and bind to larger pieces of aggregate; therefore, the silt fraction is unavailable for lofting by wheel entrainment. This adjustment only accounts for the winter weather related reduction in fugitive dust at the source.

Transportable Fraction (TF)

A 75% TF is applied to account for the near-source removal of fugitive dust emissions due to micro-scale turbulence and effects associated with vegetation and other surface obstructions. A TF of 75% corresponds to the surface characteristics associated with the grassland category (Pouliot et al. 2010).

The United States Environmental Protection Agency's (US EPA) Office of Air Quality Planning and Standards (OAQPS) has published a number of studies concluding that air quality models relying on the application of fugitive dust emission estimates and transport and dispersion models overpredict fugitive dust concentrations by as much as an order of magnitude (Pace 2005). In an effort to obtain better agreement between air quality model predictions and ambient measurements, the US EPA began to apply reduction factors to fugitive dust emission estimates. This adjustment was initially applied on an ad hoc "divide-the inventory-by-four" approach to reduce the discrepancy between model predictions and ambient data (Pace 2005).

The US EPA notes that the fundamental cause of fugitive dust over-estimate is that the fugitive dust measurements that were used to develop fugitive emission factors were generally taken within 5 m to 10 m of fugitive dust sources (Pace 2005). In addition, approximately two-thirds of the measured dust plume were found to be less than 2 m above ground level. Because the dust plume is turbulent and close to the ground, substantial dust removal processes occur near a fugitive dust source, including impaction on land cover (vegetation and structures) and other processes that enhance deposition on a local scale. These other mechanisms include electrostatic forces, thermophoresis, and particle agglomeration which could enhance gravitational settling.

With respect to the emissions assessment, the combination of these near- field removal mechanisms results in a portion of particulate matter that is not transportable beyond the PDA. The remaining fraction of particulate matter that is not removed within the PDA is defined as “transportable fraction”.

c) As indicated, both a transportable fraction (TF) adjustment and a natural control efficiency adjustment in winter were applied additively in the EIS. The model predictions appropriately reflect this condition.

d) During construction, adaptive management techniques will be used to help control the generation of airborne dust (see Volume 3A, Section 3.4.4.1, Volume 3C, Section 2.2). The adaptive management techniques will include ambient air monitoring that will be completed in conjunction with ongoing dust emission mitigation.

An Environmental Construction Operations Plan (ECO Plan) will be developed by the selected construction contractor using Alberta Transportation’s ECO Plan framework (Volume 4, Supporting Documents, Document 4). The ECO Plan will identify the mitigation measures for the potential environmental effects of construction, including the ambient air monitoring program and adaptive management techniques to control the generation of airborne dust.

The construction contractor will implement an ambient air monitoring program that will include 24-hour continuous monitoring of $PM_{2.5}$ and TSP. Monitoring will include the installation and operation of an anemometer to measure wind speed and wind direction, and an environmental beta attenuation monitor (EBAM) to measure ambient $PM_{2.5}$ and TSP concentrations. Monitoring will be continuous over 24 hours and extend throughout the construction period.

The ECO Plan will include the mitigation measures identified in Volume 4, Appendix C, Table C-1, page C.3 to page C.4. Water will be applied to haul roads and disturbed areas to mitigate dust emissions during construction. Watering could be repeated several times a day during dry periods with high wind conditions. Dust abatement brine solution will be applied on haul roads if particulate matter concentrations are in exceedance of the Alberta

Ambient Air Quality Objectives (AEP 2019) and/or an increase of watering is determined ineffective or unfeasible at the time. As necessary, dust generating construction activities will be suspended during periods of excessive winds when dust suppression measures are determined to not be effective.

If the monitoring program indicates that the ground-level $PM_{2.5}$ and TSP concentrations are greater than Alberta Ambient Air Quality Objectives (AEP 2019), the construction contractor will take immediate actions to reduce fugitive dust. The additional mitigation could include increased watering of haul roads, the application of brine solution, or the suspension of construction activity at the site.

e) Given the responses above, no updates to the effects assessment are required.

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Question IR3-37: Air Quality –Monitoring and Follow-Up

Sources:

EIS Guidelines Part 2, Sections 6.1.1; 6.1.9; 6.2.1; 6.3.4; 6.6.3; 8

EIS Volume 1, Tables 7-3; 7-6

EIS Volume 3A, Section 3, Table 3-17

EIS Volume 3C, Section 1.2

EIS Volume 4, Appendix E; Appendix O Table 4-1 pp. 4.2

Environment and Climate Change Canada Technical Review, June 18, 2018 (CEAR # 32)

Context and Rationale:

The EIS Guidelines require a description of baseline air quality levels and changes in air quality, as well as an assessment of the effects of changes to air quality on Indigenous peoples.

The EIS presents an air quality monitoring plan; however, ECCC indicated that the information provided is lacking specific details on monitoring and adaptive management strategies that will be implemented.

Levels of NO2, $PM_{2.5}$, Trisodium Phosphate (TSP), dustfall, three Volatile Organic Compounds (VOC), and one Polycyclic Aromatic Hydrocarbon (PAH) are predicted to exceed ambient air quality criteria, and the spatial extent of the exceedances is widespread (depending on the contaminant) during construction and/or post-flood operations. Because these exceedances are widespread and frequent, it is important that specific detail on the mitigation strategies and follow-up and monitoring plan are included in the EIS.

The EIS indicates that the development of the Community of Harmony and Bingham Crossing would be ongoing during the time of the Project, but would not interact with the Project's emissions because the primary wind direction is not from the direction of these future developments. The EIS indicates that a comparison of construction emission rates cannot be done for the other developments in the study area as emission rates have not been estimated for these other projects. ECCC noted that concentrations of TSP in the application case are predicted to exceed at a spatial extent that extends close to the Community of Harmony and Bingham Crossing developments. As there are many sensitive receptors between the Project and these developments it is important to consider the potential of these developments interacting with the Project.

Many Indigenous groups have raised concerns about dust monitoring. Additional information on mitigation, monitoring, and follow-up and on cumulative effects is required to understand Project effects on air quality and on Indigenous peoples.

Information Requests:

a) **Provide the details of a mitigation, monitoring and follow-up plan for NO2, $PM_{2.5}$, TSP, PAH, and dustfall, including a description of how and when adaptive management strategies will be implemented, for all phases and components of the Project.**

b) **Provide details on how air quality effects from interactions with the developments in the region will be determined, managed, and mitigated.**

Response IR3-37

a) A comprehensive list of mitigation during construction is detailed in Volume 3A, Section 3.4.4.1. A proposed meteorological and ambient monitoring program as a component of the adaptive management is described in Volume 3C, Section 2.2. Additional information is provided for each substance as follows:

TSP, $PM_{2.5}$ AND DUSTFALL

During Project construction, adaptive management techniques will be used to minimize dust emissions and to confirm the effectiveness of dust control mitigation. The adaptive management techniques will include ambient air monitoring that will be completed in conjunction with ongoing dust emission mitigation. Ambient air monitoring will be combined with review of weather data (from an onsite meteorological station) to assess the effectiveness of ongoing mitigation and the need for more rigorous dust mitigation. Monitoring will include the installation and operation of an anemometer to measure wind speed and wind direction and an environmental beta attenuation monitor (EBAM) to measure ambient $PM_{2.5}$ and TSP concentrations. Monitoring will be continuous over 24 hours and extend throughout the construction period.

An Environmental Construction Operations Plan (ECO Plan) will be developed by the selected construction contractor using Alberta Transportation's ECO Plan framework (Volume 4, Supporting Documentation, Document 4). The ECO Plan will identify the mitigation measures for the potential environmental effects of construction, including the ambient air monitoring program and adaptive management techniques to control the generation of airborne dust. The ECO Plan will follow the requirements in Alberta Transportation's *Civil Works Master Specifications for Construction of Provincial Water Management Projects* (Volume 4, Supporting Documentation, Document 10). The ECO Plan will include the mitigation measures identified in Volume 4, Appendix C, Table C-1, page C.3 to page C.4.

Water will be applied to haul roads and disturbed areas to mitigate dust emissions during construction. Watering could be repeated several times a day during dry periods with high wind conditions. Dust abatement brine solution will be applied on haul roads if particulate matter concentrations are in exceedance of the Alberta Ambient Air Quality Objectives (AEP 2019) and/or an increase of watering is determined ineffective or unfeasible at the time. As necessary, dust generating construction activities will be suspended during periods of excessive winds when dust suppression measures are determined to not be effective.

If the monitoring program indicates that the ground-level $PM_{2.5}$ and TSP concentrations are greater than Alberta Ambient Air Quality Objectives, additional mitigation to reduce dust emissions will be implemented. This mitigation could include increased watering of access roads, the spraying of surfactants, or the suspension of construction activity at the site.

NO_2

The maximum annual NO_2 concentrations are less than the AAAQO. The maximum 1-hour NO_2 concentration is predicted to be greater than the 1-hour AAAQO on the northwest PDA boundary near the north end of the haul road that is parallel to Highway 22. There are no sensitive receptors on or near the boundary at this location. 1-hour predicted NO_2 concentrations greater than the AAAQO are limited to 46 hours per year. Maximum predicted NO_2 concentrations were also compared to the CAAQS in CEAA IR3-35, which indicate that maximum 1-hour NO_2 concentrations at three residence receptors near the PDA are predicted to exceed the CAAQS in the Application Case; however, the magnitudes of the predicted exceedances are small (maximum predicted 1-hour NO_2 concentration of 123 $\mu g/m^3$ versus the 2020 CAAQS of 113 $\mu g/m^3$) and the 1-hour predicted NO_2 concentrations greater than the 2020 CAAQS are limited to 11 days per year. As stated in the Context and Rationale, predicted exceedances for NO_2 are not widespread and frequent. Rather, the air dispersion model results indicate that the predicted exceedances for NO_2 are localized and infrequent.

Alberta Transportation notes that combustion emissions, such as NO_X, are conservatively estimated in air quality modelling completed for the air quality assessment by assuming all Project construction off-road diesel construction equipment was manufactured in the year 2012 with engines certified to meet Tier 3 Canadian off-road compression-ignition engine emission standards. More stringent Tier 4 standards for off-road diesel engines came into effect in 2014 with a transitional period for some engine categories starting in 2012. It is estimated that most of the actual construction equipment will have lower emissions and have engines that meet more stringent Tier 4 emission standards. The air quality assessment used conservative diesel exhaust emissions and therefore overpredicted NO_2 concentrations during construction. As indicated in Volume 4, Appendix E, Attachment 3A, Table 3A-4, for diesel engines rated between 175 hp and 600 hp, which represents the majority of the engine sizes and emissions associated with the construction fleet, the Tier 4 emission standard represents an 89% reduction in NO_X emissions. Assuming a more realistic mix of 50% Tier 3 construction equipment and 50% Tier 4 construction equipment would result in a 45% reduction in NO_X emissions compared to using 100% Tier 3 construction equipment.

VOCs

Maximum predicted 1-hour concentrations of acrolein and formaldehyde greater than the 1-hour AAAQO occur on the PDA boundary. Maximum 24-hour concentrations of acrolein greater than the AAAQO also occur on the PDA boundary near the north end of the haul road that is parallel to Highway 22. Except for one residence near the western PDA boundary where the maximum predicted acrolein concentration is 0.407 $\mu g/m^3$, which is marginally greater than the 0.4 $\mu g/m^3$ 24-hour AAAQO, there are no predicted exceedances at sensitive receptors. As stated in the Context and Rationale, predicted exceedances for VOC are suggested to be widespread and frequent; however, the air dispersion model results indicate that the predicted exceedances for VOC are localized and infrequent.

Alberta Transportation notes that combustion emissions of VOCs associated with diesel construction equipment are conservatively estimated in air quality modelling by assuming all Project construction off-road diesel construction equipment would be manufactured in the year 2012 with engines certified to meet Tier 3 Canadian off-road compression-ignition engine emission standards. As noted above for NO_X, for diesel engines rated between 175 hp and 600 hp, which represents most of the engine sizes and emissions associated with the construction fleet, the Tier 4 emission standard represents a 27% reduction in VOC emissions.

PAHs

Maximum predicted benzo(a)pyrene concentrations greater than the AAAQO are predicted to occur near the intersection of the TransCanada Highway and Highway 22 and associated with Base Case traffic emissions. The Project contributes less than 3% (i.e., the Base Case contributes 97%) to maximum predicted concentrations for the Application Case. Similarly, the Tier 4 engine standard represents a 93% reduction in diesel particulate matter emissions compared to Tier 3. The reduction in diesel particulate matter emissions are considered representative of the reduction in PAH emissions. As stated in the Context and Rationale, predicted exceedances for PAH are suggested to be widespread and frequent; however, the air dispersion model results indicate that the predicted exceedances for PAH are localized and infrequent.

SUMMARY

As described in Volume 3A, Section 3.7, the main finding of the air quality assessment is the potential for TSP and $PM_{2.5}$ concentrations to be greater than the regulatory criteria outside the PDA. The assessment indicated a need for ambient monitoring during construction to confirm if the adopted dust control mitigation is adequate. Adaptive management techniques will be used during Project construction to ensure the effectiveness of dust control mitigation.

While the air quality assessment also indicated that maximum concentrations of several pollutants associated with diesel vehicle combustion such as NO_2, formaldehyde, acrolein, and benzo(a)pyrene were predicted to exceed the AAAQO, the predicted exceedances are generally localized areas along the PDA and are predicted to be infrequent. The air quality modelling and health risk assessment are completed using a conservative estimate of diesel exhaust emissions based upon Tier 3 Canadian off-road compression-ignition engine emission standards. Actual construction emissions are anticipated to be lower. Alberta Transportation does not propose further monitoring or adaptive management related to NO_2, formaldehyde, acrolein, or benzo(a)pyrene concentrations.

b) As described in Volume 3A, Section 3.7, the main finding of the air quality assessment for construction is the potential for TSP and $PM_{2.5}$ concentrations to be greater than the regulatory criteria outside the PDA. To confirm that there are no significant adverse air quality effects associated with TSP and $PM_{2.5}$ emissions from the Project cumulatively with other developments in the region, Alberta Transportation will implement the mitigation as detailed in Volume 3A, Section 3.4.4.1 and will implement an adaptive management program that incorporates meteorological and ambient air monitoring for TSP and $PM_{2.5}$ as described in Volume 3C, Section 2.2. The adaptive management program will confirm the effectiveness of dust control mitigation and identify conditions that require more rigorous dust mitigation such that emissions from the Project will not interact with development in the Community of Harmony and Bingham Crossing.

REFERENCES

AEP (Alberta Environment and Parks). 2019. Alberta Ambient Air Quality Objectives and Guidelines Summary. Available at: https://open.alberta.ca/dataset/0d2ad470-117e-410f-ba4f-aa352cb02d4d/resource/4ddd8097-6787-43f3-bb4a-908e20f5e8f1/download/aaqo-summary-jan2019.pdf Accessed February 2019.

Question IR3-38: Air Quality – Assessment of Effects

EIS Guidelines Part 2, Sections 6.1.1; 6.2.1

EIS Volume 3A Section 15.4.4

EIS Volume 3B Section 15.4.2.3

EIS Volume 4 Appendix O, Section 6.2.4

Alberta Transportation Responses to CEAA Annex 2: A) Early Technical Issues, May 11, 2018

Health Canada Comments on the EIS – June 15, 2018 (CEAR #30)

Context and Rationale:

The EIS Guidelines require the proponent to carry out appropriate atmospheric dispersion modelling of the main contaminants resulting from various project-related activities.

The EIS provides an assessment of the health risk from the residual effects, which is assumed to be post-mitigation. It is unclear if the full suite potential changes to air quality in all phases of the project and associated effects to health were considered in the assessment. For example, with the models presented it seems potential risks to health from inhalation of COPCs prior to the implementation of mitigation measures are not considered. Design features that are constant and therefore consistently and continuously mitigate effects to air quality should be included in air quality models. However, mitigation measures that are subject to change, intermittent, discretionary implementation, or part of adaptive management should not be included in the models as it could conceal potential air quality effects associated with the Project.

Additional information is required to understand the potential effects to health related to COPC prior to the implementation of mitigation measures that are not static parts of the Project design. This understanding is necessary to assess the effects of changes to air quality on the health of Indigenous peoples.

Information Request:

a) **Provide an updated assessment of health risk for each COPC for each phase of the Project prior to the implementation of mitigation measures that are not design features.**

Response IR3-38

a) Alberta Transportation considers all the proposed mitigation detailed in Volume 3, Attachment 3A, Section 3.4.4.1 to minimize emissions of fugitive dust and combustion emissions associated with Project construction to be an integral component of the Project (i.e., are "design measures"). CEAA (2016) states that the significance of the identified residual environmental effects will be determined following the implementation of technically and economically feasible mitigation measures for any significant adverse environmental effects. Therefore, it is not appropriate to complete a health risk assessment for a non-mitigated condition because it is not representative of potential effects associated with the Project.

   The air quality modelling and health risk assessments are completed using assumptions that lead to an overestimate of potential changes in air quality and health risk. For example, combustion emissions associated with off-road diesel construction vehicles are estimated by assuming all off-road diesel construction equipment would be manufactured in the year 2012 with engines certified to meet Tier 3 Canadian off-road compression-ignition engine emission standards. More stringent Tier 4 standards for off-road diesel engines came into effect in 2014, with a transitional period for some engine categories starting in 2012. It is estimated that most of the construction equipment will have lower emissions based upon newer vehicles with engines that meet the more stringent Tier 4 emission standards. As indicated in Volume 4, Appendix E, Attachment 3A, Table 3A-4, for diesel engines rated between 175 hp and 600 hp, which represents the majority of the engine sizes and emissions associated with the construction fleet, the Tier 4 emission standard represents an 89% reduction in NO_X emissions compared to Tier 3. Similarly, the Tier 4 engine standard represents a 93% reduction in diesel particulate matter emissions compared to Tier 3. Assuming a more realistic mix of 50% Tier 3 construction equipment and 50% Tier 4 construction equipment, a 45% reduction in NO_X emissions and a 47% reduction in diesel particulate matter emissions would result (compared to assuming 100% Tier 3 construction equipment).

   It's also important to note that during construction, adaptive management techniques will be used to ensure the effectiveness of dust control mitigation. The adaptive management techniques will include ambient air monitoring that will be completed in conjunction with ongoing dust emission mitigation. Ambient air monitoring will be combined with review of weather data (from an onsite meteorological station), to assess the effectiveness of ongoing mitigation and the need for more rigorous dust mitigation. Monitoring will include the installation and operation of an anemometer to measure wind speed and wind direction, and an environmental beta attenuation monitor (EBAM) to measure ambient $PM_{2.5}$ and TSP concentrations. Monitoring will be continuous over 24 hours and extend throughout the construction period. If the monitoring program indicates that the ground-level $PM_{2.5}$ and TSP concentrations are greater than Alberta ambient air quality objectives (AEP 2019), additional mitigation to reduce dust emissions will be implemented. This mitigation could include increased watering of access roads, the spraying of surfactants, or the suspension of construction activity at the site.

REFERENCES

AEP. 2019. Alberta Ambient Air Quality Objectives and Guidelines Summary. Available at: https://open.alberta.ca/dataset/0d2ad470-117e-410f-ba4f-aa352cb02d4d/resource/4ddd8097-6787-43f3-bb4a-908e20f5e8f1/download/aaqo-summary-jan2019.pdf Accessed February 2019.

CEAA (Canadian Environmental Assessment Agency). 2016. Springbank Off-Stream Reservoir Project. Draft Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012. June 23, 2016. Canadian Environmental Assessment Agency (CEAA). Available at: https://www.ceaa-acee.gc.ca/050/evaluations/document/114716?culture=en-CA. Accessed April 2019.

Question IR3-39: Air Quality - Ambient Light

EIS Guidelines Part 2, Section 6.1.1; 6.1.9; 6.2.1; 6.3.4

EIS Volume 1, Section 4.2

EIS Volume 3A, Section 3.4

Métis Nation British Columbia – Technical Review (CEAR #1153)

Technical Advisory Group – Meeting June 10-11, 2018

Context and Rationale:

The EIS Guidelines require the proponent to provide baseline information on and describe the changes to air quality, including consideration of light.

The EIS notes that portable lighting units will be used at night during construction. The EIS does not present information regarding the potential lighting of Project components during flood or post-flood operations. While the EIS concludes the Project is unlikely to have significant effects on ambient light as part of the air quality VC, consideration of the effects of increased ambient light on other VCs is not included in the EIS. Specifically, Indigenous groups have expressed concern with the potential effects on 24 hour lighting on wildlife and plants, including species of cultural importance, and on experience of the landscape.

Additional information is required to understand potential changes to light resulting from the Project and the effects of those changes on Indigenous peoples.

Information Requests:

a) Describe all potential light sources throughout the Project area during flood and post flood operations and anticipated light levels relative to relevant guidelines.

b) Assess potential effects to each relevant VC resulting from the anticipated change in ambient light.

Response IR3-39

a) The nighttime lighting during operations is expected to consist of some security lighting at the control building for the diversion structure (see Volume 1, Section 4.3). Permanent lighting is not planned for the floodplain berm, auxiliary spillway, service spillway, or the diversion inlet. Light levels from the luminaires at the control building are expected to be well below Commission Internationale de L'Éclairage (also known as the International Commission on Illumination) (CIE) guidelines for light trespass and glare for the nearby receptors. These luminaires are also not predicted to measurably contribute to existing sky glow near the Project.

b) Building light emissions are predicted to be very low and will use best practice design principles such as full horizontal cut-off fixtures to reduce potential light spill, glare and contributions to sky glow. The lighting during operations will be less than that during construction. As stated in, Volume 3B, Section 3, Table 3-21, light trespass and glare during construction will be less than the CIE guidelines for rural environments (light trespass no more than 22.7% of guidelines; light glare no more that 77.4% of guidelines). The CIE guidelines have been established to limit light pollution and associated effects on humans and wildlife. Consequently, the changes in ambient light during flood and post-flood operations are expected to have minimal effects on VCs.

CUMULATIVE EFFECTS

Question IR3-40: Cumulative Effects – Assessment of Effects

Sources:

EIS Guidelines Part 2, Section 6.6.3

EIS Volume 2, Section 7.2.1

EIS Volume 3C, Section 1

EIS Volume 4, Appendix O, Sections 5.2; 6.2.6

Health Canada Comments on the EIS – June 15, 2018 (CEAR # 30)

Context and Rationale:

The EIS Guidelines require the proponent to identify and assess the Project's cumulative effects. The EIS Guidelines requires that the proponent specify other projects or activities that have been or that are likely to be carried out that could cause effects on each selected VC within the boundaries defined, and whose effects would act in combination with the residual effects of the Project. The EIS Guidelines require the proponent to justify the spatial and temporal boundaries for the cumulative effects assessment for each VC.

The EIS indicates that environmental effects of other past and present projects or activities are reflected in the existing baseline environment, and are considered in the project-related environmental effects assessment for each VC. The project-related environmental effects assessment for each VC only analyzes effects within the LAA and compares the project-related effects to the existing baseline for each VC. Limited project-specific studies and baseline data gathering were completed throughout the RAAs and the current state of VCs is described only at a high level. It is not clear whether current VC conditions are static or still changing in response to past and present physical activities. This creates uncertainty in the degree to which the effects of past and present physical activities are reflected in the existing baseline environment.

Additional information is required for a complete understanding of the Project's cumulative effects with all past, present, and reasonably foreseeable physical activities.

Air Quality

The EIS includes air quality as a VC in the cumulative effects assessment and provides a qualitative planned development case which notes that several future projects could potentially overlap with project-related emissions during construction but that these are not expected to materially change the predicted project-related exposures. The EIS does not present a sufficient description of the COPC that could potentially overlap with project-related emissions. The predicted COPC contributions should be assessed for all reasonably foreseeable future projects within the RAA. Additional information is required to allow for an understanding of cumulative effects to air quality and associated effects to health of Indigenous peoples.

Information Request:

a) Update the cumulative effects assessment to:

- **further consider the effects of past and present physical activities through improved characterization of VCs throughout the RAAs and/or direct evidence to explain the effects of past and present physical activities, or present a rationale for how the level of detail available allows for a meaningful cumulative effects assessment;**
- **include a discussion of any revised RAA and/or temporal boundaries and ensure these revised boundaries are reflected in the updated assessment; and**
- **for the updated cumulative effects assessment for air quality, include predicted COPC contributions from potentially overlapping reasonably foreseeable future activities.**

Response IR3-40

a) This response addresses two issues: 1) the adequacy of data within the respective various LAAs and RAAs for each VC; and 2) the constituents included in the air quality assessment.

Overall, Alberta Transportation has completed its assessment of cumulative effects in accordance with guidelines prepared by the Canadian Environmental Assessment Agency (CEAA), including “Assessing Cumulative Environmental Effects under the CEAA, 2012, Interim Technical Guidance” (CEAA 2018); “Assessing Cumulative Environmental Effects under the CEAA, 2012, Operational Policy Statement” (CEAA 2015); and the “Cumulative Effects Assessment Practitioners' Guide” (Hegmann et al.1999).

ADEQUACY OF DESCRIPTIVE DETAIL OF STUDY AREAS

As stated in Volume 2, Section 5.3.1, the purpose of the LAA for a given VC is to assess direct effects associated with the Project and, therefore, baseline data within the LAA needs to be adequate to allow for this assessment. This expectation is carried into the cumulative effects assessment. Specifically, the descriptive level of detail used in the respective RAAs is equally adequate to assist in an understanding of the condition of VCs in support of that assessment.

The area of the RAAs is adequate to examine the potential cumulative effects of the Project with other reasonably foreseeable projects. Details of this are provided in the respective VC assessment sub-sections entitled "Existing Conditions", describing sources of information, map-based or otherwise. In general, the level of descriptive detail in an LAA ensures as complete and accurate an understanding as possible to assess direct Project effects, especially so within the PDA. Given the much broader area of RAAs, different sources of data may also be used, sometimes at a coarser spatial resolution; however, in all such instances, that information remains adequate to understand the nature of potential cumulative effects.

The practice of using baseline to also represent past conditions reflects precedence in EA practice and guidance[4] and, in the case of this Project, it is an adequate approach given that the Project already largely resides on lands reflecting a dominant historical land use in the region (agriculture).

Regional context is also discussed in the response to CEAA IR1-11 and in Volume 3C, Section 1.1.5., the latter providing an improved understanding of the historical and present-day regional land use perspective. In summary, ecological VCs prior to European colonization near the Project have largely been displaced by substantial anthropogenic change since the late 1800s, primarily urban and agricultural based changes and, most notably, Calgary. Therefore, further exploration of distant past conditions does not offer additional meaningful insight and would not alter the assessment observations and conclusions.

CONSTITUENTS ASSESSED FOR AIR QUALITY

Volume 3A, Section 3 and Volume 3B, Section 3 provide assessments of potential Project effects on air quality. Volume 3C, Sections 1.2.1 and 1.3.1 provide assessments of potential cumulative effects for air quality. These assessments are based on quantitative modelling within the LAA and RAA, which are adequate to reflect an airshed influenced by both the Project and other regional sources, including reasonably foreseeable projects. For the reasonably foreseeable projects, clear assumptions are made for their incorporation into the model used in the cumulative effects assessment. These projects are first identified as potentially interacting with the Project in the Project Inclusion List (Volume 3C, Section 1.1.4), then, for each VC, specific projects identified for that VC within the VC sub-sections entitled "Project Residual Effects Likely to Act Cumulatively".

[4] Canadian Environmental Assessment Agency (CEAA), 2015, Operational Policy Statement: Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012.

The constituents assessed in the air quality assessment reflect a full and relevant suite for the Project which also are emitted from the other interacting projects. These criteria air contaminants (CACs)[5] are particulate matter (PM), carbon monoxide (CO), sulphur oxides (SO_x), nitrogen oxides (NO_x) and volatile organic compounds (VOCs). Greenhouse Gases (GHGs) are also assessed.

Therefore, a complete assessment has been completed for air quality, both Project-specific and cumulative. Further assessment of potential implications of air quality changes to human health are also fully assessed in Volume 3A, Section 15 and Volume 3B, Section 15 for Project-specific effects; in Volume 3C, Section 1.2.10 for cumulative effects during construction and dry operations; and in Section 1.3.11 for flood operations and post-flood operations.

REFERENCES

CEAA (Canadian Environmental Assessment Agency). 1999. Cumulative Effects Assessment Practitioners' Guide. Prepared for: Canadian Environmental Assessment Agency by G. Hegmann, G., C. Cocklin, R. Creasey, S. Dupuis, A. Kennedy, L. Kingsley, W. Ross, H. Spaling and D. Stalker) and AXYS Environmental Consulting Ltd.

CEAA. 2015. Operational Policy Statement, Assessing Cumulative Environmental Effects under CEAA 2012

CEAA. 2018. Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012 Interim Technical Guidance, March 2018, Version 2.

Question IR3-41: Cumulative Effects – Hydrology

Sources:

EIS Guidelines Part 2, Section 6.6.3

EIS Volume 3C, Section 1

Tsuut'ina First Nation, Ermineskin Cree Nation, and Kainai First Nation – Technical Review of the EIS - Annexes - Combined (CEAR # 46, 47, 50)

[5] Note that the term COPC, chemicals of potential concern, as appears in the IR Context and Rationale, is used in the HHRA.

Context and Rationale:

The EIS Guidelines require the proponent to identify and assess the Project's cumulative effects, including consideration of past, present, and reasonably foreseeable future activities. This includes an assessment of cumulative effects to the Elbow River, including its hydrology and seasonal flood process, water quality, and aquatic ecology.

The EIS excludes hydrology from the cumulative effects assessment, noting that for construction and dry operations effects would be neutral and as no residual effects are predicted no cumulative effects assessment is warranted. A neutral effect does not necessarily constitute the absence of residual effects or an adequate reason for not conducting a cumulative effects assessment. Cumulative effects to hydrology from flood and post-flood operations are also not considered as the EIS states the purpose of the Project is to modify the hydrology of the Elbow River. Project effects to hydrology, intentional or otherwise, will interact with past, present, and reasonably foreseeable physical activities and therefore must be considered in a cumulative effects assessment.

The EIS does not identify any past or present activities that would interact with the surface water quality or aquatic ecology VCs in the construction and dry operations phase. Past and present agriculture, infrastructure, residential communities and recreation and tourism have the potential to have effects to water quality and aquatic ecology.

The proponent did not identify that the Bragg Creek Flood Mitigation Project or the Southwest Calgary Ring Road would interact with the hydrology and aquatic ecology VCs in the flood and post-flood phase and did not include a rationale for why there would be no interaction. Additionally, although the Glenmore Reservoir has similar pathways of effects as the Project and is included in the RAA for some VCs, the proponent did not identify the Glenmore Reservoir as a past project that would interact with the Project VCs.

Tsuut'ina Nation noted that the hydrological baseline conditions may be underestimated in the EIS cumulative effects assessment given consideration of the Bragg Creek Flood Mitigation Project. The Bragg Creek Flood Mitigation Design Report indicates that in the half kilometre immediately downstream of the boundary of the Hamlet of Bragg Creek (i.e., within the Tsuut'ina Reserve) and throughout the Elbow River reach where Redwood Meadows is located, water levels and in-flow velocities are anticipated to change. These changes could affect fluvial morphology and are not considered in the EIS. Long term changes with the shape of the river could interact with the physical barriers presented by the Project. If changes from the Bragg Creek Flood Mitigation Project are anticipated as far downstream as the Springbank floodgates, water volumes, depths, and temperatures appropriate to fish should be maintained under non-flood conditions, and consideration of effects to wildlife access and movement should be considered. A description of how the Elbow River will change shape over the long term (>50 years) as a result of the Bragg Creek Flood Mitigation Project should be taken into account in the assessment of potential cumulative effects for the Project.

Additional information is required to understand the cumulative effects of the Project on hydrology, surface water quality and aquatic ecology, and the interactions of these effects with other VCs.

Information Requests:

a) Considering the gaps identified above:

- **Update the Surface Water Quality and Aquatic Ecology cumulative effects assessment to include past and present projects or physical activities, or provide a rationale as to why no past or present projects and physical activities were identified as interacting with each VC.**
- **Update the Hydrology and Aquatic Ecology cumulative effects assessments to include the Bragg Creek Flood Mitigation Project and the Southwest Calgary Ring Road Project. Revise and provide modeling inputs to identify and account for changes to Elbow River hydrology taking into account effects from the Bragg Creek Flood Mitigation Project. Given the revised modelling, assess cumulative effects to hydrology for construction and dry operations and reassess cumulative effects to hydrology under flood and post-flood scenarios.**
- **Update the cumulative effects assessment for all VCs with RAAs that overlap with the Glenmore Reservoir to include the Glenmore Reservoir or provide a rationale for why the Glenmore Reservoir was not scoped into the cumulative effects assessment as a past project.**

b) Discuss how cumulative effects to hydrology, surface water quality, and aquatic ecology, interact with other VCs such as federal lands, wildlife use patterns, and culture/sense of place and whether the updated cumulative effects assessment affects conclusions for direct or cumulative effects to these VCs.

Response IR3-41

a) The cumulative effects assessments for the three VCs identified in the request (surface water quality, aquatic ecology and hydrology) do not need to be updated as they provide assessments fully reflective of relevant guidance (as stated in the response to IR3-40). The following addresses specific points, as raised in the request, to support this:

- Inclusion of past and present projects or physical activities for surface water quality and aquatic ecology:
  - For all VCs, the effects of past and present projects or physical activities are reflected in the VCs baseline information regarding the state of the VC.

- With one exception, there are no known specific past or present projects or physical activities, as per the Project Inclusion List (PIL; Volume 3C, Section 1.1.4, Table 1-1), that cumulatively interact with the Project.
- The one exception referred to above is for surface water quality. "Agriculture" should have been identified (checked) in Table 1-4 (construction and dry operations) and specifically itemized in Volume 3C, Section 1, Table 1-18 (flood and post-flood) because there is potential for agricultural runoff into the Elbow River watershed. An update to the cumulative effects assessment, however, is not required because the measurable implications of that are already reflected in the baseline water quality information.

- Inclusion of Bragg Creek Flood Mitigation and Southwest Calgary Ring Road for hydrology and aquatic ecology:
  - For aquatic ecology, the Bragg Creek Flood Mitigation and Southwest Calgary Ring Road projects are included for the construction and dry operations assessment, but excluded for the flood and post-flood assessment. That exclusion is based on these projects becoming operational during the flood and post-flood phase, with Southwest Calgary Ring Road completed and, hence, causing no relevant effects (which were only associated with their construction, not operation). There are no effects between the Project and the Bragg Creek Flood Mitigation project, given the distances between projects: the Bragg Creek Flood Mitigation project is 9.5 km upstream from the PDA and the Project backwater effect lies within the PDA.
  - For hydrology, the other projects (i.e., those identified in the PIL) are excluded for the construction and dry operations assessment because the Project has a neutral effect and also excluded for the flood and post-flood assessment for the same reason as stated above for aquatic ecology. As per Table 6-2 (Volume 3B, Section 6.1.5), such an effect is defined as "no net change in measurable parameters for hydrology relative to existing conditions." Given this (no measurable change) and given the specific focus of assessment under CEAA 2012 and guidance[6] of adverse effects, there is no basis to assess cumulative effects.
- Inclusion of Glenmore Reservoir:
  - Although the Glenmore Reservoir was not specifically identified by name in the PIL, it is included in the RAA of VCs in which the Glenmore Reservoir is potentially relevant to that VCs assessment. These VCs include the three associated with surface water: hydrology, surface water quality, and aquatic ecology.

[6] Canadian Environmental Assessment Agency (CEAA), 2015, Operational Policy Statement: Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012; and, CEAA, 2018, Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012 Interim Technical Guidance, Version 2.

b) The EIS assesses all relevant VCs and explains the basis of their selection. VCs assessed provide a full consideration of potential effects from the Project. Some features are not identified as VCs in the EIA, nor would be typical or reasonable to represent VCs based on Alberta Transportation's experience. They are, however, representative of important aspects of some VCs that are assessed, or certain natural or human environment features. Specifically, potential effects on:

- federal lands are included as relevant and appropriate (also see response to CEAA IR2-5) for each VC (including surface water quality, aquatic ecology and hydrology) and assessed for cumulative effects in Volume 3C, Section 1.
- wildlife use patterns are assessed as relevant and appropriate for the wildlife VC (Volume 3A, Section 11; and Volume 3B Section 11). Effects from surface water quality, aquatic ecology and hydrology on wildlife use patterns were not assessed because there are no such effects.
- culture/sense of place:
  - are assessed as relevant and appropriate for the traditional land and resource use VC (Volume 3A, Section 14; and, Volume 3B, Section 14); however, effects by the three VCs in question (surface water quality, aquatic ecology and hydrology) on culture/sense of place were not assessed as there are no such effects
  - further relevant discussion is provided in the response to CEAA IR2-2 (b) regarding Indigenous group's views on the potential impacts of the Project specifically in relation to the cultural and spiritual importance of water

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Question IR3-42: Cumulative Effects – Water Management

<u>Sources:</u>

EIS Guidelines Part 2, Section 6.6.3

EIS Volume 1, Section 2

EIS Volume 3B, Section 18

EIS Volume 3C, Section 1

Tsuut'ina First Nation, Ermineskin Cree Nation, and Kainai First Nation – Technical Review of the EIS - Annexes - Combined (CEAR # 46, 47, 50)

Context and Rationale:

The EIS Guidelines require the proponent to identify and assess the Project's cumulative effects, including consideration of past, present, and reasonably foreseeable future activities. The EIS Guidelines require the cumulative effects assessment to take into consideration regional flood mitigation works and strategies.

The EIS notes that the Project is part of broader water management and flood mitigation within southern Alberta. For example, the EIS states that the Deltares report recommended the Project, in combination with local mitigation for Bragg Creek and Redwood Meadows, over the McLean Creek (MC1) Option. Given the scope of flood mitigation activities within the region, Tsuut'ina Nation may have an interest in developing flood mitigation infrastructure, including for the protection of Redwood Meadows, on its reserve lands. The EIS does not identify if or how this specific information was sought or considered in the assessment of potential effects to Tsuut'ina Nation lands, cumulative effects, or impacts to rights.

In meetings with the Canadian Environmental Assessment Agency, Siksika Nation has noted that Alberta Transportation suggested Project benefits to Siksika Nation, through reduced potential for flooding. However, Siksika Nation reserve lands are not included in the LAA or RAA for the Project or in the assessment of potential effects to federal lands. Siksika Nation expressed concern with how the Project fits into water management in the region which cumulatively affects their reserve lands. Specifically, concerns have been raised about potential interactions with water management of irrigation districts and communication and coordination between interested parties in a flood event. The EIS does not identify if or how this information was sought or considered in the assessment of potential effects to Siksika Nation reserve lands, cumulative effects, or impacts to rights.

The EIS does not include a cumulative effects assessment for federal lands. Given the updated assessments required, determinations of potential effects to federal lands may change and potential cumulative effects to reserve lands may not have been adequately considered.

Information Requests:

a) **Describe how potential and reasonably foreseeable flood mitigation measures contemplated for Tsuut'ina Nation reserve lands were considered in the cumulative effects assessment. Identify how the Project may interact with or restrict the flood mitigation options available to Tsuut'ina Nation and how this impacts Tsuut'ina Nation's ability to exercise its governance and decision-making regarding its lands.**

b) **Clarify if potential benefits in terms of reduced flood risk are expected for Siksika Nation. Describe how the RAA adequately allows for this understanding and accounts for other water management and flood mitigation infrastructure that affects Siksika Nation reserve lands; integrate any revised information on the LAA and RAA for hydrology.**

c) Provide updated cumulative effects analyses as needed or rationale as to why the cumulative effects determinations adequately take into account the information requested above.

Response IR3-42

a) Potential and reasonably foreseeable flood mitigation measures contemplated for Tsuut'ina Nation Reserve lands were not considered in the cumulative effects assessment because information was not available describing any such project prior to filing of the EIA.

   Based on currently available information, a potential cumulative effect between the Springbank Reservoir Off-stream Project and flood mitigation proposed for Redwood Meadows is unlikely. This conclusion is based on minimal change by the Bragg Creek project to river water velocity and elevation (an increase in water elevation of 0.03 m and an increase in water velocity of 0.03 m/s at the upstream end of the community of Redwood Meadows) and the Project backwater effects lie within the Project PDA.

b) Potential benefits in terms of reduced flood risk are expected for Siksika Nation. The magnitude of this benefit is approximated as a 17% reduction in volume flow rate through the Siksika lands during a design flood. That percentage is the proportion of river flow reduced by the Project amongst the three contributing rivers to flow into the Bow River (the other three rivers being the Sheep and Highwood). Because this is the only anticipated change to Siksika lands associated with the Project, and the change is positive (a reduction in floodwater), study areas do not extend to the Siksika Nation (78 km east of the PDA).

   Regarding other water management initiatives, there is an agreement in place with TransAlta to increase flood storage in its reservoirs upstream of Calgary to reduce flood flows in Bow River through Calgary, which will reduce flood flows thru the Siksika Reserve.

c) The cumulative effects assessment does not need to be updated because the current assessment is appropriate in that there are either no anticipated cumulative effects interactions (upstream flood mitigation to Project) or only benefits (positive effects) to any land user downstream due to reduced flow volumes during a flood. As such, there is no overlap of relevant effect as there are no interactions with past, present or reasonably foreseeable future activities.

Question IR3-43: Cumulative Effects - Project Location and Existing Disturbance

Sources:

Piikani Nation – Technical Review of EIS, June 15, 2018 (CEAR #48)

Context and Rationale:

The EIS Guidelines require the proponent to identify and assess the Project's cumulative effects, including consideration of past, present, and reasonably foreseeable future activities.

The EIS is not clear about how much existing disturbance in the LAA would be absorbed during Project construction. The Project is in a heavily fragmented area and has few remaining areas with sufficient interior habitat area to support undisturbed traditional use. Minimizing new or additional disturbance by considering existing disturbed areas when planning the Project's footprint may help to mitigate cumulative effects. Additional information is required to understand to understand Project effects in this context.

Information Request:

a) Define and identify disturbed areas within the LAA and explain how existing disturbance is, or could be, absorbed during Project construction, through current Project design or design changes.

Response IR3-43

a) Anthropogenic (disturbed) areas in the vegetation LAA (1 km buffer around the PDA) represents 54% (2,638 ha of 4,860 ha) of that LAA (Volume 3A, Table 10-12). Most of this disturbed area (48%) is agriculture (annual crop, dugout, hayland, tame pasture), with the remainder (6%) being various other disturbances (includes utilities, roads, structures). The PDA (1,437 ha) is 29.6% of the LAA of which the majority is the reservoir (88%) with only 179 ha remaining as permanent (hence, directly disturbed) Project physical works area (the remaining 168 ha are temporary construction sites).

As such, the amount of land that will be permanently disturbed by the Project is relatively small compared to the total PDA area, with most of that being agriculture land (including a feedlot and tilled land which will be reclaimed and seeded to grass). Existing land use offers few opportunities to minimize additional disturbance by the Project.

Furthermore, there are no opportunities to modify the PDA (location) to optimize use of any existing disturbance because of the nature of the Project's rigourous engineering design requirements. That design is based on optimized use of landscape terrain features to maximize the volume of flood water retention and, based on civil engineering codes and other requirements, to divert and safely impound and temporarily retain that flood water.

ACCIDENTS AND MALFUNCTIONS

Question IR3-44: Accidents and Malfunctions – Residual Effects

Sources:

EIS Guidelines, Part 2, Sections 6.6.1; 6.5

EIS Volume 3D

CEAA Annex 2: A) Early Technical Issues, Question 22 (b), May 11, 2018

Rocky View County – Comments on the EIS, June 15, 2018 (CEAR #571)

Context and Rationale:

The EIS Guidelines require the proponent to identify the probability of potential accidents and malfunctions related to the Project, including the significance of these effects and outline the criteria that should be used in determining the significance of residual effects, including magnitude, geographic extent, duration, frequency, reversibility, ecological and social extent, and existence of environmental standards, guidelines or objectives for assessing the effects.

As the EIS does not identify the key criteria used in making its significance determinations for each accident and malfunction scenario, it is not clear how these determinations were made.

Information Request:

a) For each accident and malfunction scenario, provide the criteria and associated rating used to determine the significance of residual environmental effects for each VC.

Response IR3-44

a) For each accident and malfunction scenario, the criteria and rating used to determine the significance of residual effects on each VC is the same as the criteria and rating used to determine significance of residual effects on each VC during both construction and dry operations, and flood and post-flood operations. Those criteria are detailed in Table IR44-1 for each VC and are taken directly from the VC sections in the EIA. Furthermore, the effectiveness of emergency response, as appropriate, is also considered, given the unique nature of accidents and malfunctions.

Table IR44-1 Significance Criteria

VC	Significance Criteria
Air Quality and Climate	**Ambient Air Quality** A residual effect is rated as significant if ambient concentrations of the CAC (or odour) are predicted to be above the applicable regulatory objectives (i.e., are high in magnitude) and are of concern because of their geographic extent and frequency of occurrence, and the presence of potentially sensitive receptors (e.g., human, wildlife, vegetation, soils, or waterbodies). **Ambient Light** A significant environmental effect on lighting is defined as an increase in project-related light emissions such that the CIE guidelines for light trespass and glare in a rural environment (E2) are exceeded, and the resulting conditions related to sky glow would be altered toward those of a suburban environment. **GHG Emissions** Provincial and federal governments have indicated a desire to reduce their total GHG emissions and have announced GHG reduction targets. These targets have been established to identify Alberta's and Canada's contribution in reducing global GHG concentrations. Jurisdictional targets are affected by numerous factors outside the scope of this Project. Therefore, significance related to the release of GHG emission is focused on the effect project emissions would have on the provincial and national emission totals. In the absence of provincial and federal policy and legislation related to a quantitative significance threshold, this Project uses CEA Agency guidance (CEAA 2003), professional judgment, and the characterization of the effect to arrive at a qualitative determination of significance.
Acoustic Environment	A residual adverse effect on the acoustic environment is considered significant if the Project noise emissions at the identified receptor locations exceed the quantitative limits based on the Health Canada guidance for environmental assessments.
Hydrogeology	A significant adverse residual effect on groundwater quantity is defined as a measurable change in groundwater quantity that decreases the yield from an existing and otherwise adequate groundwater supply well to the point where it is inadequate for its intended use. A significant adverse residual effect on groundwater quality is one where the quality of groundwater from an otherwise adequate water supply well that meets guidelines deteriorates to the point where it becomes non-potable or cannot meet the Guidelines for Canadian Drinking Water Quality (Health Canada 2012) for a consecutive period exceeding 30 days.
Hydrology	A significant adverse residual effect on hydrology (i.e., surface water quantity) and sediment transport is defined as a measurable change that: • does not meet established instream flow needs or • contravenes a watershed management target

Table IR44-1 Significance Criteria

VC	Significance Criteria
Surface Water Quality	A significant adverse residual effect on water quality is defined as a measurable change in water quality that: • exceeds an implemented water quality objective or site-specific water quality guideline for the protection of aquatic life or • contravenes a watershed management target or • causes acute or chronic toxicity to aquatic life or • changes the trophic status of a lake or stream
Aquatic Ecology	Thresholds for significance of residual effects are defined in consideration of applicable federal and provincial regulatory requirements, standards, objectives, and guidelines to reflect the limits of an acceptable state of a fishery as defined by the *Fisheries Act* or any fish species designated under Schedule 1 of SARA. Significance thresholds address subsections 35(1) and 36(3) of the *Fisheries Act*, section 79 of SARA, and the Fisheries Protection Policy Statement (DFO 2013b). In consideration of the *Fisheries Act*, net loss of fish habitat would be assessed as a significant adverse effect (i.e., permanent alteration to or destruction of CRA fish habitat that cannot be offset). A significant adverse environmental effect on aquatic ecology is one that results in: • permanent alteration of fish habitat that likely results in serious harm to fish and cannot be mitigated or offset or • destruction of fish habitat that likely results in serious harm to fish and cannot be mitigated or offset or • serious harm to fish due to the death of fish
Terrain and Soils	A significant adverse environmental effect on terrain and soils is one that results in: • A change in terrain stability resulting in an increase in areas with a moderate to high likelihood of landslide initiation as compared to existing conditions, which cannot be offset through mitigation or • A change in soil quality or quantity resulting in a reduction in agricultural land capability which cannot be offset through mitigation or compensation measures.
Vegetation and Wetlands	A significant effect on vegetation and wetlands after the application of avoidance and mitigation measures is one that: • threatens the long-term persistence or viability of a plant species or community in the RAA, including effects that are contrary to or inconsistent with the goals, objectives or activities of recovery plans, action plans and management plans, or • results in unreplaced loss or disturbances of wetlands that has not been given prior approval by Alberta Environment and Parks, or • threatens the long-term availability of traditionally use plants within the regional assessment area.
Wildlife and Biodiversity	A significant adverse residual environmental effect on wildlife is defined as one that, following the application of avoidance and mitigation measures: • threatens the long-term persistence or viability of a wildlife species in the RAA or, • is contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans and management plans.

Table IR44-1 Significance Criteria

VC	Significance Criteria
Land Use and Management	A significant adverse environmental effect on land resource use is defined as one where: • the Project does not comply with established or amended land use plans, policies or by-laws or • the Project would create a change or disruption that restricts or degrades present land use capability to a point where the activities cannot continue at or near current levels and where compensation is not possible or • the Project is not compatible with established park or protected area plans or policies. Unique sites or special features would be substantially and irreversibly compromised because of disrupted access or reduced quality of sites.
Historical Resources	A significant adverse residual environmental effect on historical resources is defined as one that results in an unauthorized project-related disturbance to, or destruction of, all or part of a historical resource considered by ACT to be of heritage value, and that is not mitigated or compensated as required by the regulators.
Traditional Land and Resource Use	Under CEAA 2012, there is a requirement to make a determination of significance for residual environmental effects on TLRU. The lack of laws, policies, management plans or standard industry practice regarding thresholds for effects on TLRU makes choosing and applying significance thresholds challenging. The subjective nature of describing and understanding the importance of effects on current use of lands and resources for traditional purposes means that selected thresholds might not evenly apply across Indigenous groups and circumstances. Indigenous groups themselves may have differing views on the meaning of significance that reflect oral history traditions and holistic understandings of natural phenomena. Given these considerations, a significant adverse effect on TLRU is defined as a long-term loss of availability of traditional use resources or access to lands relied on for current use practices or current use sites and areas, such that current use is critically reduced or eliminated from the RAA. This may include disruption to current use activities and practices where biological resources or physical sites are not significantly affected in the RAA.
Public Health	A significant adverse effect to human health may occur when hazard exposures exceed the objectives established by relevant regulatory organizations (i.e., an ER greater than 1.0), and are likely to result in a substantive change in the health of an identified receptor. This conclusion is based on a consideration of the measurable parameter and relevant contextual effects attributes. A significant adverse effect to human health may occur when there is a persistent and substantial decline in the area of land available for country foods harvesting, and if that land provides substantial country food resources for people.
Infrastructure and Services	A significant adverse residual effect occurs when there is an exceedance of available capacity, or a substantial decrease in the quality of a service provided, on a persistent and ongoing basis, which cannot be mitigated with current or anticipated programs, policies, or mitigation measures. A significant adverse residual effect is also unlikely to recover to existing conditions.

Table IR44-1 Significance Criteria

VC	Significance Criteria
Employment and Economy	A significant adverse residual effect on the economic environment is defined as one that is distinguishable[7] from current conditions and trends and cannot be managed or mitigated through adjustments to programs, policies, plans, or through other mitigation measures. The residual effects assessment considers both positive and adverse effects after mitigation and other management measures are implemented. However, significance determination is made for adverse effects only.

[7] "Distinguishable" means that the adverse effect is measurable, predictable, and attributable to one or more project or cumulative interactions (i.e., it is not within the boundaries of normal variation of the measurable parameter under existing conditions).

ALTERNATIVE MEANS

Question IR3-45: Alternative Means

__Sources:__

EIS Guidelines Part 2, Section 2.2

EIS Volume 1, Section 1.0; 2.2.1.1; 2.2.1.3,

Rocky View County – Comments on the EIS, June 15, 2018 (CEAR #571)

__Context and Rationale:__

The EIS Guidelines require the proponent to identify and consider the effects of alternative means of carrying out the project, and to provide an analysis of alternative means of meeting the project purposes or objectives that considers environmental effects as per CEAA 2012. The Agency's Operational Policy Statement on *Addressing "Purpose of" and "Alternative Means" under CEAA 2012* states that the first step in considering alternative means of carrying out the designated project is to identify technically and economically feasible alternative means. To do this the proponent should include economic criteria such as a comparison of cost estimation.

Cost Estimates

The EIS states that the initial cost estimates are susceptible to change, but the cost-escalation risk for the McLean Creek (MC1) option is higher than for the Springbank Off-Stream Reservoir Project (the Project) based on the Deltares 2015 report. This may no longer provide an accurate comparison due to Alberta Transportation's Project updates since 2015. Updated comparisons of estimated costs and benefits for MC1 and the Project are needed to assess the potential socio-economic effects to the surrounding communities.

Environmental Effects

The EIS compares some of the environmental effects of two options, the Springbank Off-Stream Reservoir Project and the MC1 option. The evaluation of environmental effects from MC1 in the EIS does not describe how the potential changes to the environment could affect Indigenous health and socio-economic conditions, physical and cultural heritage, the current use of lands and resources for traditional purposes, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

Alternatives Considered

The EIS notes the Project's purpose is to help reduce the effects of future extreme floods on infrastructure, water courses and people in the City of Calgary and downstream communities. The Agency's Operational Policy Statement on *Addressing "Purpose of" and "Alternative Means" under CEAA 2012* states that the approach and level of effort applied to addressing alternative means is established on a project-by-project basis taking into consideration the level of concern expressed by Indigenous groups or the public.

The EIS identified five potential locations for flood mitigation measures on the Elbow River. Public comments received during technical review of the EIS indicate interest in specific alternative means of reducing effects of future extreme floods on infrastructure, water courses and people, such as the Tri-River Joint Reservoir of Alberta and the Micro-Watershed Impounding Concept (for example, CEAR 1152 and CEAR #1037).

<u>Information Requests:</u>

a) Given any Project updates, provide information on the comparison of MC1 and the Project, including costs/benefits.

b) Describe how changes to the environment from the MC1 option would affect Indigenous health and socio-economic conditions, physical and cultural heritage, the current use of lands and resources for traditional purposes, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

c) Evaluate whether the Tri-River Joint Reservoir of Alberta and the Micro-Watershed Impounding Concept are feasible alternative means of meeting the Project's purpose. Consider potential environmental effects of each alternative in this evaluation.

Response IR3-45

a) There have been no revisions to the designs of the Project or the MC1 Option since filing of the EIA, except for the addition of a debris deflector to the Project.

The current projected timeline is for SR1 to be functionally operational after the second year of construction (1:100 year flood) and to be fully operational to handle the design flood after the third year of construction.

The updated timeline for MC1 Option, assuming a 5-year regulatory process, to be operational would be 9 years from the decision to move forward (i.e. ready the following flood season).

The construction cost opinions for both projects were estimated by the design professionals for SR1 and the MC1 Option and consistent with practices for the current level of design advancement. A normal process in the development of heavy civil projects is to refine estimates as additional information and design is completed (i.e. conceptual, preliminary, advanced/final). The updated Cost Estimate Opinion for the MC1 Option is provided as Appendix IR45-1 and SR1 is provided as Appendix IR45-2.

A number of variables used in the 2017 benefit/cost analysis have changed since its submission (Volume 4. Supporting Documentation, Document 1). The 2019 benefit/cost analysis is provided in Appendix IR45-3.

b) An assessment has been undertaken to consider potential effects of the MC1 Option on Indigenous health and socio-economic conditions, cultural heritage and the current use of lands and resources for traditional purposes, and physical heritage or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance. The assessment, provided in Appendix IR45-4, drew on the findings of the *Elbow River at McLean Creek Dam (MC1) Environmental Impact Screening Report* (MC1 Option Screening Report) (Hemmera 2017) with respect to potential effects of the MC1 Option on valued components considered in the Screening Report.

The methodology used to support the assessment (Hemmera 2019) followed the methodological approach used to support the assessment presented in the MC1 Option Screening Report (Hemmera 2017) with the scope of Indigenous groups considered being consistent with the corresponding sections of the EIA for the Project.

With respect to Indigenous health and socio-economic conditions, the assessment concludes that the MC1 Option may result in following residual effects:

- positive, substantive, residual effects on non-traditional land and resource use
- positive, non-substantive, residual effects on Indigenous labour force, Indigenous contracting and procurement opportunities and Indigenous regional economic conditions
- positive, substantive, residual effects on Indigenous health and safety and emergency response
- positive, non-substantive, residual effects on Indigenous health services

With respect to cultural heritage and the current use of lands and resources for traditional purposes, the assessment concludes that the MC1 Option may result in the following residual effects:

- adverse changes in available lands and terrestrial resources which may be non-substantive or substantive, depending on the specific characteristics assigned by each individual Indigenous group
- adverse changes in available waterbodies and aquatic resources which may be non-substantive or substantive, depending on the specific characteristics assigned by each individual Indigenous group
- adverse changes to the quality of current use activities, conditions and resources which may be non-substantive or substantive, depending on the specific characteristics assigned by each individual Indigenous group
- adverse changes in access to cultural heritage and/or current use activities, conditions, and resources which may be non-substantive or substantive, depending on the specific characteristics assigned by each individual Indigenous group
- changes to the tangible and intangible aspects of cultural heritage and the current use of lands and resources were not characterized

With respect to physical heritage or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance, the assessment concludes that no recorded historical values or notable architectural values are present in the MC1 Option area. The MC1 Option would be supported by Historic Resource Impact Assessment field studies required by Alberta Culture and Tourism (ACT) for archaeology and paleontology to be completed prior to construction. As such, the assessment assumes that mitigation and/or construction monitoring required by ACT will effectively mitigate potential effects and no residual effects to physical heritage (i.e., archaeological sites and paleontological resources) are anticipated would result from the MC1 Option.

c) The following provides Alberta Transportation's evaluation of the feasibility of the Tri-River Joint Reservoir (TRJR) of Alberta and the Micro-Watershed Impounding Concept as alternative means of meeting the Project's purpose.

TRI-RIVER JOINT RESERVOIR

The proposed Tri-River Joint Reservoir (TRJR) scheme was not part of the Government of Alberta's options development and analysis for the Elbow River watershed. Alberta Transportation met with the TRJR project's proponent and the information on the TRJR that has been supplied to date has been limited to the same information provided on the proponent's website https://www.preventingalbertafloods.ca.

The details provided on the TRJR project to date are insufficient to demonstrate the feasibility of the TRJR; or draw comparisons against SR1 or the MC1 Option. Alberta Transportation has evaluated the information provided and have attempted to discern what could be the key components of TRJR.

Information on the TRJR states that "It's at the headwaters of the Highwood and the Elbow and the Kananaskis Rivers,", "That's the bull's-eye." Alberta Transportation believes that the purpose of the quote is to describe the location where the largest totals of precipitation fell in 2013. Alberta Transportation does not, however, agree that this indicates the ideal location for a flood control reservoir.

Any flood control reservoir, whether placed in-stream or off-stream, needs to be placed at a location in the watershed that is sufficiently downstream to 'catch' and hold the water draining from upstream lands. The farther downstream the reservoir is placed, the more catchment area it will have, and the more effective it will be in mitigating flooding from the upstream catchment area for the City of Calgary and downstream communities. The TRJR is proposed to be in the headwaters of the Sheep River watershed, which limits its effectiveness in meeting the Project's primary goal of flood mitigation for the City of Calgary and downstream communities.

Based on information provided by the TRJR's proponent, the TRJR would use a natural basin in the headwaters of Sheep River. Alberta Transportation's review of topographic contours on publicly available 1:50,000 scale NTS maps does not reveal the presence of a natural basin in this area. Rather, the maps suggest that a dam of considerable height would be required on the Sheep River main channel (in-stream) between Gibraltar Mountain and Mount Burns to impound water. The geology in this location is highly complex and would require comprehensive geotechnical investigation to determine the feasibility of a dam. (If a natural basin that did not require a dam were present, then it would currently hold water in the form of a lake.)

Should a dam be placed on the Sheep River, it would impound water from lands draining upstream of the catchment area, which is limited to the 72 km^2 (this comprises the Sheep River headwaters surrounding the dam-created reservoir). With inclusion of a dam in the Sheep River valley, the TRJR may be able to impound some water for water supply or hydroelectric production. However, its location in the headwaters limits its ability to have any notable flood attenuation capacity for the Sheep River watershed.

A dam and reservoir in the Sheep River watershed will only provide water management within that watershed. It would not provide water management for Elbow River, nor forHighwood River. TRJR proposes that these watersheds can be managed by tunneling from each of Elbow River and Highwood River to connect these rivers to the TRJR at their headwater tributaries, allowing the TRJR to take flood water from each of the Elbow, Highwood, and Sheep River watersheds and transfer it within those watersheds for flood and drought management. The TRJR's Phase 1 tunnel is the proposed solution to provide immediate protection for Elbow River.

Although not mentioned in the available information on the TRJR, Alberta Transportation believes that a diversion structure, similar to that for SR1, would be necessary to control the diversion of water to the TRJR. However, such a scheme would only divert 32 km^2 of the Elbow River watershed (catchment area) into the TRJR. By contrast, the current design of SR1 captures 868 km^2 of the Elbow River watershed and the MC1 Option design captures 702 km^2 of the Elbow River watershed.

The current projected timeline is for the Project to be functionally operational after the second year of construction (1:100 year flood) and to be fully operational to handle the design flood after the third year of construction.

Information on the TRJR states that it can be completed faster than SR1 and the MC1 Option and indicates that the Phase 1 tunnel provides immediate protection and could be built in three to six months. Alberta Transportation believes this to be significantly underestimated, based on its experience: its experience in evaluating the Glenmore tunnel option suggests tunneling is a slow and costly proposition and highly dependent upon geotechnical conditions. There is no indication from the proponent on their estimate of the cost of their Phase 1 tunnel and Alberta Transportation was not able to derive an estimate from the limited information available.

With regard to relative environmental effects, the TRJR is located in key wildlife areas including the Core Recovery Zone for grizzly bear within the Livingstone Bear Management Area (BMA 5) as well as mountain goat and bighorn sheep range (AEP 2016a). The grizzly bear Core Recovery Zones represent core conservation areas that contain high quality habitats and low road densities. The Core Recovery Zones are designed to reduce human-caused mortality risk and provide habitat security for grizzly bears (AEP 2016b). Development in this area would increase human-caused mortality risk for grizzly bears and result in potential direct and indirect effects within the mountain goat and sheep areas, which are designed to protect sensitive winter range as well as lambing/kidding areas. Cutthroat trout and rainbow trout occupy the upper Sheep River mainstem near the proposed TRJR footprint. The upper Elbow and Highwood rivers also support resident bull trout, brook trout and mountain whitefish. A dam on the mainstem of the Sheep River, and the impoundment, would have a considerable impact on fish and wildlife in the headwaters of the Sheep, Highwood and Elbow River valleys. In addition, the TRJR project, as proposed, would divert over 1,000,000 m^3 of water per year from one basin to another, likely triggering significant environmental reviews, which would impact overall timeline. This transfer would be a permanent inter-watershed transfer, which have a substantial negative environmental effect; it is not a temporary transfer within the watershed, as is the case with SR1.

MICRO-WATERSHED IMPOUNDING CONCEPT

Details on the Micro-Watershed Impounding scheme have not been provided to Alberta Transportation and the only available information that Alberta Transportation is aware of is on the TRJR website. Alberta Transportation does not know who its proponent is, nor does Alberta Transportation have any details to evaluate its merit, or feasibility.

Alberta Transportation assumes that Micro-Watershed Impounding scheme refers to a series of low-head dams or weirs placed throughout Elbow River and its tributaries. This concept would require significant disruption to the Elbow River system as a whole with the installation of multiple low-head dams that would be required to meet the active flood storage capacity requirements for flood control on Elbow River. Micro-hydro and other low-head dams have been proven to be barriers to fish, and mitigations using fishways are often rarely successful at these facilities. This scheme is likely to render the river impassable at multiple points in the watershed. The Micro-Watershed Impounding scheme would also require road and utility access to each of the micro-impoundment facilities. There are currently very few roads (both inactive and active) within the Sheep, Elbow and Highwood River watersheds, and disturbance from this access would likely have a considerable effect on the watershed, the fish and wildlife, and the area's stakeholders.

CONCLUSIONS

The TRJR, as it is proposed, cannot meet the Province's flood mitigation objectives. The Micro-Watershed Impounding scheme is not feasible as a flood mitigation solution for Elbow River because of its environmental impact and inefficiency in achieving Alberta's flood mitigation objectives.

REFERENCES

AEP (Alberta Environment and Parks). 2016a. Wildlife Sensitivity Maps. Available at: https://www.alberta.ca/wildlife-sensitivity-maps.aspx#toc-0

AEP. 2016b. Alberta Grizzly Bear (*Ursus arctos*) Recovery Plan (Draft). Alberta Environment and Parks, Alberta Species at Risk Recovery Plan No. 38. Edmonton Ab. 85 pp.

Hemmera Envirochem Inc. 2017. Elbow River at McLean Creek Dam (MC1) Environmental Impact Screening Report. Report prepared for Alberta Transportation by Hemmera Envirochem Inc, September 2017.

Hemmera Envirochem Inc. 2019. Assessment of Potential Effects of the MC1 Option on Indigenous Health and Socio-Economic Conditions, Cultural Heritage and Current Use of Lands and Resources for Traditional Purposes, and Physical Heritage. Report prepared for Alberta Transportation by Hemmera Envirochem Inc, April 2019.

PROJECT OPERATIONS

Question IR3-46: Project Operations - Communications

Sources:

EIS Guidelines Part 2, Sections 3.2.2; 5

EIS Volume 1, Section 3.5

Technical Advisory Group – July 10 and 11, 2018 meeting

Context and Rationale:

The EIS Guidelines require the proponent to describe project activities involved in construction and operations and to engage with Indigenous peoples.

The EIS notes that AEP will communicate with the City of Calgary in advance of and during the flood season annually, to maintain an understanding of the system's status. Communications plans with other interested parties are not described.

Indigenous groups have presented needs regarding communication about project construction and operation. For example, Piikani Nation requested that Alberta Transportation provide at least three weeks' notice to the Nation prior to disturbance so that Elders may be consulted and appropriate cultural protocols, including ceremonies, can be planned before construction. Members of the technical advisory group identified safety concerns regarding project operations and identified a need for clear communication plans with Indigenous communities.

Effective communication could serve to mitigate risk and potential effects of the Project to Indigenous peoples, for example, by allowing continued land use in a safe manner.

Information Requests:

a) Provide details of a communications plan that includes means and procedures for communicating Project construction, maintenance, and operation activities to the public and Indigenous groups, throughout the life of the Project. Consider the needs for communicating Project operations to individuals who may be in the Project vicinity upon commencement of operations. Consider how diverse populations may require specific or targeted communication (e.g. elders). Identify how these and other considerations are reflected in the plan.

b) Incorporate input from Indigenous groups and the public on the anticipated effectiveness of the proposed communication plan. Where this input is not yet complete, describe the plan for gathering and incorporating this input in to communications plan design and implementation.

Response IR3-46

a) Alberta Transportation continues to communicate and engage with the public, Indigenous groups and individual project stakeholders. A communications plan will be developed prior to Project construction that outlines the means and procedures for communicating Project information during the different phases of the Project.

Prior to construction, Alberta Transportation will appoint a Community Liaison that will serve as point of contact with surrounding stakeholders and Indigenous groups; the Liaison will primarily communicate through the local representation for, community associations, local businesses, government administration and local government officials and with the designated representatives of Indigenous groups. The Community Liaison will provide updates on Project construction activities through these local representatives.

In addition to providing updates, complaints received during Project construction will be directed by the Community Liaison to the construction contractor. The construction contractor will describe the protocol for the receipt, response and documentation of complaints in its Environmental Construction Operations Plan (ECO Plan). The construction contractor will investigate the conditions and cause of the conditions that led to the complaint. The construction contractor will take necessary actions to try to address the complaint.

AEP actively communicates with the public, Indigenous groups, and stakeholders at their other operating facilities and will use this experience as a basis for establishing communications all phases of the Project. AEP anticipates pre-season (spring) operations and emergency preparedness sessions with affected communities, Indigenous groups, stakeholders, and responders as required.

b) Through its ongoing engagement program for the Project, Alberta Transportation has developed an understanding of the communication style and preferences of the different Indigenous groups and stakeholders being engaged. Alberta is in the process of drafting the communication plan and has not yet sought formal input with respect to the plan. Alberta Transportation anticipates building upon engagement efforts to date to continue to strengthen relationships with potentially affected Indigenous groups and stakeholders. Information provided throughout the regulatory phase will be used to inform the communication plan, as appropriate.

PRIORITY SUPPLEMENTARY INFORMATION REQUESTS FROM THE NATURAL RESOURCES CONSERVATION BOARD

Question IR3-47: Priority Supplementary Information Requests from the Natural Resources Conservation Board

Sources:

Tsuut'ina Nation – Technical Review of Revised Environmental Impact Statement, June 20 2018 (CEAR #50)

Priority Supplementary Information Requests from the Natural Resources Conservation Board, February 8, 2018

Context and Rationale:

Tsuut'ina Nation has identified the information requested in the February 8, 2018 Priority Supplementary Information Requests from the Natural Resources Conservation Board as necessary to its and to the Agency's understanding of the potential effects of the Project, including potential impacts to Aboriginal and treaty rights.

Information Request:

a) **Upon submission of responses to the Natural Resources Conservation Board, provide access to these responses to interested Indigenous groups and to the Canadian Environmental Assessment Agency.**

Response IR3-47

a) Alberta Transportation received a communication from the Natural Resources Conservation Board (NRCB) on February 21, 2018 entitled "Springbank Off-Stream Reservoir Project – NRCB Application No. 1701 Priority Questions from NRCB". Alberta Transportation assumes this is the information to which the Canadian Environmental Agency is referring to in this request. The information requests were provided by the NRCB to allow Alberta Transportation additional time in which to prepare responses to questions which would likely occur within the formal SIR package. The NRCB noted in the communication of February 21 that the questions "may be modified somewhat in the formal SIR" submission. Alberta Transportation is compiling responses to the formal IR package that was received on July 28, 2018 from AEP, which included information requests from the NRCB. Copies of the responses will be shared with the Agency and Indigenous groups engaged on the Project, when the responses are submitted to AEP, and thence to NRCB.