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June 15, 2018

Via email: *CEAA.Springbank.ACEE@ceaa-acee.gc.ca*

Canadian Environmental Assessment Agency
9700 Jasper Ave, Suite 1145
Edmonton AB T5J 4C3

Dear Sir/Madam:

Re: Springbank Off-Stream Reservoir Project (80123)
File No.: 058106-0001

We are legal counsel to the owners of the lands set out in Schedule A. These lands are within the Project Area. In this correspondence, our clients will be referred to as the "**Affected Landowners**".

We provide these comments on behalf of the Affected Landowners in response to the Revised Environmental Impact Statement ("**EIS**") for the Springbank Off-Stream Reservoir Project ("**Project**" or "**SR1**"), submitted to the Canadian Environmental Assessment Agency ("**CEAA**") by Alberta Transportation on March 29, 2018.

Introduction

For the most part, the Affected Landowners' families have been on their lands for generations, some settling as early as the 1830s. The Affected Landowners have a deep and longstanding connection to their lands and have acted as responsible environmental stewards of the lands. The history of the settlement of these lands is an integral part of the cultural heritage of southern Alberta. If the Project is constructed, the Affected Landowners will be required to relinquish their lands.

Up to September of 2015, Alberta Environment and Parks ("**AEP**") was asserting that both SR1 and the MacLean Creek Dam Project ("**MC1**") were being considered for upstream flood mitigation projects for the Elbow River. In October of 2015, without any consultation with directly impacted parties, who include the Affected Land and the Tsuut'ina Nation, AEP announced SR1 had been chosen over MC1 as the upstream mitigation project to be executed. As will be discussed below, and is apparent from all of the information before CEAA, that decision is not supportable from an environmental, technical, cost or social perspective.

The construction and operation of the Project would have significant and ongoing adverse impacts on the environment, particularly on matters of federal jurisdiction, such as federal reserve lands, Aboriginal peoples and fish and fish habitat. These effects will be permanent in duration since the Project's infrastructure is not intended to be decommissioned.

The Affected Landowners therefore submit that CEAA should find that the Project poses significant adverse environmental effects and should not be approved.

Dam Safety Information Deficiency Analysis

Attached as Schedule B is a memorandum prepared by RJH Consultants Inc. (**"RJH"**) entitled "Dam Safety Information Deficiency Analysis."

RJH reached the following conclusions:

- The EIS lacks adequate information for a regulatory authority or an independent engineer to evaluate the feasibility of the concepts and the safety of the dam and other project components.
- Adequate information was not provided to evaluate the technical, safety, and performance differences and risks between the MC1 and SR1 alternatives. Further, many of the statements used to demonstrate the benefit of the SR1 over the MC1 are not supported by data and are technically questionable.
- Potential failure modes for the dam and other facilities do not appear to been identified in the EIS and therefore, have not been addressed in development of the design concept.

- The design includes a gated outlet that enables, or could result in, the dam storing water for prolonged periods of time. It does not appear that the design has adequately considered this condition, which could impact the safety of the facility.

RJH also concludes that many components of the dam design could lead to failure or accident:

- The dam has components for long-term reservoir storage; however, the dam is not designed to meet safety standards for dams having long-term reservoir storage. These include accounting for risks like embankment, foundation seepage and stability problems.
- Under seepage could lead to an erosional failure of the foundation and dam.
- Debris and sediment deposition could obstruct and block the channel.
- There are risks associated with the location of the emergency spillway.

As RJH concludes, failure of any of the critical dam components could be catastrophic, resulting in loss of life or property damage. Failure of the dam would have direct impacts on elements of the environment within federal jurisdiction. These include: (1) impacts to federal lands (Tsuut'ina's reserve lands are only 400 metres from the Project); (2) loss of fish and fish habitat; and (3) loss of migratory bird habitat. These adverse impacts on the environment are significant.

Furthermore, RJH concludes that the purported benefits of SR1 over MC1 are entirely unsupported. The Project proponent has continually attempted to justify the selection of SR1 by asserting that it is cheaper, faster and offers greater protection to the City of Calgary. RJH rejects these conclusions:

- The cost-benefit analysis failed to consider the potential for MC1 to generate revenue from hydro power, water storage, and increased recreational opportunities. It also failed to detail the risk of escalating construction costs inherent in SR1 due to its larger footprint and the need for more Project components.
- Flood risks during construction exist for both MC1 and SR1.

- The projected schedule for SR1 is unrealistic given the size of the Project.
- MC1 could capture and temporarily store all of the upper basic flood flows and easily offset the flood inflows occurring downstream of the dam. In contrast, SR1 is constrained to only divert 600 m^3 per second of upper basin flows, while MC1 could accommodate variable flows.

Overall, the EIS' comparison of SR1 and MC1 consists of conclusions unsupported by any analysis or evidence. Alberta Transportation's EIS fails to satisfy the obligation to "identify and consider the effects of alternative means of carrying out the project that are technically and economically feasible."

Finally, RJH identifies a number of areas where design and technical information and analysis is lacking, and therefore should be the subject of information requests. The Affected Landowners respectfully request that CEAA issue these Information Requests to Alberta Transportation.

Technical Deficiencies

Attached as Schedule C are Annexes A to F EIS Technical Review and Information Requests prepared by PGL Environmental Consultants.

PGL concludes:

- The EIS groundwater modeling fails to predict effects on matters of federal jurisdiction, including effects on Tsuut'ina's federal reserve lands and on Tsuut'ina's drinking water.
- The EIS fails to provide a rationale for the hydrology boundaries. The boundaries exclude any consideration of backwater effects of the diversion gates. The backwater structure is located in close proximity to Tsuut'ina's federal reserve lands.

- The EIS fails to conduct the mandated cumulative effects analysis for hydrology and wildlife and biodiversity, including the effects of the Bragg Creek project.[1]
- The EIS flood frequency analysis fails to consider the effects of climate change.
- The EIS fails to consider long-term loss of traditional use plants.
- The EIS fails to include monitoring plans, including with respect to vegetation and wetlands, and wildlife and biodiversity.
- The EIS fails to incorporate Traditional Land Use information throughout its analysis.

Conclusion

The Project would have ongoing significant adverse environmental effects on matters of federal jurisdiction, including fish and fish habitat, migratory birds, federal lands, and aboriginal peoples. The EIS does not identify adequate measures to address these effects.

The Project's design could lead to catastrophic failure, which would have significant adverse effects on federal lands, fish and fish habitat and migratory bird habitat. Furthermore, the SR1/ MC1 alternative assessment analysis is flawed and deficient, consisting of primarily assertions and conclusions unsupported by facts or analysis. Based on the information presented in the EIS, CEAA cannot be satisfied that SR1 is the best upstream flood mitigation option.

On behalf of the Affected Landowners, we urge CEAA to find that the Project poses significant adverse environmental effects and should not be approved.

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[1] EIS Guidelines, s 6.6.3.

Thank you for your consideration of these comments.

Yours truly,

MLT AIKINS LLP

Per:

For: John P. Gruber

JPG:smh
Encls.

SCHEDULE "A"

All Springbank Land Owners

Number	Legal Description
1.	First Meridian 5 Range 4 Township 24 Section 27 Quarter North West Excepting thereout all mines and minerals And the right to work the same Area: 64.7 Hectares (160 acres) more or less Second Meridian 5 Range 4 Township 24 Section 27 Quarter North East Containing 64.7 Hectares (160 acres) more or less Excepting thereout Plan Number Hectares (Acres) Road 8911908 1.62 3.99 Excepting thereout all mines and minerals And the right to work the same
2.	Meridian 5 Range 4 Township 24 Section 27 Quarter South West Excepting thereout all mines and minerals And the right to work the same Area: 64.7 Hectares (160 acres) more or less
3.	Meridian 5 Range 4 Township 24 Section 27 Quarter South East Containing 64.7 Hectares (160 acres) more or less Excepting thereout: Plan Number Hectares (Acres) Road 8911908 1.57 3.89 Excepting thereout all mines and minerals And the right to work the same

Number	Legal Description
4.	First Meridian 5 Range 4 Township 24 Section 26 Quarter North West Containing 64.7 Hectares (160 acres) more or less Excepting thereout: Plan Number Hectares (Acres) Roadway 4953JK 1.57 3.89 Road 8911908 1.60 3.95 Excepting thereout all mines and minerals And the right to work the same Second Meridian 5 Range 4 Township 24 Section 26 Quarter North East Containing 64.7 Hectares (160 acres) more or less Excepting thereout: Plan Number Hectares (Acres) Roadway 4953JK 1.62 4.01 Excepting thereout all mines and minerals And the right to work the same
5.	First Meridian 5 Range 4 Township 24 Section 26 Quarter South West Containing 64.7 Hectares (160 acres) more or less Excepting thereout: Plan Number Hectares (Acres) Road 8911908 1.64 4.05 Road 9410772 0.793 1.96 Excepting thereout all mines and minerals And the right to work the same Second Meridian 5 Range 4 Township 24 Section 26 Quarter South East Containing 64.7 Hectares (160 acres) more or less Excepting thereout Hectares (Acres) more or less A) Plan 9410772 Road 0.405 1.00 Excepting thereout all mines and minerals And the right to work the same

Number	Legal Description
6.	Meridian 5 Range 4 Township 24 Section 25 Quarter South West Containing 64.7 Hectares (160 acres) more or less Excepting thereout Hectares (Acres) more or less A) Plan 9410772 Road 0.394 0.974 Excepting thereout all mines and minerals
7.	Meridian 5 Range 4 Township 24 Section 25 Quarter North East Excepting thereout all mines and minerals Area: 64.7 Hectares (160 acres) more or less
8.	Meridian 5 Range 4 Township 24 Section 25 Quarter South East Containing 64.7 Hectares (160 acres) more or less Excepting thereout: Hectares (Acres) more or less A) Plan 9410772 Road 0.394 0.974 Excepting thereout all mines and minerals
9.	Meridian 5 Range 4 Township 24 Section 22 Quarter North East Containing 64.7 Hectares (160 acres) more or less Excepting thereout: Plan Number Hectares (Acres) Block 'A' 8110352 15.28 37.76 Road 8911908 1.46 3.61 Excepting thereout all mines and minerals

Number	Legal Description
10.	First Meridian 5 Range 4 Township 24 Section 23 Quarter North West Containing 64.7 Hectares (160 acres) more or less Excepting thereout Plan Number Hectares (Acres) Road 8911908 1.75 4.32 Excepting thereout all mines and minerals Second Meridian 5 Range 4 Township 24 Section 23 Quarter South West Containing 64.7 Hectares (160 acres) more or less Excepting thereout Plan Number Hectares (Acres) Road 8911908 1.89 4.66 Excepting thereout all mines and minerals
11.	Meridian 5 Range 4 Township 24 Section 23 Quarter North East Excepting thereout all mines and minerals Area: 64.7 Hectares (160 acres) more or less
12.	Meridian 5 Range 4 Township 24 Section 23 Quarter South East Excepting thereout all mines and minerals Area: 64.7 Hectares (160 acres) more or less
13.	Meridian 5 Range 4 Township 24 Section 24 Quarter North West Excepting thereout all mines and minerals Area: 64.7 Hectares (160 acres) more or less
14.	Meridian 5 Range 4 Township 24 Section 24 Quarter South West Excepting thereout all mines and minerals And the right to work the same Area: 64.7 Hectares (160 acres) more or less

Number	Legal Description
15.	Meridian 5 Range 4 Township 24 Section 24 Quarter North East Excepting thereout all mines and minerals And the right to work the same Area: 64.7 Hectares (160 acres) more or less
16.	Meridian 5 Range 4 Township 24 Section 24 Quarter South East Excepting thereout all mines and minerals And the right to work the same Area: 64.7 Hectares (160 acres) more or less
17.	Meridian 5 Range 4 Township 24 Section 25 Quarter North West Excepting thereout all mines and minerals Area: 64.7 Hectares (160 acres) more or less
18.	Meridian 5 Range 3 Township 24 Section 19 Quarter North East Excepting thereout all mines and minerals And the right to work the same Area: 64.7 Hectares (160 acres) more or less
19.	Meridian 5 Range 3 Township 24 Section 19 Quarter South East Excepting thereout all mines and minerals And the right to work the same Area: 64.7 Hectares (160 acres) more or less
20.	Meridian 5 Range 4 Township 24 Section 15 Quarter South East Containing 64.7 Hectares (160 acres) more or less Excepting thereout: Plan Number Hectares (Acres) Road 9012109 2.26 5.57 Excepting thereout all mines and minerals

Number	Legal Description
21.	Meridian 5 Range 4 Township 24 Section 14 Quarter North West Containing 64.7 Hectares (160 acres) more or less Excepting thereout: Plan Number Hectares (Acres) Road 9012109 1.62 4.00 Excepting thereout all mines and minerals And the right to work the same
22.	Meridian 5 Range 4 Township 24 Section 14 Quarter South West Containing 64.7 Hectares (160 acres) more or less Excepting thereout: Plan Number Hectares (Acres) Road 9012109 0.951 2.35 Excepting thereout all mines and minerals
23.	First Meridian 5 Range 4 Township 24 Section 14 Quarter North East Excepting thereout all mines and minerals Area: 64.7 Hectares (160 acres) more or less Second Meridian 5 Range 4 Township 24 Section 14 Quarter South East Excepting thereout all mines and minerals Area: 64.7 Hectares (160 acres) more or less
24.	Meridian 5 Range 4 Township 24 Section 13 Quarter North West Excepting thereout all mines and minerals And the right to work the same Area: 64.7 Hectares (160 acres) more or less
25.	Meridian 5 Range 4 Township 24 Section 13 Quarter North East Excepting thereout all mines and minerals And the right to work the same Area: 64.7 Hectares (160 acres) more or less

Number	Legal Description
26.	Meridian 5 Range 3 Township 24 Section 18 Quarter North East Excepting thereout all mines and minerals Area: 64.7 Hectares (160 acres) more or less
27.	First Meridian 5 Range 4 Township 24 Section 10 That portion of the South East Quarter Lying North West of the Elbow River Excepting thereout all mines and minerals And the right to work the same Second Meridian 5 Range 4 Township 24 Section 10 That portion of the South West Quarter Lying North West of the Elbow River Excepting thereout all mines and minerals And the right to work the same
28.	First Meridian 5 Range 4 Township 24 Section 3 That portion of the North West Quarter which lies West of the Elbow River Excepting thereout: 0.004 of a hectare (0.01 of an acre) more or less As described in transfer registered as 2235EU Excepting thereout all mines and minerals And the right to work the same Second Meridian 5 Range 4 Township 24 Section 3 That portion of the South West Quarter which lies North West of the Elbow River Meridian 5 Range 4 Township 24 Excepting thereout all mines and minerals And the right to work the same

Number	Legal Description
29.	Meridian 5 Range 4 Township 24 Section 3 Quarter South West Containing 64.7 Hectares (160 acres) more or less Excepting thereout: A) That portion of the said quarter section which lies Northwest of the Elbow River B) Plan Number Hectares (Acres) more or less Road 2309JK 0.129 0.32 Road 9710339 1.92 4.7 Excepting thereout all mines and minerals
30.	First Meridian 5 Range 4 Township 24 Section 3 Quarter North East Containing 64.7 Hectares (160 acres) more or less Excepting thereout: Plan Number Hectares (Acres) Road 9710339 2.22 5.5 Road 0813063 0.170 0.42 Excepting thereout all mines and minerals Second Meridian 5 Range 4 Township 24 Section 3 Quarter North West Containing 64.7 Hectares (160 acres) more or less Excepting thereout: That portion of said Quarter section which lies West of the Elbow River Excepting thereout all mines and minerals
31.	Meridian 5 Range 3 Township 24 Section 17 That portion of the North West Quarter which lies to the North of the Elbow River containing 53.3 Hectares (131.76 acres) more or less Excepting thereout all mines and minerals And the right to work the same
32.	Plan 0711819 Block 2 Lot 2 Excepting thereout all mines and minerals Area: 11.83 Hectares (29.23 acres) more or less (ATS Reference: 5: 4: 24: 10 NE)

Number	Legal Description
33.	Plan 0711819 Block 2 Lot 1 Excepting thereout all mines and minerals Area: 41.34 Hectares (102.15 acres) more or less (ATS Reference: 5: 4: 24: 10 NE)
34.	Meridian 5 Range 3 Township 24 Section 20 Quarter South West Excepting thereout all mines and minerals Area: 64.7 Hectares (159.88 acres) more or less
35.	Plan 2538K Block A Excepting thereout all mines and minerals And the right to work the same (ATS Reference 5: 4: 24: 13: S)
36.	Meridian 5 Range 3 Township 24 Section 20 Quarter North West Excepting thereout all mines and minerals Area: 64.7 Hectares (160 acres) more or less
37.	Description Plan 0313535 Block 1 Lot 2 Excepting thereout all mines and minerals Area: 3.4 Hectares (8.4 acres) more or less (ATS Reference: 5; 4; 24; 3; SE)
38.	Description Plan 0313536 Block 2 Lot 1 Excepting thereout all mines and minerals Area: 22.18 Hectares (54.81 acres) more or less (ATS Reference: 5; 4; 24; 3; SE)
39.	Description Plan 0313536 Block 2 Lot 1 Excepting thereout all mines and minerals Area: 22.18 Hectares (54.81 acres) more or less (ATS Reference: 5; 4; 24; 3; SE)

Number	Legal Description
40.	Description Plan 0313536 Block 3 Lot 1 Excepting thereout all mines and minerals Area: 28.11 Hectares (69.46 acres) more or less (ATS Reference: 5; 4; 24; 3; SE)
41.	Description Plan 0313536 Block 3 Lot 1 Excepting thereout all mines and minerals Area: 28.11 Hectares (69.46 acres) more or less (ATS Reference: 5; 4; 24; 3; SE)
42.	Meridian 5 Range 4 Township 24 Section 22 Quarter North West Excepting thereout all mines and minerals Area: 64.7 Hectares (160 acres) more or less
43.	Meridian 5 Range 4 Township 24 Section 4 Quarter North East Excepting thereout all mines and minerals And the right to work the same Area: 64.7 Hectares (160 acres) more or less

SCHEDULE "B"

RJH CONSULTANTS, INC.

MEMORANDUM

Project 17137

TO: **John P. Gruber, Counsel**
MLT Aikins LLP
1600, 52 – 3rd Avenue SW
Calgary, Alberta T2P 0R3

FROM: **Robert J. Huzjak – President – RJH Consultants, Inc.**

SIGNATURE: ______________________

DATE: **June 14, 2018**

RE: **Springbank Off-Stream Reservoir Project Environmental Impact Assessment Dam Safety Information Deficiency Analysis**

Section 1 - Introduction

MLT Aikins LLP retained RJH Consultants, Inc. (RJH) to perform an engineering review of technical dam safety information provided in the Springbank Off-Stream Reservoir Project Environmental Impact Assessment (EIA). The purposes of this memorandum are to present a summary of our opinions and a listing of information requests that, in our opinion, are necessary for a regulatory authority or an independent engineer to perform an evaluation of dam feasibility and dam safety.

The opinions are based on review of the information provided. The opinions presented herein may be revised if additional information becomes available.

Based on my review of the information in the EIA, I offer the following primary opinions:

- Adequate information is not available for a regulatory authority or an independent engineer to evaluate the feasibility of the concepts and the safety of the dam and other project components.
- Adequate information was not provided to evaluate the technical, safety, and performance differences and risks between the MC1 and SR1 alternatives. Further, many of the statements used to demonstrate the benefit of the SR1 over the MC1 are not supported by data and are technically questionable.
- Potential failure modes for the dam and other facilities do not appear to have been identified and therefore, have not been addressed in development of the design concept.
- The design includes a gated outlet that enables, or could result in, the dam storing water for prolonged periods of time. It does not appear that the design has adequately considered this condition, which could impact the safety of the facility.

Background

According to the EIA, a significant flood event in 2013 on the Elbow River, estimated to be a magnitude 200-year flood, was a socially and economically devasting event to the city of Calgary, Alberta. The EIA defines the selected preferred alternative (SR1) to lessen the impact of future flooding on the Elbow River. SR1 provides an on-stream river diversion structure to divert flood flows into a channel that would convey flood flows to a large off-stream reservoir, where the flood water is planned to be temporarily stored and later released after the flood had dissipated.

Based on our review of the EIA, we understand that the proposed river diversion system consists of four main elements: diversion inlet, service spillway, floodplain berm, and auxiliary spillway. An inflatable Obermeyer crest gate was selected to be raised during flood events to divert flows from a concrete service spillway into the diversion channel. An auxiliary spillway constructed of roller compacted concrete with an earthen embankment overlay was selected to pass excess flood flows without overtopping the floodplain berm. An earthen embankment floodplain berm was selected to contain a flood diversion pool when the Obermeyer crest gates are raised during a flood event. The diversion system has a dam safety hazard rating of High, in accordance with the Canadian Dam Association Dam Safety Guidelines. A high hazard rating means that in the event of a failure of the diversions system, loss of life of 10 or fewer persons is likely.

The proposed diversion channel would convey flows from the on-stream diversion system to the off-stream reservoir. The proposed channel is 4,700 meters in length, with a bottom width of 22 meters and 4 horizontal to 1 vertical (H:V) side slopes. Gradient of the channel varies from 0.1 to 0.2 percent and has a design flow capacity of 600 cubic meters per second at a depth of 6.4 meters.

The proposed off-stream reservoir would be created by constructing two zoned earthen embankments across two valleys adjacent and tributary to the Elbow River. The primary embankment is approximately 3,300 meters in length with a maximum embankment height of 30 meters. The secondary embankment is approximately 400 meters in length with a maximum embankment height of 23 meters. Total reservoir storage created by the two embankments is 77,771,000 cubic meters. A 213-meter-long, low-level gated concrete outlet works was selected to release stored flood water in a controlled manner. A concrete emergency spillway was selected to pass the routed probable maximum flood (PMF). The emergency spillway has a width of 135 meters and a flow capacity of 354 cubic meters per second at a depth of 1.25 meters. The two off stream dams have a dam safety hazard rating of Extreme which means that if either were to fail, loss of life of greater than 100 persons is likely.

Section 2 - Dam Safety and Diversion Information Presented in the Environmental Impact Assessment

General

RJH reviewed the following EIA documentation:

- EIA Summary
- Volume 1 Project Description
- Volume 2 Assessment Approach
- Volume 3A Effects Assessment (Construction and Dry Operations)
- Volume 3B Effects Assessment (Flood and Post Flood Operations)
- Volume 3D Effects Assessment (Accidents and Malfunctions)
- Volume 4 Supporting Documentation

- Debris Deflector – Environmental Assessment Addendum
- Deltares October 7, 2015

Very limited information on project components, component design, and dam safety was included in the documents reviewed. The primary source of information related to the project components, design, and dam safety was contained in Volume 1 Project Description. Volume 1 was reviewed to understand the technical basis for the project components, how dam safety issues were addressed, and as the primary source of information used to develop this memorandum. In general, the following information was identified in a number of different sections of Volume 1:

- General descriptions of the diversion and storage system components.
- Concept-level plan drawings and section drawings of some, but not all, of the system components. Most of the drawings lacked critical dimension and detail information needed to evaluate feasibility and dam safety.
- Project operational scenarios.
- Post flood project damage and maintenance requirements.
- Basic design information that was generally unsupported and lacking supporting calculations and detail.
- When referencing critical dam safety components and analyses, terms like “sufficient” and “adequate” were used without providing supportive documentation or analyses.

In my opinion, the documentation supplied did not contain sufficient information required to review and evaluate the critical dam safety components for compliance with commonly accepted dam safety standards.

Section 3 - Technical Comments on Specific Sections of the EIA

The following provides technical concerns and examples of statements that are unsupported.

Table 2-2 Comparison of the SR1 and the MC1 Projects: The following comparison statements were made in Table 2-2. The statement in the EIA is provided followed by my comment in italic.

Project Effectiveness:

- The SR1 is significantly less affected by sedimentation. The amount of large sediment that the Elbow River carried in 2013 is a key factor in supporting off-stream storage.

  Comment: The impact on the function and long-term maintenance of either an on-stream or off-stream reservoir and the associated diversion and conveyance facilities, depends on the design concept and how sediment is managed. An on-stream reservoir may actually have an advantage by periodic use of base river flows to flush reservoir sediment accumulation from the reservoir. The basis for the statement is unsupported.

- Through the design of the SR1 diversion structure, it is possible to look at ways to reduce the impact of sediment on the dam itself.

  Comment: There was no mention of methods that would be used to reduce sediment. This statement is unsupported.

Construction Risks and Operation Risks:

- Deltares indicates that fewer construction risks makes SR1 the preferred project.

  Comment: No listing or ranking of construction risks for MC1 and SR1 were provided. This statement is unsupported.

- There is a greater risk of cost increases associated with MC1 because of the complex engineering required, the on-stream nature of the dam, the comparatively limited access to the site, and the more difficult geology.

  Comment: Details of the risks, required complex engineering, site access issues, and geologic conditions were not provided or documented. Also, the complexity and risk of designing, constructing, and operating additional high hazard components was not described.

- Potential debris flows during a flood are more likely at MC1 and could threaten the structure.

  Comment: Debris flows are likely at both MC1 and SR1 and no information differentiating between the two projects was provided. Also, management of debris is typically more reliable in a larger reservoir than at a diversion structure where debris could more easily clog the diversion and dramatically reduce the effectiveness of the flood mitigation or clog the side channel spillway and impact project safety.

Social and Recreational Value:

- MC1 would have a direct negative impact on the recreational and social values in the area it affects.

  Comment: The addition of a permanent water surface reservoir would provide additional recreational opportunities to include, lake kayaking, paddle boarding, and lake fishing. Current recreational activities would continue and likely be minimally impacted by construction of the MC1 project.

Construction and Cost Estimates:

- SR1 is the preferred project because it is less expensive and therefore, has a more favorable benefit/cost ratio.

  Comment: The benefit-cost analysis did not consider the potential for the MC1 option to generate revenue from hydro power, water storage, and increased recreational opportunities a reservoir would provide. Also, detailed cost data was not provided for review of the estimated costs.

Construction Timelines:

- It is expected that the Project will take less time to construct than MC1.

  Comment: It is our opinion that the projected construction schedule for SR1 is aggressive and likely unrealistic given the complexity of the project. It is unlikely that many of the proposed mechanical components required for construction of the SR1 project could be fabricated, delivered to the site, and installed within the general time frame of the projected construction schedule. Also, for a project of this complexity, an experienced contractor should be involved in development of a construction schedule. There was no mention of contractor involvement. Even if MC1 requires more construction time, that is not a key item for a project designed to operate for 100 plus years.

Conclusions:

- There is also a clear recognition that the Project would capture a storm surge that entered a much wider area of the basin offering better protection for the City of Calgary over the long term.

  Comment: This statement is correct; however, no quantification of how much additional flood flows could be captured by SR1 was provided and this is an important consideration when comparing the two project options. Also, during a flood event, MC1 could capture and temporarily store all of the upper basin flood flows and easily offset the flood inflows occurring downstream of the dam. MC1 would not be constrained like the SR1 option to only divert 600 cubic meters per second of upper basin flows; and the MC1 option could more easily accommodate variable inflow hydrographs. There was also no distribution of flood flows provided and it is very possible the upper basin drainage area contributes more to flood flow development than the lower basin.

- The off-stream design of the Project better handles sedimentation and is more cost effective than MC1.

  Comment: See previous discussions.

- The complexity and remote location of MC1 comes with an inherently higher risk of escalating construction costs. Deltares highlighted the potential risk of a major flood during construction.

  Comment: These risks were not detailed or compared to SR1, or compared to the risks associated with a larger footprint and the need for more components for the SR1. These conclusions are unsupported. Flood risks during construction can normally be managed with a comprehensive water control plan. Flood risks exist for both SR1 and MC1, and were not quantified or compared.

<u>Table 2-3 Alternative Option Comparison:</u> The following comparison statements were made between SR1 and the MC1 Options in Table 2-3.

Geohazard:

- SR1 - Dam embankment: low risk of earthquake damage; MC1 - Larger dam embankment and so possibly greater susceptibility to earthquake damage.

  Comment: Locations and orientation of faults that could provide a ground accelerations and earthquake loading were not provided and therefore, no comparison between the two options could be made. A larger dam does not necessarily result in a greater susceptibility to earthquake damage. The potential for damage is more directly related to foundation conditions, seismic loading, construction techniques, and material properties of the embankment and foundation, than the relative size of the dam.

Geotechnical Factors:

- SR1 - No major foreseeable geotechnical issues. Dam construction will be off stream away from the geotechnical effects of the Elbow River valley; MC1 - The geotechnical issues associated with the McLean Creek option are significantly more complex than the Springbank Project.

  Comment: Potential geotechnical issues affecting both options were not listed, discussed, or quantified. This statement is unsupported.

The following sections all refer to the off stream SR1 option.

Section 2.2.2.2 Service Spillway: An Obermeyer crest gate is stated to be the preferred alternative for the service spillway. The Obermeyer crest gate has two drawbacks. Its fail-safe position is open, which means that the gate must be raised under power at the beginning of a flood and its inability to pass bed load during floods.

> *Comment: RJH agrees these are major drawbacks and if the Obermeyer crest gate fails to raise, no flood flows will be diverted into the off-stream reservoir rendering the entire flood mitigation system useless.*

Section 2.2.2.3 Auxiliary Spillway: The comparison of the auxiliary spillway alternatives focused on their operational capabilities.

> *Comment: From this statement, it appears that site and foundation conditions were not considered when comparing alternatives, both of which have the potential to control design and significantly impact cost.*

Section 2.2.3 Emergency Spillway: Based on engineering considerations, Location 2 was deemed the most appropriate location for the emergency spillway, because of the more stable bedrock materials present.

> *Comment: The referenced engineering considerations were not identified or discussed, and the reference to "more stable bedrock" does not quantify the bedrock erosion potential at Location 2. Bedrock can be highly erodible and erosion could lead to a failure of the emergency spillway during a flood. Selection of Location 2 as the appropriate location for the emergency spillway is unsupported.*

Section 2.2.5 Low-Level Outlet Channel: The choice was made to delay maintenance on the channel until such a time as it may be required. The present plan would be to only regrade part of the existing stream to convey flows away from critical infrastructure and allow for the remainder of the stream and existing ecosystem to remain intact.

> *Comment: The potential for the development of back cutting erosion in the outlet channel does not appear to be supported by analyses and the simple approach of "regrading" the existing stream channel to be used as the discharge channel is likely inadequate to protect the integrity and function of the outlet works and potentially the safety of the dam.*

Section 3.1 Design Criteria: The reservoir does not retain water between floods.

> *Comment: While this is a stated design assumption, it is not supported by the proposed outlet works configuration which is gated and when the gate is closed, the dam has the ability to store water. It is stated in the EIA that the off-stream dam is not designed for long term reservoir storage and as a result would likely be susceptible to multiple failure modes if long-term reservoir storage were to occur. Long-term storage could occur if the low-level gate failed to open or a change in reservoir operation were to occur.*

Section 3.2.1.4 Floodplain Berm: The height and southerly extent of the berm prevents a circumvention by floods, up to 1/3 between the 1:1,000 year and the PMF. The crest is set at 1 m above the calculated 1:1,000-year flood elevation and will pass the probable maximum flood without overtopping.

> *Comment: No flood routing analysis was provided to support this statement. One meter freeboard would be considered minimal and there was no mention if embankment consolidation could reduce the available freeboard and if wave run up was a design concern.*

Figure 3-5 Typical Section, Floodplain Berm:

Comments:

- *The proposed embankment filter zone does not appear to have a daylight drain.*
- *The impervious embankment Zone 1A is keyed into the alluvium but does not appear to be keyed into bedrock, which is likely necessary to control under seepage.*
- *No under seepage control measures are proposed. Under seepage exit gradients could pose a safety risk and potential failure mode.*
- *No geotechnical data or analysis was provided to support this typical dam section.*
- *Sources for the embankment materials were not defined.*
- *The effect of differential settlement between the dam foundation, bedrock, and alluvium is not defined.*

Section 3.2.1.5 Auxiliary Spillway: is a roller compacted concrete gravity structure founded on bedrock and covered with earth. The auxiliary spillway is designed to withstand overtopping for floods up to 1/3 between the 1:1,000 year and the PMF with an overtopping depth of 1.5 m.

Comments:

- *No flood routing was provided to support this statement.*
- *No stability analyses were presented to indicate the spillway would be stable at this level of overtopping.*
- *No geotechnical foundation data or analysis was provided to demonstrate adequate erosion protection of the downstream toe of the dam.*
- *No hydraulic analysis was provided to evaluate the safety and hydraulic performance of the spillway.*
- *No provisions are provided for management of underseepage.*

Figure 3-6 Cross Section of Auxiliary Spillway:

Comment: The auxiliary spillway appears to be a 5.7-meter (19 feet) high roller compacted concrete dam and is considered a high hazard structure. Figure 3-6 indicates that the dam is to be founded on competent bedrock. No supportive geotechnical data is presented to indicate where competent bedrock is located in the subsurface soil profile. The figure references a concrete slab that extends beyond the downstream toe of the dam, presumably for erosion protection, but there appears to be no provision for flood flow energy dissipation. Without energy dissipation features constructed downstream of the spillway, it is possible flood flows will erode under or uplift the downstream edge of the concrete slab. If uplift or back cutting under the slab occurs, failure of the slab is likely which would allow erosion forces to be applied at the toe of the roller compacted concrete dam. Erosion under the toe of the roller compacted concrete dam could result in an overturning or sliding failure of the dam. If this scenario occurs, loss of life is likely.

Section 3.2.2 Diversion Channel: The diversion channel carries floodwater from the diversion inlet to the off-stream reservoir (Figure 3-1). The channel is 4,700 m long with a bottom width of 22 m, 4H:1V side slopes and a slope that varies from 0.1 to 0.2 percent with a maximum flow capacity of 600 cubic meters per second.

Comment: The diversion channel is primarily an earthen channel with a grass lining. The gradient (slope) of the channel is very flat, 0.1 to 0.2 percent, and will likely result in

> *sediment and debris deposition in the channel during flood flow diversions, particularly at smaller flood flows where flow velocities will be lower. The debris and sediment deposition could obstruct and block the channel and impact the ability of the water to get to or flow over the spillways, resulting in an overtopping of the channel embankment and an erosional failure of the channel embankment. Information on flow velocity and sediment deposition were not provided. Failure of the channel embankment could result in the loss of life or significant property damage, and appears to be a potential and unaddressed failure mode.*

<u>Section 3.2.3 Emergency Spillway:</u> The emergency spillway is a concrete structure approximately 135 m long that permits unregulated overflow first to a graded outlet channel and then overland to the Elbow River. The spillway has a crest at the reservoir full service elevation of 1,210.75 m and a discharge capacity of 354 m3/s at 1.25 m of head. It is located on the east side of the diversion channel approximately 1,300 m upstream of the off-stream reservoir.

> *Comment: The emergency spillway is a critical dam safety component and very little substantive information was provided that would enable even a cursory review of the spillway adequacy. No section drawings, bedrock location and geotechnical properties, or diversion channel details are provided. From the limited information provided, it appears the spillway is located in the diversion channel side slope which is likely an embankment fill and if this is the case, several potential failure modes of the spillway would be associated with the selected location. Failure of the emergency spillway would likely result in the loss of life and significant property damage.*

<u>Figure 3-8 Typical Dam Section, Primary Embankment:</u>

Comments:

- *The primary embankment is 3,300 meters long and 30 meters high. Figure 3-8 indicates a zoned earth fill embankment having an upstream toe buttress; upstream shell; core with a key trench; chimney, blanket, and toe drain: and a downstream shell. The preparation and composition of the various materials used to construct the embankment are not described.*

- *There is a reference on the figure at the base of the embankment indicating foundations soils vary. No geotechnical properties or profiles of the foundation soils are provided. The basis for the toe berm and embankment slopes is not provided. No information is presented as to the properties of the core or the foundation soils the key trench is constructed in.*

- *Under seepage control measures only include a key trench below the core to an unidentified material. Potential seepage modes that could result in an erosional failure of the dam are not addressed. No seepage analysis or seepage exit gradients were provided. Understanding the foundation conditions and foundation seepage conditions are critical to having a safe dam. Under seepage could lead to a progressive backward erosional failure of the foundation and dam. If this scenario were to develop, significant loss of life (greater than 100 persons) and significant property damage would likely result.*

<u>Section 3.2.5.2 Slope Protection</u>: Established turf and proposed drainage features will provide erosion protection. Maintenance to repair water erosion channels on the slope will be required until grass is established. Since the reservoir will not have a permanent pool, wave wash protection will not be necessary.

> *Comment: The average annual precipitation for Calgary, Alberta is about 16.5 inches. Establishment of turf could be difficult and the effects of wave erosion during a flood do not appear to have been addressed. Wave erosion could result in damage to the dam*

embankment, loss of freeboard, and eventual failure of the embankment by an overtopping flood flow.

Table 3-4 Critical Design Load Cases for the Dam Embankment:

Comment: A number of stability load cases are presented in the table reporting the Factor of Safety (FOS) for each load case. No supportive geotechnical data or stability analyses were provided that would allow verification of the reported FOS and some of the reported factors of safety would not meet the regulatory requirements for long reservoir storage. Assuming long term reservoir storage will not occur is a poor design assumption because the reservoir has a gated low-level outlet works which if closed, would allow long term reservoir storage. If long term reservoir storage were to occur; embankment or foundation seepage and stability problems could develop resulting in a failure of the dam.

Section 3.2.5.4 Seepage: Seepage analysis was performed for input into the stability analysis and assessment of piping risk. As a reservoir with a temporary flood pool, saturation of the embankment with an elevated phreatic surface is not anticipated. However, a filter and drainage system will mitigate potential risks from piping through defects in the embankment and pressure relief in the foundation soils.

Comment: No seepage analyses were provided that would allow verification of the input and reported FOS for the stability analyses or to determine the proposed seepage control measures are adequate to protect the dam embankment and foundation from piping. The proposed under seepage control measures are considered minimal for a 30 meter (98 feet) high embankment and if uncontrolled under seepage occurs, it could lead to a piping condition and failure of the dam. Also, dams that are dry for prolonged periods of time could crack depending on the properties of the embankment materials. It is unknown if the drainage systems are adequate to manage seepage through cracks in the impervious Zone 1A materials.

Section 3.2.5.5 Seismic Events: The dam stability was assessed for an earthquake design ground motion (EDGM) with an annual exceedance probability of 1/10,000, in accordance with Canadian Dam Association (CDA) Dam Safety Guidelines (CDA, 2007) and the Extreme hazard classification.

Comment: No information on the location and orientation of faults that could impact the dam were provided. No history or location and intensity of past seismic events was provided. No analyses on the impact to the stability of the embankment and foundation was provided and as a result, it cannot be verified that the dam and foundation will not be adversely impacted by a design seismic event.

Section 3.2.6 Low Level Outlet: Floodwater is released from the reservoir to the Elbow River by means of a gated concrete structure near the east end of the dam embankment that controls discharge to an existing unnamed creek (Figure 3-1). The low-level outlet structure (Figure 3-10) consists of an approach channel, discharge gate, gatehouse, 2.7-meter-wide by 2.8-meter-high horseshoe shaped conduit, energy dissipation structure, and outlet channel. The gate is operated locally by the gatehouse.

Comment: Standard design practice for flood control dams is for the low-level outlet to be ungated so the dam has no ability to store water for long periods of time. If a low-level outlet works is gated, which would allow long term reservoir storage, standard practice is to design the dam to regulatory and safety standards required for long term reservoir storage. Failure to design to the requirements necessary to meet established safety standards for dams having long term reservoir storage could result in the development of conditions that could lead to failure of the dam. Long term reservoir storage could result with an outlet gate or operating mechanism failure that would not *allow the gate to open or changing operational criteria allowing long term reservoir storage.*

Section 5.0 Dam Safety: The design of the off-stream dam complies with CDA Dam Safety Guidelines (CDA, 2007) and Technical Bulletin Nos. 1 through 9, current Alberta Transportation Design Standards, relevant Alberta Transportation Design and Construction Bulletins. The dam design parameters and construction activities that support dam safety are presented in Section 3.2.5. They are discussed in more detail in the Interim Design Report (Stantec 2017b), which includes the Interim Geotechnical Assessment Report as Appendix D.

Comment: The CDA Dam Safety Guidelines were updated in 2013. No discussion or indication was provided as to whether the proposed project design meets all of the criteria contained in the updated guidelines. The Interim Design Report (Stantec 2017b) and the interim Geotechnical Assessment Report, Appendix D were not provided in the EIA documents. Therefore, these documents were not considered in our review.

Section 4 - Suggested Dam Design and Dam Safety Information Requests

General

The EIA was significantly lacking in detail and supportive technical data and engineering analyses required to verify many of the technical statements made in the EIA. A Stantec Interim Design Report 2017b was referenced in Section 3.2.5.3 and Section 5.0 of Volume 1 but this report was not provided with the EIA. The Interim Design Report Table of Contents was not provided in the EIA but following is a list of information that in our opinion, is needed for a regulatory or engineer to evaluate the technical adequacy and safety of the design for the following suggested information requests.

Basis of Design

- Regulatory Standards
- Intended Operations
- Survey Control and Topographic Base Map
- Design Criteria
  - Diversion Inlet
  - Service Spillway
  - Auxiliary Spillway
  - Floodplain Berm
  - Off Stream Dam Embankments
  - Outlet Works
  - Emergency Spillway and Discharge Channel
  - Freeboard
  - Instrumentation
- General Geotechnical
- General Hydraulic
- General Structural

Geotechnical Information

- Geological Assessment
- Geotechnical Field Investigation Report
- Laboratory and Field Testing Results
- Geotechnical Data Report

Hydraulic Information

- Design Storm Hydrology
- Sediment Loads

On Stream Diversion Structures

- Key Issues Affecting Design
- Stability Analysis
- Seismic Deformation Analysis
- Drainage System Design
- Slope Protection Analysis
- Consolidation and Deformation Analysis
- Spillway Gate Design
- Flood Routing and Hydraulic Analysis

Diversion Channel

- Hydraulic Capacity Analysis
- Channel Erosion Potential Analysis and Treatment
- Freeboard Analysis

Off Stream Dam Embankments

- Key Issues Affecting Design
- Stability Analysis
- Seepage Analysis
- Seismic Deformation Analysis
- Internal Filter and Drainage System Design
- Slope Protection Analysis
- Consolidation and Deformation Analysis

Outlet Works

- Key Issues Affecting Design
- Intake Structure Design
- Conduit Design
- Outlet Gate and Control System Design

- Discharge and Energy Dissipation Structure Design
- Discharge Channel Design

Emergency Spillway

- Key Issues Affecting Design
- Hydrology and Reservoir Routing
- Hydraulic Analysis
- Structural Design
- Stability Analysis
- Discharge Channel Design

Construction Considerations

- Stream Diversion Design
- Dewatering Requirements
- Required Imported Materials
- Construction Sequencing
- Construction Schedule

RJH/jmm

Robert J. Huzjak, P.E.

Expert Dams and Geotechnical Engineer

Introduction

Mr. Huzjak is nationally-recognized expert in civil engineering for geotechnical and water resource projects. His primary practice is a design engineer, but has served as an expert witness and subject matter expert in claims evaluations, dispute resolutions, and litigation. As a practicing engineer for more than 30 years, he has participated in over 1000 small to large civil engineering projects across the United States (US). Mr. Huzjak's primary expertise centers on dams, levees, seepage barriers (e.g. cutoff walls), and their related appurtenances (e.g., pipelines, spillways, outlet works, foundations, diversions, slope protection, pump stations, etc.). He successfully led the design and construction of the largest new non-Federal dam built in Colorado in the last 30 years. He has be involved as a senior engineer in many of the largest water Projects in the western United States. He has provided independent technical review on dozens of dam safety projects and designs, served on numerous consultant review boards (both as a multi-disciplined designer and as a geotechnical engineering expert), and has published numerous papers in peer-reviewed trade publications.

Mr. Huzjak actively participates in multiple industry groups (i.e., ASDSO, USSD). He has worked closely with dam safety researchers and published over a dozen papers related to his research and project case histories. The U.S. Army Corps of Engineers (USACE) has invited Mr. Huzjak to lecture on dam safety and design issues at the Dam Safety Modification Mandatory Center of Expertise in Huntington, WV and on soil-cement and seepage issues in the Jacksonville District. He has lectured on various geotechnical issues related to dam and levee safety. He routinely works with other industry experts and has consulted to multiple State Dam Safety programs on technical and regulatory matters.

Education

M.S., Civil Engineering (Geotechnical), University of Colorado, Denver, 1988

B.S., Civil Engineering Technology, Youngstown State University, Ohio, 1982

Professional Registrations

Registered Professional Engineer: Arizona, California, Colorado, Connecticut, Florida, Kansas, Kentucky, Minnesota, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, Utah, Washington, Wisconsin, Wyoming

Reference 1

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SAMPLE PROJECT EXPERIENCE

PBS&J V. USA (US ARMY CORPS OF ENGINEERS), TEN MILE CREEK, ST. LUCIE COUNTY, FLORIDA. Expert for litigation related to the design and performance of a dam and reservoir. The reservoir is created by a perimeter earthen ring dam that is about 20 feet high and about 4 miles long founded on primarily a sandy foundation. The dam includes soil-cement protection on the upstream slope and crest. Work included review and analyses of design data, geotechnical investigations, simple to complex engineering analyses, demonstration testing, identification of remediation alternatives, and providing expert services.

Case Reference: Post, Buckley, Schuh & Jernigan, Inc., a Florida Corporation, Plaintiff, vs. United States of America, through its agency, the United States Army Corps of Engineers, Defendant, Case No. 09-112 C in the United States Court of Federal Claims.

MILLER RESERVOIR AND DAM, ADAMS COUNTY, COLORADO, FOR DENVER WATER. Project Manager for design and construction of a 4,950-foot-long, and up to 20-foot-high perimeter embankment around an existing gravel mine. Design analyses for the embankment dam; and preparation of design documentation, design drawings, and specifications to obtain State Engineer approval and contract documents to bid and construct the project. Led resident engineer and construction team consisting of three consultants during construction. Served as a fact and expert witness for litigation related to construction claims.

Case Reference: Parker Excavating, Inc., a Colorado Corporation vs. City and County of Denver, acting by and through its Board of Water Commissioners, a municipal corporation of the State of Colorado, Case No. 2009 CV 11795. Also, testified as a fact witness for this case.

RUETER-HESS DAM AND RESERVOIR, DOUGLAS COUNTY, COLORADO, FOR PARKER WATER & SANITATION DISTRICT. Project Manager/Chief Engineer for planning, preliminary design, final design, and construction management for a 196-foot-high zoned earthen dam for a new water storage reservoir.

C.W. BILL YOUNG REGIONAL RESERVOIR REHABILITATION, TAMPA BAY, FLORIDA. Technical Expert responsible for providing engineering expertise and review of embankment design to the project team responsible for designing a rehabilitation to a 15.5-billion-gallon reservoir (47,600 acre-feet (ac-ft)) and an insurance company involved as a re-insurer of the Project. The rehabilitation design was required because of poor performance of the original dam designed and built just a few years earlier. The dam was a perimeter embankment and was approximately 5 miles long and up to 80 feet high. Provided expert engineering advice to insurance company and engineering review of rehabilitation design.

DEWIND V. GP AGGREGATES, PROWERS COUNTY, COLORADO. Engineering expert for litigation related to a claim for wrongful termination of a construction contract. Dispute centered on the construction methods and progress for a soil-bentonite seepage barrier wall (i.e., cutoff wall). Performed literature review and developed engineering opinion on effectiveness of construction methods. Demonstrated that methods of DeWind were at least equally effective as replacement method of traditional excavation. Full amount sought for by DeWind was paid based on opinions documented in expert report.

BURNS INDUSTRIES V. BESSETTE TRUST, L.L.C (SCRUTCHFIELD DAM), SHERIDAN, WYOMING. Expert for litigation related to damage from a failed private dam near Sheridan Wyoming. Downstream property owners (plaintiff) alleged damage to their property as a result of a breach of defendant's dam during a large flood event. Collected and reviewed available background information, performed engineering analyses to develop an opinion, and prepared an expert report and rebuttal report. Case was settled.

HUB THOMPSON DAM AND RESERVOIR, PROWERS COUNTY, COLORADO, FOR TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION, INC. Technical Expert for determining the feasibility of a dam to support water rights litigation. Project Manager for planning and preliminary design of a new 120-foot-high earthen dam that will create a 70,000 ac-ft reservoir. Work included an extensive evaluation of project alternatives and a geotechnical field program to evaluate site conditions and types and suitability of on-site materials for use in the dam. Key design issues are the relatively flat topography, limestone foundation bedrock, utilization of the on-site materials in the dam configuration, and for soil-cement to provide upstream slope protection for the dam, which will be approximately 4 miles long. Project also includes development of methods to fill the reservoir and relocate an existing canal that will be impacted by the reservoir.

ENVIROCON, INC. V. 120TH ESTATES PARTNERS, LLP. Technical Expert for litigation relating to a defective soil-bentonite seepage barrier wall that impounded a reservoir. Responsibilities included evaluation of existing data, observation of additional geotechnical data collection by opposing expert, collection of additional geotechnical data, evaluation of the integrity of the soil-bentonite cutoff wall and depth into bedrock, identification of likely construction defects, and preparation of a report documenting expert opinions. Early in our technical work, identified our opinion of client's risks. Case was settled.

SHUMWAY ARROYO RECOVERY SYSTEM PROJECT, SAN JUAN COUNTY, NEW MEXICO, FOR PUBLIC SERVICE COMPANY OF NEW MEXICO (PNM). Technical Expert during negotiations of settlement to legal action. Project Manager for planning and design of a groundwater recovery system to limit the flow of groundwater and surface water base flow through the Westwater and Shumway Arroyos. Work required geotechnical site characterization, and development of concept and final designs for a soil-bentonite barrier wall, biopolymer collection trench, and a pumpback system. Provided technical support to PNM during negotiation of the settlement. Coordinated with a specialty geotechnical contractor to develop practical design criteria and performance criteria for the recovery system, and negotiated the settlement to include feasible performance criteria for the project.

MILLER CREEK DAM, RIO BLANCO COUNTY, COLORADO, FOR BISHOP-BROGDEN ASSOCIATES, INC. Technical Expert and Project Manager for engineering study related to development of a new dam and 45,900 ac-ft reservoir in support of a water rights application. Developed a feasibility concept for a dam and reservoir that would meet the requirements of the SEO and provided consulting services to support the water rights application.

EMERGENCY STORAGE, SAN DIEGO, CALIFORNIA. Assistant Project Manager for planning, development of alternatives, and permitting of a regional water project to provide and deliver 90,100 acre-feet (ac-ft) of emergency water supply throughout San Diego County with estimated total project costs in excess of $1 billion. Worked with 22-member agencies to identify, clarify, and substantiate the purpose and needs of the project and to collect reliable information necessary to develop defensible concepts. Developed and evaluated alternatives that included diversions; tens of miles of pipelines and tunnels up to 108 inches in diameter; pump stations up to 30,000 hp; groundwater basins; reoperation of existing facilities; hydropower, earthfill, rockfill, and roller-compacted concrete (RCC) dams from 120 to over 500 feet in height; and relocation of roads, utilities and other infrastructure.

KEN MITCHELL LAKES, BRIGHTON, COLORADO, FOR CITY OF BRIGHTON. Technical Expert to support to the City for litigation and Project Manager for evaluation of causes of leakage through an existing soil-bentonite cutoff wall, development of methods to repair the wall, and construction services to repair the wall. Responsibilities included geotechnical evaluation to evaluate consistency of the soil-bentonite cutoff wall and key depth into bedrock, identification of probable construction defects, and development of procedures to repair the wall.

PALMER DAM # 5 REHABILITATION, EL PASO COUNTY, COLORADO, FOR GLEN EYRIE GROUP. Project Manager for final design services and preparation of drawings and contract documents for rehabilitation of an existing outlet works for an earthfill dam, built in the 1890s. Rehabilitation was required to address dam safety issues related to inoperable gates and a crack in the outlet conduit. Design and construction was completed without drawing down the reservoir. Project Manager for engineering and construction management services for outlet works rehabilitation. Design coordination, primary client contact, and primary contact with the State Engineer.

ANTERO DAM AND RESERVOIR, PARK COUNTY, COLORADO, FOR DENVER WATER. Technical Expert for conceptual and final design to rehabilitate Antero Dam. Responsibilities included review and organization of all available geotechnical and construction related data, and potential failure modes analysis. Based on the potential failure modes analyses, identified concepts to rehabilitate the dam and led a benefit-cost analysis to evaluate technical, permitting, construction, and cost risks. Rehabilitation included a bio-polymer filter trench, soil-bentonite barrier wall, and extensive earthwork.

CABRESTO DAM, TAOS COUNTY, NEW MEXICO, FOR NEW MEXICO OFFICE OF THE STATE ENGINEER. Project Manager for preliminary and final design for rehabilitation to the dam to address dam safety issues that include inadequate spillway, inadequate outlet works, and seepage instability along the outlet works. Work included removal and replacement of the existing outlet works with a multi-level inlet structure and a new embankment dam with a roller compacted concrete (RCC) overtopping spillway. Work was completed with a partial reservoir drawdown.

NORTH LAKE RESERVOIR, LAS ANIMAS COUNTY, COLORADO, FOR CITY OF TRINIDAD. Project Manager for dam safety modifications to this 70-foot-high earthen dam to improve seepage stability, embankment stability, and outlet surging problems. Project involved video inspection of pipelines under high-head conditions. Identified cost-effective solutions to correct safety concerns. Prepared construction documents and provided construction management for modifications to outlet works, embankment, and spillway. Replaced failed valves in the outlet tower, designed and constructed a new stream release facility, and abandoned an outlet pipe that contained numerous holes. All of this work was completed while the reservoir was full.

Performed parts of the work using a design-build approach which enabled the engineer-contractor team to rapidly modify the rehabilitation plan and sequence based on the actual conditions encountered. This approach significantly reduced the overall cost to the Owner and was one of the first design-build dam remediation projects approved by the State Engineer.

LAKE BRONSON REHABILITATION, KITTSON COUNTY, MINNESOTA, FOR MINNESOTA DEPARTMENT OF NATURAL RESOURCES. Project Manager for identification, evaluation, and remediation of dam safety issues for an earthen embankment founded on glacial deposits with a gated three-bay ogee concrete principal spillway at the maximum height of the dam. Performed PFMA and risk evaluation using USBR procedures.

MT. CARMEL DAM, CAVALIER COUNTY, NORTH DAKOTA. Technical Expert responsible for identification of the primary site, design, and construction elements contributing to erosion and undermining failure of the principal spillway. Project Manager for preparation of design documents and construction management for dam safety improvements for this 46-foot-high earthen embankment dam. The erosion had created an 8-foot void in the embankment beneath the spillway. The modifications were completed while the reservoir was about 75 percent full. Modifications included demolition of the existing spillway, construction of a new drop inlet reinforced concrete spillway, installation of relief wells to reduce high foundation water pressures, and minor embankment modifications to provide a uniform crest and stable upstream slope.

STANDLEY LAKE DAM REHABILITATION, WESTMINSTER, COLORADO. Geotechnical Project Manager responsible for evaluation of movement of a downstream valve house for a 115-foot-high, earthen embankment dam constructed on a clay shale foundation. Work included extensive subsurface explorations and laboratory testing, 2- and 3-dimensional stability analyses, and an evaluation of the life expectancy of existing rock anchors. Also, responsible for analyses and preparation of conceptual designs and cost estimates for a 15-foot raise of the dam and relocation of the outlet works and valve house. Outlet works alternatives included tunnels through the dam abutment and below the dam. Also, Geotechnical Task Manger for final design of modifications that included a new tunnel outlet works, spillway valve house, and embankment modifications.

SOUTHERN RAW WATER SYSTEM, ADAMS COUNTY, COLORADO, FOR CITY OF THORNTON. Owner's Advisor/Project Manager/Technical Expert. Worked conjunctively with the Owner for over two decades to plan, permit, negotiate, design, and construct a complex raw water system. The System is Thornton's primary raw water supply and consists of a series of twelve lined reservoirs and dams with interconnect pipelines between the reservoirs, diversion structures, spillways, groundwater wells, pipelines, and pump stations to convey the stored water to water treatment plants. When completed, the System will provide a combined storage of over 30,000 ac-ft with total project costs exceeding $200 million.

BRANNAN LAKES, THORNTON, COLORADO. Technical Expert and Project Manager for evaluation and preparation of an expert report to support litigation related to excessive seepage. Project Manager for development of preliminary design alternatives and final design to eliminate excessive seepage, and stabilize the sides of the lakes. Alternatives included repair, extension, and replacement of an existing slurry trench, and reconstruction and flattening of the side slopes. Work included finite-element seepage modeling and analysis; stability analysis; material balance and construction material evaluations; preliminary and final design drawings, specifications, and cost estimates; and construction management during slope and cutoff wall reconstruction.

USA ENVIRONMENT VS. ENVIROGROUP, COLORADO. Technical Expert for evaluation of concerns related to the investigation, design, and construction of a slurry wall liner around a gravel pit reservoir completed by another engineering consultant.

EAST SPRAT PLATTE RESERVOIR, ADAMS COUNTY, COLORADO, FOR CITY OF THORNTON. Technical Expert for a condemnation case for a new reservoir. Provided expert testimony on project feasibility and cost.

WEST SPRAT PLATTE RESERVOIR, ADAMS COUNTY, FOR CITY OF THORNTON. Technical Expert for a condemnation case for a new reservoir. Provided expert testimony to support the City's condemnation of the site. Provided expert testimony on project feasibility and costs.

DENVER RADIUM SUPERFUND SITE, COLORADO, FOR CITY AND COUNTY OF DENVER. Technical Expert for legal action between the Federal government and the City of Denver for the disposal of radioactive-contaminated material in Denver. Provided expert testimony on project risks, remediation feasibility, and costs.

JIMMY CAMP CREEK DAM AND RESERVOIR, COLORADO SPRINGS, COLORADO. Project Manager for feasibility-evaluation and design to support preparation of an Environmental Impact Study for the Southern Delivery System for this 180-foot-high zoned earth dam. Work included extensive geotechnical investigations and field testing, hydraulic analyses to develop concepts and sizing for the spillway and outlet works, slope stability and seepage analyses to develop the embankment configuration, constructability analyses to develop equipment spreads and construction schedule, cost estimates, and hydraulic analyses to develop a simulated dam failure, and associated inundation maps.

WILLIAMS CREEK DAM AND RESERVOIR, COLORADO SPRINGS, COLORADO. Project Manager for feasibility-evaluation and design to support preparation of an EIS for the Southern Delivery System for this 110-foot-high zoned earth dam. Work included geotechnical investigations and field testing, hydraulic analyses to develop concepts and sizing for the spillway and outlet works, slope stability and seepage analyses to develop embankment configuration, constructability analyses to develop equipment spreads and construction schedule, cost estimates, and hydraulic analyses to develop a simulated dam failure and associated inundation maps.

PARKER KNOLL PUMPED STORAGE, PIUTE COUNTY, UTAH, FOR SYMBIOTICS, LLC. Project Manager for a planning study and preliminary design of a 1,200 MW pumped storage project with two reservoirs capable of storing 6,700 acre-feet that required dams over 200 feet high. Lead developer of a Preliminary Design Report to support a FERC permit. Currently leading geologic and seismic evaluations.

BRUCE PARK DAM, PAONIA, COLORADO. Project Manager responsible for evaluation of effects of micro-seismicity resulting from long wall coal mining on Bruce Park Dam. Critical issues included development of ground motions caused by seismicity and seismic slope stability analysis, existing stability of landslide upstream of the dam, and seepage through the dam and foundation. Work included field investigation, stability and seepage analyses, and feasibility design for modifications to the dam to increase storage.

J-2 REGULATING RESERVOIR PROJECT, GOSPER AND PHELPS COUNTIES, NEBRASKA. Project Manager for planning study and concept evaluation of two new regulating reservoirs adjacent to the Platte River in Central Nebraska. The purpose of the project is to retime about 45,000 ac-ft of flow into the River annually. Project components include, canals and pipelines, reservoirs and river outlets. Estimated project costs exceed $170 million.

MEADOW HOLLOW RESERVOIR, COLORADO. Technical review of feasibility study for a new 60,000 acre-foot reservoir. Project included field exploration, laboratory testing, engineering analyses, and construction cost estimates for earthfill/rockfill, concrete-faced rockfill, and roller-compacted concrete dams up to 300 feet high.

PUBLICATIONS

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Huzjak, Robert, P.E. and Kappus, Uli, P.E. *Smart Dam Engineering: Urban Gravel Pit Water Supply Storage*. ASCE, 1999 International Water Resources Engineering Conference, Seattle, WA, August 8 - 12, 1999.

PROFESSIONAL WORK HISTORY

RJH CONSULTANTS, INC. – 2005 TO PRESENT. President. Manages and directs small to large multi-discipline engineering analysis for design, analysis, and construction projects for embankment and concrete dams, water supply and conveyance projects, and building foundations. Directs and manages preparation of engineering reports, design drawings, construction specifications, and cost estimates. Leads management of firm and performs technical reviews on other projects. Responsible for all engineering decisions on projects under his direction and responsible for all business decisions for the firm.

GEI CONSULTANTS, INC. – 1994 TO 2005. Senior Project Manager. Led small to large multi-discipline engineering projects for embankment and concrete dams, water supply and conveyance, and building foundations. Directed and managed preparation of engineering reports, design drawings, construction specifications, cost estimates, and construction engineering. Made engineering decisions for projects performed under his leadership.

GEI CONSULTANTS, INC. – 1994 TO 1997. Project Manager. Performed civil, geotechnical, and water resources engineering for embankment and concrete dams, building foundations, and water supply projects. Prepared engineering reports, designs, and cost estimates.

GEI CONSULTANTS, INC. – 1992 TO 1994. Senior Geotechnical Engineer. Performed civil and geotechnical engineering for earth, rockfill, and concrete dams. Performed civil and geotechnical engineering for buildings, roads, and pipeline projects. Prepared reports, cost estimates, and design drawings for new dams and rehabilitation/enlargement of existing dams. Provided construction supervision.

G.J. THELEN & ASSOCIATES, INC. – 1989 TO 1992. Project Engineer. Performed, developed, and supervised geotechnical exploration programs and laboratory testing programs for residential and commercial subdivisions, multi-story office buildings, industrial facilities, landslide and engineering analysis evaluations, and riverfront development. Performed and supervised earthwork, shallow foundation, and deep foundation construction. Prepared design drawings and specifications.

LINCOLN DEVORE, INC. – 1984 TO 1989. Staff and Project Engineer responsible for data acquisition, analysis, and report preparation for geotechnical investigations for commercial, industrial, and residential projects. Prepared earthwork and cassion quality control reports and was responsible for technical supervision of technicians performing earthwork, concrete, asphalt, foundations, and reinforcing steel observation and testing.

INTERLOCK STEEL COMPANY – 1983 TO 1984. Staff Structural Engineer for structural design of wood framed structures, primarily wood trusses. Responsibilities required review of construction plans to determine loading conditions and size of structural members. Utilized computer aided finite element analysis to design wood frames.

YOUNGSTOWN STATE UNIVERSITY – 1982 TO 1984. Limited Service Instructor for Associates degree program in Engineering Technology. Courses included statics, soil mechanics and laboratory, strengths of materials and laboratory, and foundation engineering. Full responsibilities for developing exams, assignments, and grading policy.

JOHN N CERNICA AND ASSOCIATES – 1980 TO 1982. Staff Engineer for laboratory and field testing of concrete and soils. Calculated bearing capacity of shallow foundations and deep foundations. Prepared portions of geotechnical reports and designed foundations and earth retaining structures for commercial and industrial facilities.

SCHEDULE "C"

ANNEX A

Comment Number	**Hydrogeology #1**
EIS Section Name	Volume 3A, Section 5 Hydrogeology Effects Assessment – Construction and Dry Operations
Section Number(s)	Section 5.2.2.: Overview of Existing Hydrogeological Conditions, Figure 5-6 (Page 5.17) and Section 5.4.2: Change in Groundwater Quantity, Figure 5-10 (Page 5.33)
Quotation (if relevant)	
Issue	Groundwater model fails to predict potential effects on Tsuut'ina IR 145
Concern	Figure 5-6 shows the contoured potentiometric heads for the unconsolidated hydrostratigraphic unit that were interpolated from hydraulic head measurements at each of the points shown on Figure 5-6. Figure 5-10 shows the Numerical Groundwater model output potentiometric head distribution for average current flow conditions. If the model is properly constructed, calibrated and providing a reasonable representation of the observed groundwater regime, Figures 5-6 and 5-10 should be comparable. However, along the southern model boundary, directly on and adjacent to Tsuut'ina IR 145, the **model over-estimates the hydraulic heads by between 12 and 48 m.** This means the Numerical Groundwater model cannot predict potential effects on Tsuut'ina IR 145.
Information Request	Please require the proponent to reconstruct the Numerical Groundwater model to be capable of predicting potential effects on Tsuut'ina IR 145. In particular, the southern boundary of the model must be moved to a location where the groundwater boundary conditions can be more reliably estimated. One option we recommend evaluating is the southern Elbow River watershed boundary.

Comment Number	**Hydrogeology #2**
EIS Section Name	Volume 3A, Section 5 Hydrogeology Effects Assessment – Construction and Dry Operations
Section Number(s)	Section 5.2: Existing Conditions for Hydrogeology, Page 5.10 (supporting information from Figure 5-3, Page 5.13)
Quotation (if relevant)	"The shallower monitoring wells were installed with screened intervals within the first water-bearing unit encountered. The deeper (bedrock) monitoring wells were installed in the first water-bearing bedrock unit, excluding the weathered upper portion of the bedrock, which was generally in hydraulic communication with the unconsolidated deposits."
Issue	Baseline groundwater data not sufficient to predict potential effects on Tsuut'ina IR 145.
Concern	The quote provided above suggests there were two screened intervals used to measure hydraulic heads and in turn calibrate the Numerical Groundwater Model: 1/ The saturated unconsolidated material (which, depending on the area of the RAA, may be till, clay or sand and gravel) (Figure 5-3). 2/ The saturated bedrock unit below, and not including, the upper weathered bedrock. Hydraulic conductivities and water levels were measured in these wells and used as input data to the Numerical Groundwater model. This infers the hydrogeological conditions in the upper weathered bedrock **were not** evaluated or used as model inputs and therefore the Numerical Groundwater model does not predict effects in the upper weathered bedrock. The saturated unconsolidated material may be in "hydraulic communication" with the upper weathered bedrock, meaning water can flow between the two units. However, these two units can't be considered a single hydrostratigraphic unit as they may have vastly different hydraulic properties, particularly in areas of the RAA where saturated till or clay overlies the weathered bedrock. This point is of particular importance to the Tsuut'ina First Nation as most of **their private water wells are installed in the upper weathered bedrock.**
Information Request	Please require the proponent to install monitoring wells on Tsuut'ina IR 145 that are representative of Tsuut'ina members' private water wells and use the hydraulic head data from these monitoring wells to calibrate the Numerical Groundwater model.

Comment Number	**Hydrogeology #3**
EIS Section Name	Volume 3A, Section 5 Hydrogeology Effects Assessment – Construction and Dry Operations
Section Number(s)	Section 5.2.2.2: Groundwater Flow in the RAA, Page 5.16
Quotation (if relevant)	
Issue	Groundwater flow from bedrock fractures into the diversion channel has not been properly assessed.
Concern	According to the Project Description in Volume 1, the diversion channel is 4.7 km long, 22 m wide and 8.3 m deep. Portions of the diversion channel are completed in the shallow bedrock. By excavating this structure into the bedrock, there is the potential that water bearing fracture(s) will be intersected and drain into the diversion channel, effectively opening a preferential flow pathway. If these fractures are hydraulically connected to Tsuut'ina Nation's private water wells, it can result in serious well interference. The Numerical Groundwater model used to predict flow into the diversion channel assumes the flow is in a porous media like sand. At larger scales this can be a reasonable assumption as flow in numerous fractures can average out and look similar to porous media. However, it is unlikely this assumption is valid when predicting flow into a thin long feature like the diversion channel. It is very difficult to predict the magnitude of this potential effect and the only way of evaluating this kind of well interference is to proactively monitor private water wells.
Information Request	Please require the proponent to conduct a water well survey of Tsuut'ina private water wells and monitor 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.

Comment Number	**Hydrogeology #4**
EIS Section Name	Volume 3A, Section 5 Hydrogeology Effects Assessment – Construction and Dry Operations
Section Number(s)	Section 5.1.4: Boundaries, Page 5.5
Quotation (if relevant)	
Issue	Groundwater model fails to predict potential effects on Tsuut'ina IR 145
Concern	The southern boundary of the RAA and Numerical Groundwater model is stated to be the floodplain and terrace of the Elbow River. The details of how this boundary was represented in the Numerical Groundwater model were not provided in the application. However, the Elbow River Basin Water Management Plan produced in May 2008[1] identified that the flow direction between the Elbow River and the alluvial aquifer depends on the stage of the river. As a result, it is highly unlikely the south model boundary in its current location can be assigned a boundary that reasonably represents reality.
Information Request	Please require the proponent to move the southern boundary of the Numerical Groundwater model to a location where the groundwater boundary conditions can be more reliably estimated.

Comment Number	**Hydrogeology #5**
EIS Section Name	Volume 3A, Section 5 Hydrogeology Effects Assessment – Construction and Dry Operations
Section Number(s)	Section 5.4.2: Change in Groundwater Quantity, Pages 5.30 to 5.31
Quotation (if relevant)	
Issue	Groundwater model fails to predict potential effects on Tsuut'ina IR 145
Concern	We agree that the most significant potential effect during dry operations is the presence of the dry diversion channel on groundwater hydraulic heads. This feature is permanent and incised into the current water table and will divert groundwater from the aquifer, into the channel and downgradient to another location where the groundwater can infiltrate back into ground. However, we don't agree the two Numerical Groundwater model runs (EE0 – Existing conditions and PP0 – average conditions with diversion channel in place) are evidence the negative effects to groundwater will be localized to the diversion channel. Since the southern boundary of the Numerical Groundwater model doesn't predict groundwater hydraulic heads under existing conditions, it can't predict potential effects due to the project.
Information Request	Please require the proponent to first reconstruct and adequately calibrate the model and then re-simulate project effects on groundwater.

[1] Elbow River Basin Water Management Plan: A Decision Support Tool for the Protection of Water Quality in the Elbow River Basin, Elbow River Watershed Partnership, May 2008 (Rev. Jan 16, 2009); https://www.rockyview.ca/Portals/0/Files/Agriculture/Elbow-River-Basin-Water-Management-Plan.pdf (last accessed May 24, 2018)

Comment Number	**Hydrogeology #6**
EIS Section Name	Volume 3A, Section 5 Hydrogeology Effects Assessment – Construction and Dry Operations
Section Number(s)	Section 5.4.2: Change in Groundwater Quantity, Page 5.30
Quotation (if relevant)	"The Elbow River valley is a hydraulic divide for shallow groundwater, with flow directions on either side of the valley directed inward towards it."
Issue	Groundwater model fails to predict potential effects on Tsuut'ina IR 145
Concern	This statement contradicts statements and the understanding of the alluvial aquifer provided in the Elbow River Water Management Plan (see Footnote 1) and yet it seems to be one of the driving factors justifying the existing southern boundary location.
Information Request	Please require the proponent to move the southern boundary of the Numerical Groundwater model to a location where the groundwater boundary conditions can be more reliably estimated.

Comment Number	**Hydrogeology #7**
EIS Section Name	Volume 3A, Section 5 Hydrogeology Effects Assessment – Construction and Dry Operations
Section Number(s)	Section 5.4.2: Change in Groundwater Quantity, Page 5.32 and Page 5.37
Quotation (if relevant)	
Issue	Effects from construction dewatering not quantitatively assessed.
Concern	While construction dewatering isn't a permanent process, the quantity of groundwater removed for construction dewatering is likely to be far greater than what will seep into the operating diversion channel. Further, the depth and aquifers requiring dewatering were not discussed. Since the majority of the Tsuut'ina private water wells draw water from the upper weathered bedrock, it is possible construction dewatering could significantly affect available groundwater.
Information Request	Please require the proponent to run a Numerical Groundwater model simulation (after revisions recommended above) that predicts potential effects on groundwater from construction dewatering.

Comment Number	**Hydrogeology #8**
EIS Section Name	Volume 3A, Section 5 Hydrogeology Effects Assessment – Construction and Dry Operations
Section Number(s)	Section 5.5: Determination of Significant, Page 5.43
Quotation (if relevant)	"Based on the effects assessment, the residual effects on groundwater quantity during construction and dry operation phases of the Project are assessed as not significant because they would not decrease the yield of groundwater supply wells to the point where they can no longer be used."
Issue	Effects on groundwater quantity on Tsuut'ina IR 145 have not been assessed.
Concern	This quotation is incorrect at the southern boundary of the RAA, on and adjacent to Tsuut'ina IR 145. The Numerical Groundwater model **can not predict** existing conditions at the southern model boundary and therefore can not assess effects due to the project on groundwater on Tsuut'ina IR 145.
Information Request	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.

Comment Number	**Hydrogeology #9**
EIS Section Name	Volume 3B, Section 5 Hydrogeology Effects Assessment – Flood and Post-Flood Operations
Section Number(s)	General
Quotation (if relevant)	
Issue	Groundwater model fails to predict potential effects on Tsuut'ina IR 145
Concern	Volume 3B, Section 5 is largely dedicated to showing results of various Numerical Groundwater model simulations during flooding both with and without the project structures. As the Numerical Groundwater model can't mimic current conditions at the southern boundary, it cannot predict groundwater effects on Tsuut'ina IR 145.
Information Request	Please require the proponent to re-simulate the various flood scenarios once the Numerical Groundwater model has been reconstructed to adequately predict effects on Tsuut'ina IR 145.

Comment Number	**Hydrogeology #10**
EIS Section Name	Volume 3B, Section 5 Hydrogeology Effects Assessment – Flood and Post-Flood Operations
Section Number(s)	Section 5.2.1.3: Simulation of Existing Hydrogeologic Conditions Pages 5.6, 5.12 and 5.18
Quotation (if relevant)	"The Elbow River valley is a hydraulic divide for shallow groundwater, with flow directions on either side of the valley directed inward towards it."
Issue	Numerical Groundwater model results contradict current understanding of Elbow River watershed.
Concern	The Elbow River Basin Water Management Plan (see footnote 1) states flow direction in the shallow groundwater near the Elbow River is from the river into the aquifer under flood conditions. The model predicts under the design flood, 1:10 year flood and 1:100-year flood, groundwater flows towards the Elbow River.
Information Request	Please require the proponent to reconstruct the model to adequately model the hydrogeology of the Elbow River and shallow aquifer.

Comment Number	**Hydrogeology #11**
EIS Section Name	Volume 3B, Section 5 Hydrogeology Effects Assessment – Flood and Post-Flood Operations
Section Number(s)	Section 5.2.1.4: Simulation of Post Project Hydrogeologic Conditions (Design Flood (PP1)-Series Runs), Figure 5-16 and Figure 5-27, Pages 5.27 and 5.43
Quotation (if relevant)	
Issue	The Numerical Groundwater Model may not be accurately predicting flow near the reservoir under flood conditions.
Concern	Figure 5-16 shows a dramatic decrease in hydraulic head between the reservoir and the adjacent aquifer. This could occur if the base of the reservoir is entirely comprised of competent, low permeability material like an engineered clay liner. However, the base of the reservoir is composed primarily of the naturally occurring till and clay and Figure 5-16 indicates bedrock daylights in the reservoir. Figure 5-27 indicates that when full, the hydraulic head at the reservoir increases by 28 metres compared to non-flood conditions. If the base of the reservoir is competent, it will behave like a bathtub as shown in Figure 5-16. However, if high permeable windows occur at the reservoir base, this hydraulic head increase will result in far greater changes to the groundwater system than shown in Figure 5-16. These high permeability windows may be from unidentified heterogeneities, cracking of the till/clay after multiple wet/dry cycles and high permeable fractures daylighting in the reservoir.
Information Request	Once the groundwater model is reconstructed to accurately represent groundwater conditions at the southern boundary, please require the proponent to re-model the flood simulations and also conduct sensitivity analysis on the model results by introducing high permeability windows into the reservoir base.

Comment Number	**Hydrogeology #12**
EIS Section Name	Volume 3B, Section 5 Hydrogeology Effects Assessment – Flood and Post-Flood Operations
Section Number(s)	Section 5.2.3: Changes in Groundwater Quality, Pages 5.49 to 5.51
Quotation (if relevant)	
Issue	Groundwater Quality effects weren't adequately assessed.
Concern	The risk to groundwater quality was determined to not be significant primarily because the Numerical Groundwater model particle tracking simulation predicted that water from the reservoir (and contaminants in the water) wouldn't travel far in a flood scenario due to the low permeability of the modelled reservoir. However, as discussed above, high permeability windows in the reservoir base, along with large increase in hydraulic head when the reservoir is full, could result in contaminant transport much farther than predicted.
Information Request	Once the groundwater model is reconstructed to accurately represent groundwater conditions at the southern boundary, please require the proponent to conduct ***and report*** the particle tracking simulation and conduct sensitivity analyses on the particle tracking using high permeable windows.

Comment Number	**Hydrogeology #13**
EIS Section Name	Volume 4, Appendix I, Hydrogeology Baseline Technical Data Report
Section Number(s)	Section 3.1: Conceptual Hydrostratigraphic Framework
Quotation (if relevant)	
Issue	Undifferentiated bedrock overly simplifies the hydrogeology of the bedrock with large variations in hydraulic conductivity and dominated by fractured flow
Concern	The field program identified bedrock with varying permeabilities (sandstone vs claystone), however when creating the Conceptual model, these heterogeneities were removed and the bedrock was conceptualized as a single mass. In addition, the added complexity of fractured flow in bedrock was not discussed or conceptualized at all. The uncertainty of groundwater flow direction and velocity common in bedrock environments needs to be addressed as there are huge potential implications on private water wells completed in the fractured bedrock.
Information Request	Please add the bedrock heterogeneities and fractured bedrock to the Conceptual Hydrostratigraphic Framework.

Comment Number	**Hydrogeology #14**
EIS Section Name	Volume 4, Appendix I, Groundwater Numerical Modelling Technical Data Report
Section Number(s)	Section 3.2: Hydrostratigraphic Framework, Figures 3.3 to 3.6, Pages 3.5 to 3.8 and Section 5.1: Specification of Calibration Targets, Page 5.1
Quotation (if relevant)	
Issue	The modelling report doesn't provide the calibrated hydraulic conductivities for each layer on the model domain.
Concern	It is impossible to evaluate the model without a clear description of the hydraulic properties of the final calibrated model.
Information Request	In the revised Numerical Groundwater model report provide figures similar to Figures 3.3 to 3.6 showing the final calibrated model hydraulic conductivities for each layer.

Comment Number	**Hydrogeology #15**
EIS Section Name	Volume 4, Appendix I, Groundwater Numerical Modelling Technical Data Report
Section Number(s)	Section 3.2.2: Initial Potentiometric Head
Quotation (if relevant)	
Issue	Initial conditions in model calibration not well described
Concern	The date the water levels were collected were not provided in the initial condition description and how the 6 months of data logger water levels collected in 10 of the monitoring wells, were incorporated into the understanding of the initial conditions. Further, water level data for the driest period, May to October were not collected.
Information Request	Please provide this information in the revised Numerical Groundwater Model report.

Comment Number	**Hydrogeology #16**
EIS Section Name	Volume 4, Appendix I, Groundwater Numerical Modelling Technical Data Report
Section Number(s)	Section 4.2.1: Prescribed Head Boundaries, Page 4.4
Quotation (if relevant)	"Prescribed head boundaries, Dirchilet boundaries, were specified to the top layer of the model domain to represent surface water boundaries, and at the perimeter of the model domain. As shown on Figure 4-4, the heads were assigned to surface water features in the domain, based on the elevation of the features determined from the digital elevation model (DEM). Additional prescribed head nodes were assigned to the perimeter of the model domain to represent the static water level at the model boundary, and they were also assigned based on the elevation of the nodes extracted from the DEM"
Issue	The nature of the perimeter boundary conditions is not well described.
Concern	It is impossible to evaluate the performance of the groundwater model without specific information on the perimeter boundary conditions.
Information Request	In the revised Numerical Groundwater model report, please clearly describe the following: 1. Provide the actual time-varying boundary condition data for the perimeter boundary for ***each layer of the model domain***. 2. Clearly describe how this boundary condition data was collected / inferred – for example, how exactly were the static water levels at the boundary assigned using the DEM? And how was it verified that these data were correct? 3. What time period were the boundary conditions assigned over?

Comment Number	**Hydrogeology #17**
EIS Section Name	Volume 4, Appendix I, Groundwater Numerical Modelling Technical Data Report
Section Number(s)	Section 4.2.2: Prescribed Flux Boundaries, Page 4.16
Quotation (if relevant)	"Fluid-flux boundaries, Neumann boundaries, were used to represent inflows and outflows for saturated aquifers in the model domain. These boundaries were applied where aquifer units intersected the edge of the model domain, to simulate more regional groundwater inflows and outflows in these units. The location of the prescribed-flux boundaries is presented on Figure 4-15."
Issue	It is impossible to evaluate the performance of the model without detailed described of this boundary.
Concern	The quotation provided in the only information provided on this boundary. Based on this limited description, there may be enormous uncertainty in these boundary condition estimates.
Information Request	In the revised Numerical Groundwater model report, please provide the following: 1. Show the value or time varying data set of these boundary conditions. 2. Clearly describe these values were estimated. 3. Clearly describe how these boundary conditions were verified with field data?

Comment Number	**Hydrogeology #18**
EIS Section Name	Volume 4, Appendix I, Groundwater Numerical Modelling Technical Data Report
Section Number(s)	Section 5.1: Specification of Calibration Targets
Quotation (if relevant)	The spatial distribution of the monitoring well water level points that were used for model calibration is shown on Figure 5-1. Additional domestic well records were also considered during the model calibration within the broader RAA (not shown).
Issue	The calibration monitoring wells are clustered together in the LAA and not representative of the RAA.
Concern	Steady state calibration of the model with poorly distributed calibration points is not sufficient to ensure the model is representing actual conditions at the boundaries.
Information Request	In the revised Numerical Groundwater model, please use monitoring wells located on Tsuut'ina IR 145, in both surficial and upper bedrock aquifers, to calibrate the model.

Comment Number	**Hydrogeology #19**
EIS Section Name	Volume 4, Appendix I, Groundwater Numerical Modelling Technical Data Report
Section Number(s)	General
Quotation (if relevant)	
Issue	There is no uncertainty analysis provided on the model predictions
Concern	It is impossible to evaluate the Numerical Groundwater model results without uncertainty analysis
Information Request	In the revised the Numerical Groundwater model report, uncertainty analysis should be completed and clearly reported.

ANNEX B

Comment Number	**Hydrology IR#1 - Scoping**
EIS Section Name(s)	Assessment Approach; Hydrology Technical Appendix
Section Number(s)	EIS Volume 2, Section 5.3.1, page 5.12 EIS Volume 4, Appendix J, page 2.1
Quotation	EIS Volume 2: • On page 5.15, the Proponent states that the Local Assessment Area (LAA) includes the project footprint (called the Project Development Area, or PDA) in addition to "adjacent areas where environmental effects may reasonably be expected to occur", specific to each Valued Component (VC). • The proponent also states that "The Regional Assessment Area (RAA) is the area within which the Project's environmental effects may interact or accumulate with the environmental effects of other projects or activities that have been or will be carried out such that cumulative environmental effects may potentially occur." (p. 5.15) EIS Volume 4, Appendix J: • For the hydrology study specifically, the proponent indicates (p. 2.1) that the LAA "extends from the diversion structure to the inlet of the Glenmore Reservoir" and that "the Regional Assessment Area (RAA) is the Elbow River Watershed, including Glenmore Reservoir."
Issue	CEAA's *Guidelines for the Preparation of an Environmental Impact Statement, Streambank Offstream Reservoir Project* (2016) require that the proponent "describe the spatial boundaries to be used in assessing the potential adverse environmental effects of the project and provide a rationale for each boundary". While the proponent has provided a description of the spatial boundaries to be used, a rationale has not been provided.
Concern	Based on the information provided in Volumes 2 and Volume 4 (see quotations above), it appears that the boundaries are set such that the hydrological assessment exclude consideration of the backwater effects of the diversion gates. Failure to provide a rationale for this exclusion is concerning. The backwater structure is located sufficiently close to Federal Lands (Tsuut'ina IR 145) that the potential for effects from project operation on federal lands must be assessed or a rationale for exclusion of consideration must be provided.
Information Request	Please provide a defensible rationale for the LAA selected for the Hydrology Assessment. Please indicate specifically why assessment of backwater effects has been excluded from the assessment. In the absence of a defensible rationale, please assess potential effects to hydrology from backwatering at the diversion structure. Failure to do so will render the EIS insufficient in its ability to address effects on Federal Lands.

Comment Number	**Hydrology IR#2 – Dry Operations Cumulative Effects** (also Cumulative Effects IR#1)
EIS Section Name	Cumulative Effects Assessment – Construction and Dry Operations
Section Number(s)	1.2, starting on page 1.14
Quotation	"Hydrology was not assessed for construction and dry operations because Project-specific environmental effects on hydrology and sediment transport, with the implementation of mitigation measures, are neutral (i.e., no net change in measurable parameters for hydrology relative to existing conditions). In the absence of residual effects, there is no pathway for cumulative effects and, therefore, no cumulative effects assessment is warranted for hydrology during construction and dry operations (p. 1.4)
Issue	CEAA's guidance on cumulative effects assessment is clear: a cumulative effects assessment must answer the question whether a VC (in this case hydrology) is likely to be affected by other past, present, or future physical activities. Failure to assess cumulative effects to hydrology under construction and dry operations represents a significant gap in the EIS.
Concern	As noted in the quotation above, the proponent has determined that the project itself will have "neutral" effects under construction and dry operations conditions and therefore will not interact with other project effects. There are a number of problems with this rationale. **First:** neutral effects are not the same as "no effects". Rather, it is possible to have significant effects on either size of "net zero" that, when added, appear to be neutral. This obscures individual effects that could be important for Tsuut'ina. **Second:** failure to consider cumulative effects under dry conditions ignores the fact that other projects – notably the upstream Bragg Creek project – may alter hydrological conditions such that the assumptions about Springbank baseline conditions – Elbow River water levels and flow - are underestimated. In fact, the Bragg Creek Flood Mitigation Design Report (Amec Foster Wheeler, 2017) suggest this may be the case. The data shows in the half kilometre immediately downstream of the Hamlet boundary (i.e., within the Tsuut'ina Reserve), water levels are determined to increase by about 10-30 cm and centerline flow velocities to increase by 0.1 to almost 0.5 m/s, depending on the flow structure under consideration. (Note: it is not clear from the Design Report what these differences are with all the planned structures in place). Below this initial ~500-m channel length, differences persist in the approximate magnitude of 1-10 cm in water level and 0.02-0.15 m/s in flow velocity, including increases throughout the reach where Redwood Meadows is located (2-3 cm in water level; 0.02-0.07 m/s in flow velocity). Nor is it clear where these differences disappear: from the downstream limit of Redwood Meadows, to the location of the proposed diversion gates for the Springbank Project, model outputs are not provided. **Third:** Changes in water volume and velocity are well known to affect fluvial morphology. The post-construction flood modelling associated with the Bragg Creek project (Project Description Appendix B, Figure 6.4, adobe page 129, attached for reference) shows a narrowing and deepening of the Elbow River on Tsuuti'ina lands under flood conditions. It is not clear the extent or magnitude of this change over successive flood events, the effects of these changes on other VCs and on exercise of First Nations' rights and culture. While the Bragg Creek proponent has concluded that these effects are not significant, they are <u>non-zero</u>. CEAA guidance requires that ANY effect from other projects be considered as part of a cumulative effects assessment. Failure to consider these effects

Comment Number	**Hydrology IR#2 – Dry Operations Cumulative Effects** (also Cumulative Effects IR#1)
	in the Springbank assessment raises significant questions about (a) the model inputs used to design the Springbank project, and (b) the assessment of effects of based on model inputs. Key questions under both flood AND dry conditions include the following: • The Elbow River is a product of its flood regime. How will it change shape over the long term (>50 years or a minimum of two human generations) as a result of the Bragg Creek project, how far downstream will these changes be felt, and, if changes are experienced as far downstream as the Springbank floodgates, can water volumes, depths, and temperatures appropriate to fish be maintained under non-flood conditions? • How could long term changes with the shape of the river interact with the physical barriers presented by the Springbank project affect wildlife access and movement? • How could a deeper river thalwag, increased volume, and/or and greater river velocity resulting from the Bragg Creek project affect the design and function of the Springbank diversion structure under flood conditions? • Could a deeper river thalwag, increased volume, and/or greater river velocity resulting from the Bragg Creek project cause more frequent use of the reservoir and/or cause it to have insufficient capacity to contain a design flood? How will this affect the assessment of project effects on various VCs?
Information Request	The proponent must revise and make available for review its modeling inputs to identify and account for changes to Elbow River hydrology. The proponent must further use these revised inputs to assess effects to hydrology and fluvial morphology under the construction/dry scenario and reassess effects to hydrology and fluvial morphology under flood post-flood scenarios. Finally, the proponent must indicate how the assessment/reassessment alter(s) the effects assessments of VCs that depend on the outcome of the hydrology assessment. Specific attention must be paid to interactions between hydrology and: hydrogeology; fluvial morphology; well water quality and quantity on federal lands; wildlife use patterns, and culture/sense of place.

Comment Number	**Hydrology IR#3 – Design Flood Justification**
EIS Section Name	Construction/Dry Operations and Flood/Post-Flood Assessments of Effects on Hydrology; Effects of the Environment on the Project; Hydrology Technical Appendix
Section Number(s)	Volumes 3A/3B Section 6; Volume 3D, Section 2; Appendix J
Quotation	n/a
Issue	The Springbank Project is sized to capture the 2013 flood. Based on reviews of previous flood frequency studies, the proponent provides an updated flood frequency analysis and uses this to estimate Reservoir use for difference return period flows (EIS Summary. The proponent also provides a report[1] to identify maximum possible precipitation in the Elbow River Watershed to support the determination of a probable maximum flood on which to design infrastructure associated with the Springbank Project to assure safety under all conditions.
Concern	Based on a review of the proponent's documents, it appears that the flood frequency analysis work presented in the EIS does not consider the now well-accepted nonstationary nature of the climate (Milly 2008[2]). Instead, the proponents base their likelihood assessments on assuming the past is a reasonable prediction of the future. This is no longer acceptable. It is now increasingly likely that the return period of high-flow events will be reduced below that indicated by past flood distributions alone. For example, the June-2013 flood can now be expected to be a flood of more frequent return period than is suggested by an analysis of only the historic record. Additionally, because of the ongoing change in climate and the uncertainty around the rate of future greenhouse gases emissions, there is growing uncertainty in the reliability of any return-period analysis of flood flows. Flood frequency analyses associated with the Elbow River are further complicated by the nature of the storms that generate flood flow and lead to the long-term flood frequency distributions generally analysed. Pomeroy et al.[3] (2016) provide an analysis that "demonstrates that a single flood frequency curve cannot be fitted to these data" because they are derived from two distinctly separate populations distinguished by flow-generation mechanism. For events of up to one-in-ten-year return period (snowmelt-driven), the primary source area is the Central Ranges whereas for events greater than the one-in-fifteen-year return period (rain-on-snow driven), the primary source area is the Front Ranges and Foothills. The rain-on-snow events are less frequent however when they occur, they generally present much greater risk than the annual snowmelt-dominated events. According to Pomeroy et al. (2016): "It is inappropriate to mix flow-generation and source-area mechanisms in statistical analysis, and so the return period calculation for this event [June-2013] is prone to great uncertainty… *Downstream communities have now prepared for similar floods but need to be prepared for larger floods in the future*" (emphasis added).
Information Request	Please provide a flood frequency analysis consistent with guidance provided by the Engineers and Geoscientists BC (EGBC) for specific guidance on how to incorporate specific effects of climate change into flood hazard and/or risk assessments. This includes guidance on how to modify intensity, duration, frequency (IDF) curves, account for changes in snowpack and runoff, and incorporate metrics for increases in impermeable or poorly permeable surfaces resulting from human development, wildfires, and land quality changes. This revised analysis should be written with readability in mind

[1] Kappel B, D Hultstrand, G Muhlestein, K Steinhilber, D McGlone and P Sutter 2015. *Site-Specific Probable Maximum Precipitation Study for the Elbow River Basin-Springbank Off-Stream Storage Project*. Prepared by Applied Weather Associates (Colorado) as *Appendix B.3 PMP Analysis Report* for the Springbank Environmental Impact Assessment, July 2015, 88 p plus seven appendices.

[2] Milly PCD 2008. Climate change. Stationarity is dead: whither water management? *Science* 319 (5863): 573-574.

[3] Pomeroy JW, RE Stewart and PH Whitfield 2016. The 2013 flood event in the South Saskatchewan and the Elk River basins: causes, assessment and damages. *Canadian Water Resources Journal* 41(1-2):105-117.

Comment Number	**Hydrology IR#3 – Design Flood Justification**
	and should explicitly indicate the ways in which it contains conservatism needed to account for climate change. Once completed this analysis should be used to determine if the 2013 flood is suitable as the design flood, i.e., one that is greater than a climate-change-adjusted flood return period of 1:100 years or greater or indicate the adjusted frequency of infrastructure use and increased likelihood that the reservoir will be insufficiently large to contain a flood. Note also that, in conjunction with Hydrology IR #2, this reassessment must consider changes in the context of the entrainment project at Bragg Creek (which may not itself have sufficient freeboard to contain a flood greater than the 2013 event) and the way in which this will affect Springbank's capacity, function, and behaviour in the event of a failure at Bragg Creek. This, in turn, must also consider effects on the portion of the Elbow River that is part of IR145 and a sacred cultural feature for the Tsuut'ina Nation.

Comment Number	**Hydrology IR#4 – Upstream Debris**
EIS Section Name	Accidents and Malfunctions
Section Number(s)	Volume 3D, Section 1
Quotation	n/a
Issue	Failure of upstream projects under flood conditions has not been assessed in the Springbank EIS Assessment of Cumulative Effects.
Concern	According to the Bragg Creek Flood Mitigation Design Report (Amec, 2017, p. 18), the Bragg Creek project has been designed to a flood "approximately 16% lower than the 1150 m3/s flood peak which occurred in 2013" but that a flood equivalent to the 2013 flood "would be contained within [the project's] minimum 0.6m freeboard." This statement is not a replacement for a robust methodology that explicitly identifies a design flood that accounts for climate change and develops a project to address that flood level. Without a flood level defensibly selected to account for the effects of climate change, it is possible that the Bragg Creek infrastructure could fail with greater frequency than predicted in extreme events. Failure at Bragg Creek can reasonably be expected to result in a sudden and/or large increase in entrained debris. It is not clear whether the recently added debris catch at Springbank can contain a pulse of entrained debris of this nature, how this will affect the integrity of the Springbank infrastructure, or whether it will cause unplanned flooding at Springbank's backwater location.
Information Request	Using the revised flood frequency analysis requested in Hydrology IR#3, assess the effects to the Springbank project infrastructure and to federal lands (specifically IR145) of a loss of Bragg Creek flood protection system integrity. Identify and evaluate potential debris volumes and potential deposition patterns and the way in which these will alter or exacerbate flooding on IR145.

ANNEX C

Comment #	**Vegetation/Wetlands #1**
EIS Section Name	Assessment of Potential Effects on Vegetation and Wetlands (Construction and Dry Operations) – Engagement and Key Concerns
Section Number(s)	10.1.2
Quotation (if relevant)	"TLRU information contributed to the understanding of the existing ecological conditions, was used to identify vegetation and wetland resources that are used traditionally, and informed the assessment of potential Project effects. While this information did not directly affect the significance definition it has been incorporated into the analysis of effects on which the significance determining was based."
Issue	Please clarify.
Concern	TLRU information should be considered in the context of significance determination.
Information Request	Clarify how TLRU was incorporated into the analysis of effects?

Comment #	**Vegetation/Wetlands #2**
EIS Section Name	Assessment of Potential Effects on Vegetation and Wetlands (Construction and Dry Operations) – Potential Effects, Pathways and Measurable Parameters
Section Number(s)	10.1.3
Quotation (if relevant)	-
Issue	How is direct/indirect loss of alteration of surface or groundwater flow patterns being measured with respect to wetland function?
Concern	No measurable parameter identified for this effect.
Information Request	Please describe how the loss/alteration of surface/groundwater flow patterns is being assessed for wetland function?

Comment #	**Vegetation/Wetlands #3**
EIS Section Name	Assessment of Potential Effects on Vegetation and Wetlands (Construction and Dry Operations) – Regional Boundaries
Section Number(s)	10.1.41 Regional Boundaries
Quotation (if relevant)	"The RAA was selected to encompass an average home range of a female grizzly bear (500km^2)."
Issue	The RAA is used to provide context for the assessment of potential project effects and should be relevant to the valued component (vegetation and wetlands), particularly since it is also often used as the spatial boundary for the assessment of potential cumulative effects.
Concern	Concern the RAA selected for vegetation and wetlands will not provide meaningful evaluation of residual effects particularly with respect to wetland function at the watershed level.
Information Request	How does the RAA based on the home range of a female grizzly bear provide context for the assessment of potential project effects – specifically for wetland function?

Comment #	**Vegetation/Wetlands #4**
EIS Section Name	Assessment of Potential Effects on Vegetation and Wetlands (Construction and Dry Operations) – Project Interactions with Vegetation and Wetlands
Section Number(s)	10.3.1 Mitigation
Quotation (if relevant)	Native areas disturbed by the Project would be reseeded using an Alberta Transportation native custom seed mix.
Issue	Reliance on seed mixes to replace lost habitat, and manage weeds.
Concern	Seeding is not prescriptive enough to effectively replace lost habitat or prevent the establishment of regulated weeds.
Information Request	Was planting native shrub and tree species considered to mitigate the change in species diversity and loss of native vegetation communities? If not why?

Comment #	**Vegetation/Wetlands #5**
EIS Section Name	Assessment of Potential Effects on Vegetation and Wetlands (Construction and Dry Operations) – Project Interactions with Vegetation and Wetlands
Section Number(s)	10.3.1 Mitigation
Quotation (if relevant)	
Issue	Control of regulated weeds and prevention of spread and establishment.
Concern	There is a high potential for regulated weeds to spread and establish in disturbed areas due to project clearing and construction.
Information Request	Mitigation should include developing a management plan to prevent and control the establishment and spread of regulated weeds.

Comment #	**Vegetation/Wetlands #6**
EIS Section Name	Assessment of Potential Effects on Vegetation and Wetlands (Flood and Post-Flood Operations)
Section Number(s)	10.1
Quotation (if relevant)	"Filling and draining of the reservoir, as well as reservoir sediment partial cleanup, would not fragment patches of native plant communities."
Issue	Flooding, scouring, erosion and deposition of sediment could effectively destroy/bury native plant communities, particularly native grasslands, and would have a similar effect as clearing and fragmentation, however this was not assessed.
Concern	Fragmentation as a result of filling and draining of the reservoir and sediment clean-up was not assessed.
Information Request	Please provide further information to support the claim that "native communities, may be altered, but areas would not likely be lost" as a result of filling and draining of the reservoir.

Comment #	Vegetation/Wetlands #7
EIS Section Name	Assessment of Potential Effects on Vegetation and Wetlands (Flood and Post-Flood Operations)
Section Number(s)	10.2.3.2
Quotation (if relevant)	"Permanent loss of traditional plant use species is not anticipated…effects are expected to be adverse, but local in extent and short-term in duration."
Issue	While there may not be a permanent loss, long-term impacts to traditional use plants can be reasonably expected if a flood occurs because flooded areas will likely be perceived as disturbed by those harvesting plants for traditional use.
Concern	Long-term loss of traditional use plants in flooded areas not considered.
Information Request	According to the effects assessment methods - short-term residual effects are described as limited to the construction phase. Please consider the long-term impacts to traditional plant harvesters in the assessment.

Comment #	Vegetation/Wetlands #8
EIS Section Name	Assessment of Potential Effects on Vegetation and Wetlands (Flood and Post Flood Operations)
Section Number(s)	10.3
Quotation (if relevant)	"Due to the lack of information of rare plant occurrences in the RAA, a loss of a single rare plant occurrence at the local scale does not imply a significant effect at the regional scale."
Issue	Lack of data to support rationale.
Concern	Justification of potential loss of rare plant not supported by data.
Information Request	Please discuss how this determination was made given the lack of information on rare plant occurrences. Has the proponent considered measures to prevent the loss of slender cress plant in the PDA?

Comment #	Vegetation/Wetlands #9
EIS Section Name	Assessment of Potential Effects on Vegetation and Wetlands
Section Number(s)	-
Quotation (if relevant)	-
Issue	Post construction and post flood monitoring of vegetation and ecosystems is not discussed as part of the environmental impact assessment.
Concern	Absence of monitoring plan.
Information Request	Post-construction monitoring of reclaimed areas and post-flood conditions will be important to determine the effectiveness of mitigation measures. Please confirm that a monitoring plan will be developed for vegetation and wetlands.

Comment #	**Vegetation/Wetlands #10**
EIS Section Name	Vegetation and Wetlands Supplementary Data
Section Number(s)	Appendix L
Quotation (if relevant)	
Issue	Lack of data to support environmental impact assessment.
Concern	Absence of baseline details
Information Request	Appendix L is limited to descriptions of species of management concern, and a list of plant species observed within the PDA. Where is the technical report describing baseline conditions, methods and field data for ecosystem types within the LAA and RAA. These data are needed to determine the integrity of predictions in the effects assessment.

ANNEX D

Comment #	**Wildlife #1**
EIS Section Name	Wildlife and Biodiversity Technical Data Report
Section Number(s)	Volume 4: Appendices Appendix H Section 3.6 and 3.7
Quotation (if relevant)	N/A
Issue	How do results of the camera study and tracking study for elk compare with regional data for the area? Is the Project area important for elk (i.e., wintering grounds), what are the population trends, threats to this species, numbers, etc.? What are the linkages between traditional use information and elk?
Concern	Sufficient context isn't provided to understand survey results in comparison to regional data and traditional data.
Information Request	Provide regional data and traditional data as context for baseline study results.

Comment #	**Wildlife #2**
EIS Section Name	Wildlife and Biodiversity Technical Data Report
Section Number(s)	Volume 4: Appendices Appendix H Section 3.6
Quotation (if relevant)	N/A
Issue	The location of remote cameras was not provided in a figure.
Concern	It is difficult to determine if the distribution of camera locations was suitable for this survey without this information.
Information Request	Provide a figure of remote camera locations, with habitat types.

Comment #	**Wildlife #3**
EIS Section Name	Wildlife and Biodiversity Technical Data Report
Section Number(s)	Volume 4: Appendices Appendix H Section 3.7.3
Quotation (if relevant)	"Movements of elk were relatively consistent between 2015, 2016 and 2017 winter tracking surveys."
Issue	Elk movement observations were not described other than a brief overview of 70 elk crossing Highway 22. Are there dominant movement patterns for elk in this area and/or seasonal movement patterns?
Concern	There is the potential for this project to influence movement patterns.
Information Request	Provide context for elk movement patterns in the area currently.

Comment #	**Wildlife #4**
EIS Section Name	Wildlife and Biodiversity Technical Data Report
Section Number(s)	Volume 4: Appendices Appendix H Section 11A.2.4
Quotation (if relevant)	"Elk have been shown to avoid roads, which can affect habitat use and distribution. However, the extent to which elk reduce their use near roads varies with time of day, sex, road type and traffic volume (McCorquodale 2013; Buchanan et al. 2014; Prokopenko 2016). Some studies have reported elk reduce their use near roads at distances that vary from 250 m up to 1 km or more (McCorquodale 2013)."
Issue	Although one of the three references from this section was a brief review of scientific literature on elk, there are numerous studies on elk behaviour to provide a more robust discussion on suitable buffer distances, with a focus on local habitat and studies in Alberta.
Concern	The 250m buffer distance for moderate volume roads may be insufficient.
Information Request	Provide clear rationale, with additional literature, to justify the 250m and 500m road buffers.

Comment #	**Wildlife #5**
EIS Section Name	Wildlife and Biodiversity Technical Data Report
Section Number(s)	Volume 4: Appendices Appendix H Section 11A.2.4
Quotation (if relevant)	"Industrial development and primary roads are considered high disturbance and buffered by 500 m and suitability ratings are reduced by two classes."
Issue	The rational for buffering industrial developments by 500m was not described.
Concern	This buffer distance needs to be supported with literature.
Information Request	Provide clear rationale, appropriately referenced, to explain why a 500m buffer of industrial developments was used in the elk habitat suitability model.

Comment #	**Wildlife #6**
EIS Section Name	Wildlife and Biodiversity, Effects assessment (Construction and Dry Operations)
Section Number(s)	Volume 3A Section 11.1.5
Quotation (if relevant)	"The RAA extends 15 km beyond the PDA (Figure 11-2), and is used for determining residual effects on wildlife and biodiversity and to assess where residual effects act cumulatively with residual effects of past, present, and reasonably foreseeable future activities (i.e., cumulative effects). The RAA is 102,817 ha. The spatial boundary is sufficiently large to encompass an average home range of a female grizzly bear (500 km2), which would also include home ranges of other wildlife SOMC that have relatively smaller home ranges. The RAA boundary to the east borders the City of Calgary."
Issue	The same RAA was used for several diverse components of the effects assessments.
Concern	Given the variance in subject matter, it is advisable to determine the RAA boundary based on ecological boundaries such as habitat types, watersheds, topography, etc. as they relate to wildlife.
Information Request	Provide a description of why a 15km buffer of the project area was used to assess regional project effects on all components of the effects assessment.

Comment #	**Wildlife #7**
EIS Section Name	Wildlife and Biodiversity, Technical Data Report
Section Number(s)	Volume 4: Appendices, Appendix H, Section 11A.2.5
Quotation (if relevant)	N/A
Issue	Why was elevation and aspect not included in the grizzly bear habitat suitability model?
Concern	Elevation and aspect can play a key role in habitat selection by grizzly bear.
Information Request	Provide reasoning for excluding elevation and aspect from the grizzly bear habitat suitability model, or update the model accordingly.

Comment #	**Wildlife #8**
EIS Section Name	Wildlife and Biodiversity Technical Data Report
Section Number(s)	Volume 4: Appendices Appendix H Section 11A.2.5
Quotation (if relevant)	"Industrial development and secondary roads are considered high disturbance and buffered by 500 m and suitability ratings are reduced by two classes".
Issue	The rational for buffering industrial developments by 500m was not described.
Concern	This buffer distance needs to be support with literature.
Information Request	Provide clear rationale, appropriately referenced, to explain why a 500m buffer of industrial developments was used in the grizzly bear habitat suitability model.

Comment #	**Wildlife #9**
EIS Section Name	Assessment of Potential Effects on Wildlife and Biodiversity
Section Number(s)	Volume 3A: Effects Assessment (Construction and Dry Operations) Section 11.1.3.
Quotation (if relevant)	"Construction of the Project may cause the loss of winter ungulate habitat and increase habitat fragmentation in the Project area (a concern expressed by the Tsuut'ina)."
Issue	How is the potential loss of winter ungulate range and increased fragmentation considered with reference to available data (both scientific and traditional)?
Concern	Context for population trends and threats is not described in enough detail to understand how the loss of winter ungulate range, in addition to increased fragmentation, will impact elk in the area.
Information Request	A more thorough review and description on population trends and threats to elk is needed, from a scientific and traditional perspective, to assess how trends and threats may change because of the project.

Comment #	**Wildlife #10**
EIS Section Name	Assessment of Potential Effects on Wildlife and Biodiversity
Section Number(s)	Volume 3A: Effects Assessment (Construction and Dry Operations) Section 11.1.3.
Quotation (if relevant)	"• The Project area is an environmentally sensitive area, and includes a Key Wildlife and Biodiversity Zone and Environmentally Significant Areas. • Construction of the Project may cause the loss of winter ungulate habitat and increase habitat fragmentation in the Project area. • Habitat damage, including damage to sensitive fescue grassland and wetland ecosystems, could result from contaminated sediment left behind from flood waters or debris. • The construction of the diversion channel and the off-stream dam would occur in areas of wetland. Construction activities related to these components have the potential to cause the loss or alteration of wetland habitat. • Use of the reservoir would likely result in the loss of migratory bird nests and would also temporarily reduce the availability of wetland habitat in the project area that is suitable for breeding, nesting and brood rearing for waterfowl and other migratory birds for the period the flood water is retained in the reservoir; • Debris left after floods may result in loss of bird habitat or contamination of habitat, impacts to wetlands impacts will cause further impacts to wildlife, fish and birds, as well as the exercise of Aboriginal, Treaty, and Inherent rights. • Adverse impacts could occur to the habitat of species of cultural significance, including bald eagles and grizzly bears. • The Project could impact migratory herds of elk that pass through Tsuut'ina territory"
Issue	How will the loss of wildlife habitat be compensated for?
Concern	There is no description in the effects assessment to outline plans for habitat compensation.
Information Request	Based on the concerns expressed by Tsuut'ina above, it is recommended that a habitat compensation plan is developed for the loss of habitat types (winter ungulate habitat, wetland, potential contamination of habitat, migratory movements of elk, etc.).

Comment #	**Wildlife #11**
EIS Section Name	Assessment of Potential Effects on Wildlife and Biodiversity
Section Number(s)	Volume 3A: Effects Assessment (Construction and Dry Operations) Section 11.1.7.
Quotation (if relevant)	"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."
Issue	The significance definition only refers to an effect on wildlife species.
Concern	The definition of significance should include wildlife habitat as well as changes in biodiversity.
Information Request	Update the significance definition to include changes to wildlife habitat and biodiversity. Review effects assessment conclusions to determine if any changes are warranted because of this change.

Comment #	**Wildlife #12**
EIS Section Name	Assessment of Potential Effects on Wildlife and Biodiversity
Section Number(s)	Volume 3A: Effects Assessment (Construction and Dry Operations) Section 11.2.2.6.
Quotation (if relevant)	"Existing landscape diversity and community (habitat) diversity in the RAA is described in Sections 10.2.2.1and 10.2.2.2, and 10.2.2.3 (Vegetation and Wetland). Existing habitat connectivity (fragmentation) is described in Section 10.4.2. Wildlife habitat abundance is described in Section 11.2.2.4."
Issue	Biodiversity is split between landscape, community and species diversity in the Vegetation and Wetlands Sections, while habitat fragmentation and abundance of wildlife habitat in the Wildlife and Biodiversity Sections.
Concern	It is difficult to get a clear picture of biodiversity on site both currently and because of the project when it is reported in two separate locations.
Information Request	A summary of landscape, community and species diversity should be included in the Wildlife and Biodiversity Sections to provide a complete picture on biodiversity.

Comment #	**Wildlife #13**
EIS Section Name	Assessment of Potential Effects on Wildlife and Biodiversity
Section Number(s)	Volume 3A: Effects Assessment (Construction and Dry Operations) Section 11.4.2.2.
Quotation (if relevant)	"If vegetation removal is scheduled to occur within the RAP for migratory birds and raptors, a qualified wildlife biologist would inspect the site for active nests within seven days of the start of the proposed construction activity (e.g., vegetation removal, blasting)."
Issue	Seven days is a long period of time to wait between conducting the nest survey and clearing vegetation.
Concern	The concern is that birds could construct a nest during this time.
Information Request	Provide a clear rationale for using a seven-day window to meet best practice.

Comment #	**Wildlife # 14**
EIS Section Name	Assessment of Potential Effects on Wildlife and Biodiversity
Section Number(s)	Volume 3A: Effects Assessment (Construction and Dry Operations) Section 11.4.5.1
Quotation (if relevant)	"Although project effects on species richness and relative abundance are difficult to assess without monitoring, the Project has potential to affect bird and amphibian species richness and relative abundance through the loss and alteration of land cover types."
Issue	Effects predicted during an EIA need to be compared against data collected while the project is constructed and operated.
Concern	Predicted effects could be significantly different from observed effects.
Information Request	Provide details on a robust monitoring program to monitor project effects on wildlife and biodiversity during construction and operation.

Comment #	**Wildlife #15**
EIS Section Name	Assessment of Potential Effects on Wildlife and Biodiversity
Section Number(s)	Volume 3B: Effects Assessment (Flood and Post-Flood Operations) Section 11.3.2.2.
Quotation (if relevant)	"Weed propagation will be reduced by using appropriate equipment cleaning protocols."
Issue	An invasive plant management plan has not been referenced.
Concern	Controlling invasive plants and weeds through equipment cleaning alone will not be sufficient.
Information Request	Provide an invasive plant management plan with specifics on how weeds and invasive plants will be managed during Construction and Dry Operations, as well as Flood and Post-Flood Operations. If it is too early to provide this level of detail, a commitment to developing an invasive plant management plan to comply with best management practices should be provided.

Comment #	**Wildlife #16**
EIS Section Name	Assessment of Potential Effects on Wildlife and Biodiversity
Section Number(s)	Volume 3B: Effects Assessment (Flood and Post-Flood Operations) Section 11.3.2.2.
Quotation (if relevant)	N/A
Issue	Is there a risk that potential project effects on wildlife and biodiversity have been minimized by assessing the project in two stages: Construction and Dry Operations, as well as Flood and Post-Flood Operations?
Concern	Would some of the proposed effects on wildlife and biodiversity be considered more significant if the present baseline condition was assessed against flood conditions?
Information Request	Provide rationale for splitting the effects assessment into two parts and respond to the abovementioned concern.

Comment #	**Wildlife #17**
EIS Section Name	Assessment of Potential Effects on Wildlife and Biodiversity
Section Number(s)	Volume 3B: Effects Assessment (Flood and Post-Flood Operations) Section 11.4
Quotation (if relevant)	"As defined in Volume 3A, Section 11.1.6, a significant environmental effect on wildlife and biodiversity is one that threatens the long-term persistence or viability of a wildlife species in the RAA. This includes effects that are contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans and management plans. With the application of mitigation measures, project residual environmental effects on wildlife, including migratory birds and species at risk, and biodiversity are predicted to be not significant. Although the magnitude of some residual effects related to flood operations would be moderate or high during a design flood, the residual effects on habitat, movement, and mortality risk would be unlikely to pose a long-term threat to the persistence or viability of a wildlife species, including migratory birds and SAR, in the RAA."
Issue	The conclusion of significance is discussed at a very high level for wildlife and biodiversity without a clear connection to each species assessment.
Concern	The concern is that the effects assessment may be significant for an individual species but not reflected in the combined determination for wildlife overall.
Information Request	Provide a description as to why significance was not determined for each species? Provide clear linkages between each species assessment and significance determinations.

Comment #	**Wildlife #18**
EIS Section Name	Wildlife and Biodiversity, Effects assessment (Construction and Dry Operations) Wildlife and Biodiversity, Effects assessment (Flood and Post-Flood Operations)
Section Number(s)	Volume 3A Volume 3B
Quotation (if relevant)	N/A
Issue	There is no discussion of cumulative effects on wildlife and biodiversity in Volumes 3A or 3B.
Concern	A cumulative effects assessment is an important part of understanding potential impacts to wildlife and biodiversity at the regional scale.
Information Request	Include a summary of the wildlife and biodiversity cumulative effects assessment with a link to the relevant section of the EIS for more details.

Comment #	**Wildlife #19**
EIS Section Name	Wildlife and Biodiversity, Effects assessment (Construction and Dry Operations) Wildlife and Biodiversity, Effects assessment (Flood and Post-Flood Operations) Wildlife and Biodiversity, Technical Data Report
Section Number(s)	Volume 3A Volume 3B Volume 4: Appendices, Appendix H
Quotation (if relevant)	"At the time of writing of this assessment, Alberta Transportation had received a Project-specific TUS report from Piikani Nation, as well as a joint interim TUS report from Blood Tribe and Siksika Nation…. While this information did not directly affect the significance definition it has been incorporated into the analysis of effects on which the significance determination was based."
Issue	All of the TUS reports were not incorporated into the effects assessment and those that were incorporated were not fully integrated.
Concern	Traditional use studies are critical to understanding wildlife baseline conditions and determining potential residual effects. There is no description of how TUS information was included in the habitat suitability models or baseline surveys. The two wildlife and biodiversity effects assessment volumes incorporate some information from TUSs as part of the project pathway sections and mitigation sections, but the incorporation of TUS into the conclusions on magnitude of residual effects is missing. The inclusion of TUS regarding important wildlife species and habitat is expected to influence effects assessment ratings. The definition of significance may also change as the cultural connection with wildlife and biodiversity is different. Section 14 includes detailed information on TLRU. To meaningfully incorporate TUS into the effects assessment, the wildlife and biodiversity volumes need to incorporate these details. For example, in 3A, the conclusion is made that mortality effects to elk are predicted to be low (Section 11.4.4.3.). However, the resulting effect on elk hunting in the area or access to hunt for elk by First Nations is not discussed.
Information Request	TUS reports from all First Nations should be incorporated into the baseline report and effects assessment chapters in a meaningful way to provide more context from an Indigenous perspective.

ANNEX E

Comment Number	**Federal Lands #1**
EIS Section Name	Effects to Federal Lands / Cumulative Effects
Section Number(s)	Volumes 3A/3B, Sections 13 / Volumes 3C Section 1
Quotation (if relevant)	"The federal lands included within the assessment, due to their proximity to the Project site, are the Tsuut'ina Nation Reserve 145 and the Stoney Nakoda Nations Reserves 142, 143 and 144."
Issue	Vol 3A, Figures 18-1 and 18-2 (Study boundaries) do not fully encompass the referenced federal lands.
Concern	Federal Guidance on EA Scoping for Cumulative Effects is clear: that spatial boundaries must be set that are appropriate to the valued component being studied – in this case, *federal lands* is the VC by virtue of the federal government requiring that they be part of an assessment under CEAA. The specific CEAA guidance is as follows: "spatial boundaries must support the consideration of cumulative effects for each VC identified for the cumulative effects assessment" and, "spatial boundaries of a cumulative effects assessment are based on setting adequate spatial boundaries for each VC and considering primarily the VC's geographic range and the zone of influence (ZOI) of the project for the VC. For example, spatial boundaries for a migratory species may take into account seasonal migration paths, regardless of jurisdictional boundaries."[1] In this instance, simply using the RAA boundaries for the various biophysical and socio-economic VCs assessed in sections 3A and 3B of the EIS – many of which do not encompass the entirety of any of Reserves 142, 143, 144, and 145 and some of which fully exclude the Reserves in question – presents a fragmented picture. By considering cumulative effects on subset areas of each reserve, the EIS is unable to make reliable predictions about the totality of project effects and regional development on the biophysical and socio-economic functioning of <u>the discrete and indivisible management entities</u> that are Indian Reserves. To suggest that there are no cumulative effects on federal lands based on assessment boundaries that do not fully encompass those lands runs counter to CEAA guidance and best EA practices.
Information Request	The proponent must reassess effects to federal lands based on regional study spatial boundaries for each biophysical and socioeconomic VC that include the entirety of each of the Tsuut'ina Nation Reserve 145 and the Stoney Nakoda Nations Reserves 142, 143 and 144. This is particularly important with respect to assessing cumulative effects to vegetation and wildlife as they relate to the exercise of traditional use because cumulative effects of regional development may affect patterns of use across an entire Reserve.

[1] DRAFT Technical Guidance for Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act, 2012*, Canadian Environmental Assessment Agency, December 2014.

Comment Number	**Federal Lands #2**
EIS Section Name	Effects to Federal Lands / Project Description
Section Number(s)	Volumes 3A/3B, Sections 13 / Volume 1, Section 2.0
Quotation (if relevant)	"The federal lands included within the assessment, due to their proximity to the Project site, are the Tsuut'ina Nation Reserve 145 and the Stoney Nakoda Nations Reserves 142, 143 and 144." (Vol3A) -and- "Deltares were commissioned by Alberta Environment and Parks to prepare a comparative evaluation of the MC1 Option and the off-stream reservoir. …The report recommended the Springbank Off-stream Reservoir Project, ***in combination with local mitigation*** for Bragg Creek and Redwood Meadows, over the MC1 Option [***emphasis added***]" (Vol 1) -and- "The principal benefit of the Project is to reduce the potential damaging effects of future Elbow River floods ***on the City of Calgary and downstream communities***."
Issue	The Project has been defined in a manner that omits a consideration of the full suite of recommended works. Works planned for Bragg Creek are proceeding under a separate review and no works have yet been scoped for Redwood Meadows.
Concern	This approach described above is tantamount to project splitting and results in an EIS that is silent on the effects in the reach of the Elbow River that lies between the two projects – a reach coincident with the Elbow River's passage through IR 145. Specifically, there is no there is no analysis of the effects of the recommended combined works (Bragg Creek, Redwood Meadows, and the Springbank Off-stream Reservoir Project) on any of the VCs assessed in the EIS. The result is that the EIS cannot confidently predict that flooding risk will not be transferred from the City of Calgary to IR 145. In fact, without additional information, it is reasonable to believe that entrainment works at Bragg Creek coupled with backwatering at the Project location under extreme flood scenarios will increase water volume and velocity on IR 145 with significant adverse effects to these federal lands.
Information Request	The scope of the EIS must be expanded, at a minimum, to consider potential effects from all works recommended in the Deltares report that were used as the justification to select the Project in lieu of the Mclean Creek project. The proponent should also be required to conduct a strategic EA (SEA) on the McLean Creek project to better understand its actual impacts and compare the projects on a more even footing. Considering concerns noted in the IRs associated with Hydrology, this assessment and comparison must be made using flood return periods appropriately adjusted to account for the effects of climate change.

Comment Number	**Federal Lands IR#3 – Design Flood Justification**
EIS Section Name	Construction/Dry Operations and Flood/Post-Flood Assessments of Effects on Hydrology; Effects of the Environment on the Project; Hydrology Technical Appendix
Section Number(s)	Volumes 3A/3B Section 6; Volume 3D, Section 2; Appendix J
Quotation	n/a
Issue	Further to Hydrology IR#3, the EIS does not adequately demonstrate that the design flood size has been selected to adequately account for increased flood frequency and severity expected as a result of climate change.
Concern	In the event that the EIS has either underestimated the frequency with which diversions will occur, the size of these diversions, and/or the likelihood that the capacity will be exceeded, effects to all VCs and to federal lands may be greater than predicted. Further, underestimation of flood frequency and size may underemphasize cumulative effects and or knock-on (domino) effects resulting from loss of upstream flood protection integrity, leading to significant debris and flood damage on IR 145.
Information Request	See Hydrology Information Request #3. In particular, explicitly consider changes in the context of the project at Bragg Creek (which may not itself have sufficient freeboard to contain a flood greater than the 2013 event), the way in which this will affect Springbank's capacity, function, and behaviour, and how this may affect IR 145.

ANNEX F

Comment Number	**Cumulative Effects IR#1 – Project Interactions** (also, Hydrology IR#2)
EIS Section Name	Cumulative Effects Assessment – Construction and Dry Operations
Section Number(s)	1.2, starting on page 1.14
Quotation	"Hydrology was not assessed for construction and dry operations because Project-specific environmental effects on hydrology and sediment transport, with the implementation of mitigation measures, are neutral (i.e., no net change in measurable parameters for hydrology relative to existing conditions). In the absence of residual effects, there is no pathway for cumulative effects and, therefore, no cumulative effects assessment is warranted for hydrology during construction and dry operations (p. 1.4)
Issue	CEAA's guidance on cumulative effects assessment is clear: a cumulative effects assessment must answer the question whether a VC (in this case hydrology) is likely to be affected by other past, present, or future physical activities. Failure to assess cumulative effects to hydrology under construction and dry operations represents a significant gap in the EIS.
Concern	As noted in the quotation above, the proponent has determined that the project itself will have "neutral" effects under construction and dry operations conditions and therefore will not interact with other project effects. There are a number of problems with this rationale. **First:** neutral effects are not the same as "no effects". Rather, it is possible to have significant effects on either size of "net zero" that, when added, appear to be neutral. This obscures individual effects that could be important for Tsuut'ina. **Second:** failure to consider cumulative effects under dry conditions ignores the fact that other projects – notably the upstream Bragg Creek project – may alter hydrological conditions such that the assumptions about Springbank baseline conditions – Elbow River water levels and flow - are underestimated. In fact, the Bragg Creek Flood Mitigation Design Report (Amec Foster Wheeler, 2017) suggests this may be the case. The data shows in the half kilometre immediately downstream of the Hamlet boundary (i.e., within the Tsuut'ina Reserve), water levels are determined to increase by about 10-30 cm and centerline flow velocities to increase by 0.1 to almost 0.5 m/s, depending on the flow structure under consideration. (Note: it is not clear from the Design Report what these differences are with all the planned structures in place). Below this initial ~500-m channel length, differences persist in the approximate magnitude of 1-10 cm in water level and 0.02-0.15 m/s in flow velocity, including increases throughout the reach where Redwood Meadows is located (2-3 cm in water level; 0.02-0.07 m/s in flow velocity). Nor is it clear where these differences disappear: from the downstream limit of Redwood Meadows, to the location of the proposed diversion gates for the Springbank Project, model outputs are not provided. **Third:** Changes in water volume and velocity are well known to affect fluvial morphology. The post-construction flood modelling associated with the Bragg Creek project (Project Description Appendix B, Figure 6.4, adobe page 129, attached for reference) shows a narrowing and deepening of the Elbow River on Tsuut'ina lands under flood conditions. It is not clear the extent or magnitude of this change over successive flood events, the effects of these changes on other VCs and on exercise of First Nations' rights and culture. While the Bragg Creek proponent has concluded that these effects are not significant, they are non-zero. CEAA guidance requires that ANY effect from other projects be

Comment Number	**Cumulative Effects IR#1 – Project Interactions** (also, Hydrology IR#2)
	considered as part of a cumulative effects assessment. Failure to consider these effects in the Springbank assessment raises significant questions about (a) the model inputs used to design the Springbank project, and (b) the assessment of effects of based on model inputs. Key questions under both flood AND dry conditions include the following: • The Elbow River is a product of its flood regime. How will it change shape over the long term (>50 years or a minimum of two human generations) as a result of the Bragg Creek project, how far downstream will these changes be felt, and, if changes are experienced as far downstream as the Springbank floodgates, can water volumes, depths, and temperatures appropriate to fish be maintained under non-flood conditions? • How could long term changes with the shape of the river interact with the physical barriers presented by the Springbank project affect wildlife access and movement? • How could a deeper river thalwag, increased volume, and/or and greater river velocity resulting from the Bragg Creek project affect the design and function of the Springbank diversion structure under flood conditions? • Could a deeper river thalwag, increased volume, and/or greater river velocity resulting from the Bragg Creek project cause more frequent use of the reservoir and/or cause it to have insufficient capacity to contain a design flood? How will this affect the assessment of project effects on various VCs?
Information Request	The proponent must revise and make available for review its modeling inputs to identify and account for changes to Elbow River hydrology. The proponent must further use these revised inputs to assess effects to hydrology and fluvial morphology under the construction/dry scenario and reassess effects to hydrology and fluvial morphology under flood post-flood scenarios. Finally, the proponent must indicate how the assessment/reassessment alter(s) the effects assessments of VCs that depend on the outcome of the hydrology assessment. Specific attention must be paid to interactions between hydrology and: hydrogeology; fluvial morphology; well water quality and quantity on federal lands; wildlife use patterns, and culture/sense of place.

Comment Number	**Cumulative Effects IR#2– Upstream Debris** (also Hydrology IR#4)
EIS Section Name	Accidents and Malfunctions
Section Number(s)	Volume 3D, Section 1
Quotation	n/a
Issue	Failure of upstream projects under flood conditions has not been assessed in the Springbank EIS Assessment of Cumulative Effects.
Concern	According to the Bragg Creek Flood Mitigation Design Report (Amec, 2017, p. 18), the Bragg Creek project has been designed to a flood “approximately 16% lower than the 1150 m3/s flood peak which occurred in 2013” but that a flood equivalent to the 2013 flood “would be contained within [the project’s] minimum 0.6m freeboard.” This statement is not a replacement for a robust methodology that explicitly identifies a design flood that accounts for climate change and develops a project to address that flood level. Without a flood level defensibly selected to account for the effects of climate change, it is possible that the Bragg Creek infrastructure could fail with greater frequency than predicted in extreme events. Failure at Bragg Creek can reasonably be expected to result in a sudden and/or large increase in entrained debris. It is not clear whether the recently added debris catch at Springbank can contain a pulse of entrained debris of this nature, how this will affect the integrity of the Springbank infrastructure, or whether it will cause unplanned flooding at Springbank’s backwater location.
Information Request	Using the revised flood frequency analysis requested in Hydrology IR#3, assess the effects to the Springbank project infrastructure and to federal lands (specifically IR145) of a loss of Bragg Creek flood protection system integrity. Identify and evaluate potential debris volumes and potential deposition patterns and the way in which these will alter or exacerbate flooding on IR145.

Comment Number	**Cumulative Effects IR#3 – Federal Lands** (also Federal Lands #1)
EIS Section Name	Effects to Federal Lands / Cumulative Effects
Section Number(s)	Volumes 3A/3B, Sections 13 / Volumes 3C Section 1
Quotation (if relevant)	"The federal lands included within the assessment, due to their proximity to the Project site, are the Tsuut'ina Nation Reserve 145 and the Stoney Nakoda Nations Reserves 142, 143 and 144."
Issue	Vol 3A, Figures 18-1 and 18-2 (Study boundaries) do not fully encompass the referenced federal lands.
Concern	Federal Guidance on EA Scoping for Cumulative Effects is clear: that spatial boundaries must be set that are appropriate to the valued component being studied – in this case, *federal lands* is the VC by virtue of the federal government requiring that they be part of an assessment under CEAA. The specific CEAA guidance is as follows: "spatial boundaries must support the consideration of cumulative effects for each VC identified for the cumulative effects assessment" and, "spatial boundaries of a cumulative effects assessment are based on setting adequate spatial boundaries for each VC and considering primarily the VC's geographic range and the zone of influence (ZOI) of the project for the VC. For example, spatial boundaries for a migratory species may take into account seasonal migration paths, regardless of jurisdictional boundaries."[1] In this instance, simply using the RAA boundaries for the various biophysical and socio-economic VCs assessed in sections 3A and 3B of the EIS – many of which do not encompass the entirety of any of Reserves 142, 143, 144, and 145 and some of which fully exclude the Reserves in question – presents a fragmented picture. By considering cumulative effects on subset areas of each reserve, the EIS is unable to make reliable predictions about the totality of project effects and regional development on the biophysical and socio-economic functioning of the discrete and indivisible management entities that are Indian Reserves. To suggest that there are no cumulative effects on federal lands based on assessment boundaries that do not fully encompass those lands runs counter to CEAA guidance and best EA practices.
Information Request	The proponent must reassess effects to federal lands based on regional study spatial boundaries for each biophysical and socioeconomic VC that include the entirety of each of the Tsuut'ina Nation Reserve 145 and the Stoney Nakoda Nations Reserves 142, 143 and 144. This is particularly important with respect to assessing cumulative effects to vegetation and wildlife as they relate to the exercise of traditional use because cumulative effects of regional development may affect patterns of use across an entire Reserve.

[1] DRAFT Technical Guidance for Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act, 2012*, Canadian Environmental Assessment Agency, December 2014.