Alberta Transportation

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May 11, 2018

Ms Jennifer Howe
Project Manager, Prairie and Northern Region
Canadian Environmental Assessment Agency / Government of Canada
Jennifer.Howe@ceaa-acee.gc.ca

Dear Ms Howe:

Subject: SPRINGBANK OFF-STREAM RESERVOIR PROJECT (SR1) - ANNEX 2: A) EARLY TECHNICAL ISSUES AND B) ADVICE TO THE PROPONENT

On December 19, 2017, the Agency provided *Annex 2: A) Early Technical Issues and B) Advice to the Proponent* to Alberta Transportation for consideration and response.

Alberta Transportation has completed its response to Annex 2 and has uploaded it to the FTP link provided below.

As requested by the Agency, Annex 2 is presented as both a consolidated response as well as each response provided individually. Information used to respond to Annex 2 can be found in the March 2018 EIA submission.

Login Information
Browser link: https://tmpsftp.stantec.com
Login name: s0524184827
Password: 8790509

Please contact Mr. Syed Abbas at 780-644-7022 or via email at syed.abbas@gov.ab.ca if you need further information.

Sincerely,

Landon Reppert, P.Eng.
Executive Director

cc: Syed Abbas

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A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (1) Road Realignments

EIS Guideline reference: Part 2 Section 2.2
EIS reference: Volume 1, Section 3.2.8

Context and Rationale

The EIS describes the proposed realignments and modifications of public roads including Highway 22, Springbank Road and Township Road 242. The EIS states that evaluation of the road network options considered: construction cost, environmental constraints, historical resources constraints, effects on existing developments, flood effects on the road infrastructure and remediation requirements, future access management affect, road user cost and travel distance. The EIS does not provide any details regarding the environmental constraints considered and how they affected the selection of the preferred options.

Issue or Comment

a) Describe the environmental constraints considered in the evaluation of proposed realignments for the alternatives considered and how these factors effected the selection of the preferred route alignment.

Response (1)

a) Figures 1-1, 1-2 and 1-3, taken from the Project Description (March 2018 EIA, Volume 1, Section 2.2.6) show the road options for Highway 22, the Springbank Road and Township Road 242.

[1] **Further questions will be provided to the proponent during Technical Review phase**

A) Early Technical Issues or Comments Identified
May 2018

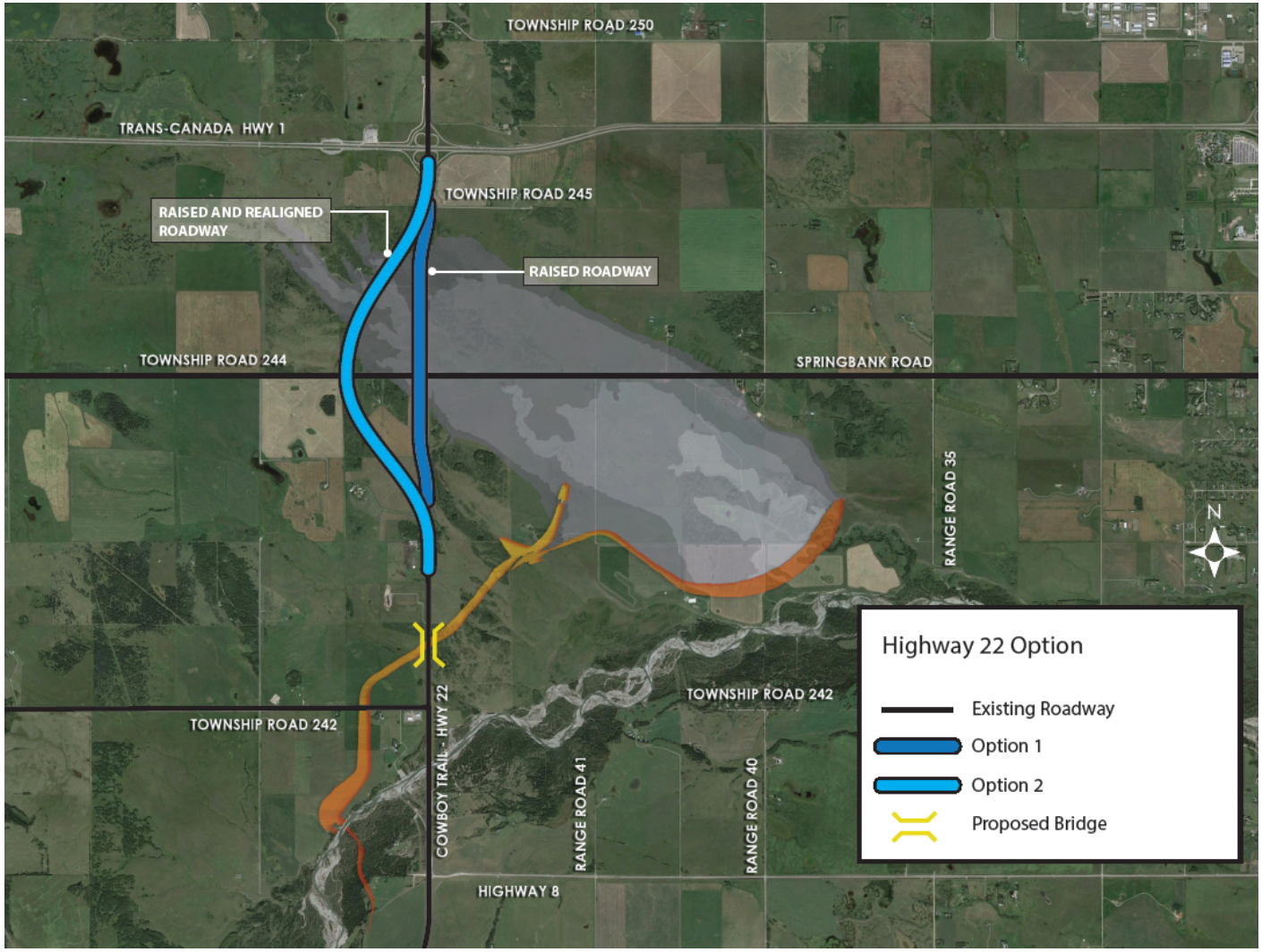


Figure 1-1 Highway 22 Road Options

Stantec

A) Early Technical Issues or Comments Identified
May 2018

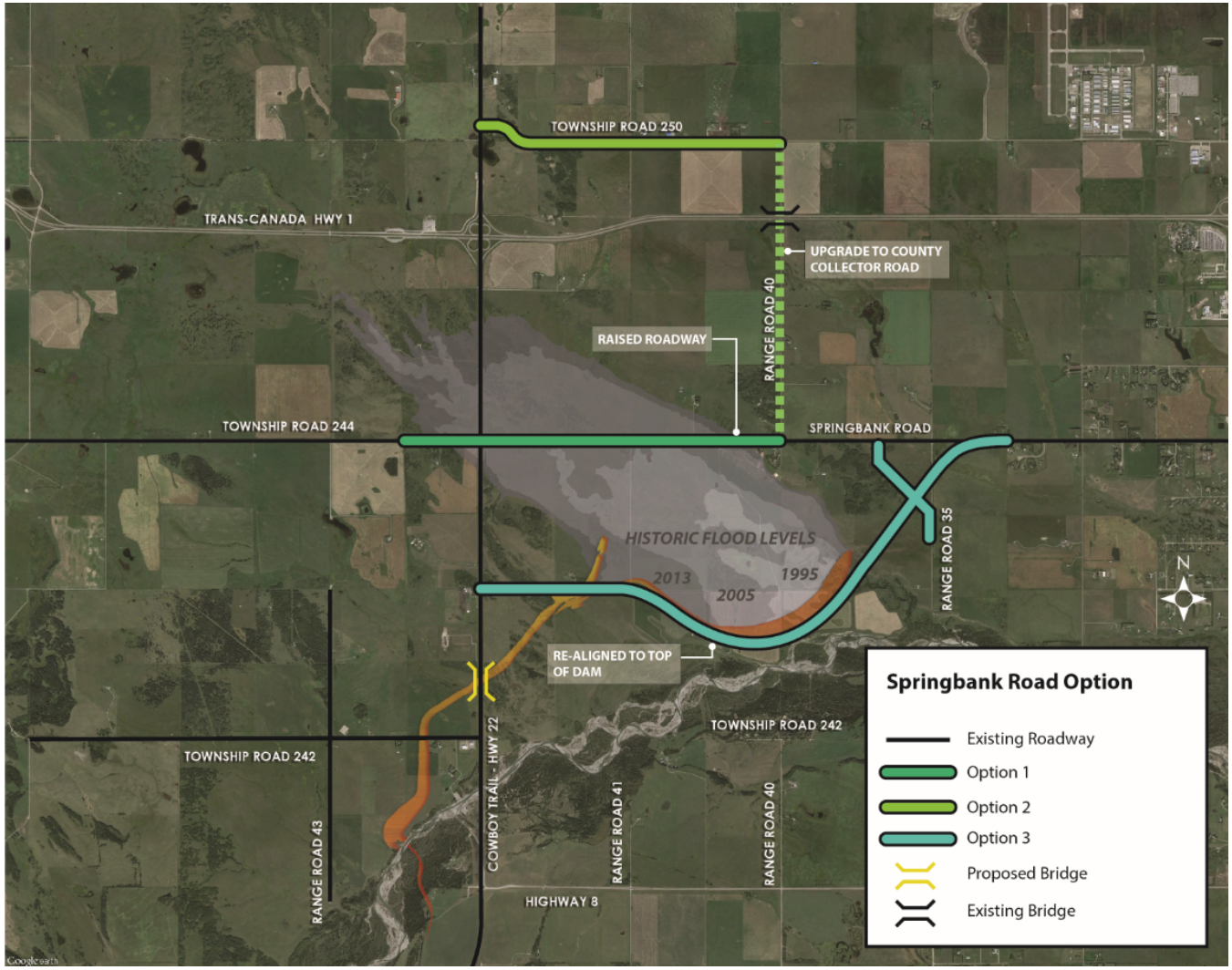


Figure 1-2 Springbank Road Options

Stantec

A) Early Technical Issues or Comments Identified
May 2018

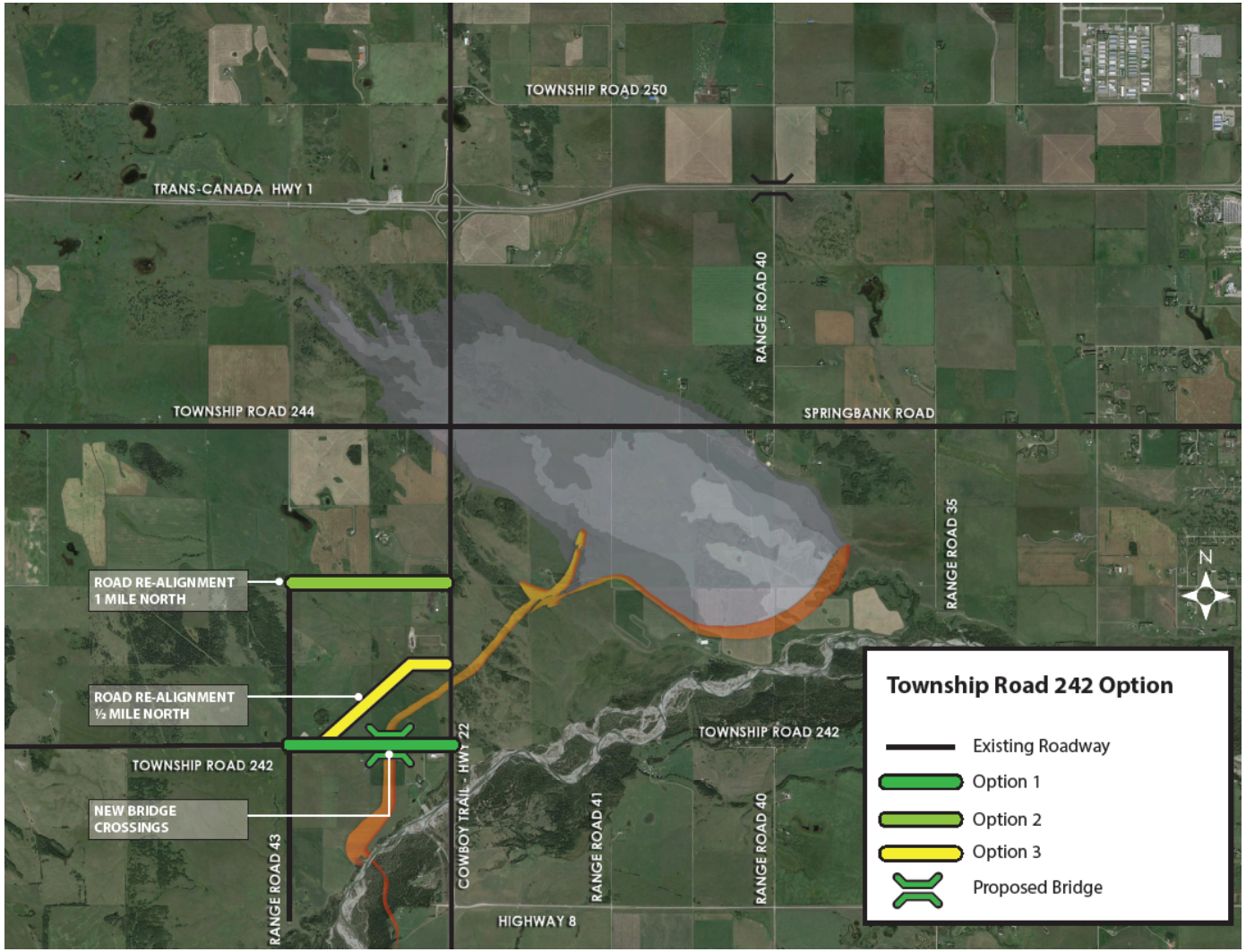


Figure 1-3 Township Road 242 Road Options

Stantec

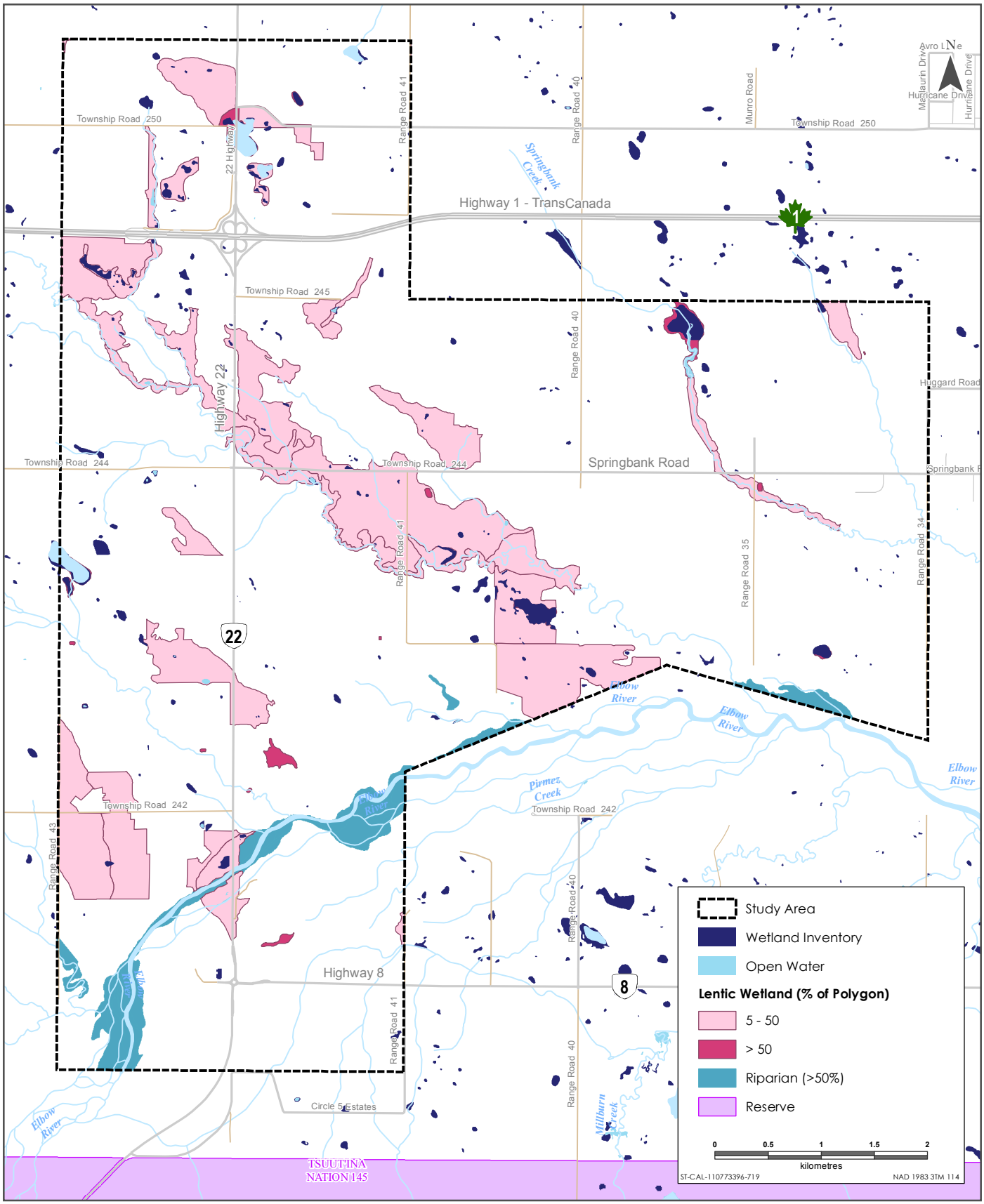
The environmental evaluation of alternative routings involved a comparison of environmental constraints for roadworks in the PDA taken from Stantec (2015). Constraints included wetland and riparian areas (Figure 1-4) native prairie and rare plants (Figure 1-5), wildlife constraints (Figure 1-6) and sections of historical interest (Figure 1-7). The comparison of alternatives for the Highway 22 and Springbank road options were based on the number of quarter sections crossed by each alternative on the constraint maps, with the preferred alternative from the environmental perspective being the one with the least number of affected quarter sections crossed by a roadway option. Table 1-1 shows the environmental ranking of alternative options for Highway 22 and Springbank Road.

Table 1-1 Environmental Ranking of Road Realignment Options

Option	Wetland and Riparian Areas	Native Prairie and Rare Plants	Wildlife Constraints	Sections of Historical Interest	Total
Highway 22					
Option 1	1	0	2	1	3
Option 2	2	3	2	1	8
Springbank Road					
Option 1	2	3	3	4	12
Option 2	1	4	1	1	7
Option 3	2	4	4	0	10

NOTE:
Numbers refer to the number of quarter sections of land with environmental constraints. The preferred option is highlighted.

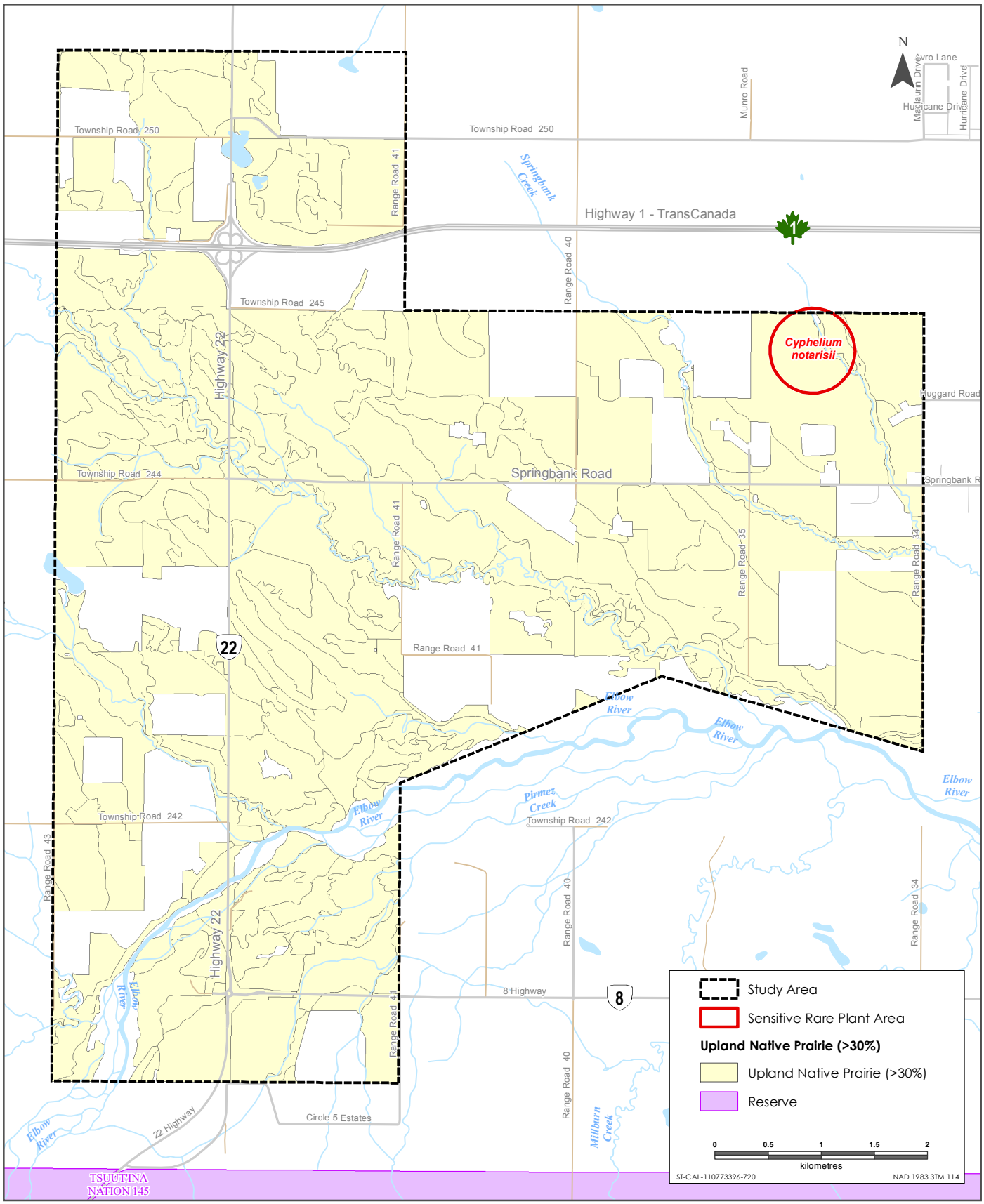
For the Township Road 242 options, the environmental evaluation was based on the overall effects on undisturbed land, where a higher potential for environmental effects exists. As a result, the construction of the bridge crossing over the channel diversion on the existing Township Road 242 alignment (Option 1) has less potential environmental impact than Option 2 and 3 that traverses undisturbed land. Figure 1-8 presents the preferred options.



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

Wetland and Riparian Areas

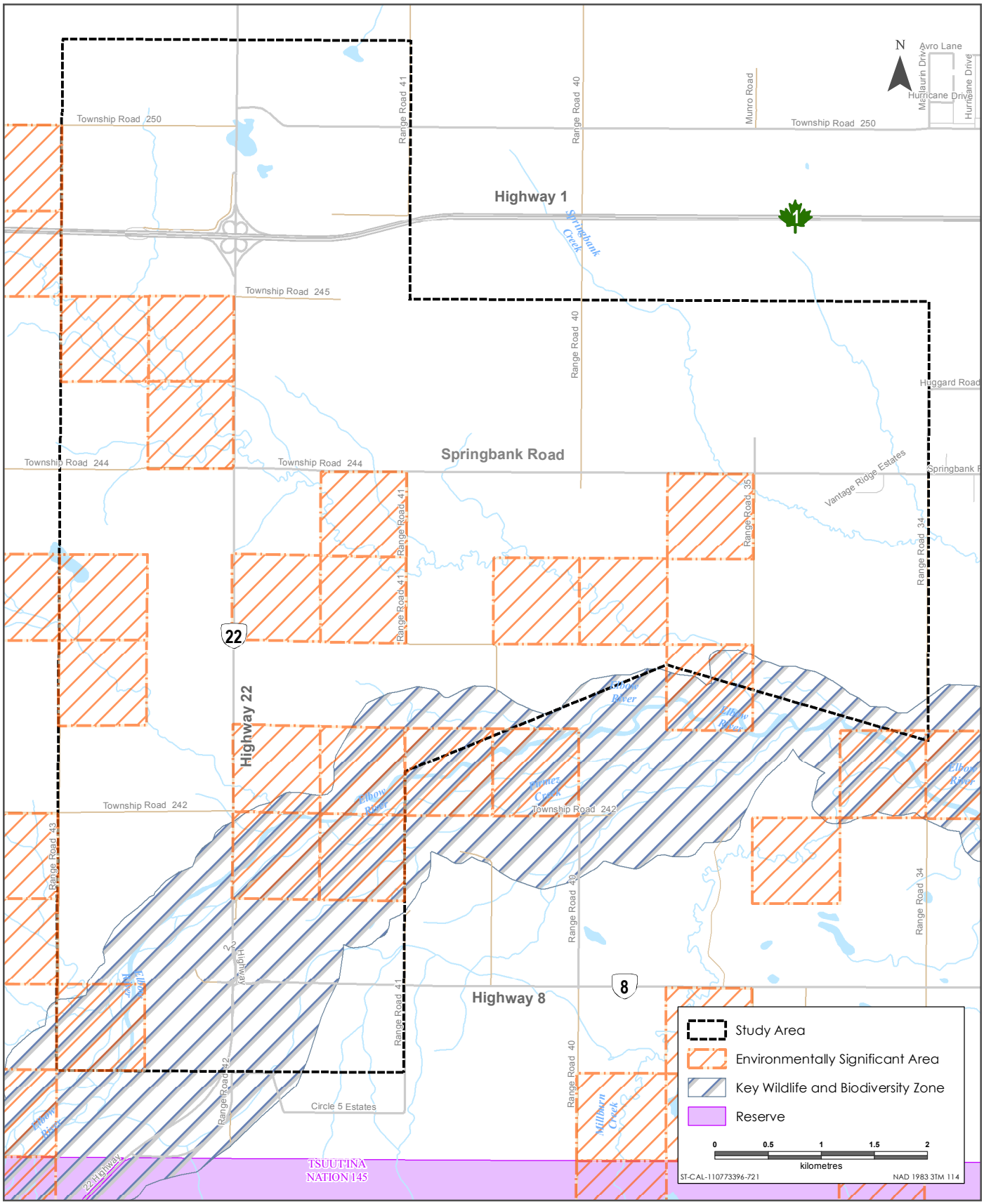
Stantec



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

Native Prairie and Rare Plants

Stantec



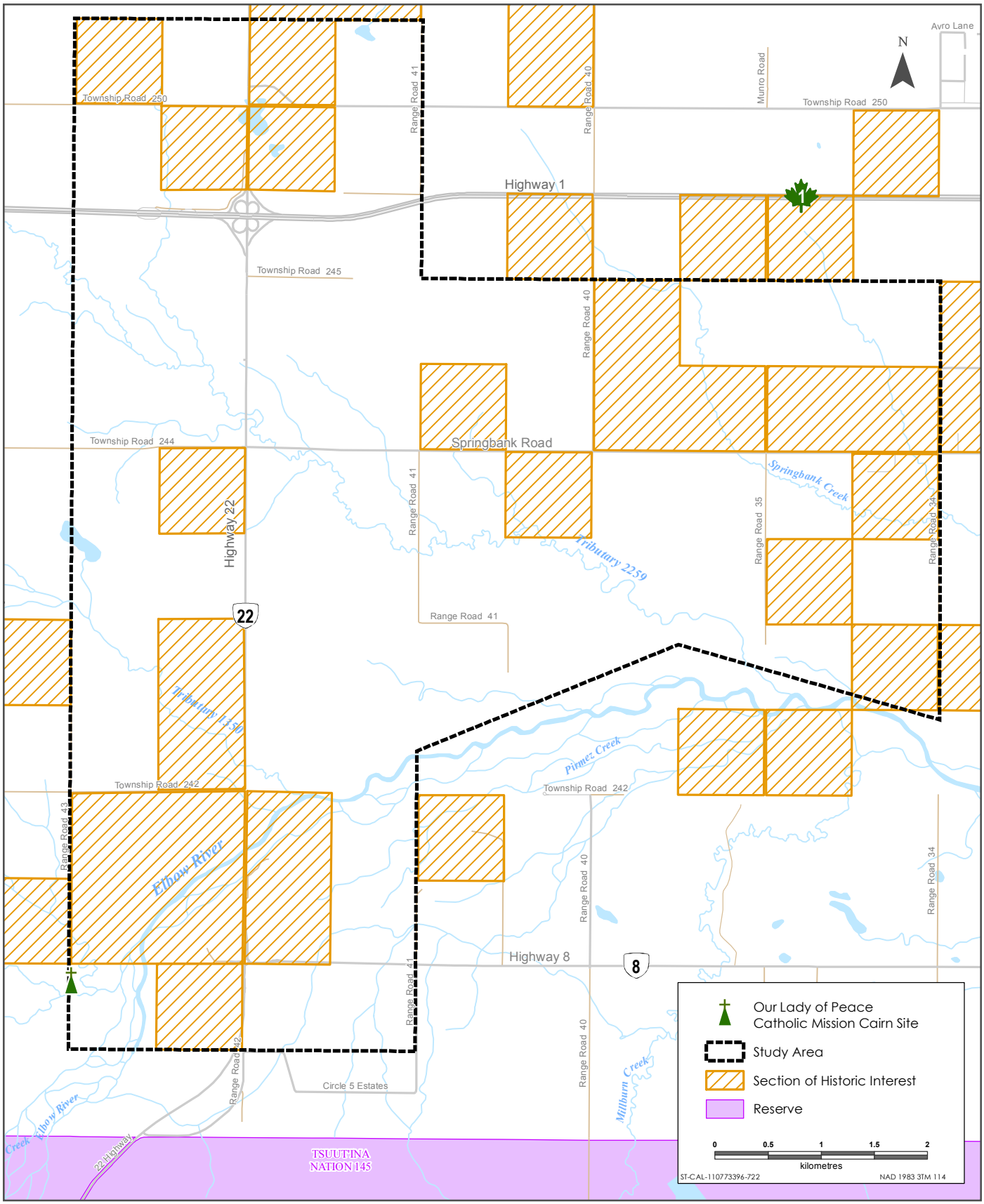
Sources: Base Data - ESRI, Natural Earth. Thematic Data - ERBC, Government of Canada, Government of Alberta

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Wildlife Constraints

Figure 1-6



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

Sections of Historical Interest

Stantec

A) Early Technical Issues or Comments Identified
May 2018

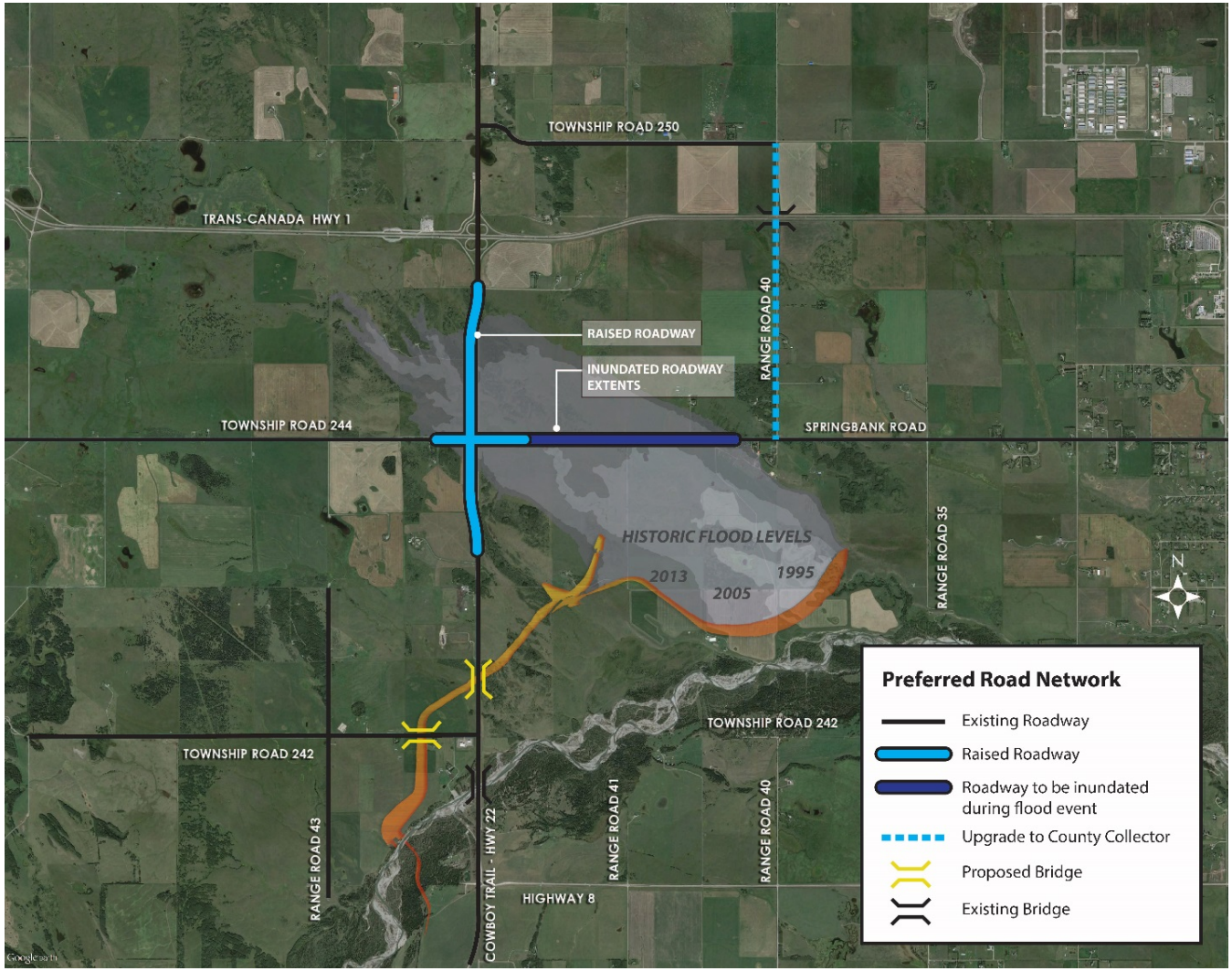


Figure 1-8 Preferred Road Network

References

Stantec Consulting Ltd. (2015). SR1 Highway 22 & Springbank Road Planning Study Environmental Review. Prepared for Alberta Transportation.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (2) Public Participation and Concerns

EIS Guideline reference: Part 2, Section 4
EIS reference: Volume 1, Section 6.0

Context and Rationale

Part 2, Section 4 of the EIS Guidelines requires, as part of the information requirements related to public participation and concerns, a description of the concerns voiced and the extent to which this information was incorporated in the design of the Project as well as in the EIS; a summary of key issues raised related to the environmental assessment as well as a description of any outstanding issues and ways to address them. The EIS provides information regarding concerns and key issues raised, but is missing information on how this information was incorporated in the design of the Project and a description of outstanding issues and ways to address them.

Issue or Comment

a) Describe how concerns voiced by the public were incorporated in the design of the Project and in the EIS.

b) Describe any outstanding key issues raised by the public related to the environmental assessment and ways to address them.

[1] **Further questions will be provided to the proponent during Technical Review phase**

Response (2)

a) Alberta Transportation has completed engagement activities since November 2014, which included project notifications, meetings with landowners and other stakeholders, public open houses, and other activities. Issues, concerns and recommendations raised by stakeholders were recorded at these events and considered in project design. Public feedback was used to modify the Project's design; such examples include:

- Concerns around wildlife passage within the area resulted in the design of Project components (e.g., diversion channel, floodplain berm) to be vegetated and built at a slope that would be more conducive to wildlife passage. The installation of wildlife-friendly fencing will also allow ungulate passage.

- Concerns that the Project would be a barrier to fish migration upstream resulted in design changes to the diversion structure (boulder V-weirs installed downstream of the diversion gates) in order to maintain fish passage, under normal river conditions.

A summary of public engagement and outcomes for the Project is provided in the March 2018 EIA, Volume 1, Table 6-3.

b) Alberta Transportation will continue to engage with Stakeholders on the Project in order to understand what outstanding key environmental concerns they have since submission of the March 2018 EIA.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (3) Geochemical Characterization

EIS Guideline reference: Part 2, Section 6.1.1
EIS reference: Volume 3A, Section 9.2, 9.4.2.1

Context and Rationale

Part 2, Section 6.1.1 of the EIS Guidelines requires baseline information on: the geochemical characterization of road cuts, blast materials, and excavated materials such as waste rock and potential construction material (e.g. borrow materials) in order to predict and mitigate metal leaching and acid rock drainage; the geochemical characterization of sediment within the Elbow River; and a description of geological hazards, including history of seismic activity in the area.

The EIS indicates that there is a potential for locally exposing acid generating bedrock (i.e., coal strata) which can be managed through site-specific acid rock drainage/metal leaching assessments where coal is encountered. The assessment of terrain stability does not include history of seismic activity in the area.

Issue or Comment

a) Provide a description of the geochemical characterization of road cuts, blast materials, and excavated materials such as waste rock and potential construction material (e.g. borrow materials).

b) Provide a description the geochemical characterization of sediment within the Elbow River.

c) Describe the potential for metal leaching and acid rock drainage, and specific mitigation measures that would be implemented to address potential effects.

d) Provide a description of the history of seismic activity in the area.

[1] **Further questions will be provided to the proponent during Technical Review phase**

Response (3)

a) Geochemical characterization of road cuts, blast materials, and excavated materials was not performed as part of primary design. However, a preliminary geochemical characterization of the top 20 cm of soil within the off-stream reservoir was completed for the analysis of sulphides and total inorganic carbon (TIC). Acid potential (AP) was calculated from sulphides, and neutralization potential (NP) was calculated from TIC. The neutralization potential ratio (NPR) (NPR=NP/AP) of samples was compared to generic thresholds proposed by Price (2009). A sample is classified as potentially acid generating (PAG) when the NPR is below 1. A sample is classified as uncertain acid rock drainage potential when NPR is between 1 and 2. All samples with NPR above 2 are non-PAG. The results showed that all soil samples had NPR values greater than 2 and are classified as non-PAG. NPR values were also calculated for sediments from the Elbow River mainstem sites using total sulphides and TIC.

b) Based on the preliminary geochemical analysis of the topsoil within the off-stream reservoir, and analysis of sediments from Elbow River, these substrates are classified as non-PAG and are not likely to generate acid.

c) Published literature (e.g., Jerzykiewicz 1997; Dawson et al. 1994) indicates that thin coal and carbonaceous shale beds, that may be PAG, are present in the upper portion of the Lower Brazeau Formation. These are not likely to be present in the upper Brazeau Formation, which comprises a coarsening-upward sequence of predominantly lacustrine mudstones inter-bedded with sandstones. It is likely that the diversion channel excavation will be cut within Upper Brazeau Formation, so the likelihood of PAG units being encountered within the excavation is low. The geotechnical investigation encountered very thin bands of carbonaceous shale, which would form a negligible percentage of the total volume of rock excavated from the cuttings.

   However, to fully describe the potential for metal leaching and acid rock drainage, additional geochemical analysis is required for road cuts, blast materials, and materials that are planned to be excavated below the top layer of soils and sediments. Specific mitigation measures would then be developed on the results of that analysis.

d) The Project is located within the eastern limit of the Cordillerian deformation belt, which is characterized by closely spaced, low displacement NNW-SSE thrust faults, including the Brazeau thrust fault. In particular, the Brazeau thrust fault is mapped as crossing the diversion channel approximately 2 km west of the off-stream reservoir. This thrust fault was developed during the Cordillerian uplift of the Rockies over 60 million years ago. This fault is not considered to be “geologically active” with respect to natural seismicity.

The Project Development Area (PDA) is within an area of low to moderate seismic activity. Induced seismicity is common in the foothills region of Southwestern Alberta. Notable areas in which induced seismicity has been documented include the Crooked Lake Sequences to west of Fox Creek, the Brazeau River Cluster and the Rocky Mountain House Seismogenic Zone located approximately 100 to 150 km northwest of Calgary, and the Cardston Earthquake Swarm located approximately 200 km southeast of Calgary. Induced seismicity in the foothills region has been associated with both hydraulic fracturing and waste injection activities associated with oil and gas extraction (Atkinson et al. 2105, 2016).

References

Atkinson, G.M., Eaton, D.W., Ghofrani, H., Walker, D., Cheadle, B., Schultz, R., Shcherbakov, R., Tiampo, K., Gu, J., Harrington, R.M., Liu, Y., Van Der Baan, M., and Kao, H. 2016. Hydraulic Fracturing and Seismicity in the Western Canada Sedimentary Basin. Seismological Research Letters. Vol. 87. No. 3.

Atkinson, G.M., Ghofrani, H., and Assatourians. 2015. Impact of Induced Seismicity on the Evaluation of Seismic Hazard: Some Preliminary Considerations. Seismological Research Letters. Vol. 86. No. 3.

Dawson, F.M., C.G. Evans, R. Marsh, and R. Richardson. 1994. "Chapter 24 – Uppermost Cretaceous and Tertiary Strata of the West Canada Sedimentary Basin." Geological Atlas of the Western Canada Sedimentary Basin. Calgary: Published jointly by the Canadian Society of Petroleum Geologists and the Alberta Research Council

Jerzykiewicz, T. 1997. Stratigraphic Framework of the Uppermost Cretaceous to Paleocene Strata of the Alberta Basin. Bulletin 510. Ottawa: Geological Survey of Canada

Price, W.A. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. Report prepared for the Mine Effluent Neutral Drainage (MEND). Report 1.20.1, p. 1-579.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (4) Surface Water Quality – Baseline Data

EIS Guideline reference: Part 2, Section 6.1.4
EIS reference: Volume 4, Appendix K Section 3.2, 3.3

Context and Rationale

Part 2, Section 6.1.4 of the EIS Guidelines requires baseline water quality information for the Elbow River, including a comparison of baseline datasets against applicable guidelines and standards and identification of exceedances and trends.

The EIS provides information on the baseline water quality and compares to guidelines. However, data are presented only in graphical form and in a table that only indicates the number of samples less than detection limits and number or samples above guidelines. Although this does provide a general overview, summary statistics should be completed on the data to provide numerical values for the baseline data.

Issue or Comment

a) Provide summary statistics for the baseline water quality data for the Elbow River.

Response (4)

a) Summary statistics (mean, median, variance, and standard deviation) for locations along Elbow River are provided in the attached Tables 4-1 to 4-18 and complement the graphical data representations in the March 2018 EIA, Volume 4, Appendix K, Aquatic Ecology Technical Data Report, Section 3.2 to Section 3.3.

[1] **Further questions will be provided to the proponent during Technical Review phase**

Table 4-1
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Highway 22																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	64	132.54	135.45	338.27	18.39	68	139.38	140.05	107.47	10.37	64	145.98	145.05	47.15	6.87	64	145.40	144.55	34.73	5.89
Bicarbonate	mg/L	4	156.19	154.97	124.52	11.16	7	168.80	168.00	83.63	9.14	3	175.13	175.54	30.21	5.50	3	176.35	174.32	65.90	8.12
Conductivity	uS/cm	128	372.25	378.80	2422.35	49.22	132	336.36	341.80	1796.19	42.38	106	376.02	375.05	884.42	29.74	90	394.73	405.90	1729.88	41.59
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	2	5.05	5.05	41.41	6.43	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	2	35.00	35.00	450.00	21.21	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	2	0.06	0.06	0.0001	0.01	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	2	0.15	0.15	0.002	0.04	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	2	62.40	62.40	5.12	2.26	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	5	8.62	8.70	2.92	1.71	6	8.43	8.45	0.61	0.78	4	6.48	6.50	0.11	0.33	4	6.93	6.90	0.14	0.38
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	2	0.003	0.003	0.00	0.00	15	56.17	55.00	8.54	2.92	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	13	56.92	55.00	29.82	5.46	18	51.94	52.10	31.49	5.61	0	n/a	n/a	n/a	n/a	15	57.32	57.20	26.57	5.15
Dissolved Chloride	mg/L	10	1.42	1.20	0.22	0.47	10	0.90	1.00	0.02	0.13	10	0.88	1.00	0.04	0.21	7	1.14	1.00	0.15	0.39
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	2	0.03	0.03	0.00	0.00	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	2	0.37	0.37	0.03	0.17	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	65	0.28	0.28	0.003	0.05	66	0.25	0.24	0.00	0.06	66	0.27	0.27	0.001	0.03	64	0.29	0.29	0.001	0.03
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	2	15.00	15.00	0.00	0.00	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	2	3.52	3.52	0.40	0.63	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	11	13.25	15.00	21.39	4.62	12	14.04	13.75	2.59	1.61	10	15.91	16.00	1.00	1.00	7	16.54	16.00	0.66	0.81
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	2	0.93	0.93	0.87	0.93	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	2	0.65	0.65	0.01	0.09	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	2	0.37	0.37	0.01	0.12	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	4	1.03	0.90	0.28	0.53	7	1.46	1.00	2.14	1.46	3	1.07	1.10	0.90	0.95	3	0.77	0.90	0.10	0.32
Dissolved Ortho Phosphorus	ug/L	7	17.86	5.00	1161.48	34.08	6	3.00	3.00	0.80	0.89	7	4.43	3.00	10.29	3.21	4	3.50	3.50	1.67	1.29
Dissolved Oxygen	mg/L	127	11.83	11.80	1.81	1.35	129	9.75	9.60	1.00	1.00	105	11.03	10.70	1.57	1.25	89	12.83	12.70	1.47	1.21
Dissolved OxygenSat	%	32	91.80	91.50	39.73	6.30	36	90.53	89.85	66.85	8.18	32	91.48	91.90	25.42	5.04	36	92.76	92.50	68.05	8.25
Dissolved Phosphorus	ug/L	115	3.41	2.00	17.03	4.13	124	3.14	1.50	18.35	4.28	95	1.40	1.00	0.81	0.90	89	1.48	1.00	0.68	0.83
Dissolved Potassium	mg/L	10	0.55	0.50	0.03	0.17	12	0.50	0.50	0.01	0.08	10	0.52	0.50	0.003	0.06	7	0.48	0.47	0.01	0.11
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	2	0.00	0.00	0.00	0.00	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	2	0.28	0.28	0.00	0.04	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	2	0.64	0.64	0.01	0.07	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	2	2.15	2.15	0.03	0.18	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	10	2.27	2.00	0.28	0.53	12	2.03	2.00	0.28	0.53	10	2.37	2.00	0.52	0.72	7	2.29	2.00	0.25	0.50
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	2	0.35	0.35	0.00	0.07	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	10	58.75	62.00	180.74	13.44	11	45.84	46.90	71.81	8.47	10	59.96	60.50	59.00	7.68	7	72.07	72.50	19.62	4.43
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	2	0.003	0.003	0.000	0.001	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	2	0.40	0.40	0.18	0.42	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	2	0.01	0.01	0.00	0.00	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	2	0.45	0.45	0.001	0.03	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	2	0.10	0.10	0.001	0.03	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-1
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Highway 22																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	2	0.03	0.03	0.001	0.03	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	2	0.50	0.50	0.00	0.00	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	2	0.06	0.06	0.002	0.04	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	19	34.56	11.60	3533.38	59.44	20	75.39	47.50	7758.31	88.08	21	11.24	5.60	781.46	27.95	22	5.57	4.90	29.36	5.42
Extractable Arsenic	ug/L	4	0.43	0.30	0.16	0.40	7	0.19	0.10	0.03	0.19	0	n/a	n/a	n/a	n/a	2	0.15	0.15	0.01	0.07
Extractable Barium	ug/L	21	57.30	56.50	25.40	5.04	24	56.18	54.50	81.04	9.00	21	57.60	58.50	18.66	4.32	22	56.20	56.95	8.08	2.84
Extractable Boron	ug/L	18	9.24	10.00	1.58	1.26	18	9.52	10.00	0.69	0.83	20	9.38	10.00	2.24	1.50	20	9.16	10.00	1.77	1.33
Extractable Cadmium	ug/L	3	0.97	1.00	0.20	0.45	2	0.50	0.50	0.00	0.00	0	n/a	n/a	n/a	n/a	2	0.75	0.75	0.13	0.35
Extractable Chromium	ug/L	19	2.50	2.40	3.40	1.84	20	1.70	1.05	2.10	1.45	21	1.85	1.30	1.89	1.37	22	1.88	1.15	1.92	1.39
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	4	1.65	1.70	0.30	0.55	2	0.75	0.75	0.13	0.35	4	1.18	0.95	0.74	0.86
Extractable Iron	ug/L	26	48.02	50.00	2831.58	53.21	26	110.20	50.00	29578.33	171.98	28	41.53	50.00	1643.26	40.54	26	38.47	50.00	460.68	21.46
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	3	2.83	1.50	7.58	2.75	0	n/a	n/a	n/a	n/a	2	1.00	1.00	0.000	0.000
Extractable Lithium	ug/L	18	2.96	3.10	0.19	0.44	18	2.94	3.10	0.22	0.47	20	3.23	3.25	0.25	0.50	20	3.14	3.20	0.19	0.44
Extractable Manganese	ug/L	18	2.12	1.05	8.84	2.97	18	7.96	2.45	203.27	14.26	20	1.27	1.00	2.32	1.52	20	1.06	1.00	0.59	0.77
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	18	0.58	0.50	0.06	0.24	18	0.55	0.50	0.02	0.12	20	0.59	0.50	0.03	0.18	20	0.60	0.50	0.03	0.17
Extractable Nickel	ug/L	18	1.54	1.70	0.61	0.78	18	1.44	1.30	0.53	0.73	20	1.29	1.35	0.35	0.59	20	1.38	1.65	0.41	0.64
Extractable Selenium	ug/L	18	0.71	0.50	0.15	0.39	18	0.68	0.50	0.11	0.33	20	0.65	0.50	0.07	0.27	20	0.86	0.75	0.18	0.42
Extractable Titanium	ug/L	18	1.28	0.50	4.07	2.02	18	1.28	0.85	0.99	0.99	20	0.54	0.50	0.16	0.41	20	0.57	0.50	0.39	0.63
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	2	0.65	0.65	0.05	0.21	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	19	2.11	2.10	1.12	1.06	20	3.62	1.75	51.98	7.21	21	1.90	1.60	0.89	0.94	22	2.08	2.15	1.05	1.03
Fecal Coliforms	ug/L	32	25.00	12.50	925.03	30.41	40	19.00	12.00	789.44	28.10	9	8.44	4.50	66.72	8.17	6	12.80	4.90	298.96	17.29
Hardness	mg/L	64	203.96	208.50	359.41	18.96	67	184.29	185.73	411.44	20.28	64	208.77	208.28	155.27	12.46	64	221.77	221.20	91.65	9.57
Kjeldahl Nitrogen	ug/L	84	0.16	0.12	0.03	0.17	91	165.16	100.00	46945.12	216.67	65	111.57	90.00	4704.91	68.59	63	132.17	70.00	44172.21	210.17
Nitrate	ug/L	95	0.11	0.11	0.00	0.03	101	81.37	72.00	881.13	29.68	96	81.13	74.50	740.47	27.21	87	0.12	0.12	0.001	0.02
Nitrate Nitrite	ug/L	125	0.10	0.11	0.00	0.03	135	81.20	74.00	894.06	29.90	106	77.39	70.50	875.50	29.59	94	0.12	0.12	0.001	0.02
Nitrite	ug/L	5	5.60	3.00	48.30	6.95	0	n/a	n/a	n/a	n/a	2	5.00	5.00	18.00	4.24	4	5.25	5.50	7.58	2.75
pH		125	8.16	8.20	0.03	0.18	130	8.24	8.30	0.04	0.21	105	8.30	8.30	0.01	0.12	94	8.18	8.20	0.02	0.14
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	2	1.28	1.28	0.55	0.74	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	8	209.50	221.00	680.57	26.09	8	206.13	202.00	496.41	22.28	7	237.57	236.00	26.29	5.13	4	242.00	237.50	87.33	9.35
Temperature	C	125	3.21	2.20	9.10	3.02	143	10.29	10.40	6.28	2.51	107	5.53	5.70	12.07	3.47	88	0.32	0.20	0.13	0.35
Total Aluminum	ug/L	13	0.17	0.15	0.03	0.17	14	271.31	49.85	190017.71	435.91	12	12.18	11.65	55.31	7.44	11	20.35	12.30	331.50	18.21
Total Ammonia	ug/L	38	23.95	15.00	452.92	21.28	47	22.13	5.00	432.33	20.79	20	37.00	50.00	306.32	17.50	18	39.72	50.00	319.04	17.86
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	3	0.61	0.08	0.89	0.94	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	4	0.49	0.41	0.14	0.37	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	13	58.33	61.90	329.75	18.16	14	61.58	61.75	124.01	11.14	12	59.86	59.30	17.04	4.13	11	60.55	58.90	24.40	4.94
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	2	0.01	0.01	0.00	0.02	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	9	8.74	8.30	3.47	1.86	10	8.42	8.55	3.16	1.78	8	7.79	7.50	0.24	0.49	7	6.66	6.90	0.79	0.89
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	2	0.01	0.01	0.00	0.004	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	45	55.09	57.80	24.60	4.96	45	49.89	50.00	30.08	5.48	44	56.02	56.55	10.53	3.24	45	59.09	59.20	2.90	1.70
Total Carbon	mg/L	7	38.14	38.00	14.48	3.80	6	39.83	41.00	34.97	5.91	7	42.29	41.00	9.24	3.04	4	43.50	43.50	1.67	1.29
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	2	0.06	0.06	0.01	0.08	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	56	1.85	1.65	0.75	0.87	57	1.13	1.10	0.08	0.29	56	1.23	1.20	0.06	0.24	57	1.52	1.30	1.09	1.04

Table 4-1
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Highway 22																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Chromium	ug/L	5	1.06	0.80	0.67	0.82	5	0.95	0.80	0.54	0.73	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	3	0.34	0.19	0.17	0.41	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	13	1.50	0.90	6.76	2.60	14	0.92	0.80	0.49	0.70	12	0.52	0.45	0.13	0.36	11	0.60	0.45	0.32	0.57
Total Fluoride	mg/L	56	0.27	0.28	0.00	0.06	57	0.23	0.23	0.00	0.04	56	0.26	0.27	0.00	0.03	57	0.29	0.29	0.001	0.03
Total Inorganic Carbon	mg/L	3	34.00	35.00	21.00	4.58	5	35.00	33.00	18.50	4.30	6	40.17	39.50	12.57	3.54	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	13	0.25	0.20	0.03	0.18	14	0.33	0.15	0.26	0.51	12	78.59	50.00	3396.48	58.28	11	92.10	74.00	3074.99	55.45
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	5	1.58	0.50	6.27	2.50	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	12	3.89	3.80	0.27	0.52	14	3.51	3.55	0.23	0.48	12	3.81	3.65	0.17	0.41	11	3.55	3.50	0.03	0.17
Total Magnese	ug/L	13	5.28	4.50	21.47	4.63	14	6.14	1.85	95.22	9.76	12	0.86	0.80	0.06	0.24	11	1.12	0.80	0.33	0.57
Total Magnesium	mg/L	45	15.46	15.90	2.83	1.68	45	13.23	13.30	3.29	1.81	44	15.34	15.50	0.82	0.91	45	16.54	16.50	0.45	0.67
Total Molybdenum	ug/L	13	0.59	0.60	0.06	0.24	14	0.58	0.69	0.03	0.17	12	0.54	0.50	0.02	0.15	11	0.64	0.40	0.15	0.39
Total Nickel	ug/L	13	1.96	1.20	6.01	2.45	14	1.22	1.06	0.49	0.70	12	0.98	0.90	0.07	0.27	11	0.91	0.90	0.02	0.15
Total Nitrogen	mg/L	62	0.25	0.21	0.04	0.20	61	0.21	0.19	0.02	0.13	55	0.18	0.16	0.01	0.10	56	0.22	0.16	0.05	0.23
Total Organic Carbon	mg/L	95	1.71	1.15	1.95	1.40	110	1.97	1.10	5.50	2.35	104	1.01	0.80	0.83	0.91	93	0.65	0.57	0.38	0.61
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	206	11.79	3.00	1224.73	35.00	202	18.91	3.00	2891.89	53.78	107	4.53	2.00	69.84	8.36	93	3.87	2.00	37.79	6.15
Total Potassium	mg/L	45	0.67	0.60	0.05	0.23	44	0.58	0.50	0.01	0.12	44	0.56	0.50	0.01	0.09	45	0.53	0.50	0.01	0.12
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	2	0.01	0.01	0.00	0.00	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	2	0.85	0.85	0.53	0.73	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	13	0.79	0.70	0.28	0.53	14	0.64	0.70	0.01	0.08	12	0.63	0.65	0.01	0.12	11	0.76	0.80	0.03	0.18
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	2	2.94	2.94	1.46	1.21	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	55	1.92	2.10	1.03	1.01	57	1.42	1.70	0.62	0.78	56	1.53	1.85	0.68	0.82	57	1.64	1.90	1.27	1.13
Total Strontium	mg/L	9	0.46	0.47	0.00	0.05	11	0.32	0.32	0.00	0.07	9	0.43	0.43	0.00	0.03	8	0.47	0.47	0.00	0.02
Total Sulphate	mg/L	11	69.85	74.00	82.71	9.09	14	54.01	56.20	116.93	10.81	12	61.83	62.45	42.74	6.54	12	72.23	72.10	4.97	2.23
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	2	0.01	0.01	0.00	0.01	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	2	0.03	0.03	0.002	0.05	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	13	1.96	1.25	3.16	1.78	14	3.40	0.90	17.55	4.19	12	0.41	0.40	0.04	0.20	11	0.62	0.40	0.10	0.32
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	2	0.01	0.01	0.00	0.00	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	6	0.52	0.50	0.00	0.04	4	0.49	0.49	0.00	0.02	3	0.50	0.50	0.000	0.000	5	0.52	0.50	0.002	0.04
Total Vanadium	ug/L	4	1.17	1.10	0.11	0.33	7	1.49	1.40	1.83	1.35	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	2	0.15	0.15	0.03	0.16	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	4	3.15	3.25	0.63	0.79	6	2.76	2.05	7.91	2.81	3	4.63	3.40	11.06	3.33	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	2	0.23	0.23	0.09	0.31	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	105	96.85	32.80	20748.16	144.04	123	330.07	152.90	346200.94	588.39	106	120.58	73.05	26747.54	163.55	93	40.58	18.50	7210.35	84.91
Total Suspended Solids	mg/L	194	24.51	2.55	20941.05	144.71	193	72.79	3.00	124397.06	352.70	103	2.17	1.70	11.53	3.40	93	2.53	2.00	9.83	3.13
Turbidity	NTU	100	6.02	1.76	126.24	11.24	114	38.79	2.05	12931.74	113.72	105	0.97	0.58	2.31	1.52	94	0.82	0.67	0.36	0.60

Notes: n/a = no results available

Table 4-2
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Outlet Channel				
Season		Summer				
Parameter	Unit	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	4	246.00	291.50	29334.00	171.27
Bicarbonate	mg/L	4	291.75	339.50	42214.25	205.46
Conductivity	uS/cm	5	998.40	1047.50	377056.93	614.05
Dissolved Aluminum	ug/L	4	4.20	3.00	22.09	4.70
Dissolved Ammonia	ug/L	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	4	0.14	0.19	0.01	0.09
Dissolved Arsenic	ug/L	4	1.35	1.40	1.23	1.11
Dissolved Barium	ug/L	4	63.18	81.05	1843.02	42.93
Dissolved Beryllium	ug/L	2	0.01	0.01	0.00	0.00
Dissolved Boron	ug/L	4	25.45	30.10	200.48	14.16
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	4	0.01	0.01	0.0001	0.01
Dissolved Calcium	mg/L	2	62.54	62.54	7803.13	88.34
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	4	0.17	0.17	0.02	0.14
Dissolved Copper	ug/L	4	1.33	1.38	0.77	0.88
Dissolved Fluoride	mg/L	0	n/a	n/a	n/a	n/a
Dissolved Iron	ug/L	4	61.50	58.00	2915.67	54.00
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	4	12.25	14.70	71.37	8.45
Dissolved Magnesium	mg/L	2	40.28	40.28	3236.10	56.89
Dissolved Manganese	ug/L	4	2.43	1.50	8.84	2.97
Dissolved Molybdenum	ug/L	4	0.94	1.15	0.39	0.62
Dissolved Nickel	ug/L	4	1.94	2.30	1.48	1.22
Dissolved Organic Carbon	mg/L	4	16.03	16.00	163.91	12.80
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	4	7.30	7.29	6.00	2.45
Dissolved OxygenSat	%	3	68.93	67.10	893.54	29.89
Dissolved Phosphorus	ug/L	4	106.93	96.05	12497.78	111.79
Dissolved Potassium	mg/L	2	6.65	6.65	43.25	6.58
Dissolved Rhenium	ug/L	4	0.02	0.03	0.0002	0.02
Dissolved Rubidium	ug/L	4	0.78	0.90	0.30	0.54
Dissolved Selenium	ug/L	4	0.30	0.31	0.01	0.09
Dissolved Silicon	mg/L	4	7.21	8.15	35.91	5.99
Dissolved Sodium	mg/L	2	65.50	65.50	8064.50	89.80
Dissolved Strontium	mg/L	4	0.43	0.47	0.10	0.32
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	4	0.004	0.004	0.00001	0.002
Dissolved Thorium	ug/L	2	0.02	0.02	0.00004	0.01
Dissolved Titanium	ug/L	4	0.78	0.56	0.76	0.87
Dissolved Tungsten	ug/L	4	0.04	0.04	0.00	0.04

Table 4-2
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Outlet Channel				
Season		Summer				
Parameter	Unit	N	Mean	Median	Variance	St Dev.
Dissolved Uranium	ug/L	4	2.69	2.90	4.20	2.05
Dissolved Vanadium	ug/L	4	0.75	0.88	0.29	0.54
Dissolved Yttium	ug/L	4	0.07	0.07	0.00	0.06
Dissolved Zinc	ug/L	4	1.48	1.10	1.64	1.28
Dissolved Zirconium	ug/L	4	0.36	0.38	0.08	0.27
Extractable Aluminum	ug/L	0	n/a	n/a	n/a	n/a
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a
Extractable Barium	ug/L	0	n/a	n/a	n/a	n/a
Extractable Boron	ug/L	0	n/a	n/a	n/a	n/a
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	0	n/a	n/a	n/a	n/a
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a
Extractable Iron	ug/L	0	n/a	n/a	n/a	n/a
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	0	n/a	n/a	n/a	n/a
Extractable Selenium	ug/L	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	0	n/a	n/a	n/a	n/a
Fecal Coliforms	ug/L	0	n/a	n/a	n/a	n/a
Hardness	mg/L	4	371.38	397.50	81082.56	284.75
Kjeldahl Nitrogen	ug/L	4	1.12	1.30	0.56	0.75
Nitrate	ug/L	4	40.00	50.00	400.00	20.00
Nitrate Nitrite	ug/L	4	47.50	55.00	225.00	15.00
Nitrite	ug/L	0	n/a	n/a	n/a	n/a
pH		5	7.40	7.98	1.27	1.13
Sulphide	ug/L	4	5.39	4.90	23.05	4.80
TDS	mg/L	4	580.25	640.00	187160.92	432.62
Temperature	C	4	14.40	15.05	4.65	2.16
Total Aluminum	ug/L	4	55.88	22.25	6689.49	81.79
Total Ammonia	ug/L	0	n/a	n/a	n/a	n/a
Total Antimony	ug/L	4	0.16	0.19	0.01	0.08
Total Arsenic	ug/L	4	1.31	1.40	1.10	1.05
Total Barium	ug/L	4	63.73	81.70	1837.42	42.87
Total Beryllium	ug/L	4	0.01	0.01	0.00	0.01
Total Boron	ug/L	4	26.50	30.50	129.67	11.39
Total Cadmium	ug/L	4	0.01	0.01	0.00	0.01

Table 4-2
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Outlet Channel				
Season		Summer				
Parameter	Unit	N	Mean	Median	Variance	St Dev.
Total Calcium	mg/L	4	67.39	71.75	2694.49	51.91
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	4	0.01	0.003	0.00005	0.01
Total Chloride	mg/L	4	83.20	83.15	4689.26	68.48
Total Chromium	ug/L	4	0.42	0.25	0.11	0.34
Total Cobalt	ug/L	4	0.21	0.22	0.02	0.14
Total Copper	ug/L	4	1.69	1.79	0.84	0.92
Total Fluoride	mg/L	4	0.09	0.11	0.002	0.05
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	4	121.00	93.50	13058.00	114.27
Total Lead	ug/L	4	0.09	0.06	0.01	0.07
Total Lithium	ug/L	4	12.35	14.80	68.71	8.29
Total Manganese	ug/L	4	9.00	9.61	52.55	7.25
Total Magnesium	mg/L	4	47.10	53.05	1190.41	34.50
Total Molybdenum	ug/L	4	1.01	1.25	0.44	0.67
Total Nickel	ug/L	4	2.09	2.37	1.82	1.35
Total Nitrogen	mg/L	0	n/a	n/a	n/a	n/a
Total Organic Carbon	mg/L	4	16.13	16.05	171.04	13.08
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	5	0.11	0.08	0.01	0.11
Total Potassium	mg/L	4	9.28	11.35	31.65	5.63
Total Rhenium	ug/L	4	0.02	0.03	0.0002	0.01
Total Rubidium	ug/L	4	0.83	0.93	0.36	0.60
Total Selenium	ug/L	4	0.33	0.34	0.01	0.10
Total Silicon	mg/L	4	7.31	8.05	37.06	6.09
Total Sodium	mg/L	4	77.03	86.55	2992.07	54.70
Total Strontium	mg/L	4	0.45	0.51	0.11	0.32
Total Sulphate	mg/L	4	154.58	164.50	14096.12	118.73
Total Thallium	ug/L	4	0.01	0.01	0.000003	0.002
Total Thorium	ug/L	4	0.01	0.01	0.0002	0.01
Total Titanium	ug/L	4	1.45	0.61	3.98	2.00
Total Tungsten	ug/L	4	0.05	0.04	0.00	0.04
Total Uranium	ug/L	4	2.69	2.85	4.31	2.08
Total Vanadium	ug/L	4	0.85	0.92	0.41	0.64
Total Yttrium	ug/L	4	0.09	0.08	0.01	0.09
Total Zinc	ug/L	4	3.35	2.75	5.52	2.35
Total Zirconium	ug/L	4	0.35	0.28	0.10	0.31
Total Coliforms	CFU/100 mL	0	n/a	n/a	n/a	n/a
Total Suspended Solids	mg/L	5	1.80	1.50	0.45	0.67
Turbidity	NTU	5	2.67	2.11	6.84	2.62

Notes: n/a = no results available

Table 4-3
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Twin Bridges																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	157	146.07	145.30	175.12	13.23	161	149.58	149.00	169.67	13.03	134	156.09	155.30	91.19	9.55	127	165.73	159.30	396.95	19.92
Bicarbonate	mg/L	3	170.50	168.22	239.83	15.49	7	177.89	177.97	70.45	8.39	4	191.57	191.99	25.32	5.03	3	203.98	209.67	315.50	17.76
Conductivity	uS/cm	290	392.43	398.70	1718.13	41.45	298	350.12	355.35	1449.50	38.07	244	393.81	396.50	599.52	24.49	220	425.78	424.40	1580.87	39.76
Dissolved Aluminum	ug/L	5	2.81	1.31	9.39	3.06	3	1.42	1.66	1.24	1.12	3	0.59	0.63	0.01	0.07	2	0.46	0.46	0.003	0.05
Dissolved Ammonia	ug/L	2	75.00	75.00	6050.00	77.78	3	36.67	40.00	233.33	15.28	0	n/a	n/a	n/a	n/a	2	25.00	25.00	50.00	7.07
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	5	0.20	0.15	0.01	0.11	4	0.21	0.20	0.004	0.06	3	0.12	0.12	0.001	0.03	2	0.10	0.10	0.0001	0.01
Dissolved Barium	ug/L	5	62.16	64.20	53.91	7.34	3	63.83	62.20	8.50	2.92	3	62.93	61.90	5.00	2.24	2	62.85	62.85	6.13	2.47
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	5	0.003	0.002	0.00002	0.004	3	0.001	0.001	0.0000	0.0005	3	0.002	0.001	0.00001	0.003	2	0.001	0.001	0.000	0.000
Dissolved Boron	ug/L	5	9.38	6.46	30.97	5.56	6	8.48	8.91	1.42	1.19	4	7.35	7.34	0.56	0.75	2	5.77	5.77	0.01	0.12
Dissolved Cadmium	ug/L	5	0.01	0.01	0.00001	0.003	3	0.003	0.002	0.000	0.001	3	0.00	0.00	0.00	0.00	2	0.01	0.01	0.00001	0.004
Dissolved Calcium	mg/L	9	50.97	52.20	79.54	8.92	11	50.92	50.10	8.18	2.86	7	56.29	55.00	20.21	4.50	5	64.82	60.30	72.08	8.49
Dissolved Chloride	mg/L	15	2.59	2.00	5.68	2.38	17	1.42	1.10	0.30	0.55	14	1.11	1.00	0.07	0.27	9	1.62	1.70	0.22	0.47
Dissolved Chromium	ug/L	5	0.43	0.39	0.02	0.15	3	0.26	0.18	0.02	0.16	3	0.10	0.08	0.001	0.03	2	0.25	0.25	0.03	0.17
Dissolved Cobalt	ug/L	5	0.02	0.01	0.001	0.03	3	0.02	0.01	0.0001	0.01	3	0.001	0.001	0.000	0.000	2	0.001	0.001	0.000	0.000
Dissolved Copper	ug/L	5	0.82	0.89	0.10	0.32	3	0.47	0.16	0.41	0.64	3	0.39	0.37	0.003	0.05	2	0.46	0.46	0.01	0.07
Dissolved Fluoride	mg/L	100	0.27	0.26	0.002	0.04	109	0.24	0.24	0.002	0.04	96	0.26	0.26	0.001	0.03	96	0.28	0.27	0.01	0.08
Dissolved Iron	ug/L	3	27.67	16.70	441.76	21.02	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	5	0.02	0.02	0.001	0.02	3	0.002	0.001	0.00001	0.003	3	0.005	0.002	0.00004	0.01	2	0.003	0.003	0.00001	0.003
Dissolved Lithium	ug/L	5	3.45	2.93	1.56	1.25	3	3.02	2.87	0.35	0.59	3	3.32	3.50	0.10	0.31	2	2.59	2.59	0.01	0.10
Dissolved Magnesium	mg/L	10	14.71	15.50	4.93	2.22	14	13.81	13.90	0.79	0.89	11	15.76	16.00	0.62	0.79	7	16.83	16.20	3.55	1.88
Dissolved Manganese	ug/L	5	1.51	0.72	5.07	2.25	4	0.79	0.79	0.04	0.20	4	2.76	0.36	23.29	4.83	2	0.37	0.37	0.00	0.02
Dissolved Molybdenum	ug/L	5	0.67	0.68	0.001	0.03	3	0.67	0.67	0.0004	0.02	3	0.60	0.60	0.00004	0.01	2	0.57	0.57	0.00	0.02
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	3	0.87	0.80	0.01	0.12	8	1.95	1.35	3.25	1.80	4	1.53	1.60	0.29	0.54	3	1.03	1.10	0.09	0.31
Dissolved Ortho Phosphorus	ug/L	6	3.83	4.00	0.57	0.75	6	2.83	3.00	0.57	0.75	7	4.71	4.00	9.57	3.09	4	3.25	3.00	1.58	1.26
Dissolved Oxygen	mg/L	150	11.73	11.80	1.79	1.34	151	9.31	9.30	0.88	0.94	126	11.11	10.90	2.30	1.52	114	12.41	12.30	1.36	1.16
Dissolved OxygenSat	%	33	91.11	90.90	57.41	7.58	38	87.63	85.90	95.11	9.75	30	88.62	89.25	307.64	17.54	36	90.22	87.55	255.37	15.98
Dissolved Phosphorus	ug/L	200	6.28	2.00	208.13	14.43	214	3.41	1.50	22.35	4.73	178	1.85	1.00	2.71	1.65	164	1.82	1.00	9.81	3.13
Dissolved Potassium	mg/L	10	0.59	0.60	0.03	0.17	14	0.55	0.54	0.02	0.15	11	0.50	0.50	0.02	0.14	7	0.56	0.60	0.04	0.19
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	5	0.60	0.61	0.01	0.10	4	0.87	0.54	0.57	0.76	3	0.47	0.48	0.001	0.02	2	0.61	0.61	0.04	0.19
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	10	2.49	2.20	0.45	0.67	14	2.24	2.00	0.51	0.72	11	2.24	2.00	0.15	0.39	7	3.26	2.70	3.18	1.78
Dissolved Strontium	mg/L	5	0.41	0.40	0.00	0.06	3	0.33	0.32	0.00	0.03	3	0.54	0.35	0.10	0.32	2	0.41	0.41	0.01	0.07
Dissolved Sulphate	mg/L	10	59.06	64.20	223.17	14.94	14	45.11	46.95	104.88	10.24	11	62.64	65.00	82.24	9.07	7	78.14	75.50	42.89	6.55
Dissolved Thallium	ug/L	5	0.01	0.01	0.00003	0.01	3	0.002	0.002	0.00001	0.002	3	0.003	0.002	0.00002	0.004	2	0.0003	0.0003	0.0000	0.0000
Dissolved Thorium	ug/L	5	0.02	0.01	0.001	0.03	3	0.01	0.004	0.00001	0.003	3	0.001	0.0004	0.000001	0.001	2	0.001	0.001	0.0000001	0.0004
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	5	0.50	0.53	0.05	0.23	3	0.41	0.42	0.000	0.01	3	0.41	0.40	0.001	0.02	2	0.50	0.50	0.00	0.02
Dissolved Vanadium	ug/L	5	0.16	0.09	0.02	0.12	3	0.16	0.16	0.002	0.05	3	0.08	0.09	0.001	0.03	2	0.06	0.06	0.00	0.01
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	5	2.02	1.08	2.37	1.54	3	0.54	0.74	0.18	0.43	3	1.72	1.18	2.19	1.48	2	0.77	0.77	0.28	0.53
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	45	43.59	20.90	5750.13	75.83	45	105.44	50.00	21611.63	147.01	40	19.06	9.85	825.25	28.73	44	13.53	5.30	1984.63	44.55
Extractable Arsenic	ug/L	20	0.33	0.10	0.11	0.33	29	0.40	0.25	0.22	0.47	15	0.40	0.20	0.29	0.54	15	0.21	0.10	0.07	0.26
Extractable Barium	ug/L	44	61.89	66.65	301.68	17.37	53	53.98	62.20	833.66	28.87	42	65.98	70.00	261.42	16.17	44	66.76	69.40	242.71	15.58

Table 4-3
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Twin Bridges																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Extractable Boron	ug/L	39	8.02	10.00	5.94	2.44	38	8.92	10.00	7.89	2.81	38	8.61	10.00	9.93	3.15	40	8.93	10.00	15.91	3.99
Extractable Cadmium	ug/L	21	0.19	0.05	0.13	0.35	23	0.12	0.05	0.02	0.14	19	0.11	0.05	0.02	0.14	19	0.15	0.05	0.05	0.23
Extractable Chromium	ug/L	50	1.39	0.55	2.50	1.58	50	1.58	1.00	2.23	1.49	44	1.41	1.00	2.19	1.48	51	1.26	1.00	1.72	1.31
Extractable Copper	ug/L	21	2.02	0.50	11.34	3.37	33	4.30	2.00	17.53	4.19	22	1.60	0.50	8.91	2.99	22	1.57	0.50	8.97	2.99
Extractable Iron	ug/L	58	62.19	50.00	4536.98	67.36	62	189.80	50.00	184698.20	429.77	52	41.62	50.00	1544.60	39.30	53	38.53	50.00	428.58	20.70
Extractable Lead	ug/L	22	0.36	0.50	0.09	0.31	37	1.13	0.50	10.83	3.29	20	0.30	0.08	0.10	0.32	20	0.62	0.50	0.36	0.60
Extractable Lithium	ug/L	28	2.95	3.00	0.24	0.49	27	3.19	3.20	0.26	0.51	27	3.35	3.30	0.42	0.65	29	2.98	3.20	0.23	0.48
Extractable Manganese	ug/L	34	2.73	1.00	12.11	3.48	35	13.18	2.80	781.95	27.96	36	1.93	1.00	3.91	1.98	38	1.57	1.00	1.11	1.05
Extractable Mercury	ug/L	14	0.03	0.03	0.0001	0.01	21	0.05	0.03	0.00	0.06	12	0.08	0.03	0.02	0.14	11	8.25	0.03	735.12	27.11
Extractable Molybdenum	ug/L	27	0.56	0.50	0.04	0.19	27	0.54	0.50	0.01	0.11	27	0.67	0.50	0.09	0.30	30	0.60	0.50	0.04	0.19
Extractable Nickel	ug/L	48	1.16	1.00	0.62	0.79	45	1.90	1.20	4.96	2.23	42	1.14	1.00	0.59	0.77	46	1.14	1.00	0.51	0.72
Extractable Selenium	ug/L	31	0.70	0.50	0.14	0.37	28	0.65	0.50	0.14	0.38	28	0.66	0.50	0.14	0.37	31	0.84	0.50	0.26	0.51
Extractable Titanium	ug/L	28	1.05	0.50	1.59	1.26	27	2.75	0.60	60.36	7.77	27	0.66	0.50	0.30	0.55	30	0.66	0.50	1.45	1.20
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	3	2.40	2.00	4.53	2.13	0	n/a	n/a	n/a	n/a	2	0.48	0.48	0.0005	0.02
Extractable Vanadium	ug/L	35	3.76	2.20	31.20	5.59	39	4.98	2.50	66.97	8.18	37	4.90	1.90	266.13	16.31	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	99	28.10	12.00	3017.03	54.93	108	35.94	17.00	4212.14	64.90	59	12.58	9.00	105.42	10.27	39	2.36	2.10	2.39	1.54
Fecal Coliforms	ug/L	158	212.84	213.35	524.71	22.91	161	188.61	187.00	362.22	19.03	134	214.41	213.80	178.26	13.35	71	27.59	14.00	1083.73	32.92
Hardness	mg/L	110	0.21	0.13	0.05	0.22	133	0.18	0.13	0.02	0.15	88	105.16	73.50	4565.84	67.57	125	237.56	234.00	341.33	18.48
Kjeldahl Nitrogen	ug/L	112	0.11	0.11	0.002	0.04	121	74.83	74.00	791.43	28.13	111	67.62	67.00	391.62	19.79	83	136.55	76.00	32027.45	178.96
Nitrate	ug/L	189	0.11	0.11	0.003	0.06	193	74.66	70.00	1459.36	38.20	168	73.09	69.50	1354.14	36.80	105	0.13	0.13	0.001	0.02
Nitrate Nitrite	ug/L	7	10.57	12.00	51.95	7.21	5	6.80	3.00	73.70	8.58	0	n/a	n/a	n/a	n/a	143	0.12	0.12	0.001	0.04
Nitrite	ug/L	291	8.18	8.20	0.02	0.15	294	8.24	8.30	0.02	0.15	240	8.24	8.30	0.02	0.15	0	n/a	n/a	n/a	n/a
pH		0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	221	8.05	8.10	0.03	0.16
Sulphide	ug/L	7	199.00	215.00	993.33	31.52	9	197.67	191.00	314.50	17.73	8	230.13	230.50	40.13	6.33	0	n/a	n/a	n/a	n/a
TDS	mg/L	225	3.49	2.50	10.80	3.29	252	11.59	11.60	5.16	2.27	196	5.65	5.60	15.00	3.87	4	239.75	234.50	242.92	15.59
Temperature	C	8	78.84	73.75	3964.33	62.96	8	604.51	97.95	990421.59	995.20	8	11.99	10.25	31.97	5.65	188	0.45	0.30	0.29	0.54
Total Aluminum	ug/L	63	29.29	10.00	1061.18	32.58	80	29.94	10.00	1181.33	34.37	38	40.79	30.00	2406.12	49.05	8	23.48	15.15	311.89	17.66
Total Ammonia	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	34	56.76	30.00	9608.91	98.03
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	5	1.72	0.50	5.28	2.30	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	8	57.09	65.10	532.59	23.08	10	74.19	70.50	368.73	19.20	9	68.11	68.90	8.92	2.99	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	8	67.36	66.55	3.27	1.81
Total Beryllium	ug/L	8	7.84	7.25	4.13	2.03	8	8.88	8.35	2.62	1.62	8	8.21	7.90	0.34	0.59	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	8	6.22	6.65	0.80	0.89
Total Cadmium	ug/L	93	57.52	58.50	25.30	5.03	111	51.59	52.00	28.12	5.303	93	58.70	58.60	12.73	3.57	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	6	35.17	35.50	80.97	9.00	6	37.17	37.50	26.97	5.19	7	37.57	37.00	5.62	2.37	92	62.96	62.30	21.80	4.67
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	4	39.25	39.50	10.92	3.30
Total Cesium	ug/L	95	2.83	2.40	2.32	1.52	116	1.68	1.60	0.33	0.57	94	1.85	1.70	0.77	0.88	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	0	n/a	n/a	n/a	n/a	6	1.63	1.25	1.61	1.27	3	0.63	0.60	0.02	0.15	92	2.08	1.85	0.65	0.81
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	8	2.01	0.90	10.69	3.27	10	1.54	1.00	1.92	1.39	9	1.19	0.50	2.31	1.52	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	90	0.26	0.26	0.00	0.04	95	0.23	0.24	0.00	0.04	85	0.26	0.26	0.001	0.03	7	0.79	0.45	0.22	0.47
Total Fluoride	mg/L	3	30.00	34.00	76.00	8.72	5	34.00	32.00	18.50	4.30	6	36.33	35.50	9.47	3.08	89	0.26	0.27	0.001	0.03
Total Inorganic Carbon	mg/L	8	0.18	0.13	0.01	0.11	10	0.76	0.23	1.60	1.26	9	99.03	73.20	4944.27	70.32	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	0	n/a	n/a	n/a	n/a	3	9.17	5.00	89.58	9.46	0	n/a	n/a	n/a	n/a	8	109.99	81.60	5547.06	74.48
Total Lead	ug/L	7	3.51	3.40	0.11	0.33	8	4.00	3.80	0.87	0.93	8	3.96	3.75	0.24	0.49	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	8	2.95	2.45	4.17	2.04	9	14.96	3.60	660.46	25.70	8	1.13	1.05	0.23	0.47	8	3.49	3.40	0.05	0.23
Total Manganese	ug/L	94	15.86	16.00	1.92	1.39	113	13.66	13.80	2.86	1.69	95	15.74	15.80	1.00	1.00	8	1.17	1.15	0.16	0.40
Total Magnesium	mg/L	8	0.53	0.40	0.09	0.30	9	0.56	0.40	0.06	0.24	8	0.48	0.40	0.02	0.14	92	16.99	16.95	1.61	1.27
Total Molybdenum	ug/L	8	2.38	1.15	9.70	3.11	10	1.78	1.60	2.44	1.56	9	1.01	0.90	0.09	0.31	7	0.44	0.40	0.01	0.11
Total Nickel	ug/L	90	0.28	0.24	0.03	0.18	99	0.25	0.21	0.02	0.16	76	0.16	0.14	0.01	0.09	7	1.01	0.90	0.02	0.16

Table 4-3
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Twin Bridges																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Nitrogen	mg/L	190	1.96	1.20	3.91	1.98	216	2.09	1.40	4.67	2.16	180	0.91	0.80	0.25	0.50	74	0.22	0.17	0.03	0.16
Total Organic Carbon	mg/L	301	21.37	4.00	4722.84	68.72	2	2.81	2.81	10.26	3.20	0	n/a	n/a	n/a	n/a	171	0.70	0.63	0.20	0.45
Total Particulate Carbon	mg/L	94	1.00	0.80	0.26	0.51	321	29.02	4.00	10086.62	100.43	201	6.33	2.00	291.06	17.06	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	113	0.75	0.70	0.04	0.20	97	0.72	0.70	0.02	0.15	178	4.46	2.00	111.64	10.57
Total Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	92	0.78	0.70	0.05	0.22
Total Rhenium	ug/L	8	0.98	0.70	0.40	0.63	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	10	0.55	0.70	0.07	0.26	9	0.61	0.70	0.06	0.24	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	95	3.21	2.90	1.18	1.09	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	8	0.78	0.77	0.01	0.09
Total Silicon	mg/L	4	0.44	0.45	0.00	0.01	113	2.52	2.30	1.35	1.16	96	2.57	2.60	0.14	0.37	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	0	n/a	n/a	n/a	n/a	5	0.31	0.29	0.00	0.03	5	0.42	0.42	0.001	0.03	92	2.84	2.70	0.80	0.89
Total Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	5	0.46	0.46	0.0004	0.02
Total Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	8	1.17	1.23	0.50	0.71	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	8	6.28	1.25	61.936	7.87	8	0.44	0.40	0.04	0.19	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	7	0.44	0.40	0.01	0.11
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	0	n/a	n/a	n/a	n/a	3	4.20	2.60	10.92	3.30	0	n/a	n/a	n/a	n/a	2	0.50	0.50	0.00003	0.01
Total Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	213	168.07	52.90	133838.97	365.84	5	8.88	6.00	43.16	6.57	2	3.25	3.25	0.05	0.21	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	247	19.80	3.20	11772.81	108.50	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	287	19.63	2.57	13628.21	116.74	212	530.26	303.30	2151242.90	1466.71	187	198.51	143.90	64611.35	254.19	194	83.50	63.10	7073.85	84.11
Total Suspended Solids	mg/L	0	n/a	n/a	n/a	n/a	267	77.69	4.00	97357.99	312.02	152	2.34	1.75	9.72	3.12	148	2.25	1.78	4.89	2.21
Turbidity	NTU	0	n/a	n/a	n/a	n/a	292	70.55	4.03	71514.68	267.42	230	1.05	0.78	2.00	1.42	220	0.85	0.71	0.26	0.51

Notes: n/a = no results available

Table 4-4
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Braggs Creek																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	33	132.17	134.60	50.13	7.08	37	144.16	137.00	3713.19	60.94	36	140.19	140.10	8.88	2.98	36	138.92	138.80	30.90	5.56
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	63	365.31	371.00	1819.94	42.66	77	317.87	324.00	2250.40	47.44	39	368.56	373.00	457.72	21.39	34	358.01	378.15	8266.78	90.92
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	2	7.30	7.30	0.08	0.28	2	9.65	9.65	19.85	4.45	2	6.30	6.30	0.32	0.57	2	7.45	7.45	0.41	0.64
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	6	57.10	57.15	23.68	4.87	6	48.85	48.50	20.22	4.50	6	51.97	53.00	14.49	3.81	6	54.02	57.40	40.71	6.38
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	33	0.28	0.29	0.002	0.04	37	0.23	0.23	0.002	0.04	36	0.26	0.27	0.001	0.04	36	0.30	0.30	0.002	0.04
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	62	11.62	11.43	1.38	1.18	77	10.25	10.16	0.93	0.97	39	11.31	11.28	1.57	1.25	36	13.07	12.90	1.81	1.34
Dissolved OxygenSat	%	25	90.35	89.50	55.16	7.43	28	90.75	90.95	60.66	7.79	27	90.67	91.80	29.59	5.44	28	90.74	89.45	101.69	10.08
Dissolved Phosphorus	ug/L	61	2.17	1.50	1.84	1.36	77	4.34	1.50	88.96	9.43	40	1.63	1.00	1.71	1.31	35	2.06	1.00	14.88	3.86
Dissolved Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-4
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Braggs Creek																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	5	9.18	6.80	57.33	7.57	6	86.78	39.20	20137.84	141.91	6	73.33	7.50	26783.80	163.66	6	2.75	2.30	2.72	1.65
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Barium	ug/L	5	55.06	52.00	91.60	9.57	6	45.10	47.05	54.04	7.35	6	51.00	49.45	14.91	3.86	6	51.52	51.15	1.39	1.18
Extractable Boron	ug/L	5	7.48	7.60	0.53	0.73	6	7.75	7.45	1.96	1.40	6	7.40	7.55	0.52	0.72	6	7.23	7.05	0.23	0.48
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	5	0.52	0.50	0.002	0.04	6	0.73	0.60	0.12	0.34	6	0.87	0.85	0.09	0.29	6	0.82	0.80	0.09	0.29
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Iron	ug/L	5	50.00	50.00	0.000	0.000	6	59.05	50.00	491.42	22.17	6	76.82	50.00	4314.80	65.69	6	50.00	50.00	0.000	0.000
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	5	3.38	3.30	0.13	0.36	6	2.70	2.60	0.19	0.43	6	3.28	3.25	0.03	0.18	6	3.47	3.45	0.06	0.25
Extractable Manganese	ug/L	5	2.08	0.80	8.59	2.93	6	4.72	1.65	31.49	5.61	6	1.57	0.80	4.54	2.13	6	3.05	0.50	37.81	6.15
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	5	0.60	0.60	0.000	0.000	6	0.53	0.60	0.02	0.14	6	0.58	0.60	0.002	0.04	6	0.62	0.60	0.01	0.08
Extractable Nickel	ug/L	5	0.50	0.50	0.000	0.000	6	0.62	0.55	0.04	0.19	6	0.52	0.50	0.002	0.04	6	0.55	0.50	0.02	0.12
Extractable Selenium	ug/L	5	0.48	0.35	0.08	0.29	6	0.38	0.35	0.00	0.06	6	0.52	0.35	0.07	0.26	6	0.68	0.80	0.07	0.26
Extractable Titanium	ug/L	5	0.45	0.25	0.09	0.29	6	0.82	0.50	0.80	0.90	6	2.04	0.25	19.26	4.39	6	0.25	0.25	0.000	0.000
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	5	1.00	1.00	0.000	0.000	6	4.42	1.00	69.23	8.32	6	1.05	1.00	0.02	0.12	6	1.10	1.00	0.06	0.24
Fecal Coliforms	ug/L	20	9.10	4.00	157.78	12.56	23	9.43	7.00	77.80	8.82	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Hardness	mg/L	33	203.74	208.40	312.15	17.67	37	174.62	173.60	393.65	19.84	36	201.03	202.70	94.44	9.72	36	217.61	215.70	134.81	11.61
Kjeldahl Nitrogen	ug/L	53	159.85	100.00	30274.900	174.00	60	0.21	0.11	0.20	0.45	36	108.31	73.50	5810.39	76.23	36	93.25	74.00	1430.76	37.83
Nitrate	ug/L	42	0.11	0.12	0.0004	0.02	60	88.30	77.50	607.64	24.65	41	93.54	86.00	478.70	21.88	36	0.13	0.13	0.001	0.03
Nitrate Nitrite	ug/L	62	0.11	0.11	0.0006	0.02	83	92.00	84.00	684.61	26.17	41	93.54	86.00	478.70	21.88	36	0.13	0.13	0.001	0.03
Nitrite	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
pH		60	8.19	8.20	0.02	0.15	71	8.25	8.30	0.02	0.13	39	8.32	8.30	0.004	0.06	36	8.20	8.20	0.01	0.11
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	68	3.87	4.00	7.04	2.65	90	9.04	9.20	4.08	2.02	43	5.92	5.80	8.86	2.98	36	0.33	0.30	0.13	0.36
Total Aluminum	ug/L	10	68.93	12.25	9194.00	95.89	10	261.39	34.20	282424.11	531.44	10	9.66	9.80	19.65	4.43	9	11.78	10.80	62.23	7.89
Total Ammonia	ug/L	31	20.97	5.00	425.70	20.63	36	21.39	5.00	396.59	19.91	10	42.50	50.00	145.83	12.08	9	47.22	50.00	69.44	8.33
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	10	56.04	56.00	4.30	2.07	10	66.11	52.15	1430.17	37.82	10	52.72	52.55	3.73	1.93	9	53.53	54.00	10.04	3.17
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	8	8.59	8.25	2.84	1.68	8	7.40	7.35	2.19	1.48	8	7.94	7.95	0.19	0.43	7	7.26	7.50	0.85	0.92
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	27	55.06	58.00	25.82	5.08	31	47.96	47.70	31.39	5.60	30	54.63	55.30	5.32	2.31	30	58.20	57.65	15.80	3.97
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	33	1.26	1.20	0.11	0.34	37	0.85	0.80	0.03	0.19	36	0.99	0.95	0.04	0.21	36	1.30	1.10	1.62	1.27

Table 4-4
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Braggs Creek																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	2	1.50	1.50	1.28	1.13	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	10	2.21	0.70	11.19	3.34	10	1.06	1.00	0.54	0.73	10	0.73	0.45	0.401	0.63	9	0.43	0.45	0.04	0.20
Total Fluoride	mg/L	33	0.28	0.29	0.00	0.04	37	0.23	0.23	0.00	0.04	36	0.26	0.27	0.001	0.04	36	0.30	0.30	0.002	0.04
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	10	0.15	0.12	0.01	0.11	10	0.35	0.13	0.40	0.64	10	80.49	57.60	3219.03	56.74	9	91.11	76.10	2683.85	51.81
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	9	3.71	3.60	0.10	0.32	10	3.45	3.20	0.26	0.51	10	3.79	3.75	0.20	0.45	9	3.66	3.70	0.12	0.34
Total Manganese	ug/L	10	2.22	0.80	5.90	2.43	10	6.81	2.30	126.17	11.23	10	0.80	0.80	0.03	0.16	9	1.02	0.80	0.25	0.50
Total Magnesium	mg/L	27	15.63	16.00	2.24	1.50	31	12.75	13.00	3.75	1.94	30	15.40	15.55	0.82	0.91	30	16.65	16.55	0.62	0.79
Total Molybdenum	ug/L	10	0.57	0.40	0.07	0.27	10	0.51	0.40	0.02	0.15	10	0.52	0.40	0.03	0.16	9	0.50	0.40	0.02	0.15
Total Nickel	ug/L	10	2.02	1.00	8.08	2.84	10	1.24	1.05	0.46	0.68	10	0.94	0.90	0.07	0.26	9	0.86	0.90	0.03	0.16
Total Nitrogen	mg/L	42	0.24	0.20	0.04	0.20	43	0.29	0.18	0.29	0.54	36	0.17	0.16	0.01	0.10	36	0.19	0.19	0.01	0.08
Total Organic Carbon	mg/L	40	1.79	0.98	3.30	1.82	58	2.11	1.30	3.95	1.99	39	0.92	0.80	0.20	0.44	35	0.68	0.60	0.13	0.35
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	138	5.72	3.00	85.18	9.23	153	15.63	3.00	7685.85	87.67	41	3.28	2.00	16.20	4.02	35	3.46	2.00	20.43	4.52
Total Potassium	mg/L	27	0.55	0.50	0.01	0.12	31	0.52	0.50	0.01	0.07	30	0.51	0.50	0.01	0.12	30	0.54	0.50	0.16	0.39
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	10	0.97	0.80	0.32	0.56	10	0.64	0.70	0.01	0.08	10	0.66	0.70	0.02	0.13	9	0.76	0.70	0.03	0.16
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	33	1.60	1.90	0.67	0.82	37	1.20	1.30	0.34	0.58	36	1.46	1.60	0.671	0.82	36	1.79	1.80	3.27	1.81
Total Strontium	mg/L	6	0.53	0.54	0.001	0.03	7	0.29	0.28	0.00	0.04	7	0.43	0.43	0.00	0.04	6	0.51	0.51	0.0008	0.03
Total Sulphate	mg/L	6	74.97	78.60	97.55	9.88	6	53.90	55.75	164.40	12.82	6	64.28	64.10	29.62	5.44	6	74.63	74.50	6.99	2.64
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	10	0.96	0.40	1.14	1.07	10	2.79	0.60	15.71	3.96	10	0.42	0.40	0.02	0.15	9	0.44	0.40	0.02	0.15
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	2	0.50	0.50	0.000	0.000	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	2	0.50	0.50	0.000	0.000
Total Vanadium	ug/L	0	n/a	n/a	n/a	n/a	3	2.30	1.20	4.71	2.17	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	3	2.57	2.70	0.17	0.42	3	9.23	9.60	48.40	6.96	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	46	70.99	29.15	24296.19	155.87	70	279.57	130.15	278518.61	527.75	45	87.44	52.00	13434.42	115.91	36	12.29	11.00	47.10	6.86
Total Suspended Solids	mg/L	125	12.45	2.00	6007.74	77.51	134	59.78	2.00	91643.56	302.73	39	1.90	2.00	0.76	0.87	36	2.11	2.00	1.03	1.01
Turbidity	NTU	40	8.20	0.82	1106.16	33.26	54	108.23	3.22	192679.10	438.95	39	0.81	0.41	3.03	1.74	36	0.49	0.45	0.05	0.22

Notes: n/a = no results available

Table 4-5
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Sandy Beach																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	52	157.14	156.90	301.72	17.37	51	144.46	141.90	235.94	15.36	49	149.65	150.50	72.01	8.49	56	174.04	174.30	74.08	8.61
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	123	433.12	440.00	2952.79	54.34	121	341.36	346.50	899.38	29.99	122	374.65	371.50	758.70	27.54	126	445.42	451.05	1101.96	33.20
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	23	39.57	30.00	413.44	20.33	4	40.00	45.00	200.00	14.14	6	26.67	30.00	26.67	5.16	29	35.86	30.00	332.27	18.23
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	52	0.29	0.27	0.007	0.08	52	0.24	0.24	0.002	0.04	51	0.29	0.28	0.007	0.08	56	0.30	0.29	0.002	0.05
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	83	11.79	11.80	1.76	1.33	80	8.92	8.90	1.20	1.09	92	10.23	10.10	2.41	1.55	88	12.73	12.60	1.32	1.15
Dissolved OxygenSat	%	21	94.17	93.70	74.23	8.62	22	96.75	94.80	91.25	9.55	20	93.79	95.65	75.91	8.71	24	93.40	93.00	86.07	9.28
Dissolved Phosphorus	ug/L	121	3.77	2.00	34.26	5.85	120	2.41	1.00	16.65	4.08	121	1.93	1.00	3.22	1.79	126	2.08	1.00	4.13	2.03
Dissolved Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-5
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Sandy Beach																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	25	0.40	0.40	0.07	0.26	26	0.38	0.23	0.31	0.55	27	0.92	0.25	5.75	2.40	30	0.39	0.37	0.05	0.22
Extractable Arsenic	ug/L	2	0.75	0.75	0.41	0.64	2	1.25	1.25	0.05	0.21	6	1.65	1.10	0.92	0.96	3	1.13	1.20	0.81	0.90
Extractable Barium	ug/L	26	84.84	79.15	813.34	28.52	27	71.41	65.50	433.44	20.82	27	77.04	74.00	145.79	12.07	30	86.58	86.65	51.56	7.18
Extractable Boron	ug/L	26	8.87	10.00	13.35	3.65	27	9.01	10.00	6.83	2.61	27	8.97	9.70	2.96	1.72	29	8.72	8.60	1.91	1.38
Extractable Cadmium	ug/L	3	1.47	1.40	0.25	0.50	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	26	2.11	1.80	2.637	1.62	27	1.80	1.20	1.35	1.16	27	2.17	1.10	4.74	2.18	30	1.81	1.00	2.07	1.44
Extractable Copper	ug/L	6	1.90	1.45	1.16	1.08	9	2.54	1.70	3.04	1.74	2	2.10	2.10	0.02	0.14	4	4.68	2.30	23.86	4.88
Extractable Iron	ug/L	24	67.48	50.00	2370.646	48.689	25	264.22	50.00	374854.76	612.25	27	155.36	50.00	204433.91	452.14	30	54.82	50.00	586.430	24.216
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	2	3.00	3.00	3.38	1.84	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	23	3.04	2.90	0.49	0.70	24	3.23	3.15	0.31	0.55	24	3.63	3.45	0.46	0.68	27	3.77	3.90	0.38	0.61
Extractable Manganese	ug/L	26	12.54	12.70	39.80	6.31	27	13.68	4.10	910.77	30.18	27	6.03	3.00	122.18	11.05	30	11.35	10.60	44.22	6.65
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	26	0.65	0.50	0.267	0.517	27	0.59	0.50	0.04	0.19	27	0.67	0.50	0.081	0.28	29	0.63	0.50	0.04	0.21
Extractable Nickel	ug/L	26	1.58	1.65	0.589	0.767	27	1.64	1.40	1.02	1.01	27	1.28	1.30	0.352	0.59	30	2.22	1.60	10.51	3.24
Extractable Selenium	ug/L	26	0.78	0.50	0.18	0.42	27	0.71	0.50	0.17	0.41	27	0.65	0.50	0.10	0.32	30	0.78	0.50	0.32	0.57
Extractable Titanium	ug/L	26	1.60	1.45	2.86	1.69	27	5.55	0.50	318.76	17.85	27	1.68	0.50	27.02	5.20	29	0.63	0.50	0.133	0.365
Extractable Uranium	ug/L	4	0.53	0.50	0.00	0.05	3	0.60	0.60	0.01	0.10	3	0.73	0.50	0.16	0.40	7	0.59	0.60	0.0014	0.04
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	3	4.23	2.70	8.52	2.92	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	26	3.38	2.65	7.178	2.679	27	4.14	1.90	65.70	8.11	27	2.48	1.60	7.57	2.75	30	2.41	1.80	3.47	1.86
Fecal Coliforms	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Hardness	mg/L	52	222.25	225.65	842.15	29.02	51	185.05	182.00	288.98	17.00	49	204.25	203.00	166.41	12.90	56	243.05	242.80	426.78	20.66
Kjeldahl Nitrogen	ug/L	51	0.19	0.18	0.012	0.11	51	0.22	0.16	0.04	0.19	50	0.17	0.15	0.01	0.09	55	0.14	0.12	0.01	0.09
Nitrate	ug/L	86	0.11	0.12	0.003	0.05	90	50.56	35.00	2321.96	48.19	90	23.38	17.00	390.51	19.76	88	0.11	0.11	0.002	0.04
Nitrate Nitrite	ug/L	88	0.11	0.12	0.003	0.05	90	51.06	35.00	2433.11	49.33	90	23.91	17.00	402.53	20.06	91	0.12	0.11	0.002	0.04
Nitrite	ug/L	5	10.80	7.00	98.70	9.93	7	6.43	5.00	20.95	4.58	3	17.67	9.00	225.33	15.01	4	13.75	7.50	164.92	12.84
pH		125	8.21	8.20	0.02	0.12	121	8.37	8.40	0.01	0.11	123	8.34	8.30	0.010	0.10	128	8.19	8.20	0.01	0.09
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	120	5.06	3.40	15.36	3.92	119	16.10	16.90	9.39	3.06	120	8.91	8.80	24.77	4.98	124	1.18	1.10	0.65	0.81
Total Aluminum	ug/L	8	0.36	0.29	0.12	0.34	8	0.48	0.42	0.11	0.33	7	0.24	0.18	0.06	0.24	7	0.28	0.27	0.07	0.26
Total Ammonia	ug/L	7	30.00	25.00	416.67	20.41	7	50.00	50.00	0.000	0.000	5	50.00	50.00	0.000	0.000	5	35.00	50.00	650.00	25.50
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	8	81.29	81.50	18.81	4.34	8	70.66	66.85	60.12	7.75	7	76.29	75.40	25.94	5.09	7	87.47	86.80	27.66	5.26
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	8	8.48	7.80	4.07	2.02	8	9.09	9.15	2.25	1.50	7	9.81	9.80	0.79	0.89	7	8.13	7.90	0.47	0.69
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	52	59.25	60.80	48.65	6.98	52	48.52	48.45	16.50	4.06	51	52.83	53.00	11.24	3.35	55	64.00	63.60	22.76	4.77
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	52	10.98	9.75	40.75	6.38	53	3.02	2.80	1.37	1.17	51	3.31	3.10	0.70	0.84	56	5.60	5.25	4.88	2.21
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	2	1.10	1.10	0.08	0.28	2	0.75	0.75	0.05	0.21	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	8	2.40	1.30	9.97	3.16	8	0.98	1.05	0.24	0.49	7	1.09	0.70	1.206	1.10	7	1.35	0.90	1.60	1.26
Total Fluoride	mg/L	52	0.29	0.27	0.01	0.08	52	0.24	0.24	0.00	0.04	51	0.29	0.28	0.007	0.08	56	0.30	0.29	0.002	0.05

Table 4-5
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Sandy Beach																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	8	0.26	0.21	0.03	0.16	8	0.27	0.17	0.05	0.23	7	80.43	82.10	999.69	31.62	7	0.13	0.13	0.003	0.06
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	7	3.99	3.90	0.21	0.46	8	3.93	3.80	0.30	0.55	7	4.61	4.30	0.71	0.85	7	4.24	4.20	0.03	0.16
Total Manganese	ug/L	8	14.43	12.65	62.40	7.90	8	9.15	7.50	30.93	5.56	7	2.96	2.50	1.54	1.24	7	18.07	16.80	65.99	8.12
Total Magnesium	mg/L	52	16.96	17.25	3.94	1.99	52	13.88	14.05	3.10	1.76	51	16.18	16.30	1.38	1.17	56	18.42	18.25	1.47	1.21
Total Molybdenum	ug/L	8	0.61	0.40	0.10	0.32	8	0.51	0.40	0.04	0.21	7	0.53	0.40	0.05	0.22	7	0.44	0.40	0.01	0.11
Total Nickel	ug/L	8	2.35	1.20	9.63	3.10	8	1.25	1.25	0.22	0.47	7	1.04	0.90	0.08	0.28	7	1.07	1.00	0.05	0.22
Total Nitrogen	mg/L	51	0.31	0.30	0.01	0.12	51	0.28	0.23	0.05	0.22	50	0.20	0.18	0.01	0.10	55	0.26	0.27	0.02	0.12
Total Organic Carbon	mg/L	115	1.70	1.25	1.18	1.09	115	2.32	1.88	1.66	1.29	118	1.40	1.35	0.10	0.32	125	1.00	0.99	0.12	0.34
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	122	12.66	9.00	141.24	11.88	121	20.96	6.00	6291.41	79.32	120	6.40	5.00	37.30	6.11	127	6.77	6.00	15.78	3.97
Total Potassium	mg/L	52	1.36	1.10	0.37	0.61	52	0.97	0.90	0.15	0.38	51	0.92	0.90	0.02	0.15	56	1.03	1.00	0.01	0.12
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	8	1.03	0.80	0.36	0.60	8	0.66	0.70	0.01	0.07	7	0.64	0.70	0.01	0.10	7	0.77	0.70	0.02	0.15
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	52	8.56	7.60	14.92	3.86	52	3.64	3.50	0.84	0.91	51	3.72	3.70	0.350	0.59	56	5.28	5.30	1.68	1.30
Total Strontium	mg/L	4	0.45	0.45	0.001	0.02	5	0.31	0.31	0.001	0.03	4	0.40	0.40	0.0004	0.02	4	0.47	0.47	0.0001	0.01
Total Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	8	2.22	1.08	7.27	2.70	8	5.93	1.80	105.33	10.26	7	0.49	0.40	0.10	0.32	7	0.38	0.40	0.003	0.06
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	4	0.68	0.70	0.003	0.050	2	0.60	0.60	0.000	0.000	2	0.55	0.55	0.01	0.07	4	0.68	0.70	0.003	0.050
Total Vanadium	ug/L	2	0.95	0.95	0.13	0.35	2	2.20	2.20	0.50	0.71	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	3	2.57	2.30	0.30	0.55	3	8.87	3.70	101.92	10.10	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	125	121.94	35.90	56917.54	238.57	105	978.71	613.10	2491892.52	1578.57	117	330.69	178.50	204204.23	451.89	128	124.09	48.75	59275.70	243.47
Total Suspended Solids	mg/L	120	5.66	3.85	64.66	8.04	121	16.41	2.60	2822.85	53.13	118	3.03	2.00	11.81	3.44	122	3.41	2.95	4.24	2.06
Turbidity	NTU	125	5.90	2.91	256.72	16.02	121	20.13	2.06	5201.19	72.12	123	2.14	1.21	20.87	4.57	128	1.84	1.75	0.63	0.79

Notes: n/a = no results available

Table 4-6
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Weaselhead Bridge																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	49	150.93	151.90	51.98	7.21	76	155.22	156.75	140.29	11.84	30	163.40	165.70	56.11	7.49	0	n/a	n/a	n/a	n/a
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	114	397.95	406.65	1287.28	35.88	175	360.08	366.30	1961.07	44.28	46	397.73	404.50	1364.47	36.94	0	n/a	n/a	n/a	n/a
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	5	66.00	50.00	3880.00	62.29	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	2	9.60	9.60	0.18	0.42	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	4	57.53	58.55	21.61	4.65	6	58.85	57.00	16.24	4.03	3	60.00	59.80	15.24	3.90	0	n/a	n/a	n/a	n/a
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	56	0.25	0.24	0.002	0.04	85	0.24	0.24	0.001	0.04	31	0.26	0.27	0.002	0.04	0	n/a	n/a	n/a	n/a
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	100	11.64	11.60	1.67	1.29	142	9.50	9.50	0.90	0.95	42	10.13	10.00	1.36	1.17	0	n/a	n/a	n/a	n/a
Dissolved OxygenSat	%	30	93.31	92.75	82.00	9.06	47	90.44	89.10	88.75	9.42	15	87.85	87.00	29.13	5.40	0	n/a	n/a	n/a	n/a
Dissolved Phosphorus	ug/L	135	7.96	3.00	226.61	15.05	220	3.90	2.00	27.49	5.24	50	1.86	1.25	2.09	1.45	0	n/a	n/a	n/a	n/a
Dissolved Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-6
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Weaselhead Bridge																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	14	78.54	54.05	3199.76	56.57	22	181.78	70.95	85562.16	292.51	7	22.79	21.90	118.46	10.88	0	n/a	n/a	n/a	n/a
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	3	1.10	1.10	0.36	0.60	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Barium	ug/L	14	71.71	70.85	12.70	3.56	23	73.21	71.50	169.11	13.00	7	77.30	77.10	32.96	5.74	0	n/a	n/a	n/a	n/a
Extractable Boron	ug/L	14	7.89	7.75	6.70	2.59	23	9.30	10.00	5.76	2.40	7	9.49	10.00	0.77	0.88	0	n/a	n/a	n/a	n/a
Extractable Cadmium	ug/L	2	0.55	0.55	0.41	0.64	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	14	2.32	2.20	3.943	1.99	23	2.31	1.50	3.23	1.80	7	3.10	2.30	6.15	2.48	0	n/a	n/a	n/a	n/a
Extractable Copper	ug/L	2	2.00	2.00	3.38	1.84	6	2.90	1.85	4.48	2.12	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Iron	ug/L	14	0.12	0.10	0.007	0.081	22	262.56	50.00	199337.92	446.47	7	50.00	50.00	0.000	0.000	0	n/a	n/a	n/a	n/a
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	6	1.52	1.55	0.54	0.74	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	14	3.01	3.10	0.14	0.37	23	3.34	3.40	0.53	0.73	7	3.87	3.90	0.51	0.71	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	14	8.16	6.35	23.09	4.81	23	17.47	5.30	707.78	26.60	7	2.93	2.80	0.52	0.72	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	14	0.69	0.55	0.151	0.389	23	0.56	0.50	0.01	0.12	7	0.73	0.50	0.149	0.39	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	14	1.60	1.70	0.840	0.917	23	1.86	1.60	1.43	1.20	7	1.70	1.80	0.373	0.61	0	n/a	n/a	n/a	n/a
Extractable Selenium	ug/L	14	0.82	0.80	0.16	0.40	23	0.71	0.50	0.14	0.38	7	0.90	1.00	0.18	0.42	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	14	2.13	1.45	2.81	1.68	23	7.24	1.60	346.92	18.63	7	0.58	0.50	0.11	0.33	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	2	0.55	0.55	0.01	0.07	2	0.50	0.50	0.000	0.000	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	5	2.76	2.10	8.44	2.90	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	14	2.91	2.85	3.216	1.793	23	6.16	2.50	102.06	10.10	7	2.07	2.10	0.51	0.72	0	n/a	n/a	n/a	n/a
Fecal Coliforms	ug/L	28	41.14	19.00	5887.53	76.73	61	58.03	31.00	8272.57	90.95	3	18.67	15.00	166.33	12.90	0	n/a	n/a	n/a	n/a
Hardness	mg/L	49	214.85	215.20	234.49	15.31	76	198.55	199.50	471.01	21.70	30	224.80	227.50	178.97	13.38	0	n/a	n/a	n/a	n/a
Kjeldahl Nitrogen	ug/L	73	0.24	0.15	0.049	0.22	111	0.21	0.15	0.04	0.19	31	0.13	0.13	0.00	0.06	0	n/a	n/a	n/a	n/a
Nitrate	ug/L	85	0.11	0.10	0.003	0.05	124	84.56	78.00	1461.86	38.23	41	76.34	81.00	1753.08	41.87	0	n/a	n/a	n/a	n/a
Nitrate Nitrite	ug/L	109	106.65	100.00	2629.229	51.28	166	82.11	76.00	1439.89	37.95	45	71.22	73.00	1876.95	43.32	0	n/a	n/a	n/a	n/a
Nitrite	ug/L	5	27.60	21.00	408.30	20.21	9	16.56	7.00	503.03	22.43	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
pH		121	8.23	8.20	0.01	0.11	184	8.27	8.30	0.02	0.12	43	8.28	8.30	0.006	0.08	0	n/a	n/a	n/a	n/a
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	115	4.78	4.60	10.23	3.20	171	12.02	12.00	6.04	2.46	46	8.59	8.90	10.61	3.26	0	n/a	n/a	n/a	n/a
Total Aluminum	ug/L	8	0.31	0.20	0.15	0.39	11	0.79	0.26	1.17	1.08	2	45.30	45.30	462.08	21.50	0	n/a	n/a	n/a	n/a
Total Ammonia	ug/L	30	22.33	10.00	577.13	24.02	50	28.30	10.00	1076.133	32.804	6	38.33	50.00	366.667	19.149	0	n/a	n/a	n/a	n/a
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	4	1.00	0.70	0.55	0.74	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	8	77.24	75.65	27.11	5.21	11	84.94	77.00	518.44	22.77	2	75.30	75.30	1.62	1.27	0	n/a	n/a	n/a	n/a
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	7	8.70	7.80	4.16	2.04	9	9.79	9.30	2.29	1.51	2	8.95	8.95	0.05	0.21	0	n/a	n/a	n/a	n/a
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	28	59.82	61.05	13.95	3.73	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	52	57.96	58.50	13.83	3.72	79	53.59	54.30	31.66	5.63	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	56	5.74	4.20	16.34	4.04	87	2.62	2.40	1.40	1.18	31	3.07	2.60	2.66	1.63	0	n/a	n/a	n/a	n/a
Total Chromium	ug/L	2	1.10	1.10	0.72	0.85	5	2.14	1.90	2.84	1.68	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	2	1.40	1.40	1.28	1.13	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	8	2.38	1.20	9.84	3.14	11	1.85	1.30	2.50	1.58	2	1.38	1.38	1.711	1.31	0	n/a	n/a	n/a	n/a
Total Fluoride	mg/L	56	0.25	0.24	0.002	0.04	85	0.24	0.24	0.001	0.04	31	0.26	0.27	0.002	0.04	0	n/a	n/a	n/a	n/a

Table 4-6
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Weaselhead Bridge																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	8	0.47	0.30	0.21	0.46	11	1.00	0.43	2.12	1.46	2	0.13	0.13	0.001	0.03	0	n/a	n/a	n/a	n/a
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	3	1.60	0.90	1.69	1.30	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	7	4.26	3.90	0.76	0.87	11	4.51	4.50	0.99	0.99	2	3.95	3.95	0.01	0.07	0	n/a	n/a	n/a	n/a
Total Manganese	ug/L	8	12.65	7.40	166.53	12.90	11	82.08	11.00	35986.61	189.70	2	4.00	4.00	0.98	0.99	0	n/a	n/a	n/a	n/a
Total Magnesium	mg/L	52	16.29	15.95	1.92	1.39	79	14.34	14.70	3.09	1.76	28	16.83	16.75	2.10	1.45	0	n/a	n/a	n/a	n/a
Total Molybdenum	ug/L	8	0.58	0.40	0.09	0.31	11	0.58	0.40	0.05	0.22	2	0.55	0.55	0.05	0.21	0	n/a	n/a	n/a	n/a
Total Nickel	ug/L	8	2.10	1.60	1.78	1.33	11	2.19	1.70	3.34	1.83	2	0.90	0.90	0.000	0.000	0	n/a	n/a	n/a	n/a
Total Nitrogen	mg/L	62	0.36	0.28	0.06	0.24	93	0.29	0.26	0.04	0.21	31	0.21	0.20	0.01	0.10	0	n/a	n/a	n/a	n/a
Total Organic Carbon	mg/L	114	2.65	1.88	5.16	2.27	186	2.23	1.52	4.10	2.02	44	1.11	1.02	0.12	0.35	0	n/a	n/a	n/a	n/a
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	216	25.64	10.00	1581.07	39.76	333	41.32	10.00	10378.16	101.87	66	13.82	5.00	368.52	19.20	0	n/a	n/a	n/a	n/a
Total Potassium	mg/L	52	1.23	1.00	0.46	0.68	79	0.89	0.90	0.03	0.18	28	0.91	0.90	0.05	0.22	0	n/a	n/a	n/a	n/a
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	8	1.90	0.70	10.73	3.28	11	0.66	0.70	0.01	0.09	2	0.65	0.65	0.01	0.07	0	n/a	n/a	n/a	n/a
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	56	5.10	4.60	8.50	2.91	85	3.04	3.10	1.43	1.19	31	3.35	3.40	2.191	1.48	0	n/a	n/a	n/a	n/a
Total Strontium	mg/L	5	0.41	0.43	0.002	0.05	8	0.34	0.34	0.002	0.05	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sulphate	mg/L	4	59.55	60.80	168.52	12.98	6	54.58	58.85	147.03	12.13	3	58.23	59.70	73.86	8.59	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	8	4.21	2.60	23.70	4.87	11	9.63	4.10	115.62	10.75	2	0.75	0.75	0.13	0.35	0	n/a	n/a	n/a	n/a
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	2	0.70	0.70	0.020	0.141	5	0.54	0.50	0.003	0.055	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Vanadium	ug/L	3	1.70	1.10	1.48	1.22	8	2.81	1.45	9.78	3.13	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	4	3.95	2.65	9.38	3.06	8	7.71	4.80	54.46	7.38	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	107	344.60	125.00	420462.47	648.43	168	901.12	638.90	1894425.10	1376.38	47	438.50	410.60	91135.91	301.89	2	109.80	109.80	537.92	23.19
Total Suspended Solids	mg/L	187	44.13	9.60	22084.28	148.61	247	78.43	14.50	35307.03	187.90	44	6.35	3.65	56.41	7.51	0	n/a	n/a	n/a	n/a
Turbidity	NTU	152	33.06	8.13	11387.02	106.71	271	79.94	10.10	58428.50	241.72	68	3.14	1.84	17.83	4.22	0	n/a	n/a	n/a	n/a

Notes: n/a = no results available

Table 4-7
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Sarcee Bridge																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	118	152.72	150.70	395.83	19.90	127	152.92	154.50	127.78	11.30	107	164.51	163.10	106.47	10.32	51	165.44	165.10	57.89	7.61
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	127	390.57	396.40	2414.95	49.14	156	350.80	350.20	2259.55	47.53	110	387.86	388.30	2690.24	51.87	50	428.43	434.55	1510.81	38.87
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	24	73.75	35.00	16441.85	128.23	20	24.00	25.00	298.95	17.29	22	30.00	30.00	238.10	15.43	4	55.00	45.00	966.67	31.09
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	2	9.30	9.30	9.68	3.11	2	9.50	9.50	0.000	0.000	2	7.55	7.55	0.05	0.21	2	7.50	7.50	0.000	0.000
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	6	60.48	60.50	5.29	2.30	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	6	59.40	58.85	36.20	6.02	6	55.38	56.45	25.91	5.09	0	n/a	n/a	n/a	n/a	6	59.37	59.00	12.81	3.58
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	92	0.27	0.26	0.002	0.05	105	0.27	0.26	0.005	0.07	86	0.27	0.26	0.006	0.08	41	0.27	0.27	0.001	0.03
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	45	12.09	12.30	1.89	1.38	67	9.55	9.40	1.33	1.16	42	11.29	10.80	3.76	1.94	35	12.99	12.72	1.59	1.26
Dissolved OxygenSat	%	36	91.91	91.50	43.63	6.61	44	88.76	88.85	101.12	10.06	36	91.38	90.10	97.81	9.89	35	89.81	88.50	81.18	9.01
Dissolved Phosphorus	ug/L	40	8.45	3.00	180.77	13.44	60	3.45	1.00	23.78	4.88	41	1.68	1.00	1.31	1.14	35	1.96	2.00	0.71	0.84
Dissolved Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-7
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Sarcee Bridge																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	0	n/a	n/a	n/a	n/a	5	208.34	79.70	82147.10	286.61	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Barium	ug/L	7	100.13	98.00	86.65	9.31	20	80.59	77.00	1069.65	32.71	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Boron	ug/L	0	n/a	n/a	n/a	n/a	3	10.00	10.00	0.00	0.00	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Cadmium	ug/L	6	0.17	0.10	0.03	0.16	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	5	0.10	0.10	0.004	0.06
Extractable Chromium	ug/L	7	1.49	0.40	6.491	2.55	4	1.93	1.75	1.21	1.10	2	1.25	1.25	0.25	0.49	6	0.73	0.75	0.06	0.25
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	3	4.37	2.10	24.10	4.91	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Iron	ug/L	12	0.23	0.16	0.034	0.185	24	125.99	54.00	75725.12	275.18	7	250.29	68.00	251706.571	501.704	7	0.11	0.11	0.005	0.072
Extractable Lead	ug/L	11	0.53	0.60	0.17	0.41	21	0.89	0.90	0.31	0.56	6	1.12	1.30	0.36	0.60	7	1.19	1.10	0.14	0.38
Extractable Lithium	ug/L	0	n/a	n/a	n/a	n/a	3	3.17	3.40	0.16	0.40	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	0	n/a	n/a	n/a	n/a	3	22.77	9.50	797.64	28.24	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	5	0.43	0.15	0.3200	0.57	14	0.06	0.02	0.01	0.10	6	0.46	0.15	0.49	0.70	7	0.15	0.18	0.01	0.11
Extractable Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	3	0.50	0.50	0.000	0.000	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	7	0.57	0.10	0.889	0.943	3	1.67	1.20	0.97	0.99	0	n/a	n/a	n/a	n/a	5	0.10	0.10	0.000	0.000
Extractable Selenium	ug/L	0	n/a	n/a	n/a	n/a	3	0.93	0.50	0.56	0.75	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	0	n/a	n/a	n/a	n/a	3	5.97	1.90	54.65	7.39	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	0	n/a	n/a	n/a	n/a	3	4.03	1.90	18.62	4.32	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Fecal Coliforms	ug/L	185	27.59	7.00	13225.10	115.00	299	55.29	23.00	13372.74	115.64	196	25.16	12.00	1975.43	44.45	16	39.31	16.00	4205.70	64.85
Hardness	mg/L	119	212.94	215.80	248.07	15.75	127	194.58	195.00	338.26	18.39	106	221.76	221.30	87.91	9.38	51	232.50	233.00	137.44	11.72
Kjeldahl Nitrogen	ug/L	38	0.24	0.19	0.03	0.18	51	0.22	0.15	0.03	0.18	40	126.70	91.00	4954.42	70.39	35	119.26	99.00	4304.43	65.61
Nitrate	ug/L	92	104.37	95.00	4269.862	65.34	115	68.94	71.00	1424.43	37.74	88	72.23	61.00	1911.53	43.72	41	0.17	0.18	0.002	0.04
Nitrate Nitrite	ug/L	51	0.16	0.15	0.009	0.10	71	100.20	98.00	756.62	27.51	49	107.59	98.00	944.62	30.73	35	0.18	0.19	0.001	0.03
Nitrite	ug/L	14	97.36	100.00	3068.25	55.39	14	45.00	50.00	161.69	12.72	9	50.00	50.00	0.000	0.000	0	n/a	n/a	n/a	n/a
pH		136	8.21	8.20	0.01	0.09	192	8.25	8.30	0.02	0.13	130	8.21	8.20	0.018	0.14	53	8.11	8.10	0.01	0.10
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	99	4.58	4.60	10.10	3.18	157	12.06	12.00	6.39	2.53	82	5.84	6.00	12.94	3.60	38	0.38	0.15	0.25	0.50
Total Aluminum	ug/L	9	0.31	0.19	0.13	0.36	10	0.77	0.25	0.87	0.93	10	101.17	67.40	8803.01	93.82	8	99.48	92.80	4619.78	67.97
Total Ammonia	ug/L	21	27.14	25.00	366.43	19.14	33	22.12	10.00	376.610	19.406	22	26.59	17.50	353.301	18.796	8	46.88	50.00	78.13	8.84
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	3	1.00	0.70	0.27	0.52	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	9	75.79	74.50	22.87	4.78	10	81.70	78.55	302.20	17.38	10	75.65	76.15	12.49	3.53	8	77.60	78.10	6.78	2.60
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	7	8.23	7.80	2.02	1.42	8	9.65	9.15	1.69	1.30	8	8.96	8.85	0.43	0.65	6	6.88	7.00	0.96	0.98
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	98	54.48	55.05	31.25	5.590	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	83	58.84	59.70	21.93	4.68	0	n/a	n/a	n/a	n/a	79	59.62	60.00	23.60	4.86	42	63.58	63.50	12.41	3.52
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	92	4.14	2.95	11.77	3.43	107	1.90	1.60	0.86	0.93	88	2.50	1.90	3.75	1.94	48	4.75	4.35	10.96	3.31
Total Chromium	ug/L	2	1.05	1.05	0.41	0.64	4	2.20	1.80	1.17	1.08	3	0.53	0.50	0.00	0.06	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	2	1.20	1.20	0.32	0.57	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	9	1.17	1.00	0.47	0.69	10	2.07	1.25	6.42	2.53	10	0.61	0.45	0.157	0.40	8	0.76	0.48	0.26	0.51
Total Fluoride	mg/L	92	0.27	0.26	0.002	0.05	105	0.27	0.26	0.005	0.07	86	0.27	0.26	0.006	0.08	41	0.27	0.27	0.001	0.03

Table 4-7
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Sarcee Bridge																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	9	0.46	0.34	0.17	0.42	10	0.95	0.41	1.54	1.24	10	0.19	0.17	0.014	0.12	8	0.21	0.17	0.013	0.11
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	3	1.20	0.80	0.93	0.96	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	9	4.18	4.00	0.47	0.69	10	4.29	4.15	0.51	0.72	10	4.34	4.10	0.25	0.50	8	3.99	4.00	0.06	0.24
Total Manganese	ug/L	9	12.17	7.70	124.92	11.18	10	20.52	9.55	511.56	22.62	10	5.39	4.80	6.54	2.56	8	5.99	6.00	3.02	1.74
Total Magnesium	mg/L	83	16.84	16.20	34.81	5.90	98	14.57	14.70	3.09	1.76	79	16.84	16.40	21.02	4.58	42	17.59	17.85	1.58	1.26
Total Molybdenum	ug/L	9	0.51	0.40	0.03	0.17	10	0.54	0.40	0.04	0.19	10	0.52	0.40	0.02	0.15	8	0.51	0.40	0.02	0.16
Total Nickel	ug/L	9	1.67	1.60	0.39	0.62	10	2.13	1.95	2.01	1.42	10	1.13	1.00	0.093	0.306	8	1.11	1.10	0.03	0.18
Total Nitrogen	mg/L	38	0.37	0.33	0.04	0.19	50	0.31	0.26	0.04	0.20	40	0.22	0.21	0.01	0.10	35	0.28	0.26	0.01	0.09
Total Organic Carbon	mg/L	44	2.75	2.17	5.27	2.30	62	2.15	1.50	2.49	1.58	41	1.06	1.00	0.06	0.25	35	0.78	0.80	0.01	0.12
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	50	31.72	20.50	1139.47	33.76	79	44.75	13.00	9190.32	95.87	47	17.06	6.00	2837.50	53.27	43	14.70	9.00	697.50	26.41
Total Potassium	mg/L	87	1.34	0.80	3.12	1.77	100	0.88	0.70	1.79	1.34	81	0.79	0.70	0.06	0.25	42	0.87	0.90	0.04	0.21
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	9	0.73	0.70	0.02	0.13	10	0.66	0.70	0.005	0.07	10	0.72	0.70	0.04	0.20	8	0.80	0.80	0.03	0.17
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	93	3.71	2.80	6.13	2.48	106	2.49	2.30	1.10	1.05	87	2.85	2.40	2.714	1.65	48	3.97	4.10	6.95	2.64
Total Strontium	mg/L	6	0.41	0.42	0.001	0.04	7	0.33	0.32	0.003	0.05	7	0.42	0.42	0.0004	0.02	6	0.45	0.44	0.0002	0.01
Total Sulphate	mg/L	6	66.98	70.50	97.37	9.87	6	55.02	56.75	121.16	11.01	6	61.80	63.95	42.88	6.55	6	70.22	71.00	3.99	2.00
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	9	4.39	2.90	17.91	4.23	10	10.07	3.75	105.55	10.27	10	1.56	1.05	1.79	1.34	8	1.31	1.00	1.118	1.06
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	3	0.67	0.60	0.013	0.115	4	0.53	0.50	0.003	0.05	4	0.53	0.50	0.003	0.05	3	0.60	0.60	0.000	0.000
Total Vanadium	ug/L	4	1.60	1.20	0.89	0.94	7	2.77	2.40	6.56	2.56	3	0.67	0.60	0.04	0.21	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	4	3.98	2.65	9.30	3.05	6	8.87	6.40	24.11	4.91	0	n/a	n/a	n/a	n/a	3	6.53	5.40	14.65	3.83
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	238	137.17	31.45	95200.29	308.55	322	317.61	93.00	339885.19	583.00	218	153.20	59.50	65123.17	255.19	43	185.26	126.70	34940.20	186.92
Total Suspended Solids	mg/L	41	65.11	23.70	21967.34	148.21	61	93.26	30.30	30074.48	173.42	41	10.41	7.40	92.03	9.59	35	11.05	7.70	72.97	8.54
Turbidity	NTU	285	21.24	3.70	5756.51	75.87	407	24.27	4.00	8941.01	94.56	275	3.47	1.50	75.17	8.67	56	3.78	2.49	17.15	4.14

Notes: n/a= no results available

Table 4-8
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Lott Creek																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	11	171.11	169.00	375.72	19.38	30	185.66	186.45	162.09	12.73	24	192.68	193.00	104.03	10.20	3	175.00	178.00	27.00	5.20
Bicarbonate	mg/L	3	203.17	206.01	68.87	8.30	5	210.64	210.89	34.47	5.87	3	223.89	223.08	6.42	2.53	3	213.32	216.98	40.11	6.33
Conductivity	uS/cm	32	453.23	450.95	506.26	22.50	65	452.00	459.00	1862.94	43.16	31	449.38	442.70	5086.20	71.32	5	411.12	414.00	808.20	28.43
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	6	60.00	60.00	360.00	18.97	22	62.27	60.00	475.54	21.81	22	76.36	70.00	729.00	27.00	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	3	62.67	62.00	9.33	3.06	5	60.98	61.10	10.93	3.31	3	62.13	64.70	66.56	8.16	3	67.97	66.60	7.40	2.72
Dissolved Chloride	mg/L	3	2.70	2.90	0.39	0.62	5	2.30	2.20	0.25	0.50	3	1.53	1.50	0.06	0.25	3	1.87	1.90	0.02	0.15
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	12	0.24	0.24	0.001	0.03	36	0.24	0.24	0.001	0.03	30	0.24	0.24	0.001	0.03	4	0.27	0.28	0.001	0.03
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	3	17.43	17.30	1.01	1.01	5	16.20	16.10	0.50	0.70	3	17.13	17.10	0.30	0.55	3	17.57	17.50	0.09	0.31
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	3	1.57	1.70	0.26	0.51	5	1.75	1.80	0.04	0.19	3	1.80	2.10	0.49	0.70	3	1.03	1.00	0.42	0.65
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	32	10.09	9.84	1.48	1.22	64	8.98	8.93	2.60	1.61	32	8.00	7.85	2.03	1.42	5	11.18	12.00	2.04	1.43
Dissolved OxygenSat	%	7	86.31	85.20	234.41	15.31	22	81.88	78.10	173.19	13.16	18	69.46	68.15	131.65	11.47	0	n/a	n/a	n/a	n/a
Dissolved Phosphorus	ug/L	34	8.74	8.00	23.16	4.81	66	8.63	7.00	36.23	6.02	32	11.16	10.50	26.07	5.11	4	15.75	12.50	80.92	9.00
Dissolved Potassium	mg/L	3	0.86	0.85	0.0003	0.02	5	0.98	1.00	0.01	0.09	3	1.07	1.00	0.01	0.12	3	0.96	0.96	0.0001	0.01
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	3	3.57	3.60	0.20	0.45	5	3.96	3.80	0.38	0.62	3	3.60	3.50	0.03	0.17	3	3.43	3.50	0.01	0.12
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	3	63.97	63.50	1.16	1.08	5	54.56	53.70	23.45	4.84	3	52.80	45.20	184.93	13.60	3	61.03	63.50	37.05	6.09
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-8
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Lott Creek																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	0	n/a	n/a	n/a	n/a	2	0.00001	0.00001	0.00000	0.00000	0	n/a	n/a	n/a	n/a	2	0.00003	0.00003	0.00000	0.00001
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	5	1.02	0.70	1.26	1.12	0	n/a	n/a	n/a	n/a	2	0.30	0.30	0.000	0.000
Extractable Barium	ug/L	0	n/a	n/a	n/a	n/a	5	90.00	90.00	50.00	7.07	0	n/a	n/a	n/a	n/a	2	100.00	100.00	0.000	0.000
Extractable Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a	2	0.50	0.50	0.000	0.000	0	n/a	n/a	n/a	n/a	2	0.50	0.50	0.000	0.000
Extractable Chromium	ug/L	0	n/a	n/a	n/a	n/a	2	0.50	0.50	0.000	0.000	0	n/a	n/a	n/a	n/a	2	0.50	0.50	0.000	0.000
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	2	0.50	0.50	0.000	0.000	0	n/a	n/a	n/a	n/a	2	0.75	0.75	0.13	0.35
Extractable Iron	ug/L	0	n/a	n/a	n/a	n/a	2	0.13	0.13	0.00	0.01	0	n/a	n/a	n/a	n/a	2	0.08	0.08	0.002	0.049
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	2	1.00	1.00	0.000	0.000	0	n/a	n/a	n/a	n/a	2	1.50	1.50	0.50	0.71
Extractable Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	0	n/a	n/a	n/a	n/a	2	4.50	4.50	24.50	4.95	0	n/a	n/a	n/a	n/a	2	1.00	1.00	0.000	0.000
Fecal Coliforms	ug/L	23	10.87	2.00	255.21	15.98	32	35.03	15.00	1946.42	44.12	4	75.00	62.00	5902.67	76.83	4	48.00	48.00	2581.33	50.81
Hardness	mg/L	11	241.55	241.15	229.62	15.15	30	239.85	238.70	208.35	14.43	24	239.00	236.90	209.00	14.46	3	242.22	237.71	63.58	7.97
Kjeldahl Nitrogen	ug/L	30	0.31	0.26	0.03	0.18	53	0.29	0.27	0.02	0.14	24	0.24	0.26	0.01	0.09	3	0.27	0.28	0.001	0.03
Nitrate	ug/L	11	90.64	77.00	1117.455	33.43	37	130.68	95.00	17402.00	131.92	29	79.17	75.00	820.00	28.64	0	n/a	n/a	n/a	n/a
Nitrate Nitrite	ug/L	33	94.67	97.00	1107.729	33.28	65	113.94	95.00	12201.53	110.46	32	82.25	82.50	831.74	28.84	4	0.11	0.11	0.0001	0.01
Nitrite	ug/L	0	n/a	n/a	n/a	n/a	4	25.00	16.50	638.00	25.26	3	21.00	5.00	868.000	29.462	0	n/a	n/a	n/a	n/a
pH		32	7.80	7.78	0.11	0.34	65	7.81	7.90	0.07	0.26	32	7.90	7.90	0.015	0.12	5	7.72	7.77	0.03	0.17
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	33	7.55	8.00	5.29	2.30	65	10.39	10.33	2.89	1.70	32	7.92	8.05	4.42	2.10	5	1.12	0.90	1.61	1.27
Total Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Ammonia	ug/L	23	86.30	60.00	5468.68	73.95	33	65.61	50.00	2760.559	52.541	5	74.00	70.00	630.00	25.10	3	90.00	90.00	100.00	10.00
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	9	65.62	65.80	7.39	2.72	31	66.23	65.60	10.07	3.17	27	65.75	66.00	7.67	2.77	0	n/a	n/a	n/a	n/a
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	9	4.39	4.40	1.80	1.34	31	6.09	5.30	4.86	2.20	27	4.49	4.30	1.54	1.24	0	n/a	n/a	n/a	n/a
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Fluoride	mg/L	9	0.23	0.23	0.001	0.03	31	0.23	0.23	0.001	0.03	27	0.23	0.24	0.001	0.03	0	n/a	n/a	n/a	n/a

Table 4-8
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Lott Creek																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnesium	mg/L	9	19.04	19.00	2.63	1.62	31	18.80	18.60	1.88	1.37	27	18.78	18.70	1.44	1.20	0	n/a	n/a	n/a	n/a
Total Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nitrogen	mg/L	17	0.49	0.45	0.05	0.23	31	0.41	0.40	0.03	0.18	21	0.31	0.32	0.01	0.12	0	n/a	n/a	n/a	n/a
Total Organic Carbon	mg/L	14	1.86	1.80	0.37	0.61	40	2.02	1.75	0.56	0.75	31	1.59	1.46	0.16	0.41	4	1.37	1.34	0.12	0.35
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	34	26.35	25.00	189.87	13.78	66	22.71	20.00	251.93	15.87	32	21.38	20.00	65.27	8.08	4	24.00	17.50	196.67	14.02
Total Potassium	mg/L	9	1.34	1.40	0.12	0.34	31	1.55	1.50	0.15	0.39	27	1.54	1.50	0.08	0.28	0	n/a	n/a	n/a	n/a
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	9	6.50	6.80	6.513	2.55	31	7.58	8.00	5.86	2.42	27	7.08	6.80	3.497	1.87	0	n/a	n/a	n/a	n/a
Total Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	15	262.93	152.90	115429.53	339.75	35	761.50	620.00	505629.39	711.08	28	699.31	573.75	321179.89	566.73	5	125.34	120.00	6247.78	79.04
Total Suspended Solids	mg/L	32	2.38	2.00	4.35	2.08	66	4.76	2.10	89.17	9.44	32	3.80	2.00	32.88	5.73	4	11.00	4.05	260.49	16.14
Turbidity	NTU	15	1.70	1.20	1.41	1.19	42	2.10	1.09	14.29	3.78	32	1.32	1.11	0.53	0.73	4	6.20	1.50	92.24	9.60

Notes: n/a = no results available

Table 4-9
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glencoe Golf Club																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	3	141.33	136.00	102.33	10.12	5	138.40	141.00	58.80	7.67	3	152.67	154.00	5.33	2.31	3	161.33	166.00	137.33	11.72
Bicarbonate	mg/L	3	169.03	165.78	243.53	15.61	5	168.71	171.88	87.38	9.35	3	186.10	187.73	7.94	2.82	3	196.66	202.35	204.08	14.29
Conductivity	uS/cm	24	374.88	381.50	879.35	29.65	27	346.02	358.00	1542.89	39.28	3	371.50	365.50	468.00	21.63	3	430.00	435.50	635.25	25.20
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	3	55.33	56.00	25.33	5.03	5	50.02	49.70	26.88	5.18	3	57.60	56.80	14.17	3.76	3	68.00	70.50	51.61	7.18
Dissolved Chloride	mg/L	3	1.87	1.70	0.22	0.47	5	1.16	1.00	0.19	0.44	3	0.97	1.10	0.05	0.23	3	1.57	1.40	0.08	0.29
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	3	0.31	0.31	0.0002	0.02	5	0.32	0.32	0.001	0.03	3	0.30	0.30	0.00003	0.01	3	0.30	0.29	0.0001	0.01
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	3	15.57	16.00	0.70	0.84	5	13.86	14.00	0.26	0.51	3	15.33	15.20	0.65	0.81	3	17.67	18.40	1.61	1.27
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	3	0.83	0.80	0.02	0.15	5	0.72	0.80	0.14	0.37	3	0.93	1.00	0.64	0.80	3	1.07	1.20	0.17	0.42
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	24	11.26	11.16	1.24	1.11	28	9.17	9.30	0.59	0.77	3	11.10	10.40	1.69	1.30	3	11.90	11.20	1.93	1.39
Dissolved OxygenSat	%	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Phosphorus	ug/L	28	2.27	1.50	1.62	1.27	33	2.85	1.50	6.77	2.60	5	1.60	1.50	0.05	0.22	3	1.50	1.50	0.000	0.000
Dissolved Potassium	mg/L	3	0.55	0.55	0.0025	0.05	5	0.58	0.60	0.00	0.03	3	0.56	0.55	0.004	0.07	3	0.65	0.67	0.0186	0.14
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	3	2.17	2.30	0.10	0.32	5	2.10	2.00	0.05	0.22	3	2.10	2.00	0.03	0.17	3	2.37	2.50	0.10	0.32
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	3	67.73	69.20	50.61	7.11	5	47.70	47.60	6.29	2.51	3	55.73	47.20	236.86	15.39	3	73.17	72.50	4.33	2.08
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	0	n/a	n/a	n/a	n/a	2	0.00001	0.00001	0.00000	0.00000	0	n/a	n/a	n/a	n/a	2	0.00001	0.00001	0.00000	0.00000

Table 4-9
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glencoe Golf Club																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	5	0.18	0.20	0.01	0.08	2	0.15	0.15	0.01	0.07	2	0.25	0.25	0.005	0.071
Extractable Barium	ug/L	0	n/a	n/a	n/a	n/a	5	60.00	60.00	0.000	0.000	2	60.00	60.00	0.000	0.000	2	65.00	65.00	50.000	7.071
Extractable Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a	2	1.25	1.25	1.125	1.061	0	n/a	n/a	n/a	n/a	2	0.50	0.50	0.000	0.000
Extractable Chromium	ug/L	0	n/a	n/a	n/a	n/a	2	1.25	1.25	1.125	1.061	0	n/a	n/a	n/a	n/a	2	0.50	0.50	0.000	0.000
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	2	0.75	0.75	0.125	0.354	0	n/a	n/a	n/a	n/a	2	0.50	0.50	0.000	0.000
Extractable Iron	ug/L	0	n/a	n/a	n/a	n/a	2	0.03	0.03	0.0001	0.01	0	n/a	n/a	n/a	n/a	2	0.02	0.02	0.000	0.007
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	2	1.00	1.00	0.000	0.000	0	n/a	n/a	n/a	n/a	2	1.50	1.50	0.50	0.71
Extractable Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	0	n/a	n/a	n/a	n/a	2	3.50	3.50	12.50	3.54	0	n/a	n/a	n/a	n/a	2	1.00	1.00	0.000	0.000
Fecal Coliforms	ug/L	23	10.57	4.00	170.89	13.07	31	24.74	12.00	2923.20	54.07	3	6.67	4.00	21.33	4.62	3	10.67	4.00	133.33	11.55
Hardness	mg/L	3	202.32	205.86	248.27	15.76	5	182.10	180.37	176.82	13.30	3	207.11	202.09	146.82	12.12	3	242.71	251.98	533.13	23.09
Kjeldahl Nitrogen	ug/L	24	0.24	0.13	0.12	0.35	32	0.18	0.15	0.02	0.14	5	0.13	0.14	0.005	0.07	3	0.11	0.12	0.001	0.02
Nitrate	ug/L	24	75.54	65.50	1269.042	35.62	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Nitrate Nitrite	ug/L	0	n/a	n/a	n/a	n/a	32	82.56	82.00	1254.13	35.41	5	52.00	52.00	583.50	24.16	3	76.00	71.00	129.0000	11.36
Nitrite	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
pH		24	8.16	8.17	0.03	0.17	27	8.00	8.02	0.06	0.25	3	7.77	7.80	0.02	0.14	3	7.59	7.60	0.03	0.18
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	26	5.34	5.10	15.58	3.95	28	11.97	12.39	7.40	2.72	3	5.60	7.80	20.44	4.52	3	0.10	0.10	0.01	0.10
Total Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Ammonia	ug/L	23	5.22	5.00	1.09	1.04	28	10.18	5.00	173.115	13.157	3	5.00	5.00	0.000	0.000	3	10.00	5.00	75.00	8.66
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Fluoride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-9
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glencoe Golf Club																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nitrogen	mg/L	9	0.43	0.16	0.32	0.57	6	0.23	0.21	0.01	0.11	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Organic Carbon	mg/L	3	0.97	1.00	0.003	0.06	5	0.90	1.00	0.21	0.46	3	1.03	1.20	0.74	0.86	3	1.40	1.40	0.25	0.50
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	97	14.42	3.00	2418.10	49.17	102	23.05	4.00	3520.60	59.33	5	3.40	3.00	1.30	1.14	3	3.33	3.00	0.33	0.58
Total Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	3	7.33	8.00	9.33	3.06	8	144.25	40.00	72135.36	268.58	3	28.00	32.00	336.00	18.33	3	18.67	8.00	485.33	22.03
Total Suspended Solids	mg/L	85	24.56	2.40	9015.25	94.95	88	105.02	5.30	77143.29	277.75	3	1.07	0.80	0.69	0.83	3	1.05	1.16	0.36	0.60
Turbidity	NTU	4	2.09	1.85	1.74	1.32	5	12.24	1.20	626.21	25.02	3	0.67	0.64	0.10	0.32	3	0.77	0.68	0.15	0.39

Notes: n/a = no results available

Table 4-10
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Milbrun Creek									
Season		Spring					Summer				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	18	497.94	469.50	22693.47	150.64	21	448.24	449.00	8400.39	91.65
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	17	11.05	11.52	1.55	1.25	21	10.04	9.56	3.06	1.75
Dissolved OxygenSat	%	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Phosphorus	ug/L	19	23.89	13.00	1095.29	33.10	23	30.76	29.00	276.68	16.63
Dissolved Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-10
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Milbrun Creek									
Season		Spring					Summer				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Extractable Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Fecal Coliforms	ug/L	18	97.11	10.00	51222.58	226.32	21	0.56	0.35	0.79	0.89
Hardness	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Kjeldahl Nitrogen	ug/L	18	0.85	0.66	0.70	0.84	22	0.62	0.63	0.06	0.25
Nitrate	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Nitrate Nitrite	ug/L	18	32.78	3.00	4579.242	67.67	22	24.45	3.00	5462.83	73.91
Nitrite	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
pH		18	8.01	7.96	0.04	0.20	21	8.18	8.19	0.04	0.20
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	17	7.43	7.73	21.82	4.67	21	14.43	14.66	11.75	3.43
Total Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Ammonia	ug/L	18	82.50	10.00	26365.44	162.37	21	17.62	10.00	201.55	14.197
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Fluoride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-10
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Milbrun Creek									
Season		Spring					Summer				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nitrogen	mg/L	7	1.12	0.76	1.94	1.39	6	0.54	0.56	0.03	0.17
Total Organic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	19	76.42	25.00	30336.48	174.17	23	59.30	42.00	1677.58	40.96
Total Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Suspended Solids	mg/L	18	19.44	1.00	5667.63	75.28	23	5.39	3.00	44.10	6.64
Turbidity	NTU	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Notes: n/a = no results available

Table 4-11
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Pirmez Creek									
Season		Spring					Summer				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	27	439.44	435.00	217.72	14.76	31	435.52	450.00	1602.19	40.03
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	26	11.52	11.50	0.43	0.66	30	10.14	10.21	0.23	0.48
Dissolved OxygenSat	%	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Phosphorus	ug/L	29	21.57	14.00	440.08	20.98	32	3.70	1.50	14.58	3.82
Dissolved Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-11
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Pirmez Creek									
Season		Spring					Summer				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Extractable Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Fecal Coliforms	ug/L	25	0.80	0.54	0.56	0.75	31	102.06	23.00	45999.00	214.47
Hardness	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Kjeldahl Nitrogen	ug/L	24	0.28	0.19	0.06	0.25	31	0.15	0.12	0.01	0.10
Nitrate	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Nitrate Nitrite	ug/L	25	0.28	0.27	0.007	0.08	31	0.33	0.24	0.07	0.25
Nitrite	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
pH		27	7.93	7.93	0.02	0.12	31	7.99	7.98	0.02	0.15
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	28	4.34	4.22	3.91	1.98	31	9.33	8.91	6.71	2.59
Total Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Ammonia	ug/L	25	14.00	10.00	312.50	17.68	30	9.00	5.00	93.79	9.685
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Fluoride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-11
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Pirmez Creek									
Season		Spring					Summer				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nickel	ug/L	9	0.65	0.48	0.14	0.37	6	0.40	0.38	0.04	0.20
Total Nitrogen	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Organic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	29	37.24	23.00	1270.19	35.64	32	8.28	5.00	58.85	7.67
Total Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Suspended Solids	mg/L	25	4.46	3.00	15.77	3.97	32	3.44	2.70	6.57	2.56
Turbidity	NTU	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Notes: n/a = no results available

Table 4-12
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Springbank Creek									
Season		Spring					Summer				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	21	871.38	866.00	19604.15	140.01	22	772.82	868.50	54360.63	233.15
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	21	11.01	11.22	0.66	0.81	22	10.67	10.57	0.69	0.83
Dissolved OxygenSat	%	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Phosphorus	ug/L	24	24.38	22.00	172.85	13.15	23	28.89	29.00	584.48	24.18
Dissolved Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-12
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Springbank Creek									
Season		Spring					Summer				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Fecal Coliforms	ug/L	20	32.00	17.00	2269.26	47.64	22	128.77	99.00	13570.76	116.49
Hardness	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Kjeldahl Nitrogen	ug/L	20	0.60	0.57	0.05	0.23	22	0.42	0.36	0.05	0.23
Nitrate	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Nitrate Nitrite	ug/L	20	73.50	52.50	6238.26	78.98	22	98.23	84.00	6044.18	77.74
Nitrite	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
pH		21	8.08	8.05	0.02	0.15	22	8.00	7.98	0.03	0.17
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	23	6.03	5.26	19.09	4.37	22	10.61	10.49	7.80	2.79
Total Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Ammonia	ug/L	20	52.75	20.00	12706.51	112.72	22	21.14	20.00	459.36	21.433
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Fluoride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nitrogen	mg/L	10	0.77	0.67	0.14	0.37	6	0.71	0.73	0.03	0.16
Total Organic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-12
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Springbank Creek									
Season		Spring					Summer				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	24	47.58	41.50	583.99	24.17	23	40.52	41.00	966.35	31.09
Total Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Suspended Solids	mg/L	19	6.17	3.80	61.72	7.86	23	2.39	2.00	3.69	1.92
Turbidity	NTU	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Notes: n/a = no results available

Table 4-13
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Head Pond																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	27	138.64	137.50	57.08	7.56	89	141.56	139.00	86.76	9.31	20	147.32	147.10	22.16	4.71	0	n/a	n/a	n/a	n/a
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	50	371.58	364.35	1252.12	35.39	151	341.45	340.80	755.27	27.48	37	361.91	364.00	617.83	24.86	4	458.28	466.25	544.66	23.34
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	8	52.50	50.00	564.29	23.75	2	15.00	15.00	50.00	7.07	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	2	52.50	52.50	24.50	4.95	6	51.10	51.15	2.70	1.64	2	50.65	50.65	14.05	3.75	0	n/a	n/a	n/a	n/a
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	26	0.23	0.24	0.0005	0.02	89	0.24	0.24	0.001	0.03	20	0.26	0.26	0.0007	0.03	0	n/a	n/a	n/a	n/a
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	23	2.04	1.85	0.72	0.85	59	2.33	2.28	0.57	0.75	9	1.99	1.51	1.00	1.00	0	n/a	n/a	n/a	n/a
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	50	10.07	9.71	1.32	1.15	149	8.68	8.70	0.50	0.70	37	9.29	9.30	0.65	0.80	4	11.05	11.35	0.90	0.95
Dissolved OxygenSat	%	43	101.34	98.30	100.49	10.02	133	99.73	99.70	77.75	8.82	31	98.55	96.90	131.92	11.49	2	89.50	89.50	3.38	1.84
Dissolved Phosphorus	ug/L	47	3.11	2.00	12.30	3.51	124	2.71	2.00	3.93	1.98	30	1.82	1.50	0.89	0.94	0	n/a	n/a	n/a	n/a
Dissolved Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-13
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Head Pond																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Fecal Coliforms	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Hardness	mg/L	27	197.27	195.80	411.02	20.27	89	186.08	185.00	187.36	13.69	20	194.85	192.60	65.47	8.09	0	n/a	n/a	n/a	n/a
Kjeldahl Nitrogen	ug/L	29	0.23	0.21	0.02	0.12	96	0.20	0.18	0.01	0.11	22	0.18	0.18	0.005	0.07	2	0.28	0.28	0.018	0.13
Nitrate	ug/L	26	47.37	44.00	1259.58	35.49	89	41.17	29.00	1496.11	38.68	19	20.58	10.00	540.37	23.25	0	n/a	n/a	n/a	n/a
Nitrate Nitrite	ug/L	37	42.24	39.00	1194.03	34.55	120	39.30	26.50	1344.03	36.66	26	19.88	11.50	451.07	21.24	2	93.00	93.00	2.00	1.41
Nitrite	ug/L	2	4.00	4.00	8.00	2.83	4	6.50	7.00	7.00	2.65	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
pH		50	8.12	8.20	0.09	0.31	151	8.19	8.20	0.04	0.20	37	8.17	8.20	0.01	0.12	4	7.48	7.65	0.37	0.61
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	47	9.39	9.40	10.28	3.21	139	16.49	16.90	7.97	2.82	35	13.13	13.10	7.92	2.81	3	0.80	0.70	0.43	0.66
Total Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Ammonia	ug/L	9	20.00	5.00	381.25	19.53	28	24.11	20.00	500.10	22.36	8	24.38	15.00	495.98	22.27	0	n/a	n/a	n/a	n/a
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	24	52.04	52.25	10.40	3.22	83	49.08	48.70	8.30	2.88	18	51.00	51.00	5.46	2.34	0	n/a	n/a	n/a	n/a
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-13
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Head Pond																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	26	5.73	5.50	3.36	1.83	89	2.74	2.60	0.62	0.79	19	2.98	2.90	0.50	0.71	0	n/a	n/a	n/a	n/a
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Fluoride	mg/L	26	0.23	0.24	0.0005	0.02	89	0.24	0.24	0.001	0.03	20	0.26	0.26	0.001	0.03	0	n/a	n/a	n/a	n/a
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnesium	mg/L	26	13.45	14.40	17.29	4.16	89	12.95	13.80	14.49	3.81	20	13.80	15.50	25.51	5.05	0	n/a	n/a	n/a	n/a
Total Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nitrogen	mg/L	28	0.27	0.28	0.02	0.13	96	0.24	0.22	0.01	0.12	21	0.20	0.19	0.01	0.09	2	0.37	0.37	0.02	0.14
Total Organic Carbon	mg/L	45	2.41	1.99	0.973	0.99	136	2.28	2.09	0.82	0.90	31	1.74	1.55	0.53	0.73	2	0.91	0.91	0.08	0.28
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	50	12.96	9.50	138.04	11.75	144	9.86	6.00	230.88	15.19	36	8.56	4.50	286.03	16.91	2	6.00	6.00	18.00	4.24
Total Potassium	mg/L	26	1.14	1.15	0.19	0.43	89	0.79	0.80	0.07	0.26	20	0.84	0.90	0.12	0.35	0	n/a	n/a	n/a	n/a
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	26	5.00	4.70	3.916	1.98	89	3.11	3.20	1.23	1.11	20	3.09	3.25	1.33	1.16	0	n/a	n/a	n/a	n/a
Total Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sulphate	mg/L	2	61.65	61.65	214.25	14.64	6	51.97	54.30	158.61	12.59	2	58.05	58.05	70.81	8.41	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	0	n/a	n/a	n/a	n/a	3	17.23	18.10	88.92	9.43	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Suspended Solids	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Turbidity	NTU	52	6.60	2.36	154.66	12.44	149	8.00	1.50	537.68	23.19	35	1.06	0.86	0.42	0.65	2	0.54	0.54	0.01	0.12

Notes: n/a = no results available

Table 4-14
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Heritage Cove																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	27	142.22	141.00	53.02	7.28	89	141.54	140.10	106.86	10.34	19	148.73	147.60	34.04	5.83	0	n/a	n/a	n/a	n/a
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	47	375.40	373.70	1010.13	31.78	144	342.19	343.30	738.76	27.18	36	363.70	365.40	821.59	28.66	2	452.65	452.65	1215.25	34.86
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	4	45.00	40.00	300.00	17.32	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	2	51.90	51.90	8.82	2.97	6	50.38	50.80	3.49	1.87	2	54.70	54.70	0.18	0.42	0	n/a	n/a	n/a	n/a
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	27	0.24	0.24	0.0006	0.03	89	0.24	0.24	0.001	0.03	20	0.26	0.27	0.0005	0.02	0	n/a	n/a	n/a	n/a
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	22	2.14	1.89	0.70	0.84	59	2.37	2.33	0.53	0.73	9	1.88	1.37	1.02	1.01	0	n/a	n/a	n/a	n/a
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	47	10.10	10.10	0.99	1.00	141	9.13	9.10	0.54	0.73	36	9.77	9.70	0.87	0.93	0	n/a	n/a	n/a	n/a
Dissolved OxygenSat	%	43	101.25	99.30	64.46	8.03	133	102.89	100.90	112.01	10.58	30	100.34	99.70	151.99	12.33	2	8.65	8.65	18.61	4.31
Dissolved Phosphorus	ug/L	46	3.15	2.00	8.11	2.85	128	2.65	2.00	4.46	2.11	30	1.85	1.50	1.05	1.03	0	n/a	n/a	n/a	n/a
Dissolved Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-14
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Heritage Cove																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Fecal Coliforms	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Hardness	mg/L	27	201.29	200.40	244.24	15.63	89	184.47	183.30	164.04	12.81	19	199.86	196.60	189.85	13.78	0	n/a	n/a	n/a	n/a
Kjeldahl Nitrogen	ug/L	20	0.28	0.28	0.02	0.14	67	0.20	0.16	0.03	0.18	18	0.16	0.14	0.004	0.06	0	n/a	n/a	n/a	n/a
Nitrate	ug/L	27	44.81	36.00	1444.20	38.00	89	36.94	19.00	1450.32	38.08	19	20.37	7.00	737.13	27.15	0	n/a	n/a	n/a	n/a
Nitrate Nitrite	ug/L	35	41.88	32.00	1410.22	37.55	112	35.17	18.50	1283.32	35.82	27	18.74	7.00	570.58	23.89	0	n/a	n/a	n/a	n/a
Nitrite	ug/L	0	n/a	n/a	n/a	n/a	2	14.00	14.00	128.00	11.31	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
pH		47	8.07	8.10	0.05	0.23	143	8.14	8.10	0.04	0.20	36	8.13	8.10	0.02	0.14	2	7.75	7.75	0.25	0.49
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	46	9.48	9.45	7.92	2.81	139	15.74	16.10	7.46	2.73	34	11.82	12.05	9.07	3.01	0	n/a	n/a	n/a	n/a
Total Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Ammonia	ug/L	6	24.17	17.50	454.17	21.31	20	41.25	25.00	5283.88	72.69	8	28.75	7.50	1226.79	35.03	0	n/a	n/a	n/a	n/a
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	25	52.96	52.50	10.53	3.24	83	48.73	48.70	8.22	2.87	18	52.13	52.60	6.16	2.48	0	n/a	n/a	n/a	n/a
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-14
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Heritage Cove																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	27	4.89	4.50	2.85	1.69	89	2.59	2.50	0.42	0.65	19	2.80	2.60	0.40	0.64	0	n/a	n/a	n/a	n/a
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Fluoride	mg/L	27	0.24	0.24	0.0006	0.03	89	0.24	0.24	0.001	0.03	20	0.26	0.27	0.000	0.02	0	n/a	n/a	n/a	n/a
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnesium	mg/L	27	13.79	14.80	17.34	4.16	89	13.06	14.00	14.65	3.83	20	13.89	15.85	24.56	4.96	0	n/a	n/a	n/a	n/a
Total Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nitrogen	mg/L	20	0.34	0.37	0.02	0.15	67	0.24	0.21	0.03	0.19	17	0.19	0.19	0.01	0.08	0	n/a	n/a	n/a	n/a
Total Organic Carbon	mg/L	42	2.49	2.10	1.007	1.00	130	2.46	2.12	2.35	1.53	31	1.75	1.48	0.54	0.74	0	n/a	n/a	n/a	n/a
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	47	13.66	9.00	173.10	13.16	141	10.67	7.00	142.07	11.92	35	12.71	5.00	898.80	29.98	0	n/a	n/a	n/a	n/a
Total Potassium	mg/L	27	1.06	1.10	0.16	0.40	89	0.78	0.80	0.09	0.29	20	0.82	0.85	0.11	0.33	0	n/a	n/a	n/a	n/a
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	27	4.69	4.40	3.809	1.95	89	3.04	3.10	1.06	1.03	20	3.02	3.20	1.27	1.13	0	n/a	n/a	n/a	n/a
Total Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sulphate	mg/L	2	60.05	60.05	285.61	16.90	6	51.58	55.35	118.93	10.91	2	59.40	59.40	115.52	10.75	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	0	n/a	n/a	n/a	n/a	3	134.70	118.70	11598.24	107.70	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Suspended Solids	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Turbidity	NTU	49	10.01	3.40	220.51	14.85	142	10.25	2.43	753.26	27.45	33	1.40	1.19	0.75	0.86	0	n/a	n/a	n/a	n/a

Notes: n/a = no results available

Table 4-15
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Mid Lake																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	27	140.57	139.60	50.55	7.11	89	142.17	140.00	97.71	9.88	20	148.25	148.60	31.27	5.59	0	n/a	n/a	n/a	n/a
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	48	372.91	370.85	1071.88	32.74	145	343.18	344.30	772.93	27.80	39	364.07	367.50	760.59	27.58	4	464.55	473.75	544.95	23.34
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	4	42.50	40.00	25.00	5.00	2	60.00	60.00	1800.00	42.43	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	2	52.30	52.30	44.18	6.65	6	50.85	51.35	3.18	1.78	2	51.95	51.95	7.61	2.76	0	n/a	n/a	n/a	n/a
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	27	0.24	0.24	0.0006	0.02	88	0.23	0.24	0.002	0.04	20	0.26	0.26	0.0006	0.02	0	n/a	n/a	n/a	n/a
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	23	2.01	1.85	0.67	0.82	59	2.27	2.21	0.59	0.77	9	1.93	1.35	1.66	1.29	0	n/a	n/a	n/a	n/a
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	48	10.00	9.95	1.23	1.11	143	9.01	9.01	0.55	0.74	37	9.74	9.70	0.75	0.87	4	10.05	10.75	6.80	2.61
Dissolved OxygenSat	%	44	99.94	98.60	67.55	8.22	133	101.22	99.00	104.10	10.20	31	100.88	99.80	129.47	11.38	2	86.55	86.55	153.13	12.37
Dissolved Phosphorus	ug/L	47	3.32	2.00	10.93	3.31	123	2.87	2.00	5.62	2.37	30	1.85	1.50	2.16	1.47	0	n/a	n/a	n/a	n/a
Dissolved Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-15
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Mid Lake																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Fecal Coliforms	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Hardness	mg/L	27	196.37	196.20	144.57	12.02	89	185.35	184.60	139.24	11.80	20	196.76	195.40	84.24	9.18	0	n/a	n/a	n/a	n/a
Kjeldahl Nitrogen	ug/L	20	0.22	0.22	0.01	0.07	69	0.21	0.15	0.07	0.26	18	0.22	0.17	0.044	0.21	0	n/a	n/a	n/a	n/a
Nitrate	ug/L	27	49.99	37.00	1568.74	39.61	88	42.00	28.50	1372.49	37.05	19	23.00	19.00	587.33	24.23	0	n/a	n/a	n/a	n/a
Nitrate Nitrite	ug/L	35	46.25	32.00	1399.03	37.40	113	40.40	27.00	1276.91	35.73	27	21.93	9.00	482.15	21.96	0	n/a	n/a	n/a	n/a
Nitrite	ug/L	0	n/a	n/a	n/a	n/a	4	11.50	10.00	19.67	4.43	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
pH		48	8.10	8.15	0.05	0.22	145	8.16	8.20	0.03	0.18	38	8.17	8.20	0.02	0.12	4	7.55	7.45	0.10	0.31
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	47	9.23	9.30	7.17	2.68	139	15.52	15.70	7.22	2.69	35	12.03	12.10	8.18	2.86	3	0.90	1.20	0.63	0.79
Total Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Ammonia	ug/L	6	29.17	32.50	434.17	20.84	22	35.23	27.50	1277.33	35.74	8	19.38	7.50	403.13	20.08	0	n/a	n/a	n/a	n/a
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	25	52.62	52.50	11.82	3.44	83	49.19	49.00	9.36	3.06	18	51.91	52.60	5.46	2.34	0	n/a	n/a	n/a	n/a
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-15
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Mid Lake																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	27	5.04	4.30	3.83	1.96	88	2.68	2.60	0.63	0.79	19	2.90	2.80	0.50	0.71	0	n/a	n/a	n/a	n/a
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Fluoride	mg/L	27	0.24	0.24	0.0006	0.02	88	0.23	0.24	0.002	0.04	20	0.26	0.26	0.001	0.02	0	n/a	n/a	n/a	n/a
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnesium	mg/L	27	13.63	14.70	17.25	4.15	89	13.07	14.00	14.71	3.84	20	14.00	16.00	25.69	5.07	0	n/a	n/a	n/a	n/a
Total Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nitrogen	mg/L	20	0.27	0.28	0.01	0.09	68	0.22	0.21	0.01	0.11	17	0.25	0.19	0.05	0.22	0	n/a	n/a	n/a	n/a
Total Organic Carbon	mg/L	43	2.36	2.00	1.013	1.01	130	2.25	2.00	0.74	0.86	31	1.66	1.50	0.44	0.66	0	n/a	n/a	n/a	n/a
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	48	14.44	9.50	174.72	13.22	140	11.26	7.00	259.29	16.10	36	23.33	5.00	10519.71	102.57	0	n/a	n/a	n/a	n/a
Total Potassium	mg/L	27	1.13	1.10	0.30	0.54	89	0.77	0.80	0.07	0.26	20	0.82	0.90	0.09	0.30	0	n/a	n/a	n/a	n/a
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	27	4.70	4.40	3.981	2.00	89	3.05	3.10	1.18	1.09	20	3.05	3.20	1.31	1.14	0	n/a	n/a	n/a	n/a
Total Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sulphate	mg/L	2	60.80	60.80	297.68	17.25	6	52.60	55.25	142.44	11.93	2	58.50	58.50	84.50	9.19	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	0	n/a	n/a	n/a	n/a	3	56.07	37.30	1828.34	42.76	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Suspended Solids	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Turbidity	NTU	49	12.22	3.23	379.20	19.47	143	12.10	2.69	1144.84	33.84	34	1.63	1.20	2.95	1.72	0	n/a	n/a	n/a	n/a

Notes: n/a = no results available

Table 4-16
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Screen House																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	35	149.70	153.80	359.67	18.97	17	141.81	140.20	107.91	10.39	27	148.01	150.10	76.36	8.74	34	171.21	173.80	121.83	11.04
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	57	392.24	386.20	1933.57	43.97	40	328.04	337.45	1773.98	42.12	58	364.61	361.50	551.64	23.49	53	428.19	430.00	772.05	27.79
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	13	43.08	30.00	989.74	31.46	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	7	47.14	50.00	357.14	18.90
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	35	0.24	0.25	0.0008	0.03	17	0.26	0.25	0.010	0.10	27	0.26	0.26	0.0007	0.03	33	0.28	0.28	0.0003	0.02
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	31	2.17	1.92	2.23	1.49	18	2.52	2.05	0.98	0.99	35	1.70	1.69	0.29	0.54	42	1.41	1.20	0.55	0.74
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	58	11.24	11.15	2.73	1.65	37	8.47	8.40	0.62	0.78	48	10.11	9.95	2.32	1.52	44	12.20	12.10	1.45	1.21
Dissolved OxygenSat	%	58	95.79	95.10	142.43	11.93	36	97.39	96.70	79.60	8.92	48	98.35	99.00	77.79	8.82	44	97.85	95.95	105.81	10.29
Dissolved Phosphorus	ug/L	55	12.16	5.00	402.44	20.06	41	2.29	1.50	3.74	1.93	50	2.85	2.00	4.90	2.21	51	2.97	2.00	6.314	2.513
Dissolved Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-16
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Screen House																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Fecal Coliforms	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Hardness	mg/L	35	222.93	231.70	985.25	31.39	17	191.96	197.60	383.83	19.59	27	210.73	210.20	474.59	21.79	34	250.65	242.50	631.35	25.13
Kjeldahl Nitrogen	ug/L	26	0.29	0.30	0.03	0.17	15	0.20	0.19	0.01	0.11	23	0.19	0.12	0.030	0.17	23	129.57	100.00	6077.08	77.96
Nitrate	ug/L	48	0.10	0.10	0.00	0.05	40	33.58	15.00	1808.97	42.53	37	8.89	6.00	76.93	8.77	39	70.31	64.00	1615.17	40.19
Nitrate Nitrite	ug/L	56	0.12	0.12	0.01	0.08	41	35.88	15.00	1957.96	44.25	49	14.39	7.00	566.33	23.80	49	83.53	77.00	2288.17	47.83
Nitrite	ug/L	6	14.00	15.00	51.20	7.16	3	3.00	3.00	0.00	0.00	0	n/a	n/a	n/a	n/a	4	8.25	7.00	22.92	4.79
pH		58	7.87	7.90	0.09	0.30	72	8.31	8.30	0.05	0.22	57	8.16	8.20	0.02	0.13	52	7.93	7.90	0.05	0.22
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	58	3.63	2.70	10.54	3.25	40	16.46	17.05	11.38	3.37	58	8.57	8.65	27.33	5.23	52	1.06	0.85	0.58	0.76
Total Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Ammonia	ug/L	2	0.14	0.14	0.01	0.12	2	27.50	27.50	1012.50	31.82	3	28.33	10.00	1308.33	36.17	4	20.00	12.50	450.00	21.21
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	33	56.86	59.20	58.73	7.66	16	48.38	48.40	20.55	4.53	28	52.44	52.30	16.43	4.05	32	64.49	65.05	15.53	3.94
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	35	6.36	5.70	7.71	2.78	17	2.80	2.40	1.48	1.22	27	2.72	2.70	0.11	0.34	33	3.57	3.40	0.80	0.89

Table 4-16
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Screen House																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Fluoride	mg/L	35	0.24	0.25	0.0008	0.03	17	0.26	0.25	0.010	0.10	27	0.26	0.26	0.001	0.03	33	0.28	0.28	0.000	0.02
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnesium	mg/L	33	15.99	16.50	4.55	2.13	16	14.36	15.50	3.91	1.98	28	16.50	16.55	1.60	1.26	32	18.54	18.50	1.27	1.13
Total Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nitrogen	mg/L	26	0.39	0.38	0.05	0.22	14	0.26	0.21	0.03	0.16	22	0.20	0.14	0.03	0.17	23	0.20	0.18	0.01	0.08
Total Organic Carbon	mg/L	49	2.50	2.46	2.112	1.45	41	2.35	1.88	1.67	1.29	50	1.62	1.63	0.26	0.51	52	1.43	1.17	0.67	0.82
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	57	31.11	16.00	3016.92	54.93	58	13.97	5.00	439.23	20.96	59	7.05	6.00	54.32	7.37	57	6.19	5.00	16.73	4.09
Total Potassium	mg/L	33	1.32	1.00	0.44	0.66	16	0.98	0.90	0.12	0.35	28	0.92	0.90	0.01	0.12	32	1.13	1.05	0.21	0.46
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	33	5.69	5.50	3.06	1.75	16	3.40	3.30	0.81	0.90	28	3.46	3.45	0.08	0.28	32	4.18	3.95	0.43	0.66
Total Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Suspended Solids	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Turbidity	NTU	58	4.61	3.11	15.75	3.97	76	9.90	1.16	791.73	28.14	56	1.19	1.13	0.22	0.47	56	1.72	1.50	1.49	1.22
Notes: n/a = no results available	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 4-17
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Weaselhead																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	27	143.04	143.00	70.71	8.41	88	142.08	141.65	181.90	13.49	20	150.31	151.20	46.29	6.80	0	n/a	n/a	n/a	n/a
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	45	372.89	369.60	1087.68	32.98	141	343.64	344.00	670.42	25.89	36	368.65	367.20	853.12	29.21	3	449.80	454.00	1148.92	33.90
Dissolved Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ammonia	ug/L	4	32.50	30.00	225.00	15.00	2	25.00	25.00	50.00	7.07	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	2	53.50	53.50	60.50	7.78	6	51.07	51.00	5.81	2.41	2	52.80	52.80	6.48	2.55	0	n/a	n/a	n/a	n/a
Dissolved Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	26	0.24	0.25	0.0008	0.03	89	0.24	0.24	0.001	0.03	20	0.26	0.27	0.0005	0.02	0	n/a	n/a	n/a	n/a
Dissolved Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Organic Carbon	mg/L	23	2.16	1.87	1.36	1.17	59	2.10	1.96	0.52	0.72	9	1.78	1.32	1.53	1.24	0	n/a	n/a	n/a	n/a
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	45	10.22	10.20	1.37	1.17	139	9.61	9.30	1.24	1.11	36	10.52	10.25	1.07	1.04	2	10.35	10.35	0.13	0.35
Dissolved OxygenSat	%	41	101.56	101.90	120.65	10.98	131	107.46	104.20	243.83	15.62	30	107.17	104.90	240.74	15.52	0	n/a	n/a	n/a	n/a
Dissolved Phosphorus	ug/L	45	3.08	2.00	12.18	3.49	123	3.13	2.00	11.66	3.41	30	2.23	1.50	6.70	2.59	0	n/a	n/a	n/a	n/a
Dissolved Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-17
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Weaselhead																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Iron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Manganese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Mercury	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Fecal Coliforms	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Hardness	mg/L	27	198.45	200.20	241.73	15.55	88	186.27	184.90	256.80	16.02	20	199.64	199.30	129.10	11.36	0	n/a	n/a	n/a	n/a
Kjeldahl Nitrogen	ug/L	21	0.23	0.22	0.02	0.15	69	0.19	0.17	0.01	0.11	18	0.16	0.15	0.005	0.07	0	n/a	n/a	n/a	n/a
Nitrate	ug/L	27	47.20	44.00	1245.35	35.29	88	36.17	22.75	1326.92	36.43	19	25.58	14.00	903.37	30.06	0	n/a	n/a	n/a	n/a
Nitrate Nitrite	ug/L	36	47.74	41.00	1440.68	37.96	113	35.23	24.00	1218.68	34.91	27	22.89	8.00	750.87	27.40	0	n/a	n/a	n/a	n/a
Nitrite	ug/L	0	n/a	n/a	n/a	n/a	2	40.00	40.00	2312.00	48.08	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
pH		45	8.05	8.10	0.07	0.26	142	8.14	8.20	0.04	0.19	36	8.14	8.10	0.02	0.14	3	7.73	7.70	0.02	0.15
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
TDS	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Temperature	C	44	9.45	8.95	8.28	2.88	135	15.19	15.20	9.19	3.03	34	11.24	10.99	9.03	3.00	2	0.20	0.20	0.02	0.14
Total Aluminum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Ammonia	ug/L	7	33.57	40.00	497.62	22.31	22	31.59	25.00	636.63	25.23	8	23.75	7.50	612.50	24.75	0	n/a	n/a	n/a	n/a
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	24	53.43	52.95	14.57	3.82	83	49.22	49.10	10.65	3.26	18	53.31	53.95	13.28	3.64	0	n/a	n/a	n/a	n/a
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	27	4.18	3.90	1.78	1.33	89	2.51	2.30	0.45	0.67	19	2.71	2.60	0.34	0.58	0	n/a	n/a	n/a	n/a

Table 4-17
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Weaselhead																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Fluoride	mg/L	26	0.24	0.25	0.0008	0.03	89	0.24	0.24	0.001	0.03	20	0.26	0.27	0.000	0.02	0	n/a	n/a	n/a	n/a
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnese	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Magnesium	mg/L	26	13.91	14.90	18.69	4.32	89	13.19	14.20	15.11	3.89	20	13.94	15.45	25.14	5.01	0	n/a	n/a	n/a	n/a
Total Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nickel	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Nitrogen	mg/L	21	0.28	0.27	0.03	0.17	68	0.23	0.21	0.01	0.12	17	0.20	0.19	0.01	0.08	0	n/a	n/a	n/a	n/a
Total Organic Carbon	mg/L	42	2.56	2.13	1.651	1.28	130	2.04	1.84	0.68	0.83	31	1.68	1.48	0.57	0.75	0	n/a	n/a	n/a	n/a
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	47	15.89	9.00	316.05	17.78	142	13.02	7.00	638.69	25.27	35	6.97	5.00	94.50	9.72	0	n/a	n/a	n/a	n/a
Total Potassium	mg/L	26	0.97	1.00	0.13	0.36	89	0.74	0.80	0.06	0.24	20	0.81	0.90	0.09	0.30	0	n/a	n/a	n/a	n/a
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	26	4.35	4.50	3.31	1.82	89	2.93	3.00	1.04	1.02	20	2.99	3.15	1.27	1.13	0	n/a	n/a	n/a	n/a
Total Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sulphate	mg/L	2	59.50	59.50	364.50	19.09	6	52.03	55.40	113.00	10.63	2	56.95	56.95	99.41	9.97	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	0	n/a	n/a	n/a	n/a	3	509.53	574.80	118455.05	344.17	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Suspended Solids	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Turbidity	NTU	49	12.62	4.04	372.29	19.29	143	13.99	3.20	1840.98	42.91	33	1.73	1.18	1.98	1.41	n/a	n/a	n/a	n/a	n/a

Notes: n/a = no results available

Table 4-18
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Dam - RW																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Alkalinity	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Bicarbonate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Conductivity	uS/cm	51	442.83	456.50	1986.17	44.57	52	350.81	347.05	806.81	28.40	50	381.07	382.40	414.48	20.36	46	453.05	456.15	461.42	21.48
Dissolved Aluminum	ug/L	6	45.72	16.00	4848.24	69.63	3	7.90	8.61	3.46	1.86	3	12.82	11.28	9.09	3.01	6	5.53	5.83	9.090	3.02
Dissolved Ammonia	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Arsenic	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Barium	ug/L	6	79.68	79.59	129.09	11.36	3	68.99	69.76	19.15	4.38	3	75.56	75.37	4.31	2.08	6	83.71	82.56	19.52	4.42
Dissolved Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Boron	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Bismuth	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Cadmium	ug/L	2	1.18	1.18	0.06	0.24	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Calcium	mg/L	50	59.98	61.00	55.27	7.43	50	49.81	49.46	23.13	4.81	49	52.63	53.00	12.17	3.49	46	63.26	63.94	12.97	3.60
Dissolved Chloride	mg/L	51	9.16	8.40	12.21	3.49	50	2.94	2.80	0.93	0.97	49	3.18	3.23	0.67	0.82	46	5.13	4.90	2.42	1.56
Dissolved Chromium	ug/L	6	4.49	3.86	4.38	2.09	2	4.73	4.73	2.49	1.58	3	3.78	4.72	4.922	2.22	6	5.02	4.96	2.41	1.55
Dissolved Cobalt	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Copper	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Fluoride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Iron	ug/L	2	0.12	0.12	0.01	0.10	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lead	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Lithium	ug/L	6	2.66	2.89	0.64	0.80	3	3.10	2.87	0.24	0.49	3	4.00	4.33	0.67	0.82	6	3.56	3.61	0.20	0.45
Dissolved Magnesium	mg/L	50	16.79	17.00	3.72	1.93	50	14.07	14.00	2.68	1.64	49	16.01	16.00	0.92	0.96	46	18.07	18.00	1.30	1.14
Dissolved Manganese	ug/L	6	9.71	10.29	17.01	4.12	2	2.07	2.07	0.28	0.53	3	2.25	2.11	0.07	0.27	6	4.04	3.60	4.27	2.07
Dissolved Molybdenum	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Nickel	ug/L	6	2.28	2.28	0.34	0.58	2	1.39	1.39	0.26	0.51	3	1.29	1.26	0.03	0.16	6	2.00	1.90	0.27	0.52
Dissolved Organic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Ortho Phosphorus	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Oxygen	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved OxygenSat	%	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Phosphorus	ug/L	20	5.45	2.00	142.47	11.94	20	3.65	3.00	8.13	2.85	21	1.94	2.00	0.35	0.59	17	2.18	2.00	0.779	0.883
Dissolved Potassium	mg/L	50	1.33	1.10	0.48	0.69	50	0.96	0.88	0.12	0.34	49	0.91	0.92	0.017	0.13	46	1.05	0.99	0.3183	0.56
Dissolved Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Selenium	ug/L	3	1.25	1.05	0.15	0.38	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	3	1.15	1.10	0.03	0.17
Dissolved Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sodium	mg/L	50	7.42	6.85	5.01	2.24	50	3.56	3.40	1.08	1.04	49	3.58	3.52	0.24	0.49	46	4.99	4.78	1.17	1.08
Dissolved Strontium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Sulphate	mg/L	51	65.04	68.08	77.23	8.79	50	43.39	41.75	126.31	11.24	49	51.96	52.00	36.51	6.04	46	65.01	64.95	22.11	4.70
Dissolved Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Titanium	ug/L	4	3.58	1.57	18.15	4.26	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Uranium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Vanadium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Yttium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Dissolved Zinc	ug/L	6	3.07	3.19	0.74	0.86	3	2.52	2.45	0.06	0.25	3	2.21	2.14	1.28	1.13	6	1.92	1.99	0.23	0.48

Table 4-18
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Dam - RW																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Dissolved Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Aluminum	ug/L	36	95.48	15.05	146936.95	383.32	40	67.10	22.64	15789.28	125.66	42	13.13	9.50	183.49	13.55	31	8.69	7.54	16.87	4.11
Extractable Arsenic	ug/L	0	n/a	n/a	n/a	n/a	6	0.62	0.65	0.01	0.10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Extractable Barium	ug/L	36	76.54	75.76	34.16	5.84	41	65.94	64.20	78.31	8.85	42	71.94	71.55	39.310	6.270	32	78.70	78.00	34.99	5.91
Extractable Boron	ug/L	29	7.22	7.00	0.82	0.91	32	8.77	8.65	1.87	1.37	33	8.55	8.50	0.86	0.93	23	7.48	7.70	1.62	1.27
Extractable Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Chromium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Copper	ug/L	24	5.19	1.15	313.59	17.71	29	4.69	1.90	134.166	11.583	27	1.59	1.30	0.91	0.96	19	7.86	1.30	810.73	28.47
Extractable Iron	ug/L	16	92.48	71.60	3866.50	62.18	21	183.70	64.90	81888.85	286.16	10	35.95	21.00	1854.69	43.07	9	38.89	34.00	274.36	16.56
Extractable Lead	ug/L	0	n/a	n/a	n/a	n/a	3	1.03	0.90	0.173	0.416	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Lithium	ug/L	36	3.50	3.60	0.25	0.50	41	3.51	3.50	0.25	0.50	42	3.92	3.90	0.13	0.36	32	3.89	3.90	0.22	0.47
Extractable Manganese	ug/L	36	9.55	8.50	29.09	5.39	38	7.85	3.75	200.20	14.15	41	3.81	2.20	74.46	8.63	31	7.38	5.40	32.92	5.74
Extractable Mercury	ug/L	3	0.02	0.003	0.001	0.03	6	0.01	0.00	0.00	0.01	8	0.03	0.00	0.00	0.04	5	0.01	0.003	0.0002	0.01
Extractable Molybdenum	ug/L	29	0.65	0.70	0.004	0.06	32	0.68	0.70	0.004	0.064	34	0.70	0.70	0.014	0.12	23	0.69	0.70	0.004	0.06
Extractable Nickel	ug/L	28	1.48	1.30	0.35	0.59	35	1.55	1.26	0.77	0.87	26	1.73	1.00	7.27	2.70	22	1.29	1.08	0.283	0.532
Extractable Selenium	ug/L	25	0.86	0.80	0.09	0.30	27	0.74	0.70	0.06	0.24	22	0.70	0.70	0.03	0.16	23	0.83	0.80	0.06	0.24
Extractable Titanium	ug/L	20	1.74	1.34	1.15	1.07	20	2.15	1.28	7.53	2.74	15	0.74	0.60	0.22	0.47	5	0.52	0.50	0.002	0.04
Extractable Uranium	ug/L	29	0.58	0.60	0.00	0.04	24	0.48	0.50	0.017	0.131	25	0.49	0.50	0.00	0.07	23	0.56	0.60	0.009	0.10
Extractable Vanadium	ug/L	3	0.60	0.60	0.01	0.10	8	1.04	1.05	0.17	0.41	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Extractable Zinc	ug/L	21	3.35	3.30	2.06	1.44	28	6.24	3.30	79.40	8.91	20	3.48	2.80	6.71	2.59	16	2.75	2.63	1.37	1.17
Fecal Coliforms	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Hardness	mg/L	51	223.75	231.00	994.48	31.54	52	182.93	182.00	179.37	13.39	50	199.75	198.50	178.44	13.36	46	236.82	237.00	102.56	10.13
Kjeldahl Nitrogen	ug/L	20	0.19	0.18	0.01	0.10	23	0.21	0.16	0.02	0.13	21	0.16	0.14	0.005	0.07	15	0.15	0.11	0.01	0.11
Nitrate	ug/L	50	0.13	0.14	0.00	0.05	48	63.48	58.40	1976.51	44.46	45	34.05	25.00	721.12	26.85	46	0.12	0.12	0.00	0.05
Nitrate Nitrite	ug/L	21	0.14	0.16	0.00	0.04	21	63.29	60.00	1288.55	35.90	21	32.50	25.00	495.65	22.26	17	0.13	0.14	0.00	0.04
Nitrite	ug/L	5	23.76	23.60	129.10	11.36	2	9.40	9.40	0.32	0.57	2	7.00	7.00	2.00	1.41	53	8.14	8.15	0.01	0.12
pH		67	8.13	8.10	0.02	0.15	87	8.33	8.36	0.01	0.11	80	8.37	8.39	0.00	0.06	0	n/a	n/a	n/a	n/a
Sulphide	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	2	3.65	3.65	0.56	0.75
TDS	mg/L	48	268.96	277.60	796.36	28.22	48	213.08	211.80	335.72	18.32	48	230.61	230.35	156.42	12.51	46	274.57	273.00	236.76	15.39
Temperature	C	20	15.41	16.05	17.41	4.17	33	19.48	19.50	4.55	2.13	30	16.52	17.30	10.68	3.27	16	14.03	14.15	5.13	2.27
Total Aluminum	ug/L	12	278.68	37.25	289656.70	538.20	13	0.93	0.12	2.85	1.69	10	22.97	19.25	102.25	10.11	9	23.30	26.10	56.18	7.50
Total Ammonia	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	2	75.00	75.00	50.00	7.07	0	n/a	n/a	n/a	n/a
Total Antimony	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Arsenic	ug/L	0	n/a	n/a	n/a	n/a	6	1.18	0.55	1.24	1.11	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Barium	ug/L	12	75.27	76.05	36.46	6.04	13	86.80	75.40	1045.69	32.34	10	76.70	76.65	8.76	2.96	9	79.79	79.90	2.25	1.50
Total Beryllium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Boron	ug/L	12	7.88	7.85	3.07	1.75	13	9.18	8.70	3.64	1.91	10	8.64	9.10	1.04	1.02	9	8.10	7.70	1.07	1.03
Total Cadmium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Calcium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Cesium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chloride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Chromium	ug/L	4	1.10	1.05	0.33	0.57	7	2.41	1.30	6.87	2.62	0	n/a	n/a	n/a	n/a	3	1.13	0.50	1.20	1.10
Total Cobalt	ug/L	0	n/a	n/a	n/a	n/a	3	1.93	1.90	2.10	1.45	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Copper	ug/L	12	10.33	1.20	962.04	31.02	13	3.60	1.80	14.88	3.86	10	1.61	1.40	0.42	0.65	9	1.31	1.20	0.14	0.38
Total Fluoride	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a

Table 4-18
Summary of Surface Water Quality Statistics
Springbank Off-Stream Reservoir Project

Location		Glenmore Dam - RW																			
Season		Spring					Summer					Fall					Winter				
Parameter	Unit	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.	N	Mean	Median	Variance	St Dev.
Total Inorganic Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Iron	mg/L	7	0.32	0.12	0.10	0.32	8	2.09	0.69	10.10	3.18	2	53.35	53.35	19.85	4.45	0	n/a	n/a	n/a	n/a
Total Lead	ug/L	0	n/a	n/a	n/a	n/a	3	2.73	2.70	4.62	2.15	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Lithium	ug/L	12	4.32	4.15	0.77	0.88	13	4.74	4.10	3.31	1.82	10	4.24	4.15	0.29	0.54	9	4.51	4.50	0.30	0.55
Total Manganese	ug/L	12	8.60	6.30	30.49	5.52	13	24.75	11.40	1604.36	40.05	10	2.05	1.90	0.28	0.53	9	5.37	5.00	5.81	2.41
Total Magnesium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Molybdenum	ug/L	12	0.69	0.70	0.01	0.09	13	0.84	0.80	0.03	0.18	10	0.77	0.75	0.01	0.08	9	0.72	0.70	0.00	0.04
Total Nickel	ug/L	11	1.29	1.20	0.11	0.33	13	2.67	1.40	10.97	3.31	10	1.10	1.15	0.05	0.23	9	1.20	1.10	0.13	0.36
Total Nitrogen	mg/L	19	0.18	0.14	0.01	0.11	20	0.21	0.18	0.03	0.16	17	0.13	0.12	0.00	0.05	12	0.13	0.14	0.00	0.03
Total Organic Carbon	mg/L	17	1.57	1.09	1.206	1.10	23	3.75	3.50	5.48	2.34	12	1.36	1.35	0.03	0.17	7	0.84	0.80	0.02	0.13
Total Particulate Carbon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Phosphorus	ug/L	46	11.32	6.00	199.81	14.14	47	20.95	6.00	1882.41	43.39	46	5.04	4.45	3.70	1.92	41	4.52	4.00	4.08	2.02
Total Potassium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rhenium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Rubidium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Selenium	ug/L	11	0.63	0.60	0.02	0.14	11	0.58	0.60	0.010	0.10	6	0.52	0.50	0.002	0.04	9	0.71	0.60	0.08	0.28
Total Silicon	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Sodium	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Strontium	mg/L	12	0.40	0.39	0.002	0.05	13	0.33	0.33	0.003	0.06	10	0.40	0.39	0.0006	0.02	9	0.45	0.45	0.0001	0.01
Total Sulphate	mg/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thallium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Thorium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Titanium	ug/L	12	5.13	1.15	63.55	7.97	12	9.43	3.90	119.59	10.94	10	0.79	0.70	0.11	0.33	9	0.88	0.80	0.06	0.24
Total Tungsten	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Uranium	ug/L	12	0.60	0.60	0.004	0.06	13	0.58	0.50	0.014	0.12	10	0.54	0.50	0.003	0.05	9	0.61	0.60	0.001	0.033
Total Vanadium	ug/L	3	2.47	2.70	1.14	1.07	7	4.56	2.40	26.52	5.15	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Yttrium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Zinc	ug/L	5	5.42	5.10	1.58	1.26	8	11.25	4.25	174.06	13.19	2	3.35	3.35	0.13	0.35	2	6.45	6.45	5.45	2.33
Total Zirconium	ug/L	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total Coliforms	CFU/100 mL	17	42.22	6.30	17077.83	130.68	136	1530.57	372.75	26095770.10	5108.40	120	572.62	461.10	459228.72	677.66	11	13.43	5.10	345.49	18.59
Total Suspended Solids	mg/L	19	1.09	1.00	1.20	1.10	21	9.67	1.90	470.97	21.70	18	0.46	0.40	0.07	0.26	16	0.41	0.40	0.11	0.33
Turbidity	NTU	28	6.83	6.89	51.40	7.17	38	219.32	2.07	410418.43	640.64	39	0.99	1.04	0.13	0.36	6	0.89	0.80	0.22	0.47

Notes: n/a = no results available

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (5) Surface Water Quality – TSS

EIS Guideline reference: Part 2, Section 6.2.2, Part 2 Section 6.4
EIS reference: Volume 3B, Section 7.4.2; Volume 4, Appendix K

Context and Rationale

The EIS outlines that upon discharge from the reservoir (post-flood), predicted TSS concentrations will range from 1798 mg/L (1:10 year flood) to 20,692 mg/L (1:100 year flood), potentially well above the maximum measured background condition of 3570 mg/L. The EIS states that it is anticipated that these suspended sediment concentrations can be controlled using two mitigation measures, reduction of flow rate and use of sediment and silt fences. The EIS does not describe the expected reduction in TSS from the implementation of these mitigation measures.

Issue or Comment

a) Discuss the expected effectiveness of each mitigation measure in reducing TSS concentrations in water discharged from the reservoir, and corresponding projected TSS discharge concentrations once mitigation measures are implemented.

Response (5)

a) Upon discharge from the reservoir, predicted total suspended solids (TSS) concentrations will range from 1,798 mg/L (1:10 year flood) to 20,692 mg/L (1:100 year flood); however, this is well below the predicted peaks during a flood of 77,649 mg/L (1:100 year flood) and 4,818 mg/L (1:10 year flood). While the Project will result in an increase in suspended sediment concentrations for a short duration (days) at the end of release of water back into Elbow River, the Project will reduce the total load of sediment in Elbow River during a flood.

The release of the water from the off-stream reservoir will occur after the larger peak flood (and peak TSS) occurs, and will have much lower concentrations than the peak flood. The natural river sediment that is being released back into the river, after containment in the reservoir, will settle within one kilometre downstream of the confluence of where the discharge returns to the Elbow River. The TSS concentration is 1,798 mg/L at the confluence but will be at less than 100 mg/L one kilometre downstream during a 1:10 year flood (Volume 3B, Section 6.4.3.4, Table 6-9 of the March 2018 EIA). Similarly, the 1:100 year flood

[1] **Further questions will be provided to the proponent during Technical Review phase**

will peak at 20,692 mg/L at the confluence and drop to 4,704 mg/L one kilometre downstream (March 2018 EIA, Volume 3B, Section 6.4.3.3, Table 6-8).

The assessment of Project residual effects is based on the release of water from the reservoir without mitigation measures. The assessment concluded that effects to water quality from the predicted sediment concentrations is not significant. Given that significant effects are not predicted, the use of sediment control measures are not anticipated to be necessary.

The follow-up and monitoring program for surface water quality (Volume 3C, Section 2.6 of the March 2018 EIA) indicates that water sampling, including TSS, will be undertaken at the low-level outlet during water release from the off-stream reservoir. Should TSS levels be significantly greater than predicted, adaptive management measures would be implemented. These measures may include adjusting the flow rate from the off-stream reservoir and the use of sediment and silt fences to reduce sediment outflow from the reservoir.

The specific design of the sediment control measures and reduction in flow rates (including temporarily stopping release back to the river) would be part of adaptive management measures and based on the nature of the monitoring results and site-specific factors affecting TSS.

It is not practical at this time to determine the expected effectiveness of mitigation in reducing TSS concentrations in water discharged from the reservoir, and corresponding projected TSS discharge concentrations, because the specific design of sediment control measures is unknown. As part of the adaptive management process, monitoring would continue following the implementation of mitigation measures to assesses their effectiveness and identify any adjustments that may be required.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (6) Surface Water Quality - Monitoring

EIS Guideline reference: Part 2, Section 8
EIS reference: Volume 3C, Section 2.5

Context and Rationale

Part 2, Section 8 of the EIS Guidelines states that a preliminary environmental monitoring program should be included in the EIS and that monitoring is meant to ensure that proper measures and controls are in place to decrease the potential for environmental degradation.

The EIS states that during discharge from the reservoir, water quality sampling will be done in the outlet channel close to the Elbow River confluence. Monitoring at this location is beyond the last point of control from the reservoir, suggesting that water quality would not be assessed prior to release. Recognizing that the monitoring program is preliminary at this stage, a more robust program should be presented, including details on additional monitoring locations and frequency of monitoring that would indicate whether mitigation measures and controls for water quality have been effective.

Issue or Comment

a) Provide additional details on the monitoring program including sampling locations prior to discharge to the Elbow River and details on frequency of sampling.

Response (6)

a) The monitoring program for surface water quality is now provided in the March 2018 EIA, Volume 3C, Section 2.6. The final follow-up and monitoring plan will rely on approval conditions (both provincial and federal), future refinement of project planning and design, and the results of ongoing consultation with Indigenous groups and public stakeholders. The final monitoring plan will include further details and guidelines for preparing monitoring reports (e.g., number, content, frequency and format). However, preliminary details are provided below.

[1] **Further questions will be provided to the proponent during Technical Review phase**

Water quality follow-up and monitoring will be implemented to measure changes in the water quality in Elbow River because of construction and, after a diverted flood, the release of retained water from the off-stream reservoir. Follow-up and monitoring will also confirm success of the erosion and sediment control measures for the Project.

During construction activities, suspended sediment concentrations will be monitored upstream and downstream of instream activities to identify potential sediment-related effects. Monitoring will include daily visual inspections for signs of sediment flux. If such occurrences are noted, the source of the sediment will be investigated by the environmental inspector and actions to prevent further influx will be implemented. Mitigation measures would include those from Alberta Transportation (2011), such as use of:

- silt fencing
- continuous perimeter control structures
- storm drain inlet sediment barrier
- straw bale barrier
- energy dissipators
- sediment traps and basins
- slope drains

Following a flood that results in the diversion of water to the off-stream reservoir, and prior to discharge of retained water from the reservoir back into Elbow River, water samples will be collected at the low-level outlet channel and analyzed for:

- turbidity, conductivity, pH, temperature, and dissolved oxygen (*in situ* measurements, including depth profiles in deeper part(s) of the reservoir)
- total suspended sediment
- major ions
- total and dissolved metals
- nutrients (including total phosphorus, dissolved phosphorus, nitrate, nitrite, and ammonia)
- methylmercury
- hydrocarbons (CCME F1-F4)

The results will be provided to the City of Calgary water services department. The final monitoring plan, to be developed using ongoing consultation with Indigenous groups and public stakeholders, will include further details and guidelines for preparing monitoring reports (e.g., number, content, frequency and format).

Flood protection will be the driving factor as to when the reservoir water will be released. Water quality data will be reviewed by key stakeholders after the flood and potential improvements to operating protocols, which can improve water quality without increasing flood risk, be made. Although some concentrations during discharge would be high (such as total suspended solids (TSS)), these concentrations are within the natural variation that occurs during large floods.

Reference

Alberta Transportation. 2011. Erosion and Sediment Control Manual – June 2011.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (7) Aquatic Ecology

EIS Guideline reference: Part 2, Section 6.1.4
EIS reference: Volume 4, Appendix M

Context and Rationale

Part 2, Section 6.1.4 of the EIS guidelines requires a description of primary and secondary productivity of aquatic resources in terms of abundance, distribution, general life cycles, movements, and seasonal availability.

The EIS includes information regarding benthic invertebrates but does not contain information for primary and secondary producers and consumers, or aquatic plants. It is not possible to assess a change from baseline in the aquatic community without this information.

Issue or Comment

a) Provide a description of the abundance, distribution, general life cycles, movements and seasonal availability for the full aquatic community; or a robust rationale as to why information for certain aspects of the aquatic community is not needed.

Response (7)

a) Primary and secondary productivity within Elbow River consists of the following communities; algae, periphyton, zooplankton, and aquatic invertebrates. Changes to primary and secondary productivity can be measured by change in benthic invertebrate communities that rely on primary and secondary production. Details on benthic invertebrate productivity are provided in the March 2018 EIA, Volume 4, Appendix M: Aquatic Ecology Technical Data Report, Section 3.2. and Volume 3A, Section 8.2.2.5.

   112 benthic invertebrate taxa were identified from data collected at 10 Elbow River sites. Most taxa were identified to the genus level (93), while 13 were identified to the family level, four to the order level and two to the phylum level. Benthic community structure and diversity (i.e., abundance, richness, evenness, percent EPT) are discussed in Volume 4, Appendix M, Aquatic Ecology Technical Data Report and changes to benthic communities regarding nutrient and food supply are assessed in Volume 3A, Section 8.4.2.1 and Volume 3B, Section 8.2.2.1.

[1] **Further questions will be provided to the proponent during Technical Review phase**

Periphyton and filamentous algae were identified during the baseline benthic invertebrate assessment (see Volume 4, Appendix M, Aquatic Ecology Technical Data Report).

As part of the baseline habitat assessments, aquatic plants were not identified to be present in Elbow River during the baseline assessment within the Local Assessment Area (LAA) (Volume 4, Appendix M, Aquatic Ecology Technical Data Report). This is explained by the "free-stone" nature of the river, where flooding and ice will scour rooted vegetation from the active channel (Sosiak 2002). Emergent vegetation is present in Glenmore Reservoir, but it is not predicted to be affected by the Project and, therefore, is not discussed further.

Changes to primary and secondary productivity may occur from changes to predation, temperature, flow regime, and nutrients in the river system (Cole et al. 1991). Because construction and dry operation of the Project is not anticipated to result in changes to fish distribution, flow, nutrient, or temperature in Elbow River, a change in primary or secondary productivity is not anticipated.

Flood and post-flood operations may result in effects on primary and secondary productivity; however, these effects would also occur without the Project. Studies of hydropower facilities (e.g., Perrin and Bennett 2013) that result in flow modification on downstream riverine habitats, similar to that which would occur during flood operations, did not indicate changes to primary or secondary productivity (e.g., such as periphyton communities) during multiple-year programs.

Over a multi-year study, Sosiak (2002) also found little correlation between periphyton and discharge or temperature in Bow River and changes in periphyton were strongly correlated to changes in phosphorus and nitrogen. Sosiak (2002) also noted that discharge had a strong influence on the presence of macrophytes, but the presence was also limited by a lack of nitrogen. Buffagni and Comin (2000) found that measuring the benthic community was an effective method of describing productivity in mountain streams and assessing ecological integrity. Therefore, there is little practicality in identifying potential changes in primary and secondary productivity that cannot also be identified through the monitoring of changes to benthic invertebrates, aquatic habitat, and fish distribution during and after flood and post-flood operations.

References

Buffagni A. and E. Comin. 2000 Secondary production of benthic communities at the habitat scale as a tool to assess ecological integrity in mountain streams. In: Jungwirth M., S. Muhar, S. Schmutz (eds). Assessing the Ecological Integrity of Running Waters. Developments in Hydrobiology, Vol 149. Springer, Dordrecht

Cole J., Lovett G., Findlay S. (eds) 1991. Comparative Analyses of Ecosystems. Springer, New York, NY

Perrin, C.J. and S.A. Bennett. 2013. Aberfeldie water use plan: Primary and secondary productivity monitoring. Report prepared by Limnotek Research and Development Inc. for BC Hydro. 52p

Sosiak, A. 2002. Long-term response of periphyton and macrophytes to reduced municipal nutrient loading to the Bow River (Alberta, Canada). Canadian Journal of Fisheries and Aquatic Science. 59: 987-1001

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (8) Species at Risk

EIS Guideline reference: Part 2, Section 6.3.3
EIS reference: Volume 3A Section 11; Volume 3B Section 11; Volume 4 Appendix H

Context and Rationale

Part 2, Section 6.3.3 of the EIS Guidelines requires the proponent to identify the potential effects of the Project on federally listed species at risk and those species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) classified as extirpated, endangered, threatened or of special concern (flora and fauna) and their critical habitat; and to identify any potential direct or indirect effects on those identified species at risk.

Barn swallow and bank swallow are noted in the EIS as observed, along with colonial nesting sites in field surveys of the Project area. Horned grebe, little brown myotis, and western tiger salamander are noted in the EIS as observed in historical field studies. Baird's sparrow, bobolink, American badger, and western toad are described as potentially occurring in the RAA. Of these species, the EIS includes effects assessment information for only three SARA listed species, Olive-sided Flycatcher, Sprague's Pipit, and Northern Leopard Frog, and one COSEWIC assessed species, Grizzly Bear. The EIS does not explain why only these species have been assessed.

Issue or Comment

a) **Provide additional site specific mitigation, follow-up and monitoring commitments for those construction activities anticipated to be located within provided setback distances of known colonial nest sites of COSEWIC assessed migratory birds, bank swallow and barn swallow.**

b) **Provide additional site specific mitigation, follow-up and monitoring commitments for those construction activities anticipated to be located within provided setback distances of wetlands that may be used by horned grebe, rusty blackbird, western tiger salamander or western toad.**

c) **Provide an assessment of potential Project effects to Little Brown Bat, including proposed mitigation measures to avoid effects, follow-up and monitoring commitments.**

[1] **Further questions will be provided to the proponent during Technical Review phase**

d) Provide a description of potential effects to western tiger salamander and western toad, describe proposed mitigation measures to avoid effects, follow-up and monitoring commitments.

e) Take into consideration critical habitat and recovery plans in the above where applicable.

Response (8)

a) Site-specific mitigation for known colonial bird nest sites will follow Environment and Climate Change Canada's (ECCC) timing and setback distances, as provided in the March 2018 EIA, Volume 3A, Section 11.4.2.2. Barn swallow nests have a setback distance of 100 m from May 1 through to August 31 (Gregoire 2014 pers. comm.). There is currently no specified timing or setback distance provided by ECCC or Alberta Environment and Parks (AEP) for bank swallow. Species-specific mitigation for bank swallow will be developed in consultation with ECCC and AEP; however, it is assumed that the timing and setback distance would be similar to that of barn swallow. If construction activities cannot avoid the recommended setback distance of known colonial nest sites between May 1 and August 31, site-specific mitigation will be developed in consultation with ECCC and AEP. There are currently no recovery plans or critical habitat identified for bank swallow or barn swallow.

b) No horned grebe, rusty blackbird, western tiger salamander or western toad were observed during baseline surveys. Pre-construction surveys will be conducted to identify wildlife features (e.g., nests, breeding wetlands). Horned grebe, rusty blackbird, western tiger salamander (Prairie population) and western toad are listed as special concern under Schedule 1 of the SARA. Species listed as special concern require management plans to be developed, which do not include the identification of critical habitat.

   If horned grebe, rusty blackbird or western toad are observed, site specific-mitigation will follow ECCC's or provincial timing and setback distances as provided in Volume 3A, Section 11.4.2.2. There is currently no specified timing or setback distance provided by ECCC or AEP for western tiger salamander. Species-specific mitigation for western tiger salamander will be developed in consultation with ECCC and AEP; however, it is assumed that the timing and setback distance would be similar to that of western toad.

   If construction activities cannot avoid the recommended setback distance for horned grebe nest sites between April 1 and August 31 or rusty blackbird nest sites between May 1 and July 31, site-specific mitigation will be developed in consultation with ECCC and AEP. Western toad and western tiger salamander breeding wetlands are protected year-round. If construction activities cannot avoid the recommended setback distance of these species' breeding wetlands during the spring or summer, site-specific mitigation for amphibians will be developed in consultation with ECCC and AEP. Recommended mitigation will include installation of exclusion fencing between wetlands and construction activities to reduce the potential for amphibians accessing the construction area. Amphibians encountered in the

exclusion area (i.e., where construction activities are occurring) will be relocated to the nearest wetland. If construction activities cannot avoid the recommended setback distance during fall or winter, exclusion fencing will be installed before the hibernation period to prevent hibernation in the exclusion area.

c) An assessment of potential project effects on little brown bat is provided in Volume 3A, Section 11.4.7.3 and Attachment A, Table A-1 (at the end of the Section 11 file); and Volume 3B, Section 11.3.8.3 and Attachment A, Table A-1 (at the end of the Section 11 file). The recovery plan for little brown bat was taken into consideration for the Project (EC 2015). Critical habitat identified for little brown bat does not occur in the wildlife Regional Assessment Area (RAA). Specific mitigation measures to avoid project effects on wildlife, including little brown bat, are described in Volume 3A, Section 11.4.2.2 and Section 11.4.4.2, which includes seasonally appropriate surveys to identify key habitat and habitat features (e.g., bat roosts) of species of management concern (SOMC) prior to construction. As stated in Volume 3A, Section 11 (Attachment A, Table A-1), if an active roost is identified, construction activities will avoid the feature through appropriate signage and/or fencing. There is currently no specified timing or setback distance provided by ECCC or AEP for little brown bat; therefore, species-specific mitigation would be developed in consultation with ECCC and AEP, if an active roost is identified.

d) An assessment of potential Project effects on western tiger salamander and western toad are provided in Volume 3A, Section 11.4.7.3 and Attachment A (at the end of the Section 11 file) and Volume 3B, Section 11.3.8.3 and Attachment A (at the end of the Section 11 file).

   If western toad is observed during pre-construction surveys, site-specific mitigation will follow ECCC or provincial timing and setback distances, as presented in Volume 3A, Section 11.4.2.2. There is currently no specified timing or setback distance provided by ECCC or AEP for western tiger salamander. Species-specific mitigation for western tiger salamander will be developed in consultation with ECCC; however, it is assumed that the timing and setback distance would be similar to that of western toad. If construction activities cannot avoid the recommended setback distance during the spring or summer, exclusion fencing between wetlands and construction activities will be installed to reduce the potential for amphibians accessing the construction area. Monitoring will be conducted for amphibians, in consultation with ECCC and AEP. Amphibians encountered in the exclusion area (i.e., where construction activities are occurring) will be relocated to the nearest wetland. If construction activities cannot avoid the recommended setback distance during fall or winter, exclusion fencing will be installed before the hibernation period to prevent hibernation in the exclusion area.

e) Consideration of critical habitat and recovery plans for the responses identified above was taken, where applicable (e.g., little brown bat, [EC 2015]). See Volume 3A, Section 11.4.

Reference

Environment Canada. 2015. Recovery Strategy for Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*) in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. ix + 110 pp.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (9) Aboriginal Peoples – Current Use of Land and Resources

EIS Guideline reference: Part 2, Section 6.3.4
EIS reference: Vol3A, Section 14.3.3; Vol3B, Section 14.2.4.3

Context and Rationale

During construction and dry operations, the EIS states that there would be no public access in Areas B and D and applied this consideration in the residual effects assessment on access to traditional resources or areas for current use. This residual effect is described as irreversible and is therefore understood to endure throughout all Project phases until decommissioning.

Indigenous peoples would not be able to pursue current use activities in Areas B and D in spite of cultural sites or areas remaining intact post-flood. Depending on the cultural values attached to potentially-affected cultural sites and areas within Areas B and D, limiting access to the site or area could be perceived by an Indigenous person or persons as a permanent loss that could result in adverse socio-cultural effects such as loss of cultural transmission.

Issue or Comment

a) Describe whether access to cultural sites or areas located in Areas B and D are an important component in maintaining Indigenous cultural value.

b) Describe any proposed mitigations to eliminate, avoid or reduce this effect.

c) Characterize the residual effect to cultural sites and areas within Areas B and D.

[1] Further questions will be provided to the proponent during Technical Review phase

Response (9)

a) Alberta Transportation recognizes the importance to Indigenous groups of cultural transmission and maintaining Indigenous cultural value. Indigenous groups have identified the potential for the Project to affect cultural sites or areas. The March 2018 EIA, Volume 3A Section 14.3.4 assesses potential effects on sites and areas for cultural or spiritual practices, or on archaeological and palaeontological sites and areas, including physical and cultural heritage resources identified by Indigenous groups. The conclusions were based upon traditional land and resource use (TLRU) information available through:

- Indigenous engagement program for the Project (see Volume 1, Section 7)
- Project-specific traditional use studies (TUS) studies provided by Indigenous groups
- review of relevant TLRU information contained in publicly-available sources

At the time of filing of the March 2018 EIA, no specific information regarding the importance of access to cultural sites or areas located in Areas B (reservoir) and D (dam and infrastructure) for maintaining Indigenous cultural value was available to Alberta Transportation (see Figure 9-1, duplicated from Volume 1, Figure 1-8). The value or importance of cultural sites within Areas B and D can only be meaningfully evaluated by the Indigenous groups to which these sites belong. Accordingly, the EIA does not attribute value or importance to cultural sites within Areas B and D.

In February and March 2018, Alberta Transportation held TLRU workshops with Stoney Nakoda Nations, Métis Nation of Alberta, Region 3, Samson Cree Nation, Siksika Nation, and Tsuut'ina Nation to receive feedback on a draft of the TLRU assessment (Volume 3A and 3B, Section 14) and discuss Project-specific concerns. Summaries of workshop proceedings have been provided to each Indigenous group for review and validation of their TLRU information for use in Project planning and the regulatory process. Alberta Transportation has not yet received approval from the Indigenous Groups to use this information.

Alberta Transportation has considered Indigenous groups' requests that access to Areas B and D be permitted when dry. However, due to the operational nature of the Springbank Project, access to Areas B and D need to be restricted at all times for operational and safety reasons. Alberta Transportation confirms that Indigenous groups will have access to Area A (conservation zone) post-construction. There may also be opportunities for access in Area C (option for lease/grazing) post-construction depending on what arrangements are made.

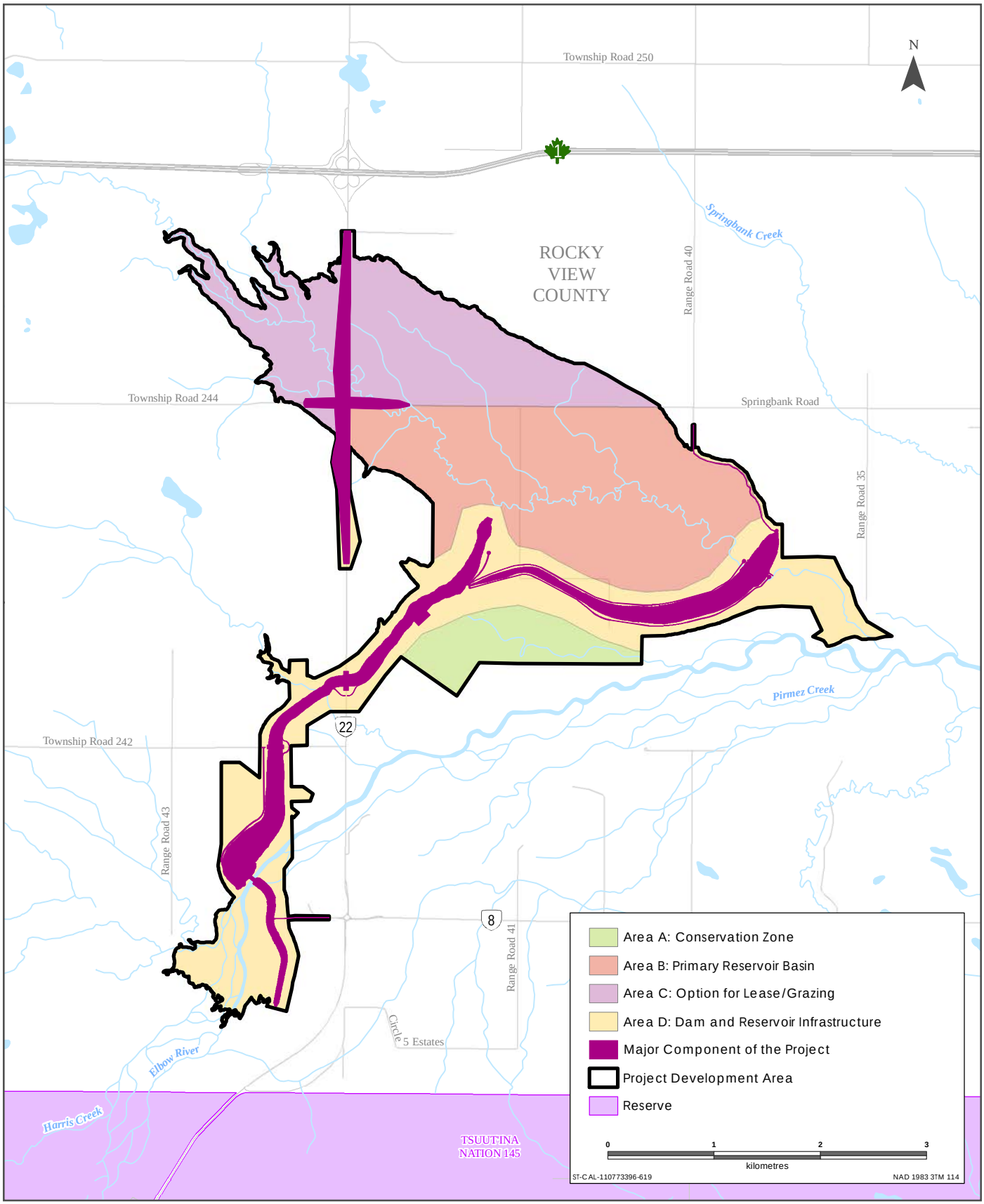
b) Alberta Transportation has identified mitigation measures designed to eliminate, avoid, or reduce effects on access to traditional resources or areas for current use and current use sites or areas (Volume 3A, Section 14.3.3.2 and Section 14.3.4.2). They include:

- The area along the Elbow River flood plain (Area A) will be accessible for some TLRU activities; this will be a conservation zone with public access and opportunities for low impact recreation.
- Alberta Transportation will maintain access to identified current use sites (located outside of the designated construction and project site limits) during construction and operations, including for hunting and fishing, and Alberta Transportation will advise Indigenous groups on post-construction access management.
- The disposition of artifacts and provision of GPS coordinates are under the jurisdiction of Alberta Culture and Tourism (ACT) and not Alberta Transportation. Alberta Transportation will limit disturbance, to the extent possible and practical, of cultural and spiritual sites and subsurface impacts. Alberta Transportation would follow heritage resource protection methods as mandated by the *Historical Resources Act*.
- Alberta Transportation will minimize disturbance to cultural and spiritual sites and subsurface impacts, and develop a protocol for recovery, collection, reporting on, and possible repatriation of artifacts found in consultation with Indigenous groups, which could include flagging, fencing, or providing signage of sites to prevent disturbance during construction.
- At the request of Indigenous groups, Alberta Transportation will participate in ceremonies (if invited) prior to the start of construction, including making offerings.
- Alberta Transportation will participate in discussions with ACT and Indigenous groups regarding further investigation of identified sites located within the designated construction site boundary.
- Alberta Transportation will follow current industry best practices and comply with provincial and federal legislation. Should additional historical resources be encountered during construction, Alberta Transportation will follow current ACT policies and guidelines.
- Alberta Transportation will participate in discussions with Indigenous groups regarding possible monitoring opportunities.
- Alberta Transportation would provide Indigenous groups with Project maps and design information and preliminary Project scheduling.
- Burial sites located outside the designated construction site boundary will not be disturbed by construction.

- Disturbance of identified burial sites located within the designated construction site boundary will be avoided to the extent possible and practical. If requested, Alberta Transportation will participate in discussions with ACT and Indigenous groups regarding possible mitigation options for burial sites located within the designated construction site boundary and particularly within the footprint of structures that will be disturbed by construction.

c) Through the Indigenous Engagement program for the Project, specific locations of sites or areas within the Project Development Area (PDA) were not identified by Indigenous groups at the time of filing of the March 2018 EIA. No site-specific information regarding sites or areas located within the PDA was identified through a review of publicly-available TLRU information. However, in considering effects on current use sites or areas, the EIA adopts the conservative assumption that TLRU activities have the potential to occur within the Regional Assessment Area (RAA), even if Indigenous groups did not specifically identify specific current use sites or areas.

   As discussed in Volume 3A, Section 14.3.4.3, current use sites or areas located within the area of permanent structures (Area A and Area D) and the off-stream reservoir will be permanently removed. Although some current use activities could be conducted elsewhere in the traditional land use RAA, Alberta Transportation acknowledges that TLRU practices and related knowledge are often rooted in specific places that have important cultural and spiritual associations that are not readily transferrable to other locations. Residual effects on current use sites or areas within the area of permanent structures and cultural, spiritual, ceremonial, and ancestral sites—as well as archaeological sites located within the areas of temporary physical disturbance—will be of high magnitude because these sites will be permanently removed. Consequently, the effects of the Project on these current use sites and areas within the area of permanent structures and areas of temporary physical disturbance will be restricted to the PDA, continuous, long term and irreversible. Timing considerations are not applicable because the loss of access to current use sites or areas located within the area would occur regardless of time of day or season.



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

Proposed Land Use in the PDA

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (10) Wildlife and Biodiversity

EIS Guideline reference: Part 2 Section 6.3.4
EIS reference: Vol3A, Section 11.2.2.5, Section 11.4.2.2, Figure 11-9, Section 11.4.3.2 and 11.4.3.3; Vol1, Table 3-7

Context and Rationale

Indigenous groups have identified elk and grizzly bear as important traditional and cultural resources for their communities and have expressed concerns regarding the potential effects of the Project on these species.

The EIS states that grizzly bears were detected during the remote camera survey and have been confirmed in the LAA and RAA from government radio-collaring data.

The EIS describes high spring feeding habitat potential, particularly along the Elbow River in the LAA, and states that grizzly bear movement was more common along the Elbow River valley where bears travel between mountain and foothill habitats. The EIS states that the Project could increase sensory disturbance and affect movement during spring and fall when grizzly bears might be travelling along the Elbow River floodplain depending on the timing of construction activities.

Mitigation to reduce potential effects on wildlife movement and wintering ungulates includes limiting construction activities during the Restricted Activity Period (RAP) for the Key Wildlife Biodiversity Zone identified along the Elbow River (December 15 to April 30). The RAP usually refers to the nesting season for birds or winter activities for ungulates in the Key Wildlife Biodiversity Zones. The EIS does not describe whether the RAP overlaps with the spring feeding period for grizzly bears.

If construction were to occur during the RAP, the EIS states that site-specific mitigation would be developed in consultation with AEP and that ungulate habitat use and response to human disturbance would be monitored. The EIS does not describe details on proposed site-specific mitigations and whether monitoring would be conducted for grizzly bears. Further, the proposed construction schedule indicates that some in-stream and diversion channel work along or within the Elbow River would likely occur during the RAP.

[1] Further questions will be provided to the proponent during Technical Review phase

The EIS also proposes to mitigate project effects to wildlife movement by installing wildlife-friendly fencing to allow ungulate passage. It does not describe design consideration for these fences and whether these fences would allow grizzly bear passage.

Issue or Comment

a) Describe the overlap between the RAP for the Key Wildlife Biodiversity Zone identified along the Elbow River (December 15 to April 30) and the spring feeding period for grizzly bears.

b) Characterize the residual effects to grizzly bears from the construction of in-stream and diversion channel works (temporary diversion inlet, diversion inlet/gate, flood plain berm and service spillway) taking into account the proposed construction schedule for these works.

c) If construction along the Elbow River were to occur during the RAP and spring feeding period, describe site-specific mitigations for elk and grizzly bear, as well as details on how their habitat use and response to human disturbance would be monitored.

d) Describe the design considerations for wildlife-friendly fencing that would allow passage for both ungulates and grizzly bears.

Response (10)

a) The Restricted Activity Period (RAP) for Key Wildlife and Biodiversity Zones (KWBZ) south of Highway #1 and west of Highway #2 is between December 15th and April 30th (ESRD 2015). The spring feeding period for grizzly bears typically occurs during April to June or mid-July. Therefore, the overlap between the KWBZ RAP identified along Elbow River and spring feeding for grizzly bears would be approximately a maximum of one month in April, depending on spring conditions and plant phenology.

b) The proposed construction schedule for the diversion structure, floodplain berm and auxiliary spillway in the KWBZ will overlap with the spring feeding period for grizzly bears (April through July). The project residual effects on grizzly bear spring and summer feeding habitat, movement, and mortality risk during construction are characterized in the March 2018 EIA, Volume 3A, Section 11.4.2.3, Section 11.4.3.3 and Section 11.4.4.3, respectively. During construction, the magnitude of the residual effect for change in habitat will be high for spring feeding habitat and moderate for summer feeding habitat and extend into the LAA. Residual effects will be short term and occur as a single event. The magnitude for changes in movement will be low.

   Construction along Elbow River is proposed to occur during the KWBZ RAP, which overlaps a portion of the spring feeding period for grizzly bears (i.e., April). Site-specific mitigation will be developed in consultation with AEP, which would include best management practices to reduce potential bear-human conflicts (e.g., where practical, avoid high suitability feeding sites, reduce attractants, provide bear awareness training to on-site workers).

Preliminary details of a monitoring plan along Elbow River are in Volume 3C, Section 2.10. The monitoring plan includes the use of six remote cameras deployed along Elbow River in the same locations as used in pre-construction baseline surveys. The collected data will allow relative comparisons of change and monitor wildlife movement, including elk and grizzly bear, in the KWBZ for a minimum of one year during the construction period.

d) The design considerations of wildlife-friendly fencing that would allow passage for both ungulates and grizzly bears include the use of four strand wire fences that are low enough for animals to jump over (e.g., no higher than 100 cm above ground), and the bottom wire high enough for other animals to crawl under (e.g., at least 45 cm above ground) (Government of Alberta 2011; Paige 2012; Visscher et al. 2016). One example considers the top and bottom wire to be smooth and not barbed. Elk can tangle their back legs if the top wires are closer together; therefore, it is recommended that the top two wires are no less than 30 cm apart (Paige 2012). Design considerations may be modified based on sites with high or continuous livestock use (e.g., change in minimum and maximum strand heights) (Paige 2012) and consultation with stakeholders and AEP.

References

ESRD. 2015. Recommended Land Use Guidelines: Key Wildlife Biodiversity Zones. Alberta Environment and Sustainable Resource Development, Fish and Wildlife Division, Edmonton, Alberta. Accessed January 2017 from: http://aep.alberta.ca/fish-wildlife/wildlife-land-use-guidelines/documents/KeyWildlifeBiodiversityZones-Apr08-2015.pdf

Government of Alberta. 2011. Wildlife and Fences, Interpretive Trail. Edmonton, AB. Accessed February 2017 from: http://www.pcap-sk.org/rsu_docs/documents/wildlife-and-fences-info-sheet.pdf

Paige, C. 2012. A Landowner's Guide to Wildlife Friendly Fences. Second Edition. Private Land Technical Assistance Program, Montana Fish, Wildlife, and Parks. Helena, MT. 56 pp.

Visscher, D.R., I. MacLeod, M. Janzen, K. Visser, and A. Lekas. 2016. The impact of wildlife friendly fences on ungulate crossing behaviour at the Wainwright Dunes Ecological Reserve. The King's University. Edmonton, AB. 52 pp.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (11) Wildlife and Biodiversity

EIS Guideline reference: Part 2 Section 6.1.9, 6.3.4
EIS reference: Volume 3A, Section 14.2.4; Volume 3A, Section 11.1.2.2

Context and Rationale

The EIS provides a list of traditional resources that are generally known to be used by Indigenous groups which also can be found in the Project area. The EIS also considers the wildlife assessment (Section 11) in the analysis of the Project's effects to the availably of traditional resources for current use, but the wildlife assessment does not indicate how the key indicator species chosen represent traditional use wildlife species.

Issue or Comment

a) Describe how the five wildlife species chosen as key indicators to assess potential Project effects on wildlife represent the traditional use wildlife species found in the Project area.

b) Upon validating the list of traditional use wildlife species with Indigenous groups, as requested in Annex I, Information Requirement 13, update any corresponding assessment of effects to the availability of traditional resources for current use, as appropriate.

Response (11)

a) The rationale used to select the five wildlife species—chosen as key indicators to assess potential Project effects on traditional use wildlife species—are described in the March 2018 EIA, Volume 3A, Section 11.1.2.2 and Table 11-1. Overall, elk and grizzly bear are representative of wildlife species used for traditional purposes because these species depend on a variety of seasonal habitat types that would include other wildlife species of traditional importance such as mule deer, white-tailed deer, coyote and weasel, which also depend on similar habitat types (e.g., grassland, shrubland, forest).

[1] **Further questions will be provided to the proponent during Technical Review phase**

b) Alberta Transportation offered to hold a workshop with each Indigenous group during February or March 2018 to obtain feedback on how traditional land and resource use (TLRU) has been presented in the TLRU sections (see Sections 14 of Volumes 3A and 3B), as well as obtain input on proposed mitigation measures, and discuss how Project-specific concerns have been addressed. The intention was to validate the use of the traditional use information and include any feedback received. If Indigenous groups were not available to participate in a workshop, Alberta Transportation welcomed other suggestions for providing views and input on the draft TLRU sections. Alberta Transportation also requested feedback by March 1, 2018 for use in the March 2018 EIA.

   Workshops were held with Stoney Nakoda Nations (February 12, 2018), Métis Nation of Alberta, Region 3 (February 22, 2018), Samson Cree Nation (February 23, 2018), Siksika Nation (February 26, 2018), and Tsuut'ina Nation (March 1, 5, 6, and 7, 2018). Each workshop was facilitated by Canadian Environmental Assessment Agency (CEA Agency) managers, and the structure and format for each workshop was developed in consultation with individual Indigenous groups. In accordance with protocols established at the start of each workshop and in recognition of the proprietary nature of TLRU, written summaries of the workshop proceedings were completed by Alberta Transportation and provided to each Indigenous group for review and validation before incorporating any information into the March 2018 EIA. As of March 16, 2018, the summaries of the workshops had not been validated by Indigenous groups for use. Relevant TLRU information, concerns, and recommendations from workshops summaries validated and approved for use on the Project by Indigenous groups after the EIA has been filed will be used for project planning and implementation purposes, where applicable. Project-specific TLRU information will be reviewed against the results of the EIA and a formal response will be developed.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (12) Vegetation and Wetlands

EIS Guideline reference: Part 2 Section 6.1.9, 6.3.4
EIS Reference: Volume 3A, Table 10-7

Context and Rationale

The EIS provides a list of traditional use plants identified in traditional ecological reports and presence in the Project Development Area. The EIS notes that some of the traditionally used names of the listed plants species had unknown corresponding scientific names and were therefore not included in the traditional use plant assessment.

Issue or Comment

a) Upon validating the list of traditional use plants with Indigenous groups, as requested in Annex I Information Requirement 13, update Table 10-7 and any corresponding assessment of effects to traditional use plants, as appropriate.

Response (12)

a) Alberta Transportation offered to hold a workshop with each Indigenous group during February or March 2018 to obtain feedback on how traditional land and resource use (TLRU) has been presented in the draft TLRU sections (Sections 14 of Volumes 3A and 3B of the March 2018 EIA), as well as obtain input on proposed mitigation measures, and discuss how Project-specific concerns have been addressed. The intention was to validate the use of the traditional use information and include any feedback received. If Indigenous groups were not available to participate in a workshop, Alberta Transportation welcomed other suggestions for providing views and input on the draft TLRU sections. Alberta Transportation also requested feedback by March 1, 2018 for use in the March 2018 EIA.

   Workshops were held with Stoney Nakoda Nations (February 12, 2018), Métis Nation of Alberta, Region 3 (February 22, 2018), Samson Cree Nation (February 23, 2018), Siksika Nation (February 26, 2018), and Tsuut'ina Nation (March 1, 5, 6, and 7, 2018). Each workshop was facilitated by Canadian Environmental Assessment Agency (CEA Agency) managers, and the structure and format for each workshop was developed in consultation with individual Indigenous groups. In accordance with protocols established at the start of each workshop and in recognition of the proprietary nature of TLRU, written summaries of the workshop

[1] **Further questions will be provided to the proponent during Technical Review phase**

proceedings were completed by Alberta Transportation and provided to each Indigenous group for review and validation before incorporating any information into the updated EIA (March 2018). As of March 16, 2018, the summaries of the workshops had not been validated by Indigenous groups for use in the March 2018 EIA Relevant TLRU information, including a listing of traditional use plants, concerns, and recommendations from workshops summaries validated and approved for use on the Project by Indigenous groups after the EIA has been filed will be used for project planning and implementation purposes, where applicable. Project-specific TLRU information will be reviewed against the results of the EIA and a formal response will be developed.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (13) Vegetation and Wetlands

EIS Guideline reference: Part 2 Section 6.3.4 and 6.4
EIS reference: Vol 3B, Section 10.2; Vol 3B, Section 10.1.1; Vol3B, Section 11.3.6.2; Vol3B, Section 3.2.2.1; Volume 4, Appendix D

Context and Rationale

The EIS states that in a design flood scenario, native upland communities would be unlikely to survive prolonged flooding but that in time, species lost would be replaced by species within the seedbank, by surviving propagules or by species that can seed-in from surrounding areas. The EIS does not provide the length of time required for native upland communities to naturally re-establish. The Agency notes that native plant re-establishment could be outcompeted by the growth and spread of regulated weeds and invasive plants.

The EIS also states that mitigating the Project's effects to vegetation and wetlands would be to hydroseed with native plant species and apply tackifier in areas where wind erosion might be an issue. The EIS does not describe the monitoring plan following a flood event to determine when this mitigation would be applied.

The Agency understands that this mitigation is also applied to reduce fugitive dust affecting human health, which could include Indigenous receptors, and to reduce the potential production of methyl mercury and transport of pathogens and contaminants that could affect wildlife health used for country foods.

Issue or Comment

a) **Describe the length of time required for native upland communities to return to baseline conditions through natural revegetation in a post-flood design scenario.**

b) **Describe the monitoring plan following flood conditions to evaluate issues of erosion, spread of regulated weeds, and fugitive dust.**

c) **Describe the criteria that would be used to determine when tackifier and reseeding with native plant species would be applied.**

[1] **Further questions will be provided to the proponent during Technical Review phase**

Response (13)

a) Time required for upland native communities to re-establish following the design flood will vary depending on community type, sediment depths, plant characteristics and climatic conditions. Areas of complete burial and full loss of existing species (i.e., 10 cm to greater than 100 cm) will likely take the longest to revegetate. Most of the dominant grasses (e.g., bluejoint [*Calamagrostis canadensis*], Kentucky bluegrass [*Poa pratensis*], slender wheat grass [*Elmus trachycaulus*]), dominant shrubs (e.g., rose [*Rosa* sp.] and buckbrush [*Symphoricarpos occidentalis*]), and trees of inundated areas (trembling aspen [*Populous tremuloides*] and balsam popular [*Populus balsamifera*]), have rapid growth and are capable of moderate to rapid vegetative spread (USDA 2018). These species should quickly colonize flooded areas following water drawdown. However, potentially more than 10 years, may be required for conditions to resemble baseline. Slow growing mountain rough fescue (*Festuca campestris*) stands have been reported to reach majority within four years (Tirmenstein 2000), but seed production is highly variable (USDA n.d). Aspen stands can also attain crown closure within four years (Howard 1996), but growth rates from seed can take longer and will be influenced by climatic conditions.

b) A site-specific erosion and sediment control plan will be developed in accordance with Alberta Transportation's Erosion and Sediment Control Manual (Government of Alberta 2011) prior to construction. The approach will include site inspection following a design flood, with inspection for areas of bare ground susceptible to erosion, dust and weed colonization. Exact inspection timing will depend on the rate of floodwater drawdown, climatic conditions, and regional plant growth.

c) Deficiencies identified during monitoring inspections will be the basis for applying supplementary mitigation measures, such as hydroseeding and the application of tackifiers in areas potentially at risk of wind erosion or weed infestation. Deficiency criteria will be established prior to construction. Tackifier and re-seeding will also be applied in response to dust or weed concerns, expressed by local residents.

References

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A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (14) Acoustic Environment

EIS Guideline reference: Part 2, Section 6.2.1, 6.3.4, and 6.4
EIS reference: Volume 3A, Section 4

Context and Rationale

Part 2 Section 6.2.1 of the EIS Guidelines requires an assessment of changes in ambient noise levels and Part 2, Section 6.3.4 requires, with respect to Aboriginal Peoples, an assessment of human health, including noise exposure. Volume 3A, Section 4 of the EIS states that mitigation will be developed further for each of the identified acoustic assessment scenarios when the Project schedule is finalized.

Considering that noise thresholds may be exceeded at several receptors, further information should be provided on noise mitigation. Special consideration should be given to mitigation measures for construction noise that occurs at night, to minimize impacts on sleep.

Issue or Comment

a) Provide information on proposed mitigation measures for noise, their implementation, and any residual effects after the measures are implemented during the construction phase.

Response (14)

a) Piling activities for bridge construction (Highway 22 and Township Road 242) includes impact noise generated from hydraulic pile driver. If required, mitigation measures that will be implemented to reduce pile driver noise include:

- Evaluate the use of drilled concrete piles as an alternative to driven steel in order to eliminate the need for pile drivers
- limit pile driving activities to prescribed working windows

[1] **Further questions will be provided to the proponent during Technical Review phase**

For other construction activities (i.e., earthworks, roadworks, floodplain berm, diversion channel, raising Highway 22 and Springbank Road interchange, diversion structure), the dominant noises are from haul road traffic and construction equipment that operate within the activity area. Mitigation measures that will be implemented to reduce noise at receptors may include:

- construction activities limited to dam site and diversion channel during the nighttime period
- use of broad band back-up alarm for all construction equipment
- use of light plant with low noise emission level
- where practical, limit activities for Highway 22 and Township Road 242 bridge construction
- if reducing equipment activities in some area is not practical, quieter pieces of machinery and construction equipment will be sourced, where feasible and reasonable
- where practical, place temporary site buildings and material stockpiles as noise barriers
- use natural landform as a noise barrier
- place fixed equipment behind earth berms where practical

After the implementation of mitigation measures, the predicted noise level at some receptors may still be above the Health Canada Mitigated Noise Level (MNL) and World Health Organization (WHO) sleep disturbance threshold. However, the predictions are based on a worst-case scenario, where the haul route traffic and construction activities are at the same elevation as the receptor.

The haul route is located along the diversion channel and the average depth of the completed diversion channel is approximately 40 feet (12 m) and as much as 100 feet (30.5 m). The haul route elevation will progressively change from the current grade to a lower elevation as the earth work progresses. The predicted exceedance is expected in the early phase of the construction within each section of the diversion channel. As the diversion channel is constructed, the ground terrain on either side of the diversion channel will provide noise attenuation from the haul truck traffic and construction activities within the channel.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (15) Acoustic Environment – Baseline Sound Levels

EIS Guideline reference: Part 2 Section 6.1.1 and 6.3.4
EIS reference: Volume 3A, Section 4.2.1.1 Receptor Locations (Figure 4-2)
Volume 4, Part 2 Appendix F, Attachment 4A Field Survey Data (pages 4A.1- 4A.7, Table 4A-1; Table 4A-2; Table 4A-3; Table 4A-4)

Context and Rationale

Part 2 Section 6.1.1 of the EIS Guidelines requires a description of baseline information for current ambient daytime and night time noise levels at key receptor points (e.g., Indigenous communities), including the results of a baseline ambient noise survey; Part 2, Section 6.3.4 requires, with respect to Aboriginal Peoples, an assessment of human health, including noise exposure. The acoustic environment was characterized over a 48 hour period (September 7-9, 2016). The EIS does not provide a rationale as to why these dates were chosen and if the measured sound levels are representative of the chosen receptors.

As stated in Health Canada's guidance, *Health Canada Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise*, the following should be included to minimize uncertainty of the validity of measured baseline sound level data:

- **the number of hours or days used for measurement, and a rationale for why the reported sound levels can be considered representative;**
- **an estimate of seasonal differences and any differences between the weekend and weekday baseline noise levels;**
- **where applicable, any differences due to weather conditions;**
- **all noise sources that contribute significantly to the baseline, by type (e.g. traffic, aircraft, trains, industrial); and a characterization of each noise type described in the assessment using descriptors such as continuous, intermittent, regular impulsive, highly impulsive, high-energy impulsive, and continuous tonal and intermittent tonal.**

Issue or Comment

a) Provide rationale as to how the baseline sound level measurements are representative of the chosen receptor locations.

[1] Further questions will be provided to the proponent during Technical Review phase

Response (15)

a) Baseline sound level measurements at locations M2, M3, and M4 were used to represent the existing sound level of receptor locations near the measurement locations. Table 15-1 lists the number of valid measurement hours at each location during both daytime and nighttime over multiple days.

Table 15-1 Baseline Sound Level Measurements

Location	Number of Valid Hours	Total Valid Hours	Monitoring Period
M1	7 hours (daytime) 7 hours (nighttime)	14 hours	Sep. 7, 2016 – Sep. 9, 2016
M2	28 hours (daytime) 18 hours (nighttime)	46 hours	Sep. 8, 2016 – Sep. 9, 2016
M3	29 hours (daytime) 18 hours (nighttime)	47 hours	Sep. 7, 2016 – Sep. 9, 2016
M4	26 hours (daytime) 18 hours (nighttime)	44 hours	Sep. 7, 2016 – Sep. 9, 2016

There is no threshold in the Health Canada noise guidance to quantify the sufficient number of hours for baseline noise measurement. Alberta Energy Regulator (AER) *Directive 038: Noise Control* recommends a monitoring period of 9 to 24 hours. However, there must be at least three hours of valid data for nighttime and for daytime periods for the survey to be considered valid.

All locations provided more than three hours of valid data during both daytime and nighttime. However, the total number of valid hours at M1 are lower than M2, M3, and M4. In addition, the seven daytime or nighttime hours are continuous during the same daytime or nighttime, instead of over multiple days. In consideration of the 9 to 24 hours recommended by AER for monitoring period, the measurement results at M1 were not used in the assessment.

There could be seasonal differences in the acoustic environment at different receptor locations. AER Directive 038 recommends baseline measurement during summertime weather conditions. The majority of noise concerns for residents would likely occur during the seasons when people are outdoor and residential dwellings may have open windows (i.e., spring, summer, fall) during nighttime.

All monitoring locations were located outdoors. The monitoring period was during the fall season and conducted during weekdays. The fall season weather condition is similar to the summertime weather condition recommended by AER Directive 038.

Monitoring location M2 is approximately 350 m from Highway 1. Noise level at this location will be affected by traffic along Highway 1. The traffic data from Alberta Transportation indicates that traffic volume along Highway 1 near the Project is higher during the weekend. Therefore, baseline measurement results are likely to be lower during the weekday due to lower traffic volume. Using a lower baseline sound level is considered a more conservative approach because the change in sound level will be higher when compared to the Project-related noise.

Monitoring location M3 is approximately 900 m from Highway 22. There is no traffic volume information to compare the weekday and weekend traffic volume near M3 along Highway 22. However, traffic volume along Highway 22 is assumed to be higher during the weekend due to increased activities (i.e., recreation, tourism) within and near the town of Bragg Creek. The baseline sound level at M3 during a weekday is likely lower than the weekend. Similar to M2, the lower baseline sound level during a weekday is a more conservative approach.

Monitoring location M4 is located at least 2.2 km from Springbank Road. This location is sufficiently far away from the road that the difference in traffic volume between a weekday and weekend will not affect the baseline sound level results.

Weather conditions were favorable during the monitoring period: there was no snow, water, ice ground cover, no rain precipitation, and wind speed was less than 15 km/hr, as defined in the AER Directive 038 noise guidelines for favorable conditions.

Noise sources that largely contribute to the baseline results includes noise from the natural environment (e.g., wind, insects) and human activities (e.g., traffic, aircraft flyover, local residence), and agricultural industry. Non-representative data points (e.g., periods of inclement weather) were excluded from the data set used in the assessment. There were no continuous impulsive and tonal noise source identified during the baseline noise measurement.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (16) Acoustic Environment – Sleep Disturbance

EIS Guideline reference: Part 2 Section 6.2.1and 6.3.4
EIS reference: Volume 3A, Section 4.4 (pages 4.18-4.19, 4.33-4.34, Table 4-14)

Context and Rationale

Part 2 Section 6.2.1 of the EIS Guidelines requires an assessment in ambient noise levels and Part 2, Section 6.3.4 requires, with respect to Aboriginal Peoples, an assessment of human health, including noise exposure. In the Acoustics Assessment, Scenario 5 (sleep disturbance) assessed sleep disturbance using the World Health Organization methodology of L_{Amax} inside the house as 32 dBA, assuming an indoor insulating value of 21 dB. Discrete events outside the home were assumed to not cause sleep disturbance at L_{Amax} 53 dBA. However, scenario 5 does not take into account the recommended annual average 40 dBA Ln outdoors (WHO 2009[2]) to avoid long-term impacts on health from sleep disturbance.

Issue or Comment

a) Assess the annual average dBA Ln outdoors within Scenario 5 (sleep disturbance) of the acoustics assessment to determine if long-term health impacts from sleep disturbance are expected due to project-related noise.

Response (16)

a) Scenario 5 assesses the maximum sound level (L_{Amax}) during peak activity level for earthworks, dam embankment, and diversion channel during nighttime. The World Health Organization (WHO) 2009 L_n outdoor threshold of 40 dBA is an annual average, instead of an maximum sound level.

The proposed mitigation measures will result in reduced noise during nighttime. Only construction activities associated with the dam and diversion channel are expected to occur during nighttime. In addition, most of the earth works will be seasonal (i.e., six months per year). In consideration of the mitigation measures and duration of construction activities, an annual average L_n outdoor Project noise is predicted to be between 27 dBA to 57 dBA for the receptors; 23 out of 45 receptors will be above the threshold of 40 dBA. The predicted

[1] **Further questions will be provided to the proponent during Technical Review phase**

[2] **World Health Organization (WHO). 2009. Night Noise Guidelines for Europe. Hurtley, C. (Ed). Available online at: http://www.euro.who.int/en/health-topics/environment-and-ealth/noise/publications/2009/night-noise-guidelines-for-europe**

results are the worst-case scenario when the haul route traffic and construction activities are at the same elevation as receptors. The predicted annual L_n level will be reduced in locations where the haul route elevation will progressively change from the current grade to a lower elevation as the earth work progress. The predicted exceedance is expected in the early phase of construction within each section of the channel. As the channel is constructed, the ground terrain on either side of the diversion channel will provide noise attenuation from the haul truck traffic and construction activities within the channel.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (17) Acoustic Environment – Traffic

EIS Guideline reference: Part 2 Section 6.2.1 and 6.3.4
EIS reference: Volume 3A, Section 4.4

Context and Rationale

Part 2 Section 6.2.1 of the EIS Guidelines requires an assessment in ambient noise levels and Part 2, Section 6.3.4 requires, with respect to Aboriginal Peoples, an assessment of human health, including noise exposure. The EIS does not indicate if the increased traffic in the region was included in the assessment of noise for Project-related effects (all scenarios).

Issue or Comment

a) Include the potential increase in traffic during the construction period of the Project to the noise related effects from the Project. If this is excluded from the assessment, provide a rationale for its exclusion.

Response (17)

a) In all five scenarios, the noise from haul route traffic during construction within the Project Development Area (PDA) are included in the March 2018 EIA, Volume 4, Appendix F, Attachment 4C, Table 4C-1, which lists traffic noise sources associated with haul routes between the following areas:

- dam site from Borrow Pit 1
- dam site from diversion channel
- Highway 22 and bridge construction from Borrow Pit 2
- topsoil stockpile to diversion channel
- dam site from diversion channel
- dam site from topsoil stockpile
- floodplain berm from diversion channel
- floodplain berm from topsoil stockpile

The noise assessment of increased traffic during construction within the PDA addressed Section 6.2.1 and 6.3.4 of the EIS guidelines; noise associated with traffic increase along the roads outside the PDA was not included.

[1] **Further questions will be provided to the proponent during Technical Review phase**

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (18) Human Health Risk Assessment

EIS Guideline reference: Part 2, Section 6.3.4
EIS reference: Volume 3A, Section 15.3

Context and Rationale

Part 2, Section 6.3.4 of the EIS Guidelines requires, with respect to Aboriginal Peoples, an assessment of human health considering, but not limited to potential changes in air quality, quality and availability of country foods, drinking water quality, and noise exposure. The EIS Guidelines specify that when risks to human health due to changes in one or more of the human health valued components (not limited to air quality, quality of country foods, drinking water quality) are predicted, a complete Human Health Risk Assessment (HHRA) examining all exposure pathways for pollutants of concern will be necessary to adequately characterize potential risks to human health.

The EIS includes only an assessment of inhalation risks for select contaminants.

Issue or Comment

a) Taking into account any updated air quality, country foods and drinking/recreational water quality assessment information that results from information requirements in Annex 1, identify if risks to Indigenous health are predicted due to changes in one or more of the human health valued components.

b) If risks are identified, provide a multi-media HHRA[2] to examine all exposure pathways for chemicals of potential concern to assess the potential risk to Indigenous health, from project-related effects during construction, maintenance, flood and post-flood.

[1] Further questions will be provided to the proponent during Technical Review phase
[2] The proponent should refer to Health Canada's *Useful Information for Environmental Assessments* document. This document can be obtained at http://publications.gc.ca/collections/collection_2015/sc-hc/H128-1-10-599-eng.pdf

Response (18)

a) The potential risks to Indigenous health are assessed in the March 2018 EIA, Volume 4, Appendix O, HHRA Technical Data Report, Section 2.3, 2.4, and 3.2. The assessment demonstrates that, based on the predicted changes to air quality, water quality and country foods, a change to human health is not predicted for Indigenous receptors, as summarized below.

Contaminants of potential concern (COPC) are identified in consideration of Project activities for each project phase (see Volume 4, Appendix O, HHRA Technical Data Report, Section 3.2). For contaminants in air, additional consideration was given to the potential for indirect exposure pathways related to deposition (e.g., deposition of contaminant into soil and uptake into plants). Contaminants were screened for persistence and bioaccumulation. Metals and some Polycyclic aromatic hydrocarbons (PAHs) were identified as meeting the criteria for persistence and bioaccumulation, and, therefore, further consideration for secondary multi-media exposures related to deposition were considered. The deposition rates for these COPCs in diesel exhaust are low (the construction period is limited to 3 years). Therefore, to evaluate whether these secondary pathways represent a potential risk to human health, a review of the maximum potential Project-related effects on soil chemistry were evaluated, as described in Volume 4, Appendix O, HHRA Technical Data Report, Section 3.4.

Soil concentrations for each of the COPC are predicted, based on maximum deposition rates, as described in Volume 4, Appendix O, HHRA Technical Data Report: Attachment B. Project-related changes in soil chemistry are considered negligible because:

- maximum changes in soil chemistry are negligible (less than 5%) or
- predicted concentrations are less than health-based screening levels

The point of maximum deposition is located near the boundary of the Project Development Area (PDA). Deposition rates (and hence potential changes in soil chemistry) at the receptor locations are lower. Given the negligible change in soil chemistry, the potential for changes in country food quality is also considered negligible. Based on these results, secondary pathways related to the airborne COPC (such as direct contact with soil, ingestion of country foods and garden produce) would not result in a change to health for Indigenous receptors.

Predicted concentrations of NO_2 (1-hour), $PM_{2.5}$ (24-hour and annual) and DEP (1-hour) are greater than 1.0 at some residential receptor locations within 200 m of the PDA; however, there are no predicted exceedances at the locations where Indigenous receptor presence is expected (see Volume 4, Appendix O, HHRA Technical Data Report, Table 3-1 and Volume 3A, Table 15-9 for locations identified as those where Indigenous receptors are likely to be present). Because predicted concentrations of the COPC at the locations where

Indigenous receptors are expected are less than the health-based limits, a change to human health through inhalation is not predicted for Indigenous receptors.

Tsuut'ina Nation identified Elbow River and groundwater in the Elbow River alluvial aquifer as sources of drinking water and expressed concern regarding effects of the Project on Tsuut'ina Nation's ability to use the river as a source of drinking water. Five registered water wells have been identified on the Tsuut'ina Nation reserve. Also, it is understood that Tsuut'ina Nation hold a license to withdraw water from Elbow River, located upstream of the PDA. The effects of sediment from construction on downstream water quality in Elbow River and Glenmore Reservoir is negligible. Effects on water quality from potential herbicide use is expected to be reversible through dilution, given the very low frequency of herbicide detection in the watershed. Groundwater quantity and quality are not expected to be materially affected due to the limited extent and duration of project effects on groundwater. Therefore, it is anticipated that there will be no effects on the ability of Tsuut'ina Nation to use groundwater in the Elbow River alluvial aquifer or the Elbow River for drinking water; effects to functioning of the identified wells on the Tsuut'ina Nation reserve within the hydrogeology RAA are not anticipated. As a result, health risks to Indigenous receptors associated with use of the Elbow River and groundwater in the Elbow River alluvial aquifer are not expected.

Health risks associated with methylmercury ingestion of water and fish from Elbow River are also considered in the HHRA (Volume 4, Appendix O, HHRA Technical Data Report, Section 5.2 and Section 6.3.2). The predicted concentration of total mercury in water is below the Canadian drinking water quality guideline for total mercury and, given the short duration that methylmercury forming conditions could occur (approximately 1 month), there is a low likelihood that methylmercury could migrate throughout the aquatic food web to change the quality of fish harvested from Elbow River. As a result, methylmercury health risks to Indigenous receptors through water and fish ingestion pathways are not expected.

b) As noted in a), the HHRA considered the potential for secondary (multi-media) exposure pathways associated with air emissions (see Volume 4, Appendix O, HHRA Technical Data Report, Section 3.2). Project-related changes in soil chemistry were assessed at the location of maximum deposition (located near the boundary of the PDA) and were found to be negligible. Given the negligible change in soil chemistry, the potential for changes in country food quality through secondary pathways is also considered negligible. Based on these results, secondary pathways related to the airborne COPC (such as direct contact with soil, ingestion of country foods and garden produce) would not result in a change to health for Indigenous receptors.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (19) PM_{10} and Diesel Particulate

EIS Guideline reference: Part 2, Section 6.1.1, 6.2.1 and 6.3.4
EIS reference: Volume 3A, Section 15.0

Context and Rationale

Part 2, Section 6.1.1 and 6.2.1 of the EIS Guidelines requires information and an assessment on specified parameters for the atmospheric environment. Part 2, Section 6.3.4 requires, with respect to Aboriginal Peoples, an assessment of human health.

Contaminants examined in the EIS include $PM_{2.5}$, VOCs, PAHs, SOx and NOx. There is no assessment of PM_{10} and diesel particulate in the construction phase as required by the EIS guidelines. An assessment of secondary pollutants is not provided (e.g., ground level ozone and secondary fine PM) in the assessment of potential effects on public health. These two pollutants can be formed by various atmospheric reactions if certain precursors (NOx, SOx and VOCs) are present.

Issue or Comment

a) Provide an assessment of emissions of PM_{10} and diesel particulate during construction and the predicted effects on Indigenous receptors.

b) Provide an assessment of emissions of secondary pollutants (ground level ozone and secondary fine PM) during construction and their predicted effects on human health.

c) Where the proponent is of the view that inclusion of certain parameters is not required for the assessment of predicted effects, provide a robust rationale for the exclusions.

Response (19)

a) Project emission rates including diesel exhaust particulate and coarse (TSP) and fine particulate matter ($PM_{2.5}$) are described in the March 2018 EIA, Volume 3A, Section 3.4.3.3. The air quality assessment presented pollutant concentration predictions for substances for which there are Alberta Ambient Air Quality Objectives (AAAQO) and Guidelines or for which there are Canadian Ambient Air Quality Standards (CAAQS). Because there are no

[1] **Further questions will be provided to the proponent during Technical Review phase**

AAAQO or CAAQS for diesel exhaust particulate or PM_{10}, potential effects associated with these substances are only evaluated in the human health risk assessment.

Chemicals of potential concern (COPCs) that are evaluated in the human health risk assessment are the chemicals that may be released by project activities that have the potential to affect human health. Inhalation health risk associated with emissions of fine particulate matter (PM2.5) and diesel exhaust particulate (DEP) for residential receptors and Indigenous receptors are presented in Volume 3A, Section 15.4.4.1. Inhalation health risk associated with PM10 emissions was screened out as a potential health risk as detailed in part c) of this response. With mitigation measures for reducing exposures to COPCs, residual effects to residential and Indigenous health are not significant.

b) Secondary pollutants are considered in the human health risk assessment. It was concluded that the Project will not result in an appreciable difference in ozone formation and as, a result, ozone was not selected as a COPC. The dispersion model predictions for fine particulate included the contribution from secondary particulate formation. Additional supporting detail about ozone formation and secondary particulate formation are presented in the following subheadings.

Ozone

Ozone is a naturally occurring constituent of the lower atmosphere (troposphere) and natural background concentrations can vary between about 20 µg/m^3 to 60 µg/m^3 (or equivalently, 10 ppb and 30 ppb). Ozone also occurs naturally in the stratosphere (upper atmosphere), and this ozone can occasionally be mixed to the ground. This atypical circumstance is known as a 'stratospheric intrusion' and is associated with a unique combination of meteorological circumstances.

Ozone is not emitted directly by combustion sources. Rather, ozone can be formed in the troposphere when oxides of nitrogen (NO_X) and volatile organic compounds (VOC) react in the presence of sunlight. These substances are known as ozone precursors. Ozone formation is a very complex process which involves many meteorological and photochemical factors and is influenced by both local and distant upwind pollutant emission sources. The potential for the formation of ozone tends to peak during conditions of strong solar radiation, high temperatures, and low wind speeds.

Due to the NO to NO_2 conversion reaction, ozone concentrations near emission sources of NO (e.g., congested roadways, urban areas and industrial complexes) can be less than natural background values. Downwind of ozone precursor areas, the photochemically produced ozone concentration reaches its maximum a few hours past solar noon. At night, ozone reverts back to oxygen (O_2) in the presence of nitric oxide (NO), which is oxidized to NO_2. Ozone can be transported long distances under certain circumstances. Areas far

removed from precursor source regions can experience elevated ozone if they are positioned along a downwind trajectory from a source region.

Future Conditions without the Project

Photochemical modelling was not undertaken specifically for the Project because regulatory dispersion models such as CALPUFF are not capable of realistically simulating the complicated atmospheric chemistry that leads to ozone formation.

The potential for the Project to contribute to the formation of ozone was examined through the review of regional photochemical model studies. It is important to recognize that the South Saskatchewan Planning Region includes both VOC-limited and NO_X-limited ozone formation regimes. The VOC-limited regime exists within City of Calgary and likely extends to nearby suburban and rural communities. In a VOC-limited regime, potential ozone formation associated with the addition of NO_X is limited by the lack of VOC. In contrast, ozone formation within the rural areas is likely to be dominated by a NO_X-limited regime. In a NO_X-limited regime, potential ozone formation associated with the addition of VOC is limited by the lack of available NO_X (Novus 2011).

Alberta Environment and Sustainable Resource Development (AESRD) contracted ENVIRON (EC) Canada Inc. to conduct a photochemical modelling study using the CMAQ model to improve the understanding of ozone and particulate matter formation in the South Saskatchewan Region (Environ 2013). The study developed modelling inputs for the CMAQ modelling system for the 2006, 2007 and 2008 base years and two future year emission scenarios (2020 and 2050). The CMAQ emission inventory database was then used to conduct air quality simulations for the 2006-2008 base years and two future-year scenarios to predict ozone and particulate matter concentrations. The CMAQ concentration estimates were then compared against the Canada Wide Standards (CWS), the Canada National Ambient Air Quality Objectives (NAAQOs), and the Alberta Ambient Air Quality Objectives (AAAQOs). In addition, the CMAQ model was applied to estimate impact of local emissions to air quality.

Ozone trends of the 4th highest maximum 8-hour ozone measured at monitoring stations were analyzed using measured ozone concentrations from 1986 to 2009. The trend in ozone concentrations over the time at each monitoring station were evenly split between both stations with positive (increasing) and negative (decreasing) concentration trends. Negative (decreasing) trends were primarily observed at the monitoring stations with higher ozone concentrations. In all cases, the trend in ozone concentrations were very small and none of the trends were statistically significant (Environ 2013).

The CMAQ 2006-2008 base case ozone model predictions were compared against the CWS, NAAQS, AAAQOs and to measured ozone concentrations over this same period. Both the model predictions and the ambient measurements indicate that the 4th highest maximum 8-hour ozone concentration averaged over three years do not to exceed the CWS of 65 ppb. The CMAQ model was also run for the 2020 and 2050 future emission scenarios. The predicted change in ozone concentrations for the 2020 and 2050 years as compared to the base case prediction are summarized in Table 1. Similar to the findings of the trend analysis, the CMAQ model predictions for the future year scenarios indicate only small changes to maximum and minimum ozone concentrations. In fact, maximum predicted ozone concentrations are predicted to decrease slightly in the 2020 and 2050 future year scenarios (approximately 1 to 2 ppb) at the locations of maximum predicted ozone concentration in the South Saskatchewan Region. The CMAQ model predictions also indicate that the minimum predicted ozone concentration will increase slightly (2 to 4 ppb). The trend analysis of historic ozone measurements and the photochemical model predictions indicate that ozone concentration in the South Saskatchewan region have been and are predicted to remain relatively insensitive to historic and future changes in NO_X and VOC emissions.

Table 19-1 Predicted Changes in Maximum and Minimum O_3 Concentration (ppb)

Averaging Period	Maximum			Minimum		
	Base Case	2020 Scenario	2050 Scenario	Base Case	2020 Scenario	2050 Scenario
1-h	98	96	95	56	54	54
8-h (4th highest)	56	54	54	47	47	44
24-h	68	66	66	40	42	38
Annual	40	39	39	18	22	22
NOTE: Model Predictions based upon CMAQ Model for South Saskatchewan Planning Region (Environ 2013, Table 2).						

Future Conditions with the Project

The Project will increase NO_X and VOC precursor emissions. Table 19-2 compares the Project NO_X and VOC emissions in comparison to the emissions in the South Saskatchewan Planning region from the CMAQ model study. The Project is anticipated to increase NO_X and VOC precursor emissions by 0.16% and 0.016%, respectively.

Table 19-2 Change in Ozone Precursor Emissions (tonne/day)

Assessment Case	NO_X Emissions (t/d)	VOC Emissions (t/d)
Project	1.1	0.093
South Saskatchewan Region	708	572
Percent Increase	0.16%	0.016%
NOTE: Project emissions are annual average values (see Volume 4, Appendix E, Attachment 3A, Table 3A-2). South Saskatchewan Planning Region Emissions for 2006 (Environ 2013, Table 1).		

The potential for the Project precursor emissions to contribute to regional ozone formation was examined through the review of recent regional photochemical model studies and an analysis of the increase in ozone formation precursor emissions. The Project ozone precursor emissions are predicted to increase emissions in the South Saskatchewan Planning region by only a small amount (0.16% for NO_X and 0.016% for VOC). Based upon the small increase in ozone precursors and the relatively small predicted changes in future year ozone concentrations from regional photochemical modelling studies, it is concluded that the Project will not likely result in an appreciable difference in the magnitude of maximum ozone concentration. Because ozone is not emitted directly by Project activities and the Project is not anticipated to result in an increase in ozone formation, ozone was not selected as a COPC for the HHRA. The Project is not predicted to result in an adverse effect on human health associated with ozone formation.

Secondary Particulate

The CALPUFF model was used to predict secondary inorganic particulate formation associated with precursor SO_2 and NO_X emissions. The CALPUFF model predicts particulate nitrate NO_3^-, which can exist as an aerosol (i.e., dissolved in a water droplet) or as a particle (e.g., NH_4NO_3); see Volume 4, Appendix E, Attachment 3C, Section 3C.3.9. Similarly, sulphate SO_4^{2-} can also exist as an aerosol or as a particle (e.g., ammonium sulphate [$(NH_4)2SO_4$]). NO_3^- and SO_4^{2-} are assumed to react with ambient ammonia (NH_3) to produce ammonium nitrate and ammonium sulphate, respectively. The particulate matter predictions considered in the health risk assessment include potential contributions associated with secondary fine particulate matter formation. The health risk associated with secondary particulate formation is correctly considered in the HHRA.

c) Coarse grained particulate (e.g., PM_{10} and TSP) was not selected as a COPC in the human health risk assessment health effects associated with particulate matter are primarily attributable to $PM_{2.5}$ rather than coarser particles. The composition of the coarser particulate is primarily soil and silt, which is inert crustal material. When inhaled, coarse particulate such as PM_{10} is trapped in the upper respiratory passages (e.g., mouth, nasal cavity, pharynx) which are subsequently swallowed. The primary health risk associated with particulate matter emissions is specific to particles less than 2.5 micron in size, so $PM_{2.5}$ was selected as a COPC. $PM_{2.5}$ can penetrate deep into the lungs, bronchioles and alveoli.

Federal and international health regulatory agencies (e.g., Health Canada, World Health Organization) recognize that health risk from dust inhalation is primarily associated with $PM_{2.5}$, rather than coarse particulate matter. For example, Health Canada reviewed studies that indicated, "…only limited evidence that crustal coarse particulate matter from Asian dust storm events has an effect on mortality, in spite of the extremely high levels of PM_{10} from dust storms". In contrast, traffic-related $PM_{2.5}$ had a stronger demonstrable relationship with adverse health effects (Health Canada 2016a). The World Health Organization notes that, "the effects of long-term particulate matter exposure on mortality seem to be attributable to $PM_{2.5}$ rather than coarse particles" (WHO 2006). Consequently, potential effects on human health associated with PM_{10} and TSP emissions were screened out and not considered as a COPC.

References

Environ. 2013. Air Quality Modelling Exercise using Community Multiscale Air Quality (CMAQ) Model for South Saskatchewan Regional Plan. January 2013. Prepared for: Land-use Framework Strategy Division Alberta Environment and Sustainable Resource Development. Prepared By: ENVIRON (EC) Canada Inc.

Health Canada. 2016a. Human Health Risk Assessment for Coarse Particulate Matter. Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Novus 2011. Identifying Drivers for Local Anthropogenic Ozone in the Calgary Region. Novus Environmental Inc. Final Report Completed Under Request for Proposals (RFP) Number CRAZ-002. March 2011.

WHO. 2006. Health Risks of Particulate Matter from Long-Range Transboundary Air Pollution. Joint WHO/Convention Task Force on the Health Aspects of Air Pollution. European Centre for Environment and Health.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (20) Inhalation Health Risk

EIS Guideline reference: Part 2, Section 6.3.4
EIS reference: Volume 3A, Section 15.0

Context and Rationale

Part 2, Section 6.3.4 of the EIS Guidelines requires, with respect to Aboriginal Peoples, an assessment of human health. The EIS provides an assessment of health risk from inhalation as residual effects for change to human health, which is assumed to be post-mitigation. However, an assessment of inhalation health risk should also be provided prior to mitigation within Section 15.3.1 Air Quality and Public Health.

Issue or Comment

a) Provide an assessment of inhalation health risk prior to the implementation of mitigation measures.

Response (20)

a) Both the CEAA EIS Guidelines and the Alberta Environmental and Parks (AEP) Terms of Reference describe the assessment of residual effects. Residual effects take into consideration mitigation measures associated with the Project. Part 2, Section 6.3.4 EIS Guideline does not describe a requirement to assess inhalation health risks prior to implementation of mitigation measures. Similarly, the Terms of Reference provided by AEP also does not describe a requirement to assess potential impacts prior to implementation of mitigation measures.

   Mitigation measurements are an integral part of, and included in, the design of the Project. For example, the mitigation measures embedded throughout all aspects of the Project include such items as the types of heavy duty diesel construction equipment and the requirements to meet current emission control standards for diesel engines and the use of low-sulphur diesel fuel. The Project will also include a dust management program to minimize fugitive dust generated by construction activities or during periods of excessive winds. The dust management program will include application of water and/or water in combination with dust control chemicals to reduce dust emissions. The construction fleet composition and fuel use estimates include emissions from vehicles associated with water application

[1] **Further questions will be provided to the proponent during Technical Review phase**

associated with the dust management program. A version of the Project without the proposed mitigation is implausible, and an assessment of inhalation health risks without mitigation is not appropriate.

Ambient and meteorological monitoring will be implemented in conjunction with construction activities to provide real time information about meteorological conditions and off-site particulate concentrations. The monitoring program will provide information to determine the effectiveness of the mitigation and determine the need for more rigorous mitigation measures. Monitoring systems will include the installation and operation of a meteorological tower and particulate monitoring equipment. This emissions mitigation management is referred to as adaptive management. Based upon the proposed adaptive management strategy, Alberta Transportation is confident that the proposed mitigation measures will be effective.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (21) Units for Public Health Assessment

EIS Guideline reference: Part 2, Sections 6.1.1 and 6.2.1
EIS reference: Volume 3A, section 15.0

Context and Rationale

Part 2, Section 6.3.4 of the EIS Guidelines requires, with respect to Aboriginal Peoples, an assessment of human health. The Assessment of Potential Effects on Public Health does not provide modelled values in µg/m³ to enable a comparison of predicted data to health-based standards and guidelines.

Issue or Comment

a) Provide data in concentrations (µg/m³) that are determined or predicted for time periods corresponding to the applicable health-based standards, guidelines or objectives.

Response (21)

a) Concentrations are now provided in µg/m³ for the MPOI and each of the human receptor locations in the March 2018 EIA, Volume 4, Appendix O, HHRA Technical Data Report. Concentrations are provided for the Base Case, Project Case, and Application Case for the relevant exposure periods. Further discussion of the selection of the appropriate health-based guidelines are provided in Volume 4, Appendix O, HHRA Technical Data Report, Section 4.2.

   Receptor locations, including identified Indigenous receptors are listed in Table 21-1 (a duplicate of Volume 3A, Section 15.4.1, Table 15-9).

[1] **Further questions will be provided to the proponent during Technical Review phase**

Table 21-1 Human Receptor Locations

Receptor ID	Zone 11 UTM Coordinates		Land Use, Occupancy (Receptor Location Description)	Approximate Distance to PDA (m)	Indigenous Receptor	Special Receptor
	Easting (m)	Northing (m)				
SR1	676781	5661332	Residential, Permanent (rural residence 1,000 m from intersection of Highway 1 and Highway 22)	22	-	-
SR2	678048	5662120	Residential, Permanent (rural residence 750 m from intersection of Highway 1 and Highway 22)	457	-	-
SR3	678552	5662111	Residential, Permanent (rural residence 450 m south of Highway)	730	-	-
SR4	679819	5660801	Residential, Permanent (rural residence adjacent to Springbank Road)	44	-	-
SR5	680547	5660634	Residential, Permanent (rural residence 255 m from intersection of Springbank Road and Range Road 40)	231	-	-
SR6	681210	5661082	Residential, Permanent (rural residence adjacent to Range Road 40)	924	-	-
SR7	682145	5661010	Residential, Permanent (rural residence adjacent to Range Road 35)	1,457	-	-
SR8	683263	5660233	Residential, Permanent (rural residence adjacent to Springbank Road)	1,619	-	-
SR9	677002	5660074	Residential, Permanent (rural residence 520 m from intersection of Springbank Road and Highway 22)	202	-	-

Table 21-1 Human Receptor Locations

Receptor ID	Zone 11 UTM Coordinates		Land Use, Occupancy (Receptor Location Description)	Approximate Distance to PDA (m)	Indigenous Receptor	Special Receptor
	Easting (m)	Northing (m)				
SR10	676827	5659179	Residential, Permanent (rural residence adjacent to Highway 22)	616	-	-
SR11	677449	5658688	Residential, Permanent (rural residence adjacent to Highway 22)	96	-	-
SR12	680518	5660339	Residential, Permanent (rural residence 260 m from intersection of Springbank Road and Range Road 40)	19	-	-
SR13	680670	5660343	Residential, Permanent (rural residence 110 m from intersection of Springbank Road and Range Road 40)	103	-	-
SR14	680684	5660190	Residential, Permanent (rural residence 245 m from intersection of Springbank Road and Range Road 40)	62	-	-
SR15	681089	5660001	Residential, Permanent (rural residence 545 m from intersection of Springbank Road and Range Road 40)	53	-	-
SR16	682288	5658906	Residential, Permanent (rural residence adjacent to Range Road 35)	59	-	-
SR17	683867	5659435	Residential, Permanent (rural residence adjacent to Range Road 34)	1,589	-	-
SR18	677183	5658120	Residential, Permanent (rural residence adjacent to Highway 22)	215	-	-

Table 21-1 Human Receptor Locations

Receptor ID	Zone 11 UTM Coordinates		Land Use, Occupancy (Receptor Location Description)	Approximate Distance to PDA (m)	Indigenous Receptor	Special Receptor
	Easting (m)	Northing (m)				
SR19	677141	5657024	Residential, Permanent (rural residence adjacent to Township Road 242)	53	-	-
SR20	677303	5656696	Residential, Permanent (rural residence adjacent to Township Road 242)	35	-	-
SR21	679639	5656961	Residential, Permanent (rural residence adjacent to Elbow River)	1,008	-	-
SR22	680364	5657431	Residential, Permanent (rural residence in wooded area adjacent to Elbow River)	565	-	-
SR23	681065	5657451	Residential, Permanent (rural residence in wooded area adjacent to Elbow River)	893	-	-
SR24	682806	5658065	Residential, Permanent (rural residence in wooded area adjacent to Elbow River)	307	-	-
SR25	677400	5657051	Commercial, Permanent (commercial premises adjacent to intersection of Township Road 242 and Highway 22)	179	-	-
SR26	676700	5654151	Residential, Permanent (rural residence in wooded area adjacent to Elbow River)	301	-	-
SR27	677250	5653751	Residential, Permanent (rural residence in wooded area)	866	✓	-

Table 21-1 Human Receptor Locations

Receptor ID	Zone 11 UTM Coordinates		Land Use, Occupancy (Receptor Location Description)	Approximate Distance to PDA (m)	Indigenous Receptor	Special Receptor
	Easting (m)	Northing (m)				
SR28	677250	5653751	Recreational, Permanent (Entheos Conference and Retreat Centre)	845	✓	-
SR29	677500	5653751	Residential, Permanent (rural residence in wooded area)	923	✓	-
SR30	677500	5654001	Residential, Permanent (rural residence in wooded area)	755	-	-
SR31	677500	5654001	Residential, Permanent (rural residence in wooded area)	732	-	-
SR32	677750	5654251	Residential, Permanent (rural residence in wooded area)	750	-	-
SR33	678000	5654501	Residential, Permanent (rural residence in wooded area)	933	-	-
SR34	678250	5654751	Residential, Permanent (rural residence in wooded area)	1,041	-	-
SR35	678250	5654751	Residential, Permanent (rural residence in wooded area)	1,020	-	-
SR36	682450	5659251	Residential, Permanent (rural residence adjacent to Range Road 35)	355	-	-
SR37	681250	5657501	Residential, Permanent (rural residence in wooded area adjacent to Elbow River)	965	-	-

Table 21-1 Human Receptor Locations

Receptor ID	Zone 11 UTM Coordinates		Land Use, Occupancy (Receptor Location Description)	Approximate Distance to PDA (m)	Indigenous Receptor	Special Receptor
	Easting (m)	Northing (m)				
SR38	677800	5656551	Recreational, Temporary (Camp Gardner)	640	-	-
SR39	677350	5655701	Recreational, Temporary (Kamp Kiwanis)	200	-	-
SR40	676400	5657101	Residential, Permanent (rural residence adjacent to Township Road 242	217	-	-
SR41	676750	5657001	Residential, Permanent (rural residence adjacent to Township Road 242	69	-	-
SR42	676250	5663001	Residential, Permanent (rural residence 1,250 m from intersection of Highway 1 and Highway 22	1,105	-	-
SR43	678000	5662751	Residential, Permanent (rural residence 600 m from intersection of Highway 1 and Highway 22	944	-	-
SR44	685500	5660501	Educational, Permanent (Springbank Community High School and Springbank Park for All Seasons)	3,893	-	✓
SR45	685000	5662001	Educational, Permanent (Springbank Middle School and Elbow Valley Elementary School)	4,318	-	✓
SR46	685000	5662501	Recreational, Seasonal (Calaway Park)	4,653	-	-

Table 21-1 Human Receptor Locations

Receptor ID	Zone 11 UTM Coordinates		Land Use, Occupancy (Receptor Location Description)	Approximate Distance to PDA (m)	Indigenous Receptor	Special Receptor
	Easting (m)	Northing (m)				
SR47	685500	5662501	Commercial, Permanent (Commercial area adjacent to Highway 1)	5,310	-	-
SR48	683500	5664001	Industrial, Permanent (Springbank Airport)	5,133	-	-
SR49	684500	5663501	Educational, Permanent (The Edge School)	5,442	-	✓
SR50	687500	5657001	Recreational, Seasonal (Glencoe Golf and Country Club)	5,713	-	-
SR51	683250	5658001	Recreational, Seasonal (River Spirit Golf Club)	845	-	-
SR52	675750	5652751	Residential, Permanent (Redwood Meadows community)	2,132	✓	-
SR53	682000	5665001	Residential, Permanent (Harmony community)	5,521	-	✓
SR54	675000	5651501	Recreational, Seasonal (Curtis Field Park)	3,178	✓	-
SR55	674000	5650501	Recreational, Seasonal (Redwood Meadows Golf and Country Club)	4,639	✓	-
SR56	671500	5651001	Recreational, Seasonal (Wintergreen Golf and Country Club)	6,368	-	-

Table 21-1 Human Receptor Locations

Receptor ID	Zone 11 UTM Coordinates		Land Use, Occupancy (Receptor Location Description)	Approximate Distance to PDA (m)	Indigenous Receptor	Special Receptor
	Easting (m)	Northing (m)				
SR57	676750	5653751	Recreational, Seasonal (Bragg Creek Paintball)	689	✓	-
SR58	688500	5666001	Recreational, Seasonal (Springbank Links Golf Course)	8,850	-	-

NOTE:
Special Receptor Location - Location where sensitive sub-groups are more likely to be present, such as schools, hospitals, retirement complexes, and assisted care homes

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (22) Effects of Potential Accidents or Malfunctions

EIS Guideline reference: Part 2, Section 6.6.1
EIS reference: Volume 3D

Context and Rationale

Part 2, Section 6.6.1 of the EIS Guidelines state that the proponent will identify the probability of potential accidents and malfunctions related to the project, including an explanation of how those events were identified, potential consequences (including the environmental effects as defined in section 5 of CEAA 2012, and the significance of these effects), the plausible worst case scenarios, alternative accident scenarios, and the effects of these scenarios.

The EIS does not describe in sufficient detail worst case scenarios, such as for hazardous materials spills and pipeline ruptures, and the potential environmental effects of accidents and malfunction scenarios.

Issue or Comment

a) For all accident and malfunction scenarios during all Project phases, including hazardous materials spills and pipeline ruptures, describe the change to the receiving environment (e.g., change in air quality, water quality, water quantity, sediment quality) and resulting potential effects to wetlands, sensitive habitats, and effects as defined in section 5 of CEAA 2012.

b) Provide further details on the worst case scenarios for a hazardous materials spill and pipeline rupture such as how or when the events would occur, environmental consequences, and temporal and geographical extents.

Response (22)

a) The accidents and malfunctions section in the March 2018 EIA (Volume 3D, Section 1) now includes a description of the potential changes to the receiving environment and resulting potential effects on selected valued components (VCs) (e.g., air quality, public health (including drinking water quality and country foods), vegetation, wildlife and biodiversity (including migratory birds and species at risk)) during all phases of the Project.

[1] **Further questions will be provided to the proponent during Technical Review phase**

b) Additional details on selected accident and malfunction scenarios and the potential effects on human and environmental receptors are provided in Volume 3D, Section 1. A brief summary of what is provided in the section for a hazardous material spill and pipeline rupture is presented below.

Hazardous Material Spill

This event may occur as the result of improper handling, use, or storage of these materials on-site. Effects from a hazardous material spill are dependent on the volume, location, and type of material spilled. Two scenarios were considered: a release onto land and a release into an aquatic environment. Both scenarios could result in human injury and effects on terrestrial and aquatic environments. A scenario of potential higher consequence would be a release into an aquatic environment. The potential effects with a release into an aquatic environment could be greater because of the difficulty in containing and subsequently cleaning up contaminants, compared with a release on land, which can be more quickly contained and cleaned. The extent of potential adverse effects would be a function of the volume, location, and type of material spilled. In the unlikely event of a hazardous materials spill, VCs such as surface water quality, vegetation and wetlands, public health (including drinking water quality, if a spill reaches an aquatic environment; and country foods), and wildlife could be adversely affected.

Pipeline Rupture

Two scenarios have been considered that could result in a pipeline rupture: during construction as retrofitting or re-location activities would occur at the same time as the Project construction phase; and, during flood operations when there is water in the off-stream reservoir. If a pipeline rupture were to occur, the potential effects on the environment and human receptors would depend on the nature of the rupture (e.g., mechanism of release, volume of product released, type of product within the pipeline, the characteristics of the receiving environment and the effectiveness of applicable spill response). The timing (i.e., phase of the Project) of the rupture would also influence the VCs affected and extent of potential adverse effects. Effects from released materials into an aquatic environment (i.e., during flood operations) could be greater than a release into a terrestrial environment (i.e., during construction re-location and retrofitting). In the unlikely event of a pipeline rupture, VCs such as hydrogeology, surface water quality, vegetation and wetlands, public health (including exposures via inhalation of vapours, ingestion of drinking water and ingestion of country foods), air quality and wildlife could be adversely affected.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (23) Cumulative Effects - Map

EIS Guideline reference: Part 1, Section 4.4
EIS reference: Volume 3C, Section 1

Context and Rationale

Part 1, Section 4.4 of the EIS Guidelines requires that the EIS include charts, diagrams, tables, maps and photographs, where appropriate, to clarify text. The cumulative effects section of the EIS would benefit from a map illustrating the relationship between the projects considered in the cumulative effects assessment and the Project.

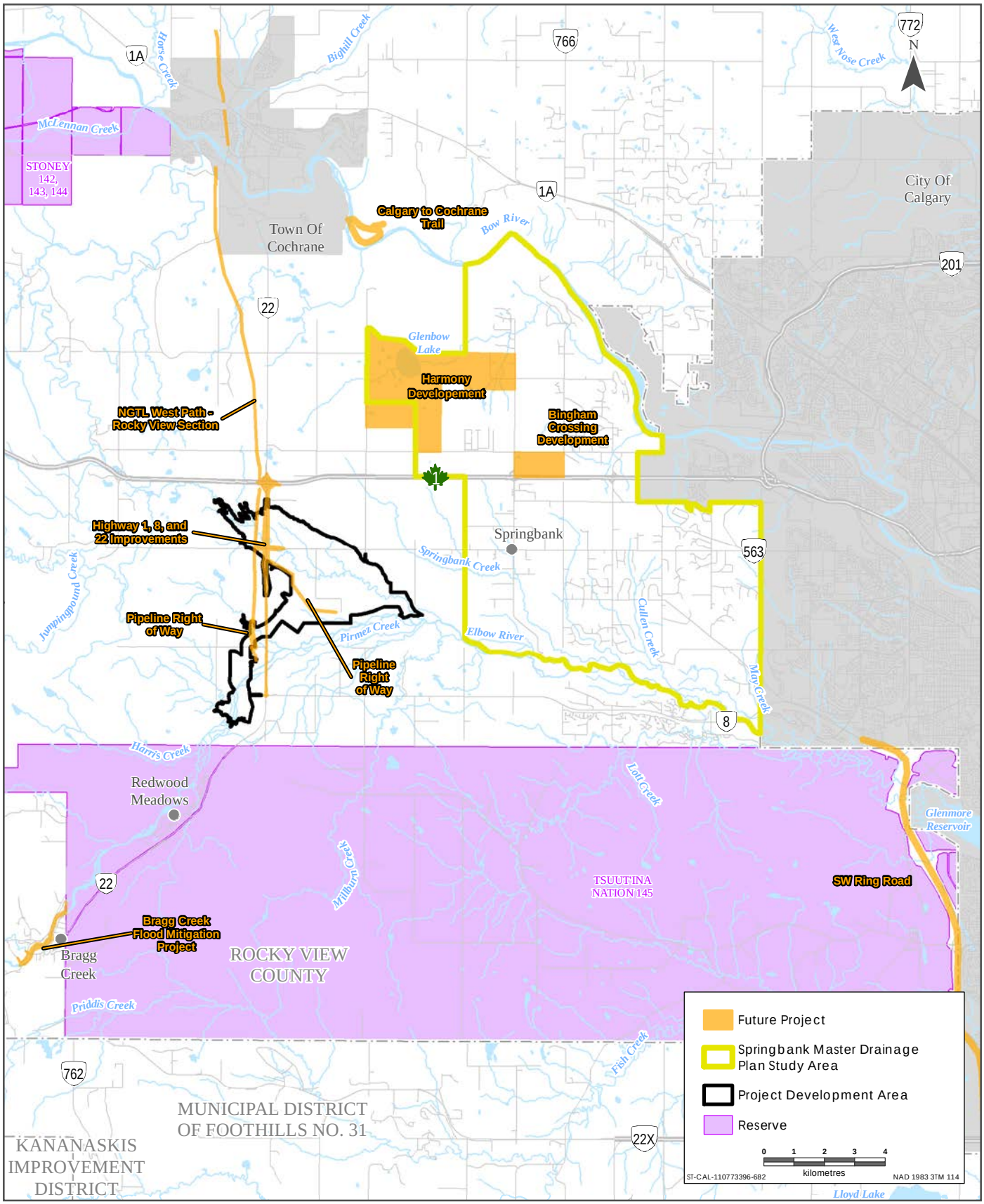
Issue or Comment

a) Include a map showing the relationship between the projects considered in the cumulative effects assessment and the Project.

Response (23)

a) A map of projects and physical activities considered in the cumulative effects assessment is provided in the March 2018 EIA, Volume 3C, Section 1.1.4, Figure 1-1 and duplicated here for ease of reference (Figure 23-1).

[1] **Further questions will be provided to the proponent during Technical Review phase**



Sources: Base Data - ESRI, Natural Earth, Government of Alberta, Government of Canada
Thematic Data - Alberta Environment and Parks (AEP), Alberta Conservation Information Management System (ACIMS), ERBC, Government of Alberta, Stantec Ltd

Future Projects and Physical Activities

Stantec

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (24) Cumulative Effects - Surface Water Quality

EIS Guideline reference: Part 2 Section 6.6.3
EIS reference: Volume 3C, Section 1.5.1

Context and Rationale

The cumulative effects section of the EIS does not identify potential interactions from the upgrades to Highways 1, 8 and 22, and the realignment of existing pipelines and utilities with the Project construction and dry operation because the upgrade and realignment projects will implement standard industry mitigation and best management practices. The EIS indicates that no residual effects are anticipated on surface water quality from the Southwest Calgary Ring Road with mitigation based on the project design, measures outlined in the EPP and the contractor's ESC and ECO plans.

Issue or Comment

a) Describe the potential effects from the upgrades to Highways 1, 8 and 22, and the realignment of existing pipelines and utilities to surface water quality and the specific mitigation measures that can be expected to be implemented.

b) Describe how the Southwest Calgary Ring Road has been designed to mitigate effects on surface water quality and the specific mitigation within the EPP and contractor's plans.

Response (24)

a) Potential upgrades to Highways 1, 8 and 22 and the realignment of existing pipelines and utilities will occur within and near the Project Development Area (PDA). However, these changes will be made using standard industry mitigation and best management practices and no residual effects on surface water quality are anticipated.

   Additional details on potential cumulative effects on surface water quality are provided in the March 2018 EIA, Volume 3C, Section 1.2.3. Standard industry mitigation measures, and best management practices, as well as Project-specific mitigation measures are listed in Volume 4, Appendix C.

[1] **Further questions will be provided to the proponent during Technical Review phase**

b) The environmental assessment completed for the Southwest Calgary Ring Road determined that "*Impacts to surface water quality during the construction and operations phase can be mitigated through Project design and measures outlined in the EPP, and the contractor's ESC and ECO plans*" (AMEC Environment and Infrastructure 2014). Specific details of the mitigation measures, including the Environmental Protection Plan (EPP) proposed for the Southwest Calgary Ring Road can be found in the environmental assessment (AMEC Environment and Infrastructure 2014) and on the Southwest Calgary Ring Road Project website at: http://www.swcrrproject.com/about/environmental-management. In the absence of residual effects on surface water quality from the Southwest Calgary Ring Road, there is no pathway for cumulative effects with the Project.

Reference

AMEC Environment and Infrastructure 2014. Environmental Assessment for the Southwest Calgary Ring Road (Updated December 2014). Submitted to Alberta Transportation, Edmonton, Alberta. CE04163.100.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (25) Cumulative Effects - Aquatic Ecology

EIS Guideline reference: Part 2 Section 6.6.3
EIS reference: Volume 3C, Section 1.6.2.3

Context and Rationale

The EIS quotes from the environmental assessment completed for the Southwest Calgary Ring Road that, *"residual effects to fish and fish habitat from the proposed SWCRR Project are predicted to be negligible to minor. Channel realignments at the Elbow River and Fish Creek crossings will result in a permanent decrease in existing fish habitat. The CEP will mitigate habitat losses and ensure that the quantity and productive capacity of fish habitat in the Elbow River and Fish Creek are sustained."*

Issue or Comment

a) Describe the total net loss in habitat from the Southwest Calgary Ring Road and the Construction and dry operation of the Project.

b) Describe the percentage of total habitat loss from the two projects compared to the total habitat available within the RAA.

Response (25)

a) As described in the March 2018 EIA, Volume 3C, Section 1.2.4, the Project will result in a net loss of 2,154 m^2 of fish habitat within Elbow River and unnamed tributary [ID1350]. The Southwest Calgary Ring Road will result in the net loss of 20,482 m^2 of fish habitat in Elbow River (AMEC Environment and Infrastructure 2014). Therefore, the total net loss of fish habitat from the two projects is 22,636 m^2.

b) As described in Volume 3C, Section 1.2.4.2, the total fish habitat available within the aquatic ecology Regional Assessment Area (RAA) is estimated to be 3,000,000 m^2, based on 67 km of Elbow River in the aquatic ecology RAA and the average channel width of 45 m channel in the 12 reaches. The loss of fish habitat due to the Southwest Calgary Ring Road and the Project is estimated to be 0.75% of total available fish habitat in the aquatic ecology RAA.

[1] **Further questions will be provided to the proponent during Technical Review phase**

A) Early Technical Issues or Comments Identified
May 2018

Reference

AMEC Environment and Infrastructure. 2014. Environmental Assessment for the Southwest Calgary Ring Road (Updated December 2014). Submitted to Alberta Transportation, Edmonton, Alberta. December 2014. CE04163.100

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (26) Cumulative Effects - Vegetation

EIS Guideline reference: Part 2 Section 6.6.3
EIS reference: Volume 3C, Section 1.8.2.3

Context and Rationale

The EIS indicates that, relative to the size of the RAA (approximately 100,000 ha), loss of vegetation from the combination of the Project and future projects is limited.

Issue or Comment

a) Describe the total loss of vegetation from the combination of the Project and future projects and update the cumulative effects assessment as appropriate.

Response (26)

a) The Project will result in the loss of 178 ha of vegetation due to the permanent project structures. Because the Project is anticipated to have adverse residual effects on vegetation and wetlands, a cumulative effects assessment was competed. Table 26-1 (a duplicate of Volume C, Section 1.2.6.1, Table 1-7 in the March 2018 EIA) lists projects that have the potential to act cumulatively with residual environmental effects from the Project.

Table 26-1 Interactions with the Potential to Contribute to Cumulative Effects on Vegetation and Wetlands, Construction and Dry Operations

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Environmental Effects			
	Change in Landscape Diversity	Change in Community Diversity	Change in Species Diversity	Change in Wetland Function
Past and Present Projects and Physical Activities				
Agriculture	✓	✓	✓	✓
Infrastructure	✓	✓	✓	✓
Residential and Communities	✓	✓	✓	✓
Recreation and Tourism	✓	✓	✓	✓
City of Calgary	✓	✓	✓	✓

[1] **Further questions will be provided to the proponent during Technical Review phase**

Table 26-1 Interactions with the Potential to Contribute to Cumulative Effects on Vegetation and Wetlands, Construction and Dry Operations

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Environmental Effects			
	Change in Landscape Diversity	**Change in Community Diversity**	**Change in Species Diversity**	**Change in Wetland Function**
Project-Related Physical Activities	✓	✓	✓	✓
Future Physical Activities				
Bragg Creek Flood Mitigation	✓	✓	✓	✓
Calgary to Cochrane Trail - Phase 2 and 3	✓	✓	✓	✓
The Community of Harmony - Stage 2 and 3	✓	✓	✓	✓
Bingham Crossing Development	✓	✓	✓	✓
Upgrades to Highways 1, 8 and 22	✓	✓	✓	✓
Southwest Calgary Ring Road	-	-	-	-
Realignment of existing pipelines and utilities	-	-	-	-
NGTL West Path Rocky View Section pipeline	✓	✓	✓	✓
Rocky View County Springbank Master Drainage Plan	-	-	-	-
City of Calgary	-	-	-	-

NOTES:
✓ = Other projects and physical activities whose residual effects are likely to interact cumulatively with Project residual environmental effects.
– = Interactions between the residual effects of other projects and residual effects of the Project are not expected.

Future projects with the potential to act cumulatively with the Project are the Bragg Creek Flood Mitigation, Calgary to Cochrane Trail, Community of Harmony (approximately 700 ha in the vegetation RAA), Bingham Crossing development (approximately 60 ha in the RAA), NGTL West Path Rocky View Section and upgrades to Highways 1, 8 and 22. These projects would be expected to have similar effects on vegetation and wetlands as those identified for the Project during construction (i.e., loss or alteration of vegetation and wetland species from stripping, or introduction and establishment of regulated weeds and non-native invasive species). Although the specific extent of vegetation loss as a result of other future projects is unknown, a conservative assumption is made that the footprint of the Community of Harmony and the Bingham Crossing development will result in direct total vegetation loss. In combination with the Project, the total vegetation lost as a result of the three projects combined would be 938 ha. This represents approximately 0.9% of the vegetation in the RAA.

The cumulative loss in vegetation cover from existing conditions during construction with future projects applied is 1.6% (860.9 ha) for native upland cover and 5.9% (118.2 ha) for wetland cover. During dry operations, the cumulative loss in habitat from existing conditions when all future projects are applied is 1.1% (616.1 ha) for native upland cover and 5.7% (114.7 ha) for lowland cover.

With mitigation, the incremental contribution of future projects combined with the Project's predicted residual effect on vegetation and wetlands is low in magnitude, occurs within the RAA, and occurs as multiple irregular events as future projects go forward.

Further discussion of cumulative effects on vegetation is in Volume 3C, Section 1.2.6. and Section 1.3.7.

A) EARLY TECHNICAL ISSUES OR COMMENTS IDENTIFIED[1]

Question (27) Cumulative Effects - Wildlife

EIS Guideline reference: Part 2 Section 6.6.3
EIS reference: Volume 3C, Section 1.9.3.3

Context and Rationale

The EIS describes the residual cumulative effects on wildlife arising from reduced landscape connectivity and physical and sensory barriers. It is noted that the future development of the Harmony community, Bingham Crossing and upgrading of Highway 1, 22 and 8 have potential to contribute to existing cumulative effects on wildlife movement in the RAA. It is concluded that because the Harmony community development and Bingham Crossing occur primarily on previously disturbed lands, the potential for these projects to contribute to a change in regional wildlife movement is limited. Further, upgrading Highways 1, 22 and 8 is considered to have a relatively greater potential cumulative effect on large mammals (e.g., elk, deer) as well as less mobile species (e.g., amphibians) because of increased traffic volumes resulting in incremental sensory disturbance and altered movement patterns.

These large mammals are an important traditional and cultural resource for Indigenous groups that use the area.

Issue or Comment

a) Quantitatively describe current wildlife movement patterns and anticipated change in movement patterns within the Project and future developments and how this may affect traditional use activities.

b) Identify known wildlife corridors that would be impacted by the Project and future activities, and the percentage of the RAA that this area represents.

c) Describe specific mitigation measures that would be implemented to reduce impacts to wildlife movement and mortality from vehicle collisions.

[1] Further questions will be provided to the proponent during Technical Review phase

Response (27)

a) Quantifying wildlife movement patterns requires a modelling approach that uses species-specific movement data typically generated from GPS technology (i.e., radio-collars). These data are not available to quantitatively describe current wildlife movement patterns in the wildlife Local Assessment Area (LAA) or Regional Assessment Area (RAA). As such, potential cumulative changes on wildlife movement are addressed qualitatively in March 2018 EIA, Volume 3C, Sections 1.2.7.1 and Section 1.3.8.1. Future development of the Harmony community, Bingham Crossing, flood mitigation dikes in Bragg Creek, and upgrading of Highway 1, 22 and 8 have potential to contribute to existing cumulative effects on wildlife movement in the RAA. Although it is recognized that upgrading Highways 1, 22 and 8 is more likely to have a relatively greater potential cumulative effect on large mammals (e.g., elk, deer) than the Project and other developments, the extent of the residual effect will vary by wildlife species and future traffic volumes. Overall, because future development of the Harmony community development, Bingham Crossing, and Bragg Creek Flood Mitigation project occur primarily on previously disturbed lands, the potential for these projects to contribute to a change in regional wildlife movement is limited. Therefore, the effects on traditional land use activities are also expected to be limited.

b) Bow River is the only recognized wildlife corridor in the RAA, as identified in the South Saskatchewan Regional Plan (GOA 2017). However, the RAA contains 18,149.7 ha of Key Wildlife and Biodiversity Zones (KWBZ) along Elbow River, Bow River, and Jumping Pound Creek. KWBZs are designed to protect ungulate winter ranges and river corridors where ungulates concentrate, as well as protect locally and regionally-significant wildlife movement corridors (ESRD 2015). The KWBZs along Elbow River and Bow River are 7.1% (7,340 ha) and 5.3% (5,426.8 ha) of the RAA, respectively.

   The Project Development Area (PDA) overlaps 2.8% (207 ha) of the KWBZ along Elbow River. Future project activities such as the Bragg Creek Flood Mitigation, upgrades to Highway 22, NOVA Gas Transmission Ltd. (NGTL) West Path Rocky View Section pipeline, and realignment of existing pipelines and utilities overlap 0.4% (31.4 ha) of the KWBZ along Elbow River. Overall, the Project and future activities overlap 3.2% (238.4 ha) of the Elbow River KWBZ. Future activities for the NGTL West Path Rocky View Section pipeline and Calgary to Cochrane Trail overlap 0.04% (2.4 ha) of the KWBZ along Bow River.

c) Specific mitigation measures that will be implemented to reduce potential project effects on wildlife movement and mortality from vehicle collisions are described in Volume 3A, Section 11.4.4.2 and include:

   - all construction traffic will adhere to safety, road closure regulations
   - other access measures and guidelines for the construction area and associated access roads

Although the specific mitigation measures that would be implemented for other future projects are unknown, industry standard mitigation measures are expected to be implemented (e.g., adherence to safety and speed limits), which would reduce potential changes to movement and incremental increases in mortality risk to wildlife.

References

ESRD (Alberta Environment and Sustainable Resource Development). 2015. Recommended Land Use Guidelines: Key Wildlife and Biodiversity Zones. Available online at: http://aep.alberta.ca/fish-wildlife/wildlife-land-use-guidelines/documents/KeyWildlifeBiodiversityZones-Apr08-2015.pdf. Accessed April 2018

Government of Alberta. 2017. South Saskatchewan Regional Plan 2014 – 2024. Available online at: https://www.landuse.alberta.ca/LandUse%20Documents/South%20Saskatchewan%20Regional%20Plan%202014-2024%20-%20February%202017.pdf. Accessed April 2018.

B) ADVICE TO THE PROPONENT

FISHERIES AND OCEANS CANADA (DFO)

Question a)

EIS reference: Volume 1, Section 3.3.1.3 Diversion Channel

Context and Rationale

This is standard advice given on measures to avoid and mitigate Serious Harm to Fish.

Advice to the Proponent

Please see "Measures to avoid causing harm to fish and fish habitat including aquatic species at risk" on DFO's website http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html, and incorporate all relevant measures into the project plans.

e.g., "If explosives are required as part of a project (e.g., removal of structures such as piers, pilings, footings; removal of obstructions such as beaver dams; or preparation of a river or lake bottom for installation of a structure such as a dam or water intake), the potential for impacts to fish and fish habitat should be minimized by implementing the following measures….."

Response

The March 2018 EIA, Volume 3A, Section 8.4.3 describes the mitigation measures to avoid causing harm to fish and fish habitat, including aquatic species at risk. The section refers to DFO's website (http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html) and indicates that relevant avoidance and mitigation measures will be undertaken. Inspectors will be on site during construction activities and expert personnel, such as qualified aquatic environment specialists (QAES), will monitor and inspect activities for confirmation of compliance with these measures. In addition to DFO's measures to avoid causing harm to fish and fish habitat, including aquatic species at risk, avoidance and mitigation measures are in accordance with:

- Environmental Construction Operations Plan Section 01390 of the Civil Works Master Specifications for Construction of Provincial Water Management Projects (see Volume 4, Supporting Documentation, Document 11)

- Environmental Protection Section 01391 of the Civil Works Master Specifications for Construction of Provincial Water Management Projects (see Volume 4, Supporting Documentation, Document 12)
- Turbidity Barriers and Monitoring Section 02242 of the Civil Works Master Specifications for Construction of Provincial Water Management Projects (see Volume 4, Supporting Documentation, Document 10)
- Care of Water Section 02240 of the Civil Works Master Specifications for Construction of Provincial Water Management Projects (see Volume 4, Supporting Documentation, Document 13)
- Fish Capture and Release Section 02244 of the Civil Works Master Specifications for Construction of Provincial Water Management Projects (see Volume 4, Supporting Documentation, Document 15)

B) ADVICE TO THE PROPONENT

FISHERIES AND OCEANS CANADA (DFO)

Question b)

EIS reference: Volume 3A-7, Section 7.4.1 Analytical Assessment Techniques; Volume 3A-8, Section 8.1.1.3 Additional Guidance; and Volume 3A-8, Section 8.4.1 Analytical Assessment Techniques

Context and Rationale

This is standard advice given on measures to avoid and mitigate Serious Harm to Fish, and information requirements for an Application for Authorization under Paragraph 35(2)(b) of the *Fisheries Act*.

Advice to the Proponent

Since November 25, 2013 changes to the *Fisheries Act*, the "Practitioners Guide to the Risk Management Framework for DFO Habitat Management Staff (DFO 2010)" is no longer a valid document.

Please refer to the following guidance documents on the DFO website at http://www.dfo-mpo.gc.ca/pnw-ppe/fpp-ppp/guide-eng.html :

- **The Fisheries Protection Policy Statement;**
- **The Pathways of Effects**
- **An Applicant's Guide to Submitting an Application for Authorization under Paragraph 35(2)(b) of the *Fisheries Act* (November 2013);**
- **The *Fisheries Act* Applications Regulations.**

Response b)

The applicant's guide to Submitting an Application for Authorization and the *Fisheries Act* Applications Regulations were not referenced because the March 2018 EIA is a baseline information document that also assesses the potential effects of the proposed project on existing environmental conditions.

B) Advice to the Proponent
Fisheries and Oceans Canada (DFO)
May 2018

Fisheries and Oceans Canada (DFO) policy documents were referenced to guide aspects of the assessment, not for the purposes of preparing an Authorization; therefore, the applicant's guide and Applications Regulations were not referenced.

The reference to DFO (2010) is used to establish the history of risk management for fisheries and the development of the pathways of effects tools. It is included with DFO's pathways of effects (PoE) and DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat Including Aquatic Species at Risk guidance found at: http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html as reference only. The legislation and documents identified in the March 2018 EIA, Volume 3A, Section 8.1.1 identify the federal Fisheries Act, the Fisheries Protection Policy Statement, and the Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting that were used as the guiding documents for the assessment.

Mitigation and avoidance measures in Volume 3A Section 8.4.3 are based on guidance documents on the DFO website at http://www.dfo-mpo.gc.ca/pnw-ppe/fpp-ppp/guide-eng.html.

B) ADVICE TO THE PROPONENT

FISHERIES AND OCEANS CANADA (DFO)

Question c)

EIS reference: Volume 3A, Section 8.1.3.1 Selection of Effects

Context and Rationale

This is standard advice given on measures to avoid and mitigate Serious Harm to Fish.

The EIS indicates that "Changes in fish habitat are measurable as the net change of the quantity and quality of fish habitat from all Project activities and works. This recognizes both habitat losses (e.g., related to infilling) and habitat gains (e.g., related to habitat creation or enhancement)".

Advice to the Proponent:

The Fisheries Protection Program considers serious harm as:

- **the death of fish;**
- **a permanent alteration to fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes;**
- **the destruction of fish habitat of a spatial scale, duration, or intensity that fish can no longer rely upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes.**

Proponents are responsible for avoiding and mitigating serious harm to fish that are part of or support commercial, recreational or Aboriginal fisheries. When proponents are unable to completely avoid or mitigate serious harm to fish, their projects will normally require authorization under Subsection 35(2) of the *Fisheries Act* for the project to proceed without contravening the Act.

B) Advice to the Proponent
Fisheries and Oceans Canada (DFO)
May 2018

Response c)

As described in the March 2018 EIA, Volume 3A Section 8.1.3, serious harm is defined by the *Fisheries Act* as the death of fish or any permanent alteration to, or destruction of, fish habitat. This applies to work being conducted in or near waterbodies and watercourses that are part of or that support a Commercial, Recreational, and Aboriginal (CRA) fishery. Serious harm to fish includes:

- the death of fish that may affect the sustainability and ongoing productivity of a CRA fishery;
- a permanent alteration to fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes or
- the destruction of fish habitat of a spatial scale, duration, or intensity that fish can no longer rely upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes.

Serious harm as a result of the Project's activities that cannot be avoided or mitigated is identified in Volume 3A, Section 8.7 and Volume 3B, Section 8.5.

B) ADVICE TO THE PROPONENT

FISHERIES AND OCEANS CANADA (DFO)

Question d)

EIS reference: Volume 3A, Section 8.1.5 Residual Effects Characterization (Page 8.12)

Context and Rationale

This is standard advice given on measures to avoid and mitigate Serious Harm to Fish.

It is stated in the EIS that, "The criteria describe the potential residual effects on aquatic ecology that remain after mitigation measures, including habitat offsetting, have been implemented."

Advice to the Proponent

When considering residual effects as they relate to the *Fisheries Act* and the prohibition against causing serious harm, residual effects are to be considered after avoidance and mitigation and are to be offset.

Response d)

Habitat offsetting was not included as a mitigation measure when assessing project residual effects. Residual effects identified as serious harm that cannot be avoided or mitigated is identified in the March 2018 EIA, Volume 3A, Section 8.7 and Volume 3B, Section 8.5. Habitat offsets of serious harm were not identified.

The statement in Volume 3A, Section 8.1.5 should read:

"*The criteria describe the potential residual effects on aquatic ecology that remain after mitigation measures~~, including habitat offsetting,~~ have been implemented*."

B) ADVICE TO THE PROPONENT

FISHERIES AND OCEANS CANADA (DFO)

Question e)

EIS reference: 1.6.2 Destruction of Fish Habitat; Volume 3A, Section 8.1.6.3 Death of Fish

Context and Rationale

This is clarification of "serious harm".

It is stated in the EIS that, "Such changes would likely cause serious harm to fish if the results of this change in fish habitat cannot be mitigated or offset."

Advice to the Proponent

Please refer to section 8.2 of the Fisheries Protection Policy Statement on the DFO website at http://www.dfo-mpo.gc.ca/pnw-ppe/fpp-ppp/guide-eng.html .

Response e)

It is confirmed that habitat offsetting was not included when assessing serious harm and should not have been included in those sections, as per the Fisheries Protection Policy Statement on the DFO website at http://www.dfo-mpo.gc.ca/pnw-ppe/fpp-ppp/guide-eng.html.

The March 2018 EIA, Volume 3A, Section 8.1.6.2 and Section 8.1.6.3 should have references to offsets removed and should read as follows:

8.1.6.2 Destruction of Fish Habitat

Destruction of fish habitat prevents fish use of such habitats for spawning, nursery, rearing, food, migration, or to carry out one or more other life processes affecting the productivity and sustainability of a fishery. Such destruction would likely result in serious harm to fish if the results of this destruction of fish habitat cannot be mitigated ~~or offset~~. Destruction of fish habitat includes barriers that prevent fish from accessing habitat.

8.1.6.3 Death of Fish

This refers to the likelihood of fish mortality (including eggs), or reductions in fish health, after mitigation measures are implemented. Such changes would occur at a level that reduces the productivity and sustainability of a fishery~~ and cannot be offset~~.

B) ADVICE TO THE PROPONENT

FISHERIES AND OCEANS CANADA (DFO)

Question f)

EIS reference: Volume 3B, Section 8.2.2.1 Project Pathways (Page 8.6), Permanent Alteration of Habitat due to Introduction of Deleterious Substances

Context and Rationale

This is clarification of the *Fisheries Act* prohibitions.

Advice to the Proponent

Refer to the *Fisheries Act* Section 36 regarding prohibition against the deposit of deleterious substances to fish bearing waters.

Response f)

The March 2018 EIA, Volume 3B, Section 8.2.2.2 identifies measures that will be undertaken to prevent or avoid the deposit of deleterious substances. Volume 3B, Section 8.2.2.1 identifies potential effects on the aquatic environment in the case of accidental leaks and spills without the application of best management practices or avoidance and mitigation measures.

B) Advice to the Proponent
Health Canada
May 2018

B) ADVICE TO THE PROPONENT

HEALTH CANADA

Question a)

EIS reference: Volume 3A, Section 15.0 Assessment of Potential Effects on Public Health

Context and Rationale

This is standard advice provided to proponents regarding the assessment of health risks associated with air quality.

Advice to the Proponent

Health Canada encourages the inclusion of four assessment scenarios in the air quality assessment, namely:

i. **baseline;**
ii. **project alone;**
iii. **baseline plus project; and**
iv. **cumulative or future development, as appropriate.**

Response a)

The air quality assessment evaluates effects on air quality associated with construction and dry operations in the March 2018 EIA, Volume 3A, Section 3. The air quality assessment includes a summary of emissions for each assessment case in Volume 3A, Section 3.4.3. Dispersion modelling is presented in Volume 3A, Section 3.4.5.1 for the Base Case (defined by existing emissions in the LAA/RAA), the Project Case (considers only project emissions), and the Application Case (considers the combined effects of the Base Case and the Project Case).

The air quality assessment evaluates effects on air quality associated with flood and post-flood operations in Volume 3B, Section 3. The air quality assessment includes a summary of emissions for each assessment case in Volume 3B, Section 3.2.3. Dispersion modelling is presented in Volume 3B, Section 3.2.5 for all assessment cases.

B) Advice to the Proponent
Health Canada
May 2018

The potential interactions of future developments on air quality are considered in Volume 3C, Section 1.3.1. There are no other known significant future industrial developments proposed in the RAA and, as a result, a cumulative or future development case is not included in the dispersion modelling.

B) Advice to the Proponent
Health Canada
May 2018

B) ADVICE TO THE PROPONENT

HEALTH CANADA

Question b)

EIS reference: Volume 3A, Section 15.4.3 Mitigation

Context and Rationale

This is standard advice provided to proponents regarding the assessment of health risks associated with air quality.

Advice to the Proponent

Health Canada encourages the use of all available mitigation measures that are technically and economically feasible to limit negative impacts to air quality. The best management activities outlined in Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities (Cheminfo, 2005) can be implemented to mitigate air quality effects during the site preparation and construction phase.

Reference: Cheminfo Services Inc. 2005. Best Practices for the Reduction of Air Emissions From Construction and Demolition Activities. Prepared for Environment Canada by Cheminfo Services Inc. March 2005.

Response b)

The March 2018 EIA, Volume 3A, Section 3.4.4 provides a description of the mitigation measures that will be implemented to manage and reduce emissions during the construction phase of the Project. Alberta Transportation confirms that these mitigation measures are based on the recommended Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities prepared for Environment Canada (Cheminfo 2005) and on Alberta Transportation's ECO Plan Framework (provided in Volume 4, Supporting Documentation, Document 4).

Reference

Cheminfo Services Inc. 2005. Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities. Report prepared for Environment Canada Transboundary Issues Branch.

B) Advice to the Proponent
Health Canada
May 2018

B) ADVICE TO THE PROPONENT

HEALTH CANADA

Question c)

EIS reference: Volume 3A, Section 15.2.2 Volume 3A, Section 15.3

Context and Rationale

Annex 1, Information Requirement 14 (Aboriginal Peoples – Country Foods) identified that the EIS and EIS Summary be updated to include an assessment of country foods, describing what is available in all areas to be impacted by the Project, include predicted rates of consumption, and assess which country foods may be contaminated by Project activities throughout all Project phases.

Advice to proponent

Given the apparent uncertainty as to the country foods consumption patterns within the PDA, Health Canada suggests surveying potentially impacted Indigenous groups to establish which country foods are consumed in the PDA to establish baseline and predicted rates of consumption. This information can be used to support the assessment of the potential impacts of the project on country foods and subsequently, on human health.

Response c)

The March 2018 EIA (Volumes 3A and 3B, Sections 14 and 15) assesses the potential for effects on traditional land and resource use (TLRU) and on public health as a result of changes to country foods. The Project is located predominantly on private lands and although some land owners permit access to Indigenous groups for TLRU activities, opportunities for harvesting country foods are not expected to be extensive. Some Indigenous groups reported that TLRU activities occur in the area of the Project; however, the locations where country foods are harvested in the area of the Project or the frequency of consumption of country foods was not provided by Indigenous groups, neither through Project-specific traditional use studies nor the Indigenous engagement program for the Project. In addition, the Project will not introduce chemicals into the environment that could bioaccumulate or bioconcentrate in edible tissues. As a result, effects on human health through the consumption of country foods are expected to be negligible (Volume 3B, Section 15.4.2.3). For example, the human health risk assessment (Volume 4, Appendix O, HHRA Technical Data Report, Section 5.2 and 6.3.2) predicted that, given the short duration that methylmercury forming conditions could occur, there is a low likelihood that

methylmercury could migrate through the aquatic food web and therefore risks to Indigenous receptors through water and fish ingestions pathways are not expected.

Given the location and scope of the Project, surveys (as suggested by Health Canada) are not expected to change the baseline conclusions reached in the EIS regarding country foods. However, any Project-specific TLRU information that may be received after the EIA was filed in March 2018, including information about country foods consumption patterns, will be considered and reviewed against the results of the EIA and a formal response will be developed.

B) ADVICE TO THE PROPONENT

HEALTH CANADA

Question d)

EIS reference: Volume 3A, Section 4

Context and Rationale

Volume 3A of the EIS states that mitigation will be developed further for each of the identified acoustic assessment scenarios when the project schedule is finalized.

Advice to proponent

Health Canada requests that a noise management plan is provided for review prior to the completion of the assessment, to allow for comment on the suitability and appropriateness of the proposed mitigation.

Response d)

A Noise Management Plan (NMP) will be implemented with the following major components:

- mitigation measures
- notifications
- monitoring
- complaint process
- corrective action
- records

The sections below provide further details on each component of the NMP.

Mitigation Measures

Mitigation measure recommendations are presented in the March 2018 EIA, Volume 3A, Section 4.4.2.2 and in this Annex 2, Section A, Early Technical Issues, Question 14.

B) Advice to the Proponent
Health Canada
May 2018

Notifications

This section of the NMP is adapted from the recommendations in Appendix H of the Health Canada noise guidance. The following actions will be considered for Project-related noise effects that are close to the threshold at noise sensitive receptors:

- provide advance notification to noise sensitive receptors concerning construction duration
- define activities that are expected to be noisy and their expected duration and the noise mitigation measures being applied, and when noise respite periods will occur
- provide information to noise sensitive receptors before and during construction through media such as letterbox drops, meetings, website, or individual consultation
- A site information board will be available at the front of the construction site with contact details, hours of operation and regular information updates

Monitoring During Construction

If required, long-term continuous noise monitoring will be implemented at a noise sensitive receptor. The purpose of the noise monitoring program is to monitor, analyze, evaluate, and document if the Project successfully meets the regulatory thresholds presented in Volume 3A, Section 4.1.1. The monitoring will use dedicated sound level meters, and results will be used to compare the Project-related noise with the threshold. In addition, short-term measurements near the noise emission sources will be conducted to quantify the noise emission levels. The monitoring methods will be consistent with the requirements outlined in Alberta Energy Regulator (AER) Directive 038 noise guideline.

The applicability, requirement, monitoring location and duration of the monitoring program will be finalized when final Project design details are available.

Complaint Process

The Noise Complaint Investigation Form in the AER Directive 038 noise guideline provides the framework for noise compliant investigation. The forms will be incorporated as part of the complaint investigation and resolution process in the NMP.

During construction, a public complaints protocol will be implemented to address noise complaints in a timely manner from the community. Complaints can be received formally or informally, following a process that will be posted on the project website. A formal complaint will include correspondence, phone calls, comments posted to the project website or emails sent to Alberta Transportation specifying a concern, making a claim or otherwise critical of the construction activities.

Informal complaints will include issues or concerns expressed verbally to project employees, as well as concerns raised by individuals through social media, such as Facebook, Twitter and other online platforms. Complaints will be accepted anonymously, although Alberta Transportation notes that responses can only be provided to individuals who provide contact information.

In every instance, the receipt of a formal or informal complaint will require the employee or contractor who receives it to complete a written record and deliver it promptly to Alberta Transportation.

Corrective Action

Alberta Transportation will identify and correct incidents, including non-compliance with relevant compliance obligations associated with noise related activities, with appropriate and lasting measures aimed to prevent reoccurrence and/or similar occurrences. Corrective actions will be assigned to the responsible Alberta Transportation personnel, including actions to prevent their reoccurrence. Corrective actions will vary according to the results of incident investigation and in consideration of other incidents related to noise.

Records

Records associated with NMP activities will be maintained and include the following:

- contractor/supplier communications regarding noise management
- incident reports
- monitoring data and records as identified in the NMP
- noise complaints from the community (i.e. complaint investigation forms, telephone records, and community liaison meetings)
- corrective actions related to noise

Records will be stored in either hardcopy and/or electronic formats and maintained in such a way that they are readily retrievable and protected against damage, deterioration, or loss.

B) ADVICE TO THE PROPONENT

TRANSPORT CANADA

Question

EIS reference: Volume 1, Section 1.3.2 Non-permit Regulatory Requirements

Context and Rationale

The EIS lists the Navigation Protection Act under 'non-permit environmental legislation'. It is unclear what is meant by "non-permit legislation".

The Elbow River is a non-scheduled water therefore an approval under the Navigation Protection Act (NPA) is not required for this Project. However, the NPA includes an "opt-in" provision that allows owners of works in non-scheduled navigable waters to ask for assessment and review of their work under the NPA. Although making a request to opt-in to the NPA is optional, owners of projects may wish to have their work reviewed so they can proceed with the added assurance that the work's interference with navigation is sanctioned under the NPA.

Transport Canada may accept an opt-in request or deny the request if it is determined to be unwarranted. If the request is accepted the full NPA regime and all requirements apply to the work.

To formally request to opt-in a work, an Opt-in Form must be completed and submitted to the regional Navigation Protection Program office along with a Notice to Minister Form. Once a work has successfully opted in to the NPA regime, owners are required to provide notice to the Minister before undertaking an alteration, repair (other than a minor repair), rebuilding, removal, or decommissioning of the work.

Advice to the Proponent

It is recommended that the proponent indicate as soon as possible if it intends to opt-in to the NPA. If so, it is recommended that the proponent submit a formal request to Transport Canada to opt-in to the NPA.

Response

It is Alberta Transportation's intension to opt-in to the *Navigation Protection Act*.