MEMO

From	Kristina Benoit
To	Richard Dwyer
Ref.	2AM-BRP1831
Date	2 Aug 2024
Subject	2023 Annual Report for 2AM-BRP1831 – Responses to Comments

Dear Mr. Dwyer,

Thank you for the opportunity to respond to comments received on the Back River Project's (Project) 2023 Annual Report for 2AM-BRP1831. Comments were received from the Kitikmeot Inuit Association (KIA), Environment and Climate Change Canada (ECCC), Fisheries and Oceans Canada (DFO), and Crown Indigenous Relations and Northern Affairs Canada (CIRNAC).

B2Gold Back River Corp. (B2Gold Nunavut) thanks all parties for their review of our submission and provides responses below.

Sincerely,

Kristina Benoit
Manager, Environmental Permitting
B2Gold Nunavut

Cc: Merle Keefe, Manager, Environment, B2Gold Nunavut

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1. KIA-NWB-01

Review Comment Number	KIA-NWB-01
Subject/Topic	2023 Geochemical Testing – Sources of Applied Criteria and Results
References	B2Gold Nunavut Back River Project 2023 Annual Report for Water Licence 2AM-BRP1831, Section 2.6
Summary	In 2023, environmental monitoring was carried out for geochemical programs at the Back River Project site. A total of 57 samples of waste rock were collected and submitted for acid- base accounting (ABA) and shake flask extraction (SFE) testing. Results presented in Section 2.6 of the Annual Report indicated most of the samples were classified as non-potentially acid generating (NPAG), according to criteria established for the project and shown in Section 2.6c. These criteria appear to be project-specific and the source(s) or supporting information associated with establishing these criteria was not provided. The SFE test results were summarized in the report text, which identified exceedances of aluminum in 26 (of 57) samples; however, results were not provided in-text or appended to complete a review of this summary.
Detailed Review Comment	In 2023, 57 samples of potential construction material were collected. The ARD potential of these materials was assessed using measured total sulphur and total carbon percentages, as proxies for a materials' acid potential (AP) and neutralization potential (NP), respectively. Use of these parameters assumed: All sulphur species are "present as pyrite and can generate acid" All carbon species are "present as calcite and can neutralize acid". The document indicates the determination of NP was considered "conservative as it discounts the contribution from silicate minerals"; however, no supporting data nor references were provided. Other carbonate mineral species (i.e., other than calcite) may be present and the presence of iron or manganese bearing carbonates do not provide net neutralization. It was noted in the Final Environmental Impact Statement (FEIS) for the project that iron carbonates tend to be the dominant forms in samples with higher carbonate NP contents (SRK Consulting (Canada) Inc., November 2015). The Project's Waste Rock Management Plan (Sabina, April 2022) indicated that total inorganic carbon is to be used to calculate a sample's NP (see Section 7.1.4 of that document) The ratio of a sample's calculated NP and AP is the neutralization potential ratio (NPR), which is used to determine if a sample is classified as NPAG or potentially acid generating (PAG). The criteria provided for the Back River Project is broken into four project-specific classifications that involves both

	a sample's NPR as well as its total sulphur percentage, Results from SFE testing were compared to 10x Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of freshwater aquatic life.
	The document states that total aluminum exceeded the 10x CCME guideline in 26 (of 57) samples and no other exceedances were noted. The document also states that the SFE results are "not suggestive of a high metal leaching potential". However, results were not provided for review, nor were the reference for the criteria with which to define a "high" metal leaching potential.
Recommendation/ Request	Comparison criteria and the source of these criteria used to assess the ARD and/or ML potential of a material should be presented as part of annual reporting. Statements of the conservatism of analytical approaches should provide adequate supporting descriptions or references. Confirm whether total carbon and not total inorganic carbon should be used to assess a sample's NP. Results from all geochemical testing are requested to be provided as part of annual reporting.
Importance	Moderate
B2Gold Nunavut Response	The annual report's purpose is not to present the derivation of project specific criteria or provide commonly available background information. B2Gold Nunavut notes that the classification criteria that are used for waste rock classification are described in Table 5.3-1 of the approved Waste Rock Management Plan (WRMP; Sabina, 2022). As described in Section 5.3 of the approved WRMP, the criteria were developed through an extensive geochemical assessment program conducted by SRK (Appendix E-3 of the 2017 Sabina FEIS application, referenced here as SRK 2015). B2Gold Nunavut will provide the requirements outlined within Part 6, Schedule B of the Type A Water License.

2. KIA-NWB-02

Review Comment Number	KIA-NWB-02
Subject/Topic	2023 Geochemical Testing – Sample Details
References	B2Gold Nunavut Back River Project 2023 Annual Report for Water Licence 2AM-BRP1831, Section 2.6

Summary	A total of 57 samples of waste rock were collected and submitted for ABA and SFE testing in 2023, which were tabulated and provided in Section 2.6 (Table 2.6-1) of the Annual Report. Details associated with the timing and location of the 57 samples collected were not provided in the report to provide an understanding of the representativeness of these data to the waste rock produced in 2023. Monthly records of NPAG versus PAG classified waste rock volumes produced and used in 2023 were not provided, which would provide an assessment of the Project's waste rock monitoring program.
Detailed Review Comment	In 2023, a total of 284,173 bank cubic metres (BCM) of waste rock was generated and used for construction and 57 samples of potential construction material were collected at the Project site. The details provided in the Annual Report suggest a sample frequency of one sample per 5,000 BCM was achieved in 2023, which aligns with the minimum sampling guidance provided in the Waste Rock Management Plan (Sabina, April 2022) (i.e., minimum of 8 samples per 100,000 tonnes). The Waste Rock Management Plan also indicates that quantities of NPAG and PAG waste rock will be recorded on a monthly basis, as per Water Licence 2AM BRP1831 Part 1 Item 9b. These details were not provided in the Annual Report. The Waste Rock Management Plan states that samples are to be collected from blast holes drilled in the rock quarries prior to waste rock excavation, and details associated with sample depth, location and blast hole number are to be recorded. Such sample details were not provided in the Annual Report.
Recommendation/ Request	Additional details associated with the 57 samples collected in 2023 are requested, which should align with the Project's Waste Rock Management Plan. Monthly records of the amount of NPAG to PAG material produced and its use are requested to be provided, to align with the Project's Water Licence. If these records have been provided, but are located in a separate document, this reference should be cited in the Annual Report.
Importance	Moderate
B2Gold Nunavut Response	This information was provided in Section 2.6 of the 2023 Annual Report. Due to the majority of material being utilized for construction, and the small amount of PAG produced, it was not broken down by month. B2Gold Nunavut will provide the requirements outlined within Part 6, Schedule B of the Type A Water License.

3. KIA-NWB-03

Review Comment Number	KIA-NWB-03
Subject/Topic	Monitoring Program – General Information
References	2.13 The Results and Interpretation of the monitoring program in accordance with Part I and Schedule I Text: A high-level monitoring summary outlining activity related to each monitoring station indicated in Part I and Schedule I of the Licence is provided in Appendix C. Monitoring details are provided below for monitoring stations that were active in 2023.
Summary	No figure with monitoring stations is included.
Detailed Review Comment	See above.
Recommendation/ Request	Add Figure with monitoring stations in Appendix C for better understanding.
Importance	Low
B2Gold Nunavut Response	Sampling locations are established at the initiation of discharge. Many stations have not yet been established as the associated project infrastructure or activity has not yet been constructed or initiated. Water Licence monitoring locations are provided in the Water Management Plan, and a location map is not a requirement of the annual report. However, B2Gold Nunavut can include a sampling location map in future annual reports to improve clarity.

4. KIA-NWB-04

Review Comment Number	KIA-NWB-04
Subject/Topic	Monitoring Program - Greywater (BRP-42 MLA)
References	2.13 The Results and Interpretation of the monitoring program in accordance with Part I and Schedule I Text: BRP-42 MLA Greywater Approximately 3,896 m^3 of greywater was discharged to the tundra from the MLA camp at a monthly rate approximately equivalent to the quantity of desalinated water produced at the MLA (Table 2.13-1). No flow or water was available for sampling downstream of the discharge point (i.e. at BRP-42). No site seepage or runoff with the potential to enter a freshwater waterbody was observed at the MLA site. Appendix C – Table C-1 2023 Monitoring Activity Overview by Station
Summary	No water sample was collected for the greywater discharge from the MLA camp.
Detailed Review	Appendix C – Table C-1 2023 Monitoring Activity Overview by Station

Comment	includes the frequency of monitoring prior to discharge or transfer of water. The Annual Report indicates that 3,896 m^3 of greywater was discharged to the tundra from the MLA camp, but no sample collection was taken.
Recommendation/ Request	B2Gold should clarify the reason for not collecting the water sample when greywater was discharged to the MLA. Water quality sampling should occur during future greywater discharges in accordance with monitoring requirements. A discussion of the potential effects should also be included in the Annual Report.
Importance	Moderate
B2Gold Nunavut Response	B2Gold Nunavut is required to collect a sample monthly from BRP-42, which is located at the point of entry of the greywater into the ocean. No water has been available for sampling at BRP-42 during any monthly sampling event. This is due to the substantial overland distance from the point of discharge to the ocean (hundreds of meters). This overland transit allows extensive land treatment, water uptake, and evaporation of this camp greywater.

5. KIA-NWB-05

Review Comment Number	KIA-NWB-05
Subject/Topic	Goose & MLA Project Sites – 2023 Annual Geotechnical Inspection (Overburden Stockpile)
References	Paragraph 5.2.3 – Overburden Stockpile (Page 13) The ponding water was observed in areas at the toe of the stockpiles. This is likely in part from the release of water from the overburden soil due with the high ice and water content as the outside layers of the stockpile thaw in the warmer months. It would be suggested collect water samples from the ponded water around this area to better characterize (in terms of water quality, e.g. TSS, salinity, ammonia etc.). Based on the water sampling result and observations around the time of next freshet, additional water management or sediment management (such as a small filtering berm or silt fencing) at the toe of this stockpile may be considered. *– SRK was informed that site has an overburden stockpile monitoring program and corresponding that is in place and should address this comment. This overburden monitoring program was not reviewed as part of the 2023 AGI.*
Summary	Ponded water was observed at the toe of the overburden stockpile during the 2023 SRK Geotechnical Inspection.
Detailed Review Comment	Sampling of the ponded water from the toe of the overburden stockpile should be characterized. In case of elevated concentrations of one or more variables (e.g., TSS, ammonia, metals, salinity), a collection channel should be created around the stockpile to prevent the mixing of runoff water with contact water, especially during spring thaw and summer months when the surficial layer above the permafrost is active.

Recommendation/ Request	The water quality and final discharge location of the contact water from the overburden stockpile should be included in the annual report.
Importance	Moderate
B2Gold Nunavut Response	Ponding water occurred in small volumes and ultimately evaporated. If ponding water occurs in volumes requiring management, B2Gold Nunavut will complete water quality sampling in advance as suggested and provide this information within the annual report.

6. KIA-NWB-06

Review Comment Number	KIA-NWB-06
Subject/Topic	Goose & MLA Project Sites – 2023 Annual Geotechnical Inspection (Goose Tank)
References	Paragraph 5.2.4 – Goose Tank Farm (Page 23) The base of the containment area had some water over the base in areas during the inspection. This likely was due to some of the recent rainfall on site around the time of the inspection. Active pumping was not noted at the time of the inspection. *Site staff indicated that each spring water from both sides of the containment area are managed / pumped. Around the time of the 2024 freshet, additional pumping and water management would be expected to be required. It is SRK's understanding that this is on sites radar and plans have already been made for this ongoing operational and maintenance support.*
Summary	Ponded water was observed in the containment area during the 2023 SRK Geotechnical Inspection.
Detailed Review Comment	Sampling of the water within the containment area is required before discharging, and the water quality results should be included in the report, as well as the water quantity and final discharge location.
Recommendation/ Request	The water quality and quantity, as well as final discharge location, should be included in the annual report.
Importance	Moderate
B2Gold Nunavut Response	Ponding water within the Goose Tank Farm will be managed in accordance with Part F, Item 12, of Type A Water License 2AM-BRP1831 (Amend. No. 1). Results will be provided with the annual report.

7. KIA-NWB-07

Review Comment Number	KIA-NWB-07

Subject/Topic	Ground Thermal Monitoring Plan
References	Appendix D - Back River Project: Site-wide Ground Thermal Monitoring Plan Table 2: Recent Ground Temperature Sites Installed Between 2023 and 2024

Primary Pond Dam	SRK-24-PP-DH01	2024	7271328	429660	Inactive	Temporary	8
	SRK-24-PP-DH02	2024	7271366	429613	Inactive	Temporary	9
	SRK-24-PP-DH03	2024	7271323	429658	Inactive	Temporary	8
	SRK-24-PP-DH04	2024	7271319	429664	Inactive	Temporary	5

Summary	The digital ground temperature cables (GTCs) at Primary Pond Dam have been installed to maximum depths ranging from 5 to 9 mbgs.
Detailed Review Comment	Paragraph 2.4 of the Appendix D indicates that the seasonally thawed active layer ranges from approximately 1 to 4 meters below ground surface (mbgs). Based on the above, Palmer recommends installing the future GTCs up to at least 15 mbgs to capture future potential impacts of the primary pond on the vertical temperature profile.
Recommendation/ Request	Install GTCs up to at least 15 mbgs.
Importance	Moderate
B2Gold Nunavut Response	B2Gold Nunavut agrees with this comment. The future and final instrumentation installation plans, for the Primary Pond dam, include the installation of vertical Ground Temperature Cables (GTCs) that will be at least 15mbgs. Once these additional vertical GTC s are installed, at the Primary Pond, then this information will be added into the next revision of the “Site-wide Ground Thermal Monitoring Plan”.

8. KIA-NWB-08

Review Comment Number	KIA-NWB-08
Subject/Topic	Llama and Umwelt Lake Dewatering Plan
References	*CHAPTER 2.0 DEWATERING VOLUMES (Page 2)* *If water treatment is undertaken (Stage 2), it is anticipated that TSS in the Llama and Umwelt will continue to increase over time to a point where treatment is no longer practical or sufficiently effective. At that time, Stage 3 of pumping would be initiated.*
Summary	Trigger levels/criteria to switch from Stege 2 to Stage 3 should be identified and clearly communicated.
Detailed Review Comment	Please produce a flow diagram to clearly identify the criteria to switch from Stage 2 to Stage 3 or cite the document containing this information. Trigger levels/criteria should be based both on water quality (TSS maximum concentration) and water quantity (maximum flow rate that can be treated to lower TSS below Licence discharge criteria).

Recommendation/ Request	Provide a flow diagram that identify quality and quantity trigger levels to switch from Stage 2 to Stage 3.
Importance	Low
B2Gold Nunavut Response	B2Gold Nunavut has discussed this comment with the KIA and understands that their comments on the Dewatering Plan have been satisfied through the approval process recently completed in relation to that plan.

9. KIA-NWB-09

Review Comment Number	KIA-NWB-09
Subject/Topic	Llama and Umwelt Lake Dewatering Plan
References	*CHAPTER 2.0 DEWATERING VOLUMES (Page 2) Stage 3 of dewatering may be initiated, with the storage of non- compliant water in either Llama or Umwelt Lakes or in the Primary Water Pond or another water management structure.*
Summary	*Clarify how water will be managed during Stage 3.*
Detailed Review Comment	*The dewatering plan mentions that non-compliant water will be discharged either to Llama or Umwelt Lake or in the Primary Water Pond or another water management structure.* *It is unclear how the discharge will be directed to Llama or Umwelt Lakes if the purpose of the dewatering activities is to dewater Llama Lake and Umwelt Lake.* *The client should also clarify the rationale for discharging and the approximate volumes available at each location.* *Flow diagrams of Stage 3 might be useful to provide clarification about the water management during Stage 3. Trigger water quantity and quality levels should also be in place to define the final discharge location during Stage 3.*
Recommendation/ Request	*Update Stage 3 description and define more accurately discharge locations.*
Importance	*Low*
B2Gold Nunavut Response	B2Gold Nunavut has discussed this comment with the KIA and understands that their comments on the Dewatering Plan have been satisfied through the approval process recently completed in relation to that plan.

10. KIA-NWB-10

Review Comment Number	KIA-NWB-10
Subject/Topic	Llama and Umwelt Lake Dewatering Plan
References	Figure 3

Summary	Update Figure 3 to extend the dewatering pipeline to Goose Lake.
Detailed Review Comment	The dewatering pipeline from Umwelt Lake is directed to the nearby surface watercourse, which is connected to Goose Lake. The dewatering pipeline should be extended to Goose Lake as per Water Licence 2AM- BRP1831.
Recommendation/ Request	Update Figure 3 to include the extension of the dewatering pipeline to Goose Lake.
Importance	Low
B2Gold Nunavut Response	B2Gold Nunavut has discussed this comment with the KIA and understands that their comments on the Dewatering Plan have been satisfied through the approval process recently completed in relation to that plan.

11. KIA-NWB-11

Review Comment Number	KIA-NWB-11
Subject/Topic	Consolidation of reporting
References	Section 1, 2-AM-BRP1831 Annual Report
Summary	Annual reporting for Type A and Type B water licenses should be consolidated.
Detailed Review Comment	The Annual Report indicates that use of exploration waste and water management facilities in 2023 are reported in the Annual Report for Water Licence 2BE-G002028.
Recommendation/ Request	KIA recommends that activities permitted under the Type B water licence be included in Type A licence reporting once construction begins (including dewatering of the Lama and Echo Pit lakes).
Importance	High
B2Gold Nunavut Response	B2Gold Nunavut respectfully notes that these two water licences have separate scopes, compliance criteria, and requirements. For full transparency, both the Type A and Type B reports clearly identify within them what water uses/wastes deposits are within the scope of the other annual report and why. B2Gold Nunavut also points out that dewatering activity falls solely under the scope of the Type A water licence, and as such this data and monitoring information will be reported in the Type A annual report; it is not within the scope of the Type B water licence or related to an exploration activity.

12. KIA-NWB-12

Review Comment Number	KIA-NWB-12
Subject/Topic	Monitoring programs
References	Appendix C Monitoring Activity Overview by Station

Summary	Results of all water monitoring programs should be reported in the Annual Report.
Detailed Review Comment	Table C-1 shows that several types of water monitoring occurred in 2023. It is not clear where in the Annual Report the results of monitoring at BRP-43 (for discharge of 10 m3) and BRP-G-01 to BRP-G (for flow during culvert construction) are reported.
Recommendation/ Request	We recommend that the details of regulated monitoring at the MLA Fuel Tank Farm (for discharge of water at BRP-43) and for general site runoff during culvert construction (at BRP-G-01 to BRP-G) be included in the Annual Report.
Importance	High
B2Gold Nunavut Response	There was no discharge from MLA fuel berm in 2023; this was an accidental carry over of 2022 information in Appendix C. Monitoring data for the general site run off during culvert construction was provided as Appendix G of the 2023 NIRB Annual Report and has been provided here as Appendix A.

13. KIA-NWB-13

Review Comment Number	KIA-NWB-13
Subject/Topic	Use of hydrogen peroxide
References	Back River Project Spill Contingency Plan, Section 9.3.4 Chemicals
Summary	Full details on the use of hydrogen peroxide should be provided.
Detailed Review Comment	Section 9.3.4 states that “Hydrogen peroxide – is used in the Process Plant (for what)” (p. 45). No explanation of “for what” is provided.
Recommendation/ Request	More detail on what hydrogen peroxide is used for should be provided.
Importance	Moderate
B2Gold Nunavut Response	It has been clarified that B2Gold Nunavut will not be using hydrogen peroxide at the Process Plant. This information will be corrected in the next SCP revision.

14. KIA-NWB-14

Review Comment Number	KIA-NWB-14
Subject/Topic	Spill reporting in Annual Report
References	Back River Project: 2023 Annual Report for Water Licence 2AM-BRP1831. April 2024, Appendix G Type A Water Licence: 1 AM-BRP1831 (Amendment No. 1)

Summary	B2Gold wrote a spill contingency plan as part of their overall Emergency Response Program for the Project. This plan was written to meet requirements of a Type A Water Licence as well as Canada's Environmental Emergency Regulations. Zoetica™, on behalf of the KIA, audited the report alongside the water license and identified some deficiencies. The Type A water licence requires spills be logged and reported in the annual report. All required information was not supplied with regards to follow-up plans and linking spill logs to adaptive management.
Detailed Review Comment	The Type A water licence requires that B2Gold keep a log of all reportable spills and outlines specific requirements for parameters (a list and description of all unauthorized discharges, including volumes, identification numbers, and follow-up actions to be reported within the annual report). The term 'follow-up' is typically used in EIAs to do one or more of the following, depending on context: verify predictions of environmental effects identified in the environmental assessment; determine the effectiveness of mitigation measures so that measures can be modified, or new measures can be implemented if required; support the implementation of adaptive management measures to address previously unanticipated adverse environmental effects; provide information on environmental effects and mitigation that can be used to improve and/or support future environmental assessments (including cumulative environmental effects assessments); and/or support environmental management systems used to manage the environmental effects of projects. Appendix G of the Annual Report provides a spill log with information on spill date, product spilled, quantity, spill description, site, approximate
	location, spill number and mitigation (how the spill was cleaned up). However, in the log table provided in Appendix G, B2Gold reduces the term 'follow-up' to immediate mitigation/cleaning of the spill. The table lacks information on follow-up actions and how the information was used to inform adaptive management or to improve mitigation. Fixing this logging system to feed into adaptive management and to meet the criteria set out in the Type A water licence is critical for the identification of root causes and fixing root problems/improving spill mitigations and responses (e.g., via Non- conformance and Corrective Action reporting). In general, the spirit of QA/QC in the water licence and the requirements of the spill log data collection emphasize follow-up plans that enable adaptive management. This core element is being missed and it appears that Back River is recording spill issues that are cleaned up and then repeated. In one case, 150 L of gear oil was spilled due to a valve being left open. Follow-up actions that go beyond the cleanup of the spill would include an investigation of root causes (lack of adequate training, lack of checks and verification protocols by a second or third personnel to capture human errors, etc.) and revisiting operating procedures or on-site plans with corrective actions, and potential procedural updates for prevention in the future. Other instances involving equipment failure resulted in large incidents, including 3140 L of raw sewage being spilled. The mitigation to

	clean spills up is again listed, but there is no discussion of follow-up activities to determine and correct procedures, materials, or to properly manage personnel that contributed to the spill, and to implement corrective actions and adaptive management. There are also multiple instances of only high-level locations being indicated as the spill location and "other" being used to describe the product type where a large spill occurred. As such, this log does not appear to currently meet the requirements of the Type A Water Licence and improvements should be made to logged information and reporting on how spills are investigated. This logged information should be used in a functioning adaptive management system that learns from mistakes and implements additional safeguards where needed so that the same mistakes are not repeated.
Recommendation/ Request	Please include all information required for spill logs, including follow-up actions to improve spill plans and prevent recurrences in the future by implementing corrective actions following investigations. Outline how the information was fed into adaptive management. If spill log information is not being used to develop follow up plans and to feed into adaptive management, please modify the information collection protocol and log form with updates to meet these requirements next year. Please modify the plan to include a procedure for repeated training and frequent QA/QC of the spill log to ensure people are reporting the exact locations and products spilled. The QA/QC should be done on a timeframe that would enable someone to revisit a spill site to take a GPS coordinate if one was not taken, or to determine the product spilled if "other" is listed.
Importance	Moderate
B2Gold Nunavut Response	B2Gold Nunavut will include further information on follow up actions where appropriate in the next Annual Report, and will ensure that spill records are reviewed to ensure relevant information is captured. The SCP does outline training and adaptive management, but we will review and ensure this information is clarified in the updated SCP.

15. KIA-NWB-15

Review Comment Number	KIA-NWB-15
Subject/Topic	Language for communicating about spill incidents.
References	B2Gold Spill Contingency Plan Version 4, February 2024 Type A Water Licence : 1 AM-BRP1831 (Amendment No. 1)
Summary	The Type A water license requires that signs are printed in English, Inuktitut, Inuinnaqtun, and French.
Detailed Review Comment	Four languages are required on signs communicating locations of water storage and waste disposal facilities. It would seem prudent for communications to the public about spills to be released in the same languages, where relevant.

Recommendation/ Request	Please note the languages to be included for communicating spills to the public within the spill contingency plan.
Importance	Moderate
B2Gold Nunavut Response	Spill information will be communicated in English, as adding translation requirements could significantly delay the ability to communicate information quickly, which is a necessity in the event of a major spill. Due to the location of the Back River Project, the risk to the public of even a major spill is anticipated to be very low. B2Gold Nunavut will continue to post signage in all required languages at water and waste locations.

16. KIA-NWB-16

Review Comment Number	KIA-NWB-16
Subject/Topic	Bulk Fuel Storage Facilities and Fuel Transfer Area at the Marine Laydown Area (MLA) – applicable legislation
References	B2Gold Spill Contingency Plan Version 4, February 2024 Type A Water Licence: 1 AM-BRP1831 (Amendment No. 1)
Summary	B2Gold wrote a spill contingency plan as part of their overall Emergency Response Program for the Project. This plan was written to meet requirements of a Type A Water Licence as well as Canada's Environmental Emergency Regulations. Zoetica™, on behalf of the KIA, audited the report alongside the water license.
Detailed Review Comment	While additional legislation related to spill contingency planning is noted within the Type A water licence, it would be helpful to pull those pieces of legislation forward for readers that do not have the Type A water licence in hand when reading the plan. Namely, it would be helpful to note legislation and standards such as the Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products, 2003; CCMA PN1326 (most recent version); Relevant standards of the Canadian Standards Act (CSA); and the National Fire Code, 2015 (or more recent).
Recommendation/ Request	Please note the additional relevant legislation and best practices that will be followed as part of minimizing spill risk within the spill contingency plan, even if those pieces of legislation are noted within the Water Licence.
Importance	Moderate
B2Gold Nunavut Response	Additional legislation related to spill contingency planning is detailed in Section 3.0 of the SCP and includes the legislation and standards referenced above, or more recent versions thereof (e.g. for the Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations (2008 rather than 2003) and National Fire Code (2020 rather than 2015).

17. KIA-NWB-17

Review Comment Number	KIA-NWB-17
Subject/Topic	Concordance with Type A Water Licence
References	Section 2.0, B2Gold Spill Contingency Plan Version 4, February 2024 Type A Water Licence: 2AM-BRP1831, Amendment 1 (August 31, 2021)
Summary	B2Gold wrote a spill contingency plan as part of their overall Emergency Response Program for the Project. This plan was written to meet requirements of a Type A Water Licence and Canada's Environmental Emergency Regulations. Zoetica™, on behalf of the KIA, audited the report alongside the water license, and identified some deficiencies.
Detailed Review Comment	The Back River Type A Water Licence, Section 16 (under General Conditions) states that: "The Licensee shall review the plans referred to in this license, as required by changes in operation and/or technology and modify the Plan accordingly. Revisions to the Plans are to be submitted in the form of an Addendum to be included with the Annual Report required by Part B, Item 2, complete with a revisions list detailing where significant content changes are made." The Revisions log does not accomplish this requirement as there was no revisions list supplied with the required details of content that changed (which differs from a versioning table).
Recommendation/ Request	Please supply a detailed revisions list detailing where significant content changes were made.
Importance	Low-Moderate
B2Gold Nunavut Response	B2Gold Nunavut will ensure the revision log provides more detail on where significant content changes have been made in plan updates.

18. KIA-NWB-18A

Review Comment Number	KIA-NWB-18a
Subject/Topic	Conformity with Canada's Environmental Emergency Regulations
References	Section 2.0, B2Gold Spill Contingency Plan Version 4, February 2024 Canada's Environmental Emergency Regulations (Link)
Summary	B2Gold wrote a spill contingency plan as part of their overall Emergency Response Program for the Project. This plan was written to meet requirements of a Type A Water Licence as well as Canada's Environmental Emergency Regulations. Zoetica™, on behalf of the KIA, audited the report alongside Canada's Environmental Emergency Regulations (CEER) and identified some deficiencies.
Detailed Review Comment	Deficiencies against CEER include the following: • CEER, Schedule 2, Information to be Submitted in the Notice

	Regarding Substances Located at a Facility, 1(d) includes: the range, among the following ranges: (i) 0 to 4, (ii) 5 to 19, (iii) 20 to 49, (iv) 50 to 99, (v) 100 to 299, (vi) 300 to 499 or (vii) 500 or more. If this information is housed elsewhere, it should also be included within the SCP as per the CEER. ○ The facility description within the SCP does not state the range of the maximum number of people that work at the site. • CEER, Environmental Emergency Plan section on preparation, required contents, Section 2(k) notes that facilities using or storing regulated substances are required to communicate with members of the public who may be affected by an environmental emergency. This includes communicating before an incident (to create awareness of the potential effects to human health and the environment), providing notification of an emergency, as well as giving updates during and after an environmental emergency. ○ The current plan does not provide explicit clarity on how the public will be notified (e.g., through what communication channels and materials, and in what languages (see Type A WL), will the public be notified?) ○ Roles remain unclear regarding communication with the public (e.g., do both the public information officer and communications officer communicate with the public? Is there seniority between these roles? How does the Joint Information Centre (JIC) differ from these communication roles? There is little information on the JIC). • The CEER, Environmental Emergency Plan, Preparation, Required Contents, Simulation exercise, Section 7 (1), mentions the need for: (a) annual simulation exercises in respect to one substance from each of the hazard categories referred to in column 5 of Parts 1 and 2 of Schedule 1, using an environmental emergency identified under paragraph 4(2)(d) as the emergency being simulated, and (b) every five years, a full-scale simulation exercise in respect of any one substance, using an environmental emergency referred to in paragraph 4(2)(e) or (f) as the emergency being simulated. ○ The current SCP for Back River makes minimal reference to a functional spill response exercise in Section 6.5. ○ Simulation exercises provided in the plan do not include details about how often they will be done or list methods for conducting them. • The CEER regulation on Record Keeping, Section 21(1) and (2) states that any records prepared in accordance with sections 8 and 10 must be kept at the facility referred to in subsection 4(1) for not less than seven years beginning on the day on which they are prepared. ○ Section 10.3 of the SCP for Back River does not list how

	long records will be maintained. The plan should specify they will be kept at the facility for a minimum of 7 years, as per the CEER. ○ Additionally, there is no mention of how documents relating to simulation exercises performed and other materials relevant to the SCP would be recorded and retained, for how long, and where. The CEER regulations, Record Keeping, 21(2) 3 (1-g) list information that should be kept for each substance located at the facility. The information should include: (a) its name, (b) CAS registry number, (c) its UN number, if applicable, (d) the maximum expected quantity of the substance, (e) if a quantity of the substance is not contained in a container system, a statement to that effect, (f) if all quantities of the substance are contained in a container system, the maximum capacity of the largest container system in which the substance is contained, and (g) the day on which the situation described in paragraphs 3(s)(a) and (b) of the Regulation occurred, as applicable. Please ensure that the plan indicates that all this information will be recorded for substances located at the facility.
Recommendation/ Request	The KIA requests B2Gold make the changes to the SCP to bring it into compliance with the CEER, which include: 1) Adding the range of the maximum number of people that work at the site to the SCP as per categories in the CEER. 2) Provide clarity within the SCP on how the public will be notified (e.g., through what communication channels and materials will the public be notified, and in what languages). 3) Clarify roles regarding communication with the public within the plan, including seniority, differences in communication roles with the public between the public information officer and communications officer, and more information about the Joint Information Centre (JIC) and how it differs from these communication roles. 4) Include more information within the SCP, Section 6.5, on functional spill response exercises. 5) Provide information on simulation exercises within the SCP, including how often they will be done and methods for conducting them. 6) Provide required information on record-keeping, including: ○ Section 10.3 of the SCP for Back River should specify that records will be kept for a minimum of 7 years, as per the CEER. Ensure that records that will be kept for this length of time will include all information noted in the CEER regulations, Record Keeping, 21(2) 3 (1-g). ○ Information on how documents relating to simulation exercises performed and other materials relevant to the SCP would be recorded and retained, for how long, and

	where they should be included. Please include information on when the annual review would occur for documentation and simulation exercises.
Importance	High
B2Gold Nunavut Response	It is noted that not all CEER requirements, such as those noted by the KIA, are to be met in the SCP itself. For instance, the information related to "*CEER, Schedule 2, Information to be Submitted in the Notice Regarding Substances Located at a Facility*" is filed in B2Gold Nunavut's Schedule 2 Notice Regarding Substances Located at a Facility within ECCC's SWIM system, as is required. B2Gold Nunavut believes that the Back River Project is in conformity with the CEER, and that the Spill Contingency Plan is in conformance with the plan-specific requirements. However, B2Gold Nunavut will re-examine the SCP to confirm conformity with the plan-relevant requirements and make updates if and where needed.

19. KIA-NWB-18B

Review Comment Number	KIA-NWB-18b
Subject/Topic	Improvements to SCP – information collected on spilled products
References	Section 2.0, B2Gold Spill Contingency Plan Version 4, February 2024
Summary	There are some improvements that can be made to information to be collected and reported compared to what is specified in the SCP.
Detailed Review Comment	Section 9.1.5 of the SCP for Back River (titled 'Report the Spill') states to: *"Provide basic information such as the date and time of the spill, type and amount of product discharged, photographic records, location and approximate size of the spill, actions already taken to stop and contain the spill, meteorological conditions and any perceived threat to human health or the environment"*. The plan would be improved by including the concentration of the substance released, as quantity is only part of the story of toxicity.
Recommendation/ Request	The KIA requests that B2Gold include the concentration of the product spilled (where relevant) in Section 9.1.5.
Importance	High
B2Gold Nunavut Response	B2Gold Nunavut will include an indication that the concentration of the product discharge be noted where relevant.

20. KIA-NWB-18C

Review Comment Number	KIA-NWB-18c
Subject/Topic	Improvements to SCP
References	Section 2.0, B2Gold Spill Contingency Plan Version 4, February 2024
Summary	There are some improvements that can be made to information to be collected as specified in the SCP.
Detailed Review Comment	When reading the SCP, the following questions arose: Is reporting the perceived threat to human health or the environment the same as describing the potentially harmful effects of the emergency? This should be clarified in the report, and if there are differences, the two should be differentiated. Overall, who is the primary individual responsible for the whole site/mine with regard to spills? No emails or fax numbers are listed for Key Site Emergency Contacts. Also, no location or phone number is listed for the Canadian Wildlife Service (CWS). Would be useful to emphasize that the individuals who are serving in the roles listed in 5.1 – 5.18 are named in Tables A-1 and A-2. It would help the reader if this was added either to each role description or to section 5.
Recommendation/ Request	The KIA requests answers to these questions and additions to the SCP as appropriate.
Importance	Low-Moderate
B2Gold Nunavut Response	The primary person responsible for the Back River Project in the event of a spill is the General Manager. He is listed in Table A-1 or Appendix A of the SCP and is registered as the responsible authority in ECCC's SWIM system for the E2. B2Gold Nunavut will consider including fax numbers and emails for project contacts in the updated SCP, along with CWS contact information. As personnel change over time, and available personnel on site vary by day and week due to the rotational nature of site work, attempts to assign names to positions would be outdated.

21. KIA-NWB-19

Review Comment Number	KIA-NWB-19
Subject/Topic	Annual report does not include the location of additional water sources not identified in the 2023 Winter Ice Road Technical Memo.
References	Back River Project, 2023 Annual Report for Water Licence 2AM- BRP1831, Section 2.2, page 6, April 2024.
Summary	The annual report noted that some new water sources were identified and used for Winter Ice Road construction. However, the locations of these water sources are not provided.

<table>
<tr><td>Detailed Review Comment</td><td>Section 2.2, page 6 of the report includes the following information:
“During the 2022/2023 WIR season, some water sources not identified in the 2023 Winter Ice Road Technical Memorandum for the Back River Project which was submitted to NWB prior to the 2022/2023 WIR construction. For these water sources, available water capacity has been retroactively calculated to ensure these withdrawals would not have had a negative impact on the water sources. To calculate available water capacities, the surface area of the water source (as determined by available GIS data) was multiplied by 10 cm. This calculation is considered protective of the lake habitat and has been previously used to determine water withdrawal capacity in both Nunavut and the Northwest Territories”.
As these water sources were not previously documented, additional documentation around this water use should be supplied.</td></tr>
<tr><td>Recommendation/ Request</td><td>The KIA requests the following information be supplied:
Please provide the locations of all newly identified water sources used in WIR construction, their locations relative to the WIR, and the relative volumes taken from each.
Please state the communication steps used by B2Gold to notify the NWB and the KIA about these additional water sources and proposed or post-hoc use of them.</td></tr>
<tr><td>Importance</td><td>High</td></tr>
<tr><td>B2Gold Nunavut Response</td><td>The GPS coordinates of these waterbodies are now provided below. A calculation of their available water capacities which would be protective of environmental impact (=surface area of the waterbody x 10 cm), as well as the water used from each waterbody was provided in the 2023 annual report. B2Gold Nunavut only discovered this error during compilation of the annual report information and provided notification of this information in the Annual Report.

<table>
<tr><th>Lake ID</th><th>Longitude</th><th>Latitude</th></tr>
<tr><td>LAKE5</td><td>-106.424</td><td>65.3622</td></tr>
<tr><td>LAKE10</td><td>-106.596</td><td>65.3946</td></tr>
<tr><td>LAKE12</td><td>-107.095</td><td>65.4449</td></tr>
<tr><td>LAKE27</td><td>-107.096</td><td>66.0335</td></tr>
<tr><td>LAKE101</td><td>-107.02</td><td>65.4046</td></tr>
<tr><td>LAKE202</td><td>-106.353</td><td>65.3447</td></tr>
<tr><td>LAKE204</td><td>-107.075</td><td>65.5757</td></tr>
<tr><td>LAKE281</td><td>-107.094</td><td>66.0508</td></tr>
<tr><td>LAKE401</td><td>-106.413</td><td>65.3644</td></tr>
<tr><td>LAKE8A</td><td>-106.504</td><td>65.3739</td></tr>
<tr><td>LAKE8B</td><td>-106.522</td><td>65.3805</td></tr>
<tr><td>LAKE9B</td><td>-106.562</td><td>65.3909</td></tr>
<tr><td>LAKE 35</td><td>-107.164</td><td>66.3612</td></tr>
</table>
</td></tr>
</table>

22. KIA-NWB-20

Review Comment Number	KIA-NWB-20
Subject/Topic	Reference to what is included in Appendix G
References	Back River Project, 2023 Annual Report for Water Licence 2AM- BRP1831, Section 2.11, Spills, Page 12, April 2024.
Summary	As noted in KIA-AR-01, the spill log does not appear to include follow- up actions; rather it includes what was done to clean up spills.
Detailed Review Comment	The title of Section 2.11, which references the reader to the spill log in appendix G, is "A LIST AND DESCRIPTION OF ALL UNAUTHORIZED DISCHARGES INCLUDING VOLUMES, SPILL REPORT LINE IDENTIFICATION NUMBER AND SUMMARIES OF FOLLOW-UP ACTION TAKEN". As previously noted in KIA-NWB-14, only the immediate response taken to clean up the spill is noted in appendix G, and the full meaning of follow-up actions is not included/reported on.
Recommendation/ Request	The KIA requests the following information be supplied: Please include follow-up actions in spill log in Appendix G to match the title of Section 2.11 of the Annual report.
Importance	High
B2Gold Nunavut Response	B2Gold Nunavut understands that the "summaries of the follow up action taken" are intended to document the clean-up, as required by the Licence condition. The summaries of the follow-up actions taken were included in the Annual Report and match the section heading. An alternate interpretation of this condition could result in important spill information not being reported.

23. KIA-NWB-21

Review Comment Number	KIA-NWB-21
Subject/Topic	Vague comments that could be improved
References	Back River Project, 2023 Annual Report for Water Licence 2AM- BRP1831, Section 2.6e, Spills, Page 12, April 2024.
Summary	Some of the technical reporting is vague and does not provide any
	actual reported information.
Detailed Review Comment	Section 2.6e, titled "Any geochemical outcomes or observations that could imply or lead to environmental impact" contains only the statement that: "Geochemical outcomes and observations were within those outlined during Project assessment and permitting as being anticipated". This could be better stated by noting what measurements and observations are being spoken of at this point in the project cycle, and the EA predictions they are being compared to.

Recommendation/ Request	The KIA requests that annual reports avoid broad statements saying that measurements were within range of predictions without reporting on what those results are and what values they are being compared to.
Importance	Moderate
B2Gold Nunavut Response	B2Gold Nunavut notes the recommendation and will avoid broad statements in future versions of the annual report.

24. KIA-NWB-22

Review Comment Number	KIA-NWB-22
Subject/Topic	In two cases, "other" is noted as the produced spilled within the spill log
References	Back River Project, 2023 Annual Report for Water Licence 2AM- BRP1831, Appendix G
Summary	Appendix G within the Back River Reportable Spills for 2023 shows two entries for "Other" on Mar 13, 2024.
Detailed Review Comment	Two entries for "other" are found in the spill log, which appear to have occurred in two separate instances on the same day – Mar 13, 2024. The quantities noted are substantial (300 kg and 250 kg, respectively), and the spill description simply includes the word "breakage". Under mitigation, it simply states "material cleaned up with equipment and hand tools; placed in lined megabags and disposed of off-site". This sort of reporting of spills provides the KIA with very little detail about anything and does not constitute proper spill reporting. Please include the product spilled and more of a description of what happened. Again, results of a follow-up are missing, and there are only notes on how something was cleaned up (immediate mitigation). If a product that has been spilled by B2Gold cannot be identified in a spill log, this is an issue that needs to be resolved.
Recommendation/ Request	The KIA requests that annual reports always include the product within the spill log. If the product is unknown to the person documenting the spill, there is a problem with the procedure – someone should come to the scene and identify it. As well, SDS data sheets need to be kept onsite, and everyone needs to know how to use them.
Importance	High
B2Gold Nunavut Response	B2Gold Nunavut will ensure product is recorded for each spill log entry. All SDS's are maintained on site and are in the SCP.

25. KIA-NWB-23

Review Comment Number	KIA-NWB-23

Subject/Topic	High-level, inexact locations provided in spill log
References	Back River Project, 2023 Annual Report for Water Licence 2AM- BRP1831, Appendix G KIA-AR-1, KIA-AR-4
Summary	Appendix G within the Back River Reportable Spills for 2023 shows 7 locations where spills occurred that are very high-level and could not be found by an independent third party wishing to test the site for full remediation. If a GPS is not available, spill sites should be revisited with a GPS to record the location precisely, to within 5 m.
Detailed Review Comment	As per KIA-NWB-14, and KIA-NWB-22, there are some issues with the current spill log procedure and information being collected. As previously noted, modifications need to be made to the spill log procedure to ensure that it is always capturing: 1) the precise location of spills rather than vague/high- level descriptions like "Umwelt Lake", and 2) the follow-up actions taken (above and beyond immediate clean up actions). In addition, a review of the spill log reveals 7 entries with vague location descriptions, which would not enable testing to determine if a site has undergone proper remediation. This signals a need to also update the requirements for logging spill location. The KIA requests a GPS location with a precision close to +/- 5 m, or +/- 10 m if that is not possible.
Recommendation/ Request	The KIA requests that annual reports always include the exact location within the spill log and that procedures be modified to explicitly require this. If the location is unknown to the person documenting the spill (i.e., they do not have a GPS on them), they should radio to someone who can bring a GPS to site to record the location.
Importance	High
B2Gold Nunavut Response	GPS coordinates will be included in the spill log for all externally reportable spills.

26. CIRNAC-NWB-01

Review Comment Number	CIRNAC-NWB-01
Subject/Topic	Site Water Management – Treated Sewage Effluent and Grey Water Discharges
References	2023 Annual Report for Water Licence 2AM-BRP1831, Action 2.13 2023 Annual Report for Water Licence 2BE-GOO2028
Detailed Review Comment	The Report notes that the new Goose Mine Camp Sewage Treatment Plant (STP) was commissioned in August of 2023 and the eventual plan is to discharge the treated effluent to the mine's Tailings Storage Facility (TSF) which has not yet been constructed. In the interim, throughout the remainder of 2023 and 2024 treated sewage effluent from the new mine site Accommodations Complex and associated Sewage Treatment Plant (7,650 m3) has/will be discharged

	onto the tundra at a monthly rate equal to the monthly volume of water provided to the Goose Mine Camp. In addition, greywater generated at the Goose exploration camp (total annual camp water usage of 6,795 m3 and average of 19 m3/day, was discharged at two tundra locations at the Goose exploration camp located at a site away from surface water. CIRNAC is concerned that the cumulative total volume and nature of the effluents being discharged onto the tundra could begin to negatively impact the condition of the existing tundra vegetation of the affected areas.
Recommendation/ Request	(R-01) CIRNAC recommends that B2Gold Nunavut: Provide information on the STP design and operational details including details for the management of STP sludge. Provide a map showing the location(s) and areas affected by these interim effluent discharges onto the tundra. Monitor and report on the quality of the treated effluent and grey water being discharged to the tundra. Develop and implement a tundra monitoring plan to document possible changes to the tundra as a result of these discharges.
B2Gold Nunavut Response	Information on operation of the Sewage Treatment Plant can be found in the Sewage Treatment Plant Operations Manual included here as Appendix B. STP sludge is disposed of as outlined in the waste management plans (see the Landfill and Waste Management Plan and the Incineration Management Plan). The treated STP effluent is discharged to the tundra at a location selected to allow over-land attenuation and evaporation. This location has been moved to optimize over-land treatment. Water quality is monitored downslope of the discharge point, at a drainage location representative of the discharge area. As discharge commenced late in 2024, just prior to freeze up, no water was available for sampling at the downslope monitoring location. The STP discharge point is inspected frequently for any erosion or ponding. B2Gold Nunavut will review adding a vegetation monitoring plot at the discharge location as per the Vegetation Monitoring Plan.

27. CIRNAC-NWB-02

Review Comment Number	CIRNAC-NWB-02
Subject/Topic	Infrastructure & Engineering – Echo Pit Open Pit Walls
References	Goose & MLA Project Sites – 2023 Annual Geotechnical Inspection, Section 5.2.2 (Echo Pit)

Detailed Review Comment	The 2023 Annual Geotechnical Inspection notes that "no detailed assessment on the pit walls was performed during the inspection" for Echo Pit and this is not addressed anywhere else in the 2023 Annual Report for Back River. Annual geotechnical inspections must include open pit walls as per Part I, Condition 10. e. of the Project's approved Water Licence.
Recommendation/ Request	(R-02) CIRNAC recommends that B2Gold Nunavut perform geotechnical inspections of all open pit walls, including assessment of rock wall faces, and report its findings in all future Annual Geotechnical Inspections.
B2Gold Nunavut Response	At the time of the 2023 SRK AGI the ultimate extents of the Echo Pit walls had not yet been reached. Therefore the slopes in the pits were actively being mined and were not at the design limits. In 2024, Terracon was mobilized to the Goose Mine and completed a third-party geotechnical inspection of the Echo pit walls, noting no concerns and positive comments made about the armoring of the walls which has since been completed. A geotechnical inspection of the Echo Pit is planned to be completed in 2024 as part of the AGI and will be included as part of the 2024 annual reporting.

28. CIRNAC-NWB-03

Review Comment Number	CIRNAC-NWB-03
Subject/Topic	Infrastructure & Engineering – Fuel Tank Farm Liner System
References	Goose & MLA Project Sites – 2023 Annual Geotechnical Inspection, Section 5.2.4 (Goose Tank Farm)
Detailed Review Comment	The liner system installation for the Goose Fuel Tank Farm (Phase 1) appears to have been completed as fuel is currently being stored in Tank #1; however, the 2023 Annual Geotechnical Inspection notes that much of the liner system remains exposed and unprotected while construction for Tank #2 is ongoing. This leaves the liner system at risk to damage from construction activities as well as degradation due to solar exposure (i.e., ultraviolet light degradation).
Recommendation/ Request	(R-03) CIRNAC recommends B2Gold Nunavut place sufficient liner cover material over the entire liner system for the Goose Fuel Tank Farm to prevent damage from future construction activities and solar degradation.
B2Gold Nunavut Response	Vehicular traffic in 2024 will be restricted to designated areas where cover has been placed over the liner, and long-term plans will be to fully cover the tank farm liner when sufficient overliner cover material has been generated, and is available, on site. This information will be provided in the Construction Summary Report which will be submitted to the NWB 90 days following completion of construction.

	When exposed, HDPE lining has good UV and chemical resistance for years of service and longevity (see below references). Mitigation of potential impact to the liner from vehicle traffic well be managed with traffic and construction plans and ongoing visual monitoring. References: 1. "GRI-GS20: Exposed Lifetime Prediction of Geosynthetics Using Laboratory Weathering Devices." Geosynthetic Institute. (2019). Accessed online at https://geosynthetic-institute.org/grispecs/gs20.pdf . 2. G. Hsuan et al., "Long-term performance and lifetime prediction of geosynthetics." EuroGeo4 Keynote Paper. (2008). Accessed online at https://pdfs.semanticscholar.org/5098/e4606b93a143ab69fd902ed3f50eac826bde.pdf . 3. https://www.layfieldgroup.com/geosynthetics/solutions/environmental-containment/high-density-polyethylene-hdpe-geomembranes/

29. CIRNAC-NWB-04

Review Comment Number	CIRNAC-NWB-04
Subject/Topic	Infrastructure & Engineering – Camp Pad Contact Water Pond Liner System
References	Goose & MLA Project Sites – 2023 Annual Geotechnical Inspection, Section 5.2.6 (Camp Pad Contact Water Pond)
Detailed Review Comment	The 2023 Annual Geotechnical Inspection notes that the liner system for the Camp Pad Contact Water Pond is exposed and unprotected while the pond appears to be operational. This leaves the liner system at risk to damage from construction activities as well as degradation due to solar exposure (i.e., ultraviolet light degradation). Additionally, it was noted that the liner system is damaged in several locations along the southern limits of the pond.
Recommendation/ Request	(R-04) CIRNAC recommends B2Gold Nunavut to: Repair the liner system before allowing contact water into the Camp Pad Contact Water Pond. Ensure that sufficient liner cover material is placed over the entire liner system of the pond to protect from further damage due to construction future activities and solar degradation.
B2Gold Nunavut Response	Plans have been made on site to repair the damaged Northern edge of the existing Pad CWP liner. It's noted that the damaged sections are high up and near the very top edge of the pond. The designs for the Camp Pad Contact Water do not include a cover(backfill) over the exposed HDPE liner. B2Gold Nunavut notes that the Engineering

	Design Report for this pond was provided to the NWB and reviewed at least 60 days in advance of construction. Current plans are that this liner will not be covered, no vehicle access will be allowed into this pond, and routine (weekly) visual inspection will be completed at this pond for any periods when water is temporarily stored or captured in this pond. This pond is planned to only be used as a surge contact water pond and will be typically maintained empty (to have the storage capacity available for storm events or upset conditions). When exposed, HDPE lining has good UV and chemical resistance for years of service and longevity (see below references). References: 1. "GRI-GS20: Exposed Lifetime Prediction of Geosynthetics Using Laboratory Weathering Devices." Geosynthetic Institute. (2019). Accessed online at https://geosynthetic-institute.org/grispecs/gs20.pdf . 2. G. Hsuan et al., "Long-term performance and lifetime prediction of geosynthetics." EuroGeo4 Keynote Paper. (2008). Accessed online at https://pdfs.semanticscholar.org/5098/e4606b93a143ab69fd902ed3f50eac826bde.pdf . 3. https://www.layfieldgroup.com/geosynthetics/solutions/environmental-containment/high-density-polyethylene-hdpe-geomembranes/

30. CIRNAC-NWB-05

Review Comment Number	CIRNAC-NWB-05
Subject/Topic	Infrastructure & Engineering – Primary Pond Dam Unknown Backfill
References	Goose & MLA Project Sites – 2023 Annual Geotechnical Inspection, Section 5.2.7 (Primary Pond Dam)
Detailed Review Comment	The 2023 Annual Geotechnical Inspection notes that a portion of the temporary road constructed on the upstream side of the Primary Pond Dam was backfilled with unknown "dark color fill material with a more synthetic smell". It is unknown if this material is considered suitable for dam construction by the Designer-of-Record (SRK Consulting (Canada) Inc.)
Recommendation/ Request	(R-05) CIRNAC recommends that within thirty (30) days B2Gold Nunavut confirms with the Designer-of-Record as to the suitability of the unknown material for use of the Primary Pont Dam as required by the Dam's construction quality assurance program.
B2Gold Nunavut Response	B2Gold Nunavut, in consultation with the Designer-of-Record (SRK), have now removed or encapsulated (outside of the main structural dam components) this unknown/questionable material. This was done as part of the ongoing 2024 construction activities. SRK has had frequent site supervision presence (for all critical construction periods) and has been

	completing Quality Assurance (QA) checks as part of the ongoing Primary Pond construction. This QA checks have been done in part to assist B2Gold Nunavut ensure the Primary Pond construction is in conformance with the site material technical specifications.

31. CIRNAC-NWB-06

Review Comment Number	CIRNAC-NWB-06
Subject/Topic	Infrastructure & Engineering – Goose Neck and Echo Crossings Culvert Blockages
References	Goose & MLA Project Sites – 2023 Annual Geotechnical Inspection, Section 5.2.9 (Goose Neck and Echo Crossings)
Detailed Review Comment	In the 2023 Annual Geotechnical Inspection, three of the five culverts at the Goose Neck Crossing were observed to be blocked by rockfill material. Additionally, one culvert inlet at the Echo Crossing was observed to be blocked by sloughed material.
Recommendation/ Request	(R-06) CIRNAC recommends that B2Gold Nunavut clear blockages from all culvert inlets and outlets for the Goose Neck and Echo Crossings to prevent surface water flows from ponding next to the road embankments.
B2Gold Nunavut Response	B2Gold Nunavut is completing regular monthly inspections of the culverts, over the months when there is no snow cover on site (approx. from June to September) to help identify ongoing maintenance at these culvert locations and to confirm water is flowing unimpeded and not ponding. That said, additional work will be done on site around these culverts before the next freshet period to ensure that any blockages are cleared.

32. CIRNAC-NWB-07

Review Comment Number	CIRNAC-NWB-07
Subject/Topic	Infrastructure & Engineering – Goose Airstrip Ponding
References	Goose & MLA Project Sites – 2023 Annual Geotechnical Inspection, Section 5.2.14 (Goose Airstrip and Access Road)
Detailed Review Comment	The 2023 Annual Geotechnical Inspection observed water ponding and permafrost degradation at the south end of the Goose Airstrip. Additionally, the current southeast extension of the airstrip was noted to intersect several surface water features which have not yet been diverted away from the airstrip embankment.
Recommendation/ Request	(R-07) CIRNAC recommends that B2Gold Nunavut actively manage surface water ponding along the airstrip with temporary dewatering until

	permanent water management structures (e.g., the Rascal Diversion Berm) are in place. This will reduce the potential for thermal degradation which could lead to settlement along the airstrip embankment.
B2Gold Nunavut Response	B2Gold Nunavut thanks CIRNAC for the comment and confirms monitoring of the water is ongoing and active pumping of the non-contact water will occur if ponding persists.

33. CIRNAC-NWB-08

Review Comment Number	CIRNAC-NWB-08
Subject/Topic	Infrastructure & Engineering – MLA Quarry Tank Farm Liner System
References	Goose & MLA Project Sites – 2023 Annual Geotechnical Inspection, Section 5.3.1 (MLA Quarry Tank Farm)
Detailed Review Comment	The 2023 Annual Geotechnical Inspection notes that much of the liner system remains exposed and unprotected while construction for the MLA Quarry Tank Farm is ongoing. This leaves the liner system at risk of slippage as well as future solar degradation.
Recommendation/ Request	(R-08) CIRNAC recommends that B2Gold Nunavut place sufficient liner cover material over the entire liner system for the MLA Quarry Tank Farm to prevent liner system slippage and solar degradation.
B2Gold Nunavut Response	Since the 2023 site inspection, B2Gold Nunavut has been placing additional backfill material overtop of the exposed MLA tank farm liner. The construction of this tank farm is still in progress but, as per the available IFC design drawings, the final bunded area will include full backfill protection over the HDPE and non-woven geotextile liner containment system. The liner in the MLA tank farm is not planned to be left unexposed once the tank farm construction is complete.

34. CIRNAC-NWB-09

Review Comment Number	CIRNAC-NWB-09
Subject/Topic	Infrastructure & Engineering – Lead Author of 2023 Annual Geotechnical Inspection
References	Goose & MLA Project Sites – 2023 Annual Geotechnical Inspection, Second Page and Closure

Detailed Review Comment	The Lead Author (Anna Timchenko) of the 2023 Annual Geotechnical Inspection is not a professional engineer registered with the Northwest Territories and Nunavut Association of Professional Engineers and Geoscientists (NAPEG), which is a requirement as per Part I, Condition 10 and is a regulated profession defined in Schedule A of the Project's Water Licence.
Recommendation/ Request	(R-09) CIRNAC recommends that B2Gold Nunavut ensure that the Lead Author and Inspector for all future Annual Geotechnical Inspections for Back River is a professional engineer registered with NAPEG.
B2Gold Nunavut Response	The 2023 Annual Geotechnical Inspection was completed by a professional engineer registered with the Northwest Territories and Nunavut Association of Professional Engineers. John Kurylo, MSc, PEng was the engineering from SRK Consulting (Canada) Inc. that was responsible for the 2023 Annual Geotechnical Inspection (AGI). John is registered with the Northwest Territories and Nunavut Association of Professional Engineers. Anna and John went to the site together (completed the site inspections together) and all of Anna's work was done under supervision and under the direct direction of John. John has done a detailed review of all components presented in the 2023 report and assisted with communication of the finding from this inspection to site (to B2Gold Nunavut). As part of John's professional judgement, he identified a qualified candidate (Anna) to accompany him on the field visit and to assist with the report compilation. John has confirmed that he takes all responsibility for, has been intimately involved with, and signs off on all the work in the 2023 AGI.

35. CIRNAC-NWB-10

Review Comment Number	CIRNAC-NWB-10
Subject/Topic	Acid Rock Drainage & Metal Leaching
References	B2Gold Nunavut 2023 Annual Report, Section 2.6a, 2.6b, and 2.6c Sabina Back River Project Waste Rock Management Plan 2022, Section 7.1.4
Detailed Review Comment	The annual report states that a total of 284,173 bank m3 of waste rock was generated and used for construction in 2023. It also states that 5,400 m3 of waste rock was identified as PAG, which equates to approximately 2% of the total waste rock used in construction. The geochemical characterization results presented in the report indicate that 30% of potential construction material during the project are classified as PAG.

Recommendation/ Request	(R-10) CIRNAC recommends that B2Gold Nunavut provide more detailed discussion of: The source of the 5,400 m3 PAG waste rock, The source of the 284,173 m3 of waste rock used in construction, The source of all PAG-classified samples identified in the annual report, The results of a-c compared to as built volumes of waste rock used in construction, as well as all daily records which link rock disposal locations to sampling results.
B2Gold Nunavut Response	B2Gold Nunavut notes that all material utilized in 2023 came from Echo Pit, however, will report more detailed information in future water license reports.

36. CIRNAC-NWB-11

Review Comment Number	CIRNAC-NWB-11
Subject/Topic	Acid Rock Drainage & Metal Leaching
References	B2Gold Nunavut 2023 Annual Report, Section 2.6b, and 2.6c Sabina Back River Project Waste Rock Management Plan 2022, Section 5.3.1.
Detailed Review Comment	Section 2.6b of the annual report states that in 2023, generated waste rock was used as construction material; however Section 2.6c of the report notes that construction material was evaluated based on criteria outlined in the Quarry Management Plan, as opposed to the Waste Rock Management Plan.
Recommendation/ Request	(R-11) CIRNAC recommends that B2Gold Nunavut clarify the source of the construction material as originating from either waste rock or quarry rock and its evaluation of materials based on the appropriate material management plan.
B2Gold Nunavut Response	B2Gold Nunavut confirms that only waste rock was used for construction in 2023. The rock meets the appropriate waste rock criteria, as described in described in Table 5.3-1 of the approved Waste Rock Management Plan (WRMP; Sabina, 2022).

37. CIRNAC-NWB-12

Review Comment Number	CIRNAC-NWB-12

Subject/Topic	Landfill & Waste Management – Timeline for Construction of Hazardous Waste Storage Facility
References	Section 2.22 of the Back River Project, 2023 Annual Report
Detailed Review Comment	CIRNAC inspections in March and September of 2023 identified concerns with B2Gold's storage and containment of Hazardous Wastes. The Annual Report comments on the removal of barrels from the snow pile near the runway and that a third-party engineering firm was retained to review options for a new hazardous waste storage facility. Construction drawings and a construction report are to be submitted at least 60 days prior to the construction of the new facility.
Recommendation/ Request	(R-12) CIRNAC recommends that B2Gold Nunavut: Identify the proposed timeline for the completion of the options review and provide an approximate schedule for submission of the proposed detailed report, drawings, and construction of the new hazardous waste storage facilities. Include a summary in the Annual Report of the corrective actions taken to address CIRNAC's concerns with the current storage and containment of hazardous waste as noted in CIRNAC's 2023 inspection reports.
B2Gold Nunavut Response	B2Gold Nunavut will produce and submit an Engineering Design Report for Hazardous Waste Management Facilities in Q4, 2024. A summary in the Annual Report of the corrective actions taken to address CIRNAC's concerns with the current storage and containment of hazardous waste as noted in CIRNAC's 2023 inspection reports will be provided in the 2024 Annual Report

38. CIRNAC-NWB-13

Review Comment Number	CIRNAC-NWB-13
Subject/Topic	Landfill & Waste Management – Registration as a Hazardous Waste Generator
References	Section 2.9 of the Back River Project, 2023 Annual Report
Detailed Review Comment	The 2023 Back River Annual Report states that the quantity and type of wase backhauled to KBL in Yellowknife is included in Appendix B. The Nunavut Guideline for Hazardous Waste Management (Oct. 2017) requires Registration of Hazardous Waste Generators, Carriers, and Receivers, and that all manifests must be completed by the generator and signed-off by carriers and receivers of all hazardous waste. The Report implies, but does not clearly state, that backhaul to KBL in Yellowknife was completed by air transport.

Recommendation/ Request	(R-13) CIRNAC recommends that B2Gold Nunavut: Confirm its registration as a Hazardous Waste Generator and that hazardous waste manifests are completed as required. Confirm that the transportation of hazardous waste to KBL was via air transport and if so, that the shipping of hazardous waste by air was compliant with the International Civil Aviation Organization (ICAO).
B2Gold Nunavut Response	Sabina Gold & Silver Corporation (the previous name of the B2Gold Back River Corporation; B2Gold Nunavut) is registered as Hazardous Waste Generator for the Back River Project under NU10018. B2Gold Nunavut has been pursuing a company name change but has not received a response from the GN to date. B2Gold Nunavut confirms that hazardous waste manifests are completed as required, and that shipment of hazardous waste by air has been and is compliant with the International Civil Aviation Organization (ICAO) and transportation of dangerous goods (TDG).

39. CIRNAC-NWB-14

Review Comment Number	CIRNAC-NWB-14
Subject/Topic	Landfill & Waste Management - Classification of Wastes
References	Appendix B of the Back River Project, 2023 Annual Report
Detailed Review Comment	Appendix B includes the types and quantities of wastes backhauled in 2023. It is assumed that all wastes listed in Appendix B were shipped to KBL in Yellowknife. Several items refer to contaminated snow, contaminated soil, or contaminated water, but do not identify the contaminant. The management and tracking of hazardous waste requires classification of those wastes according to the Transportation of Dangerous Goods Act. Classification of the wastes is not clearly stated in Appendix B Table.
Recommendation/ Request	(R-14) CIRNAC recommends that B2Gold Nunavut: Confirm its registration as a Hazardous Waste Generator and that hazardous waste manifests are completed as required. Confirm that the transportation of hazardous waste to KBL was via air transport and that the shipping of hazardous waste was compliant with the International Civil Aviation Organization (ICAO). Identify the contaminant in soil, snow, and/or water. Revise the table in Appendix B to include an additional column for waste classification of hazardous waste and that non-hazardous waste is identified as non-hazardous.

B2Gold Nunavut Response	See response to CIRNAC-NWB-13. In future reports, B2Gold Nunavut will include contaminant information and a column to clearly indicating whether the waste is identified as hazardous or non-hazardous.

40. CIRNAC-NWB-15

Review Comment Number	CIRNAC-NWB-15
Subject/Topic	Landfill & Waste Management - Incinerator Testing
References	Section 2.10 of the Back River Project, 2023 Annual Report
Detailed Review Comment	B2Gold Nunavut notes that incinerator testing was not completed in 2023 and that further testing is scheduled for 2024. The Nunavut Department of Environment Guidelines for the Burning and Incineration of Solid Waste (2010, revised January 2012) provides best management practices. Table 2 lists waste that can be burned or incinerated, and those that may be incinerated if equipment has sufficient air pollution controls. Table 3 identifies basic parameters to be measured and recorded. Furthermore, the guideline recommends either one-time or continuous emission monitoring, depending on the type and quantity of waste incinerated, including oxygen and carbon monoxide in undiluted gases. Annual or periodic stack sampling for hydrogen chloride, dioxins and furans may be required where feedstocks include organic materials that contain chlorine, such as chlorinated solvents and plastics, PVC, or marine driftwood.
Recommendation/ Request	(R-15) CIRANC recommends that B2Gold Nunavut provide: Additional details for all planned incinerator testing in 2024 and its proposed schedule for sampling and analysis. Details on its proposed sampling of incinerator ash. The frequency and approximated schedule for sampling and testing to be completed in 2024.
B2Gold Nunavut Response	B2Gold Nunavut acknowledges the need for stack and emissions testing on incinerator infrastructure on-site. The existing incinerator is scheduled to be replaced with a newer, more energy efficient and environmentally friendly unit that is slated to be delivered on the winter ice road in 2025. Stack testing to date has not occurred but is scheduled for third quarter of 2025. Incinerator ash testing information can be found in the Incineration Management Plan.

41. CIRNAC-NWB-16

Review Comment Number	CIRNAC-NWB-16
Subject/Topic	Landfill & Waste Management – Schedule for Landfill Construction
References	Section 2.9 of the Back River Project, 2023 Annual Report
Detailed Review Comment	The Annual Report states that solid waste suitable for landfill disposal is being temporarily stored at the Goose Quarry until the Goose Mine Site WRSA Landfill is operational. Item #11 of CIRNAC's review of the 2022 Annual Report recommends that the Annual Report provide an approximate timeframe for the development and completion of the landfill. Section 2, Storage of Waste in Quarries CIRNAC's September 21, 2022, review of the Landfill and Waste Management Plan, recommended the applicant provide more information how waste will be contained within quarries.
Recommendation/ Request	(R-16) CIRNAC recommends that B2Gold Nunavut provide an approximate schedule for the construction and commissioning of the proposed landfill be included in the 2023 annual report. Furthermore, the report should provide a summary of how stockpiles wastes are contained to avoid environmental impacts to surrounding land and waters.
B2Gold Nunavut Response	B2Gold Nunavut recently started transferring landfillable material to a landfill area in the Echo waste rock storage area as stated in the Landfill and Waste Management Plan. Waste material deposited into the landfill is covered by waste rock to minimize odors and prevent wind deposition of loose materials onto the tundra. The waste material is a capped by a will not encroach upon 3 m of the outer edge of the landfill at closure.

42. CIRNAC-NWB-17

Review Comment Number	CIRNAC-NWB-17
Subject/Topic	Outstanding 2022 Technical Review Comments From 2022 Annual Report
	There are five outstanding comments from the 2022 Annual Report which were not addressed in the 2023 Annual Report. The outstanding comments are R-01, R-02, R-09, R-10 and R-11. Please refer to Appendix A for a summary table of the outstanding issues. Please see below for the comments and recommendations.

43. CIRNAC-NWB-17A

Review Comment Number	CIRNAC-NWB-17A R-2022-01
Subject/Topic	R-2022-01. Surface Water Quality- Goose Lake Hydrodynamic and Water Quality Model
References	Sabina 2022 Annual Report, Section 1.3; Appendix E Back River Project - 2022 Aquatic Baseline Report - Appendix C, Tables C-1, C-2, C-3, C-4, C-5, C-6, C-7
Detailed Review Comment	Upon review of the water quality monitoring data presented in the Back River Project - 2022 Aquatic Baseline Report for Goose Lake West Bay (Table C-1) Goose Lake Central Basin (Table C-2), Goose Lake SE Basin (Table C-3), Goose Lake Tail (Table C- 4),Propeller Lake (Table C-5), and Reference Lake B (Table C-6), it is apparent that pH values in all of these water bodies sampled in 2022 were consistently reported to be below a pH of 6.5, with average values of 6.3 at Goose Lake West Bay, 6.3 at Goose lake Central Basin, 6.4 at Goose Lake SE Basin, 6.15 at Goose Tail, 6.3 at Propeller Lake and 6.5 at Reference Lake B. As reported, these pH values are generally below the CCME Guideline (chronic) range for the protection of freshwater aquatic life of 6.5-9.0 and the Health Canada Aesthetic Guideline range of 7.0-10.5. This indicates that the pH of the water in these water bodies are indicative of a naturally low level of acidity. Similarly, the low degree of hardness (as CaCO3) consistently measured in these water bodies, with average values of 29 mg/L at Goose Lake West Bay, 17.3 mg/L at Goose lake Central Basin, 12 mg/L at Goose Lake SE Basin, 14 mg/L at Propeller Lake and 16.6 mg/L 6 at Reference Lake B are indicative of naturally very soft water, which typically ranges from 0-60 mg/L. (Health Canada Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Hardness, 2022). The combination of chronically low pH water, combined with the very soft waters that are characteristic of the freshwater bodies in the Back River project area, indicate that these waters have a low buffering capacity. This means that these waters, and the resident aquatic resources, are exceptionally vulnerable to the introduction of contaminants such as mine-related wastewater.
Recommendation/ Request	(R-2022-01) CIRNAC recommends that the Licensee update the Goose Lake Hydrodynamic and Water Quality Model by incorporating the results of the 2022 field program reported in the Back River Project - 2022 Aquatic Baseline Report. The updated Hydrodynamic Model should be made available for review prior to submission of the 2023 Annual Report to allow for review to be completed and recommendations on Aquatic effect developed.

B2Gold Nunavut Response	B2Gold Nunavut confirms that the low pH and hardness conditions observed in 2022 have been accounted for in the current version (i.e., August 2022) of the Goose Lake Hydrodynamic and Water Quality Model. Although pH is not directly modelled, it is accounted for in toxicity modifying factors that influence the surface water quality effects benchmarks for the protection of aquatic life used to screen against model predictions. As described in the footnotes of Table 1 of the Goose Lake Hydrodynamic and Water Quality Model Report, a minimum pH value of 5.9 was applied when calculating surface water quality benchmarks that decrease with lower pH values; in these cases, a pH value of 5.9 is a more conservative estimate of pH than using the lowest pH (i.e., 6.15) observed during the 2022 monitoring program. The model predicts hardness values are based on predicted calcium and magnesium concentrations, and these predicted hardness values were used to calculate surface water quality effects benchmarks; these benchmarks decrease with lower hardness. The lowest hardness used in the model (i.e., <1 mg/L as CaCO3) was a more conservative estimate than the lowest hardness values measured in Goose Lake (i.e., 12 mg/L as CaCO3) during the 2022 monitoring programs. In summary, based on the results of the 2022 monitoring, the conservative assumptions applied to pH and hardness in the current model continue to be adequately conservative and updates to these assumptions are not warranted. B2Gold Nunavut will continue to monitor water quality in Goose Lake and in accordance with the Type A Water Licence 2AM-BRP1831 Amendment No. 1 (Schedule I; NWB 2021) and will consider this information in the next model update consistent with typical Type A License requirements for updates to reflect changes in operation. **References:** NWB (Nunavut Water Board). 2021. Water Licence 2AM-BRP1831 (Amendment No. 1) for Sabina Gold and Silver Corp.'s Back River Project. Issued August 31, 2021.

44. CIRNAC-NWB-17B

Review Comment Number	CIRNAC-NWB-17B R-2022-02
Subject/Topic	R-2022-02. Surface Water Quality- Goose Lake Hydrodynamic and Water Quality Modeling
References	Hydrodynamic and Water Quality modelling of Goose Lake, August 2022

Detailed Review Comment	In the 2022 Annual Report, Sabina has made a number of revisions to the Modeling done. CIRNAC recognizes these modifications based on feedback from intervenors. The following further issues have been identified. a) The modelling time period has been increased to 67 years (Sections 2.2, 3.2), this addresses one of the deficiencies of the previous model that ended with the end of operations. Various sensitivity analyses were run to evaluate effects of changes to meteorological conditions, ice cover, and inflow quantity and quality for a 10- year period – extending five years into post-closure. A longer ice cover period was also evaluated. However, modelling 67 years into the future should also consider the possible effect of climate change. Presently, their hydrological inputs are the past 10 years repeated into the future. b) Selenium concentrations – in Section 9.0, the predicted 95th percentile concentrations of iron and phosphorous are slightly above the water quality guideline values but there is no mention of selenium. In the Appendix B timeseries for constituents, concentrations of selenium for PN04 are well above the water quality benchmark value and slightly over for PN05. In Appendix C, the concentrations of selenium at GLTL are over the benchmark value. c) Phosphorous concentrations – in Section 9.0, the 95th percentile concentrations of most constituents are predicted to remain below water quality benchmarks (Table 1) at the edge of mixing zones, with the exception of phosphorus. The predicted 95th percentile concentration of phosphorus at two other assessment locations (i.e., central basin and tail of Goose Lake) are also predicted to be above the benchmark. The conservative model approach adopted (e.g., exclusion of biological uptake during open-water conditions) likely contributed to the exceedances of the phosphorus benchmark.
Recommendation/ Request	(R-2022-02) CIRNAC recommends that the as follows. The Licensee is to include a discussion of climate change effects on the forecasts provided in further Annual reports. This includes an evaluation of various scenarios. As Selenium can be more toxic than iron or phosphorous, it is recommended that risks associated with Selenium exceedances should be discussed and addressed in the aquatic effects management plan and included in the next annual report. It is recommended that the Licensee attempt to quantify what the phosphorous uptake could be over the summer and indicate whether elevated levels of phosphorus may contribute to a change in the lake's trophic status over time. This is to be reported on in the next Annual Report.
B2Gold Nunavut Response	a) B2Gold Nunavut notes that further discussion of climate change was provided by B2Gold Nunavut in its responses to interveners'

	comment on the Hydrodynamic and Water Quality Model of Goose Lake (Sabina 2022), refer to KIA-NWB-07 and ECCC-03. As per CIRNAC request, B2Gold Nunavut will provide further discussion on climate change in the next model update consistent with typical Type A License requirements for updates to reflect changes in operation. b) The predicted concentrations of selenium in Goose Lake are not expected to result in harmful effects to aquatic life because the exceedances of the water quality benchmark (Table 1 in the Hydrodynamic and Water Quality Modelling of Goose Lake Report), which is based on the CCME chronic guideline for the protection of aquatic life, occur infrequently (i.e., approximately one month or less in a given year), are temporary (i.e., occur for 2 or 3 years during Closure) and are localized (i.e., at the edge of a mixing zone or in the tail of Goose Lake). The predicted exceedances occur every year during a transition period in the model that represents a potential 'worse case' condition when temperatures are warm enough that runoff from the site is occurring but the entire lake is still frozen (e.g., late May to late June). Although the risk to aquatic life based on predictions for selenium are considered negligible, selenium concentrations at the mixing zone boundaries and in Goose Lake will be monitored as part of the Aquatic Effects Management Plan (AEMP; Sabina 2017) and relevant changes in concentrations will be addressed through the response framework. c) B2Gold Nunavut disagrees that quantification of the phosphorus uptake in Goose Lake during the summer is necessary or relevant in the next annual report. B2Gold Nunavut would like to reiterate that the predicted changes in total phosphorus concentrations in Goose Lake, which indicate no change in trophic status of Goose Lake, conservatively assumed no removal of phosphorus from the water column. B2Gold Nunavut has committed to monitoring phosphorus and chlorophyll annually in Goose Lake through the Aquatic Effects Management Plan (AEMP; Sabina 2017), which will provide an indirect measurement of processes that remove phosphorus from the water column, including biological uptake. B2Gold Nunavut has also committed to applying nutrient enrichment Action Levels in the AEMP Response Framework. If Action Levels are triggered for nutrient enrichment, then additional follow-up activities, such as plankton monitoring or assessing uptake of phosphorus (e.g., by comparing modelled versus observed phosphorus concentrations in Goose Lake), will be considered. **References:**

	Sabina (Sabina Gold and Silver Corp.). 2022. Back River Project. Responses to Review of Water and Load Balance Report and Hydrodynamic and Water Quality Modelling of Goose Lake Report. November 2022. Sabina (Sabina Gold and Silver Corp.). 2017. Back River Project. Aquatic Effects Management Plan. October 2017.

45. CIRNAC-NWB-17C

Review Comment Number	CIRNAC-NWB-17 R-2022-09
Subject/Topic	R-2022-09. Landfill and Waste Management Plan – Approvals
References	Sabina 2022 Annual Report, Section 2.20; September 21, 2022, letter re. CIRNAC review of Landfill & Waste Management Plan; September 16, 2022, letter re. Kitikmeot Inuit Association (KIA) review of Landfill and Waste Management Plan
Detailed Review Comment	Section 2.20 of the 2022 Annual Report references revisions to the Landfill and Waste Management Plan were submitted in August 2022. There is no reference to responses to this plan received from CIRNAC and KIA, or of follow-up actions by Sabina.
Recommendation/ Request	(R-2022-09) CIRNAC recommends that the Licensee provide clarification on Section 2.20 reference that responses were received, and feedback is pending and include a detailed explanation of how the comments received have been incorporated into the plan to date.
B2Gold Nunavut Response	Through the ongoing NIRB process of the Back River Project Energy Center, B2Gold Nunavut has made the following commitment (CIRNAC-TRC-10): B2Gold Nunavut commits to updating the Landfill and Waste Management Plan to reflect the Government of Nunavut 2011b guideline as stated in CIRNAC Technical Review Comment CIRNAC-TC-10. These updates will be submitted within 90 days of Project approval by the Minister. As part of this process, and in advance of submission of the revised Landfill and Waste Management Plan, B2Gold Nunavut commits to engaging CIRNAC to discuss the planned revisions and the inclusions of the above technical review comment.

46. CIRNAC-NWB-17D

Review Comment Number	CIRNAC-NWB-17 R-2022-10
Subject/Topic	R-2022-10. Landfill and Waste Management Plan

Detailed Review Comment	The CIRNAC review reiterated the requirement for submission of a design and construction report 60 days prior to construction of a landfill. Section 2.9 of annual report indicates landfill will be constructed in the future; however, the timing is unclear. We present this comment to flag that pre-development reporting will be required for this element, and that with a 60-day window for review it should be well in advance of the planned construction season so as to avoid potential construction delays.
Recommendation/ Request	(R-2022-10) CIRNAC recommends that the Licensee provide an approximate timeframe for development and a proposed workplan for the coming year that includes milestones for submission of plans to be reviewed.
B2Gold Nunavut Response	Through the ongoing NIRB process of the Back River Project Energy Centre, B2Gold Nunavut has made the following commitment (CIRNAC-TRC-10): B2Gold Nunavut commits to updating the Landfill and Waste Management Plan to reflect the Government of Nunavut 2011b guideline as stated in CIRNAC Technical Review Comment CIRNAC-TC-10. These updates will be submitted within 90 days of Project approval by the Minister. As part of this process, and in advance of submission of the revised Landfill and Waste Management Plan, B2Gold Nunavut commits to engaging CIRNAC to discuss the planned revisions and the inclusions of the above technical review comment.

47. CIRNAC-NWB-17E

Review Comment Number	CIRNAC-NWB-17 R-2022-11
Subject/Topic	R-2022-11. Waste Management Plans – Waste oil
References	Sabina 2022 Annual Report, Section 2.9 and Appendix B
Detailed Review Comment	Appendix B, second table includes a column itemizing “waste oil to furnace”. This is not referenced in Section 2.9 or any other location within the 2022 Annual Report.
Recommendation/ Request	(R-2022-11) CIRNAC recommends that the Licensee provide clarity related to this item and explain why it is included in Section 2.9 of the Annual Report. Sabina is to provide information on what this item represents and whether it is included according to a specific plan that has been reviewed.
B2Gold Nunavut Response	Waste oil to furnace quantities noted in the annual report are waste oil recycled by using it to power waste oil-fueled heating units.

48. ECCC-NWB-01

Review Comment Number	ECCC-NWB-01
Subject/Topic	Open Burning of Natural Fiber Textiles
References	Section 2.9: A Summary Report of All General Waste Disposal Activities Including Monthly and Annual Quantities in Cubic Metres of Waste Generated and Location of Disposal, B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM- BRP1831, April 2024 ECCC's Brochure on Open Burning, link: https://www.canada.ca/content/dam/eccc/migration/main/gdd-mw/684b44dd-5780- 4f73-bc58-a97e31a19edc/com1170_open_burning_brochure_e_v6_for-20web.pdf
Detailed Review Comment	Section 2.9 from the 2023 Annual Report document, states that "B2Gold Nunavut confirms that only paper products, paperboard packing including boxboard and cardboard, and untreated wood including lumber and plywood, and natural fiber textiles are open burned at the Back River Project" in response to ECCC's comments on open burning from the 2022 Annual Report. ECCC discourages the practice of open burning where practicable, and would like to note that even natural fiber textiles may contain chemical dyes, that could be released into the atmosphere or remain in the ash, if burned. Please refer to ECCC's Brochure on Open Burning for more details.
Recommendation/ Request	ECCC recommends that the Proponent eliminate the practice of open burning, where practicable. ECCC further recommends that the Proponent dispose of natural fiber textiles using the on-site incinerator.
B2Gold Nunavut Response	B2Gold Nunavut minimizes the use of open burning where practical, but for the disposal of highly flammable materials such as cardboard and untreated wood it is necessary, because these materials can periodically be generated in quantities that exceed the optimal proportion of an incinerator feed batch to attain optimal burn temperatures and times. B2Gold Nunavut agrees to burn natural fiber textiles in the incinerator.

49. ECCC-NWB-02

Review Comment Number	ECCC-NWB-02
Subject/Topic	Acid Rock Drainage (ARD)/Metal Leaching (ML) Classification Criteria
References	Section: 2.6: Geochemical Monitoring Results, B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM-BRP1831, April 2024 Table 2.6-1: Geochemical Characterization Results, B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM-BRP1831, April 2024

	MEND (2009): MEND Report 1.20.1 Prediction manual for Drainage Chemistry from Sulphidic Geologic Materials, December 2009, link: https://mend-nedem.org/wp-content/uploads/1.20.1_PredictionManual.pdf
Detailed Review Comment	Section 2.6 of the 2023 Annual Report document states that "These data indicated that the materials with low ARD potential (NPAG [non potentially acid generating] and NPAG – Low Sulphur) are suitable for use in construction based on the material classification criteria outlined in the Quarry Management Plan…". The following criteria is also stated as the ARD classification of samples results uses the following criteria: "NPAG = NP/AP > 3 NPAG – Low Sulphur = NP/AP < 3 and Total Sulphur < 0.16 wt. % PAG – Uncertain = 1 < NP/AP < 3 PAG = NP/AP < 1" Table 2.6-1 of the report demonstrates that some of the samples classified as 'NPAG – Low Sulfur' have a neutralization potential ratio (NPR) less than 2. ECCC would like to note, that information provided in the MEND (Mine Environment Neutral Drainage) Report 1.20.1 (2009), indicates that samples that have NPR less than 2, are capable of generating acid rock drainage (ARD), and are to be classified as 'uncertain'. With the 'uncertain' classification, ECCC is of the opinion that these rock materials should not be used for construction, because of their ARD/ML potential. The MEND report further indicates that a '% sulphur' cut-off should not be used as the only means of assessing ARD, because it also depends on the amount of neutralization potential available. An NPR less than 2, seems to be an indication that there is not enough neutralization potential available. ECCC acknowledges the Proponent for using NPR 3 as a cut of PAG and non-PAG.
Recommendation/ Request	ECCC recommends that the rock samples that have NPR less than 2, not be used for construction, given that they may be capable of generating acid rock drainage. ECCC further recommends that the Proponent use the conventional classification scheme detailed in the MEND report 1.20.1 , where all samples with 1 < NPR < 3, should be classified as 'uncertain'.
B2Gold Nunavut Response	B2Gold Nunavut notes that the classification criteria that are used for waste rock classification are described in Table 5.3-1 of the approved Waste Rock Management Plan (WRMP; Sabina, 2022). As described in Section 5.3 of the approved WRMP, the criteria were developed through an extensive geochemical assessment program conducted by SRK (Appendix E-3 of the 2017 Sabina FEIS application, referenced here as SRK 2015).

	The approved criteria that are being applied for PAG and NPAG classification at the back River site are: NP/AP > 3 or total S <0.15% are classified as NPAG. NP/AP < 3 and total S >0.15% are classified as PAG. B2Gold Nunavut does not apply an 'uncertain' classification in operations. Samples with 1 < NPR < 3, and a total S >0.15% were classified as PAG.

50. ECCC-NWB-03

Review Comment Number	ECCC-NWB-03
Subject/Topic	Geotechnical Recommendations
References	Part 1, Section: 4 Design and Operation Considerations, Appendix E: Geotechnical Inspection Report, B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM-BRP1831, April 2024 Section 5.2.14 Goose Airstrip and Access Road, Appendix E: Geotechnical Inspection Report, B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM-BRP1831, April 2024
Detailed Review Comment	Section 4 of the Geotechnical Inspection Report states that "Goose airstrip extension to the South is currently in progress. As this airstrip extends to the south, it intersects some more notable surface water flow pathways / ephemeral streams (Figure 5)." Section 5.2.14 of the Geotechnical Inspection Report states that "It should be noted that the southern extension of the airstrip is in a low lying area with numerous natural small ponds and ephemeral stream flow paths" Section 4 of the Geotechnical Inspection Report then goes on to state that "The South end of the extended Goose Airstrip is expected to be an area that will need to be closely monitored and more permanent long term water conveyance through portions of the airstrip should be considered by site (again depending on the length and use of the airstrip that site is targeting)." ECCC notes that the findings from the inspection indicate that the southern end of the airstrip intersects some more notable surface water flow pathways / ephemeral streams. It is not clear to ECCC whether the recommendations mentioned in the report, will be implemented by the Proponent, and if the runoff from the south extension of the airstrip will be monitored.
Recommendation/ Request	ECCC recommends that the Proponent implement the Geotechnical Inspection Reports' recommendation, that the runoff from the south extension of the airstrip be monitored.
B2Gold Nunavut Response	B2Gold Nunavut confirms water conveyance structures will be constructed and will monitor flows in the area.

51. ECCC-NWB-04

Review Comment Number	ECCC-NWB-04
Subject/Topic	Landfill Water Management
References	Section: 5.2.1: Goose Quarry, Appendix E: Geotechnical Inspection Report, B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM-BRP1831, April 2024 B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM-BRP1831, April 2024
Detailed Review Comment	Section 5.2.1 of the Geotechnical Inspection Report states "Development of the pit was started in 2021 to provide the Non Potentially Acid Generating (NPAG) Run of Mine (ROM) material for the site, but since the Echo Pit pre-stripping development was initiated in 2022, there has been no notable activity at the Goose quarry. As a result, the former Goose quarry is currently being used as a temporary landfill / storage site with long term plans of relocating all temporarily placed landfill material within the limits of a waste dump (as permitted)." ECCC was unable to find reference to applicable water management practices or plans, for runoff or seepage out of the quarry, given that it is now used as landfill.
Recommendation/ Request	ECCC recommends that the Proponent provide, and reference in the Geotechnical Inspection Report, any applicable plans for the management of water runoff and/or seepage from the Goose Quarry landfill, for review with the 2023 Annual Report.
B2Gold Nunavut Response	The old Airstrip Quarry (Goose Quarry landfill) is negatively draining and therefore water runoff and/or seepage is not possible. The temporary location was reviewed with the Kitikmeot Inuit Association (KIA) and primarily chosen for this reason. In addition, it's noted that landfill material consists of inert, non-hazardous material, and therefore leachate is not anticipated to be generated. Routine inspections of the location have yielded no observations of runoff and/or seepage.

52. ECCC-NWB-05

Review Comment Number	ECCC-NWB-05
Subject/Topic	Ponded Water Recommendation
References	Section: 5.2.3 Overburden Stockpile, Appendix E: Geotechnical Inspection Report, B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM-BRP1831, April 2024
Detailed Review Comment	Section 5.2.3 of the Geotechnical Inspection Report states that "The ponding water was observed in areas the toe of the stockpiles. This is likely in part from the release of water from the overburden soil due with the high

	ice and water content as the outside layers of the stockpile thaw in the warmer months. It would be suggested collect water samples from the ponded water around this area to better characterize (in terms of water quality, e.g. Total Suspended Solids (TSS), salinity, ammonia etc..)."It is unclear to ECCC whether the Proponent intends to implement the Geotechnical Inspection Reports' recommendation, to collect water samples from the ponded water and characterize it.
Recommendation/ Request	ECCC recommends that the Proponent implement the Geotechnical Inspection Reports' recommendation, to collect water samples from the ponded water and characterize it.
B2Gold Nunavut Response	Ponding water occurred in small volumes and ultimately evaporated. If ponding water occurs in volumes requiring management, B2Gold Nunavut will complete water quality sampling in advance as suggested and provide this information within the annual report.

53. ECCC-NWB-06

Review Comment Number	ECCC-NWB-06
Subject/Topic	List of Hazardous Substances On-Site
References	Section 9.4: Hazardous Materials On-Site, Back River Project, Spill Contingency Plan, Version #4.0, February 2024 Section 3.1: Overview, Appendix E: Geotechnical Inspection Report, B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM-BRP1831, April 2024 Environmental Emergency Regulations, 2019 (link: https://laws.justice.gc.ca/PDF/SOR-2019-51.pdf) Application for MLA Tank Farm Modification (Phase 3: Addition of Tank 5), B2Gold Nunavut, May 28, 2024
Detailed Review Comment	Section 9.4 of the Spill Contingency Plan, states that "A list of the main hazardous materials to be transported to and stored on-site is provided within the Hazardous Materials Management Plan (HMMP)." However, the only HMMP that ECCC could locate, dates back to November 2015 and does not provide an accurate account of the hazardous substances currently stored on-site. This information is necessary to evaluate if the Proponent has appropriate preparedness and response measures in place and compliance with the Environmental Emergency Regulations (E2 Regulations). Additionally, with the recent construction and ongoing construction of large storage tanks, and significant infrastructure at the Project sites, it is unclear what fuels or hazardous substances are stored, and in what quantities.
Recommendation/ Request	ECCC recommends that the Proponent provide an updated account of all hazardous substances stored at the various Project sites in the Spill Contingency Plan. This should include detailed information on the location,

	volume/mass, types of containment, and number of containers for each hazardous substance.
B2Gold Nunavut Response	B2Gold Nunavut will provide an updated account of all hazardous substances stored at the various Project sites in an update to the HMMP which will be submitted with the next Annual Report, if not before. Relevant information will be included in the future SCP update.

54. ECCC-NWB-07

Review Comment Number	ECCC-NWB-07
Subject/Topic	Response to Worst Case Scenario of Table 9-1
References	Table 9-1: Diesel Fuel Spill – Worst Case Scenario in Container, Back River Project, Spill Contingency Plan, Version #4.0, February 2024
Detailed Review Comment	Table 9-1 indicates that in the 'Potential Loss' situation, where "10 million liters [of diesel is] released into bulk fuel secondary containment catchment where it would be captured in full" that the product would be recovered "with sorbents or skimmer." It is unclear from the information presented, whether the Proponent possesses enough sorbents to respond to a spill of this magnitude, or if other recovery methods will be utilized in conjunction with the use of sorbents and skimmers.
Recommendation/ Request	ECCC recommends that the Proponent provide clarification in Table 9-1 of the Spill Contingency Plan, on whether the recovery methodology to be used in response to the scenario of a 10 million litre diesel spill, includes only sorbents or skimmer, or sorbents and skimmer in conjunction with other recovery methods.
B2Gold Nunavut Response	B2Gold Nunavut confirms that any appropriate recovery methods and materials available on site may be used, and that external resources may also be retained if needed. A full list of Back River Project equipment is provided in the SCP.

55. ECCC-NWB-08

Review Comment Number	ECCC-NWB-08
Subject/Topic	Responsibility Under the E2 Regulations
References	Section 9.3.1.1: Identification and Assessment of Diesel Environmental Emergency Scenarios, Back River Project, Spill Contingency Plan, Version #4.0, February 2024 Section 3.1, p.3, Appendix E: Geotechnical Inspection Report, B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM-BRP1831, April

	2024Environmental Emergency Regulations, 2019 (link: https://laws.justice.gc.ca/PDF/SOR-2019-51.pdf) Application for MLA Tank Farm Modification (Phase 3: Addition of Tank 5), B2Gold Nunavut, May 28, 2024
Detailed Review Comment	Section 9.3.1.1 of the Spill Contingency Plan states that "Project diesel containment volumes and maximum quantities necessitate additional and specific consideration of potential diesel spills per the Environmental Emergency Regulations (E2)." With the progress on the construction of the tank farms, ECCC would like to bring to the attention of the Proponent, that a 'notice of change' may be required as stipulated in subsection 3(5) of the Environmental Emergency Regulations, 2019, which state: "A responsible person must, within 60 days after the day on which any of the following situations occurs, submit an updated notice to the Minister that contains the information referred to in Schedule 2: (a)the information that was reported under section 1 or 2 of Schedule 2 has changed; (b)the maximum expected quantity that was most recently reported under paragraph 3(d) of Schedule 2 in respect of a substance has increased by 10% or more; or (c)the maximum capacity that was most recently reported under paragraph 3(f) of Schedule 2 in respect of a container system, in which a quantity of a substance is contained, has increased by 10% or more."
Recommendation/ Request	ECCC recommends that the Proponent submit an updated 'notice of change', if a situation covered under subsection 3(5) of the Environmental Emergency Regulations occurs. This recommendation was also provided in ECCC's comments, dated June 24, 2024, for the review of the Marine Laydown Area (MLA) Tank Farm Modification Request on the Back River project.
B2Gold Nunavut Response	B2Gold Nunavut has and will continue to submit E2 notifications, such as Schedule 2 notifications, as required. These updates are made through ECCC's SWIM Portal and all historical filings, as well as all consequentially triggered additional filings (such as B2Gold Nunavut's Schedule 3, 4, and 5 filings), can be viewed by ECCC within SWIM.

56. ECCC-NWB-09

Review Comment Number	ECCC-NWB-09
Subject/Topic	Description of Spill Event
References	Section 2.11: A List of Description of All Unauthorized Discharges Including Volumes, Spill Report Line Identification Number and Summaries of Follow-Up Actions Taken, B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM-BRP1831, April 2024

	Appendix G: Spill Records, B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM-BRP1831, April 2024
Detailed Review Comment	Appendix G of the 2023 Annual Report, indicates that a spill of 5000 L of 'Petroleum lubricating oil' occurred on the winter ice road on January 22, 2023. However, details regarding the cause of the spill, or if appropriate mitigation measures have been implemented to minimize the risk of future releases of this magnitude, are not provided. Generally, a description of the events and circumstances surrounding a spill is necessary to analyze if the appropriate measures were taken in response. This helps ensure that effective steps are implemented to prevent similar incidents in the future.
Recommendation/ Request	ECCC recommends that the Proponent update the 2023 Annual Report, to include a description of the events that led to the release of 5000 L of 'Petroleum, lubricating oil', and the corresponding measures taken to prevent future releases of this magnitude. ECCC further recommends that future annual reports include both: Copies of spill reports; and Descriptions of spill events, including circumstances surrounding any spill events, and follow-up measures taken to mitigate future similar incidents.
B2Gold Nunavut Response	B2Gold Nunavut clarifies that a 5000 L spill did not occur, it was a 2 L spill, and there appears to be an administrative error on the NT/NU Spill database. B2Gold Nunavut will include more detail on spills and follow-up measures taken, as well as a summary of any corrective actions implemented in future reports. Copies of the NT/NU Spill line reports are available to all parties through the Spill line.

57. ECCC-NWB-10

Review Comment Number	ECCC-NWB-10
Subject/Topic	Reported Residual Oil in Geotechnical Report
References	Image M-43, Appendix E: Geotechnical Inspection Report, B2Gold Back River Project, 2023 Annual Report for Water Licence 2AM-BRP1831, April 2024
Detailed Review Comment	The Description of Image M-43, in Part 4 of the Geotechnical Inspection Report, states that "Oil was noted at the surface of the ponding water". ECCC is unclear from the information provided in the report, if the location was cleaned following the inspection.
Recommendation/ Request	ECCC recommends that the Proponent clean-up the oil observed in Image M-43 of the Geotechnical Inspection Report, if this already hasn't been completed. ECCC further recommends that the Proponent implement

	procedures to help make sure that all future dismantling of secondary containments is completed without releasing the residual oil.
B2Gold Nunavut Response	The sheen was investigated and determined to be naturally occurring (organic) rather than a sheen caused by petroleum products.

APPENDIX A: CULVERT INSTALLATION MONITORING REPORT

REPORT

Rascal Stream West Culvert Installation Construction Monitoring Report

B2Gold Back River Project

Submitted to:

Merle Keefe

666 Burrard St
Vancouver, BC
V6C 2X8

Submitted by:

WSP Canada Inc.

9, 4905 - 48 Street, Yellowknife, Northwest Territories, X1A 3S3, Canada

+1 867 873 6319

22567626

December 12, 2023

Distribution List

1 electronic copy - B2Gold

1 electronic copy - WSP Canada Inc.

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APPENDICES

1.0 INTRODUCTION

1.1 Background

B2Gold Corp. (B2Gold; formerly Sabina Gold & Silver Corp.) operates the Back River Project located in western Nunavut. The Back River Project consists of operations in the Marine Laydown Area and the Goose Lake Property Area. The Goose Lake Property Area is currently being developed for mining operations and is within the construction phase of their approved Water Management Plan. As part of mine development, the Rascal Stream West (RSW) crossing upgrade (the Project) was completed to accommodate haul truck traffic by replacing the bridge crossing on the primary and secondary RSW channels with culvert designs. Design specifications were provided by WSP Canada Inc (WSP; formerly Golder) (Golder 2021), which included twin steel oblong (pipe arch) culverts to be installed at the primary channel crossing and a single steel circular culvert to be installed at the secondary channel of Rascal Stream West.

Although the construction plan was to complete the installation of the crossings during frozen conditions in advance of the spring freshet, an early spring melt created flowing conditions and challenges for the installation, including the potential requirement for an isolation area for work to proceed and environmental monitoring to evaluate risks for fish. B2Gold then secured WSP to provide immediate environmental support, including environmental technicians who arrived at site on 10 May 2023 to monitor turbidity and complete fish rescues at the construction work area, as needed. During which time, the Contractor (Ledcor) and on-site B2Gold staff successful installed the culvert crossing over the secondary channel where there were minimal flows in the watercourse. The culvert crossing for the secondary channel was installed by 14 May 2023. Unfortunately, continued snow and ice melt runoff entered the primary watercourse, flooding the construction area for the twin steel oblong culverts. To redirect water, the Contractor constructed a diversion berm on the primary channel to divert all flow through the secondary channel crossing (such that the work isolation area on the primary channel would be dry). Construction then paused on 17 May 2023 due to water seepage under the diversion berm, subsequent flooding of the isolation area, and the observation of adult Artic Grayling at the secondary channel crossing. It was decided that the Contractor and B2Gold would continue the installation when flow conditions subsided to summer baseflow levels and when dates fall outside the DFO restricted activity window for spring spawning Salmonids in Nunavut (specifically after 15 July). The diversion berm was left in place and surface flow was maintained through the secondary channel until the completion of the primary channel crossing. The primary channel crossing was completed under dry (or nearly dry) watercourse conditions during the second phase of construction in late August / early September 2023.

The objective of this technical memo is to provide a summary of construction monitoring and fish salvage activities that were conducted in spring and summer 2023. Construction monitoring included measurements of turbidity upstream and downstream of the work area during in-water construction, and a qualitative (visual) evaluation of whether fish passage was maintained during any overlap of construction activities with the migration period for Arctic Grayling.

1.2 Event Timeline

An approximate timeline of relevant construction and environmental tasks are provided Figure 1.1. Photos of construction activities and a detailed construction log are provided in Appendix A and B, respectively.

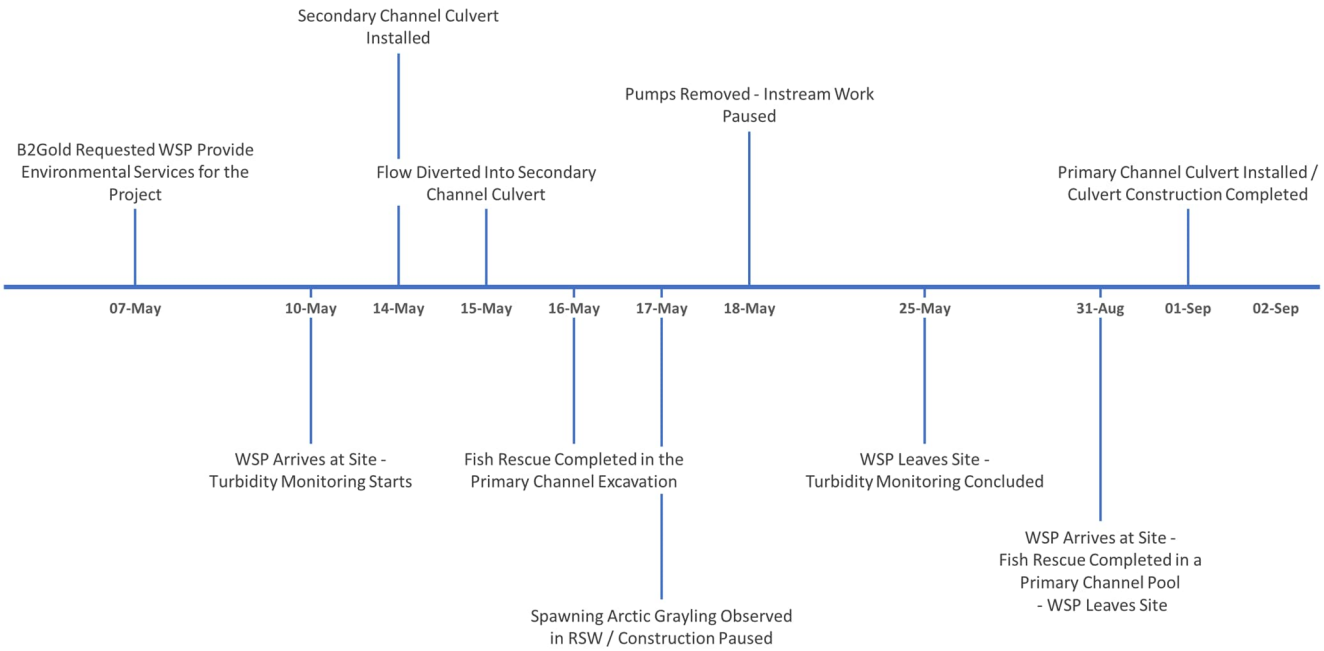


Figure 1-1: Approximate Timeline of Construction Works and Environmental Services Support During the Rascal Stream West Culvert Crossing Construction, 2023

1.3 Regulatory Overview

Section 34.4(1) and 35(1) of the *Fisheries Act* prohibits the death of fish and the harmful alteration, disruption, or destruction of fish habitat (HADD), respectively (GOC 1985). Section 36.3 of the *Fisheries Act* prohibits the deposition of a deleterious substance in any waterway frequented by fish. Since the Project constitutes works in and around fish bearing waters, a Request for Review application was submitted to DFO for approval to proceed with planned culvert construction works. The application included fish and fish habitat protection measures to reduce risk of residual effects to fish and fish habitat. DFO subsequently reviewed the construction activities and mitigation measures provided in the application and determined that the culvert crossing construction works could proceed under a Letter of Advice (LOA) dated 15 July 2022 (file # 18-HCAA-00185). DFO was subsequently notified during a meeting on 31 January 2023 between DFO and B2Gold that the installation was delayed until April 2023. DFO was then notified on 19 April 2023 by email from WSP that construction activities were to begin immediately under frozen conditions in advance of the spring freshet.

1.4 Water Quality Guidelines

Instream construction works has the potential to introduce sediment and/or foreign materials into the waterbody and cause harm to aquatic organisms (Canadian Council of Ministers of the Environment (CCME 2002), triggering *Section 36.3* of the Fisheries Act. Possible direct and indirect effects of introduced sediment include changes in substrate composition, habitat degradation for macroinvertebrates and fish, smothering of benthic communities and fish eggs, and abrasion to the respiratory surfaces of macroinvertebrates and fish (CCME 2002). As a best management practise, B2Gold requested that WSP monitor turbidity and/or total suspended sediment (TSS) during construction activities if and when such activities would be completed under flowing conditions.

The turbidity guidelines described under the *Canadian Water Quality Guidelines for the Protection of Aquatic Life – Total Particulate Matter* (CCME 2002) were applied to the Project (Table 1-1). According to the guidelines for when background turbidity levels are less than 80 nephelometric turbidity units (NTU), a short-term exceedance occurs when turbidity has increased by at least 8 NTU above background levels over a 24-hour period. A long-term exceedance occurs when turbidity has increased by at least 2 NTU above background levels over a multi-day period. When background levels are greater than 80 NTU, an exceedance occurs when a maximum increase of 10% is observed at any time. The CCME definitions were used as guidelines to determine if an increase in instream sedimentation resulting from construction works constituted a potential residual impact on fish habitat, potentially requiring follow-up with regulators (e.g., DFO).

Table 1-1: Water Quality Guidelines for Construction Monitoring

Parameter	CCME Guideline[(a)] (relative to background level)		
	Background is < 8 NTU	*Background is 8 to 80 NTU*	*Background is > 80 NTU*
Turbidity (NTU)	Maximum increase of 8 NTU for a short-term exposure (e.g., 24-hour period) Maximum average increase of 2 NTU for a long-term exposure (e.g., 30 days)	Maximum increase of 8 NTU	Maximum increase of 10%

(a) Source: CCME 2002.

2.0 METHODS

Environmental monitoring was conducted for the Project from 10 to 25 May 2023. Monitoring activities included the collection of data to determine the effectiveness of mitigation measures to meet requirements under *Fisheries Act* policies, including Codes of Practices (COPs; DFO 2020a and 2020b), and in accordance with conditions of the DFO LOA (file # 18-HCAA-00185). The WSP environmental monitor conducted the following on-site tasks:

- provided technical assistance and recommendations to improve or modify environmental mitigation
- prepared daily environmental monitoring reports summarizing the activities on site
- monitored water quality (i.e., turbidity) and compared against CCME guidelines
- conducted fish rescue activities, where and when required to reduce risks of fish mortality during construction

Instream work was paused on 17 May 2023 due a combination of excessive seepage into the primary channel and the observation of adult Arctic Grayling in Rascal Stream West. As such, the environmental monitors stayed on-site until 25 May 2023 to collect additional fish and fish habitat information from RSW. This consisted of the following:

- continuation of turbidity monitoring
- fish habitat and watercourse crossing surveys to evaluate fish passage downstream and upstream of the newly installed culvert on the secondary channel, including the temporary diversion channel from the secondary channel to the confluence with the natural primary channel above the work area
- fish presence visual surveys along the shoreline of the entire watercourse length and fish egg presence surveys using in-water kick-net methods to better understand the distribution of fish and whether fish were migrating and/or spawning above the diversion

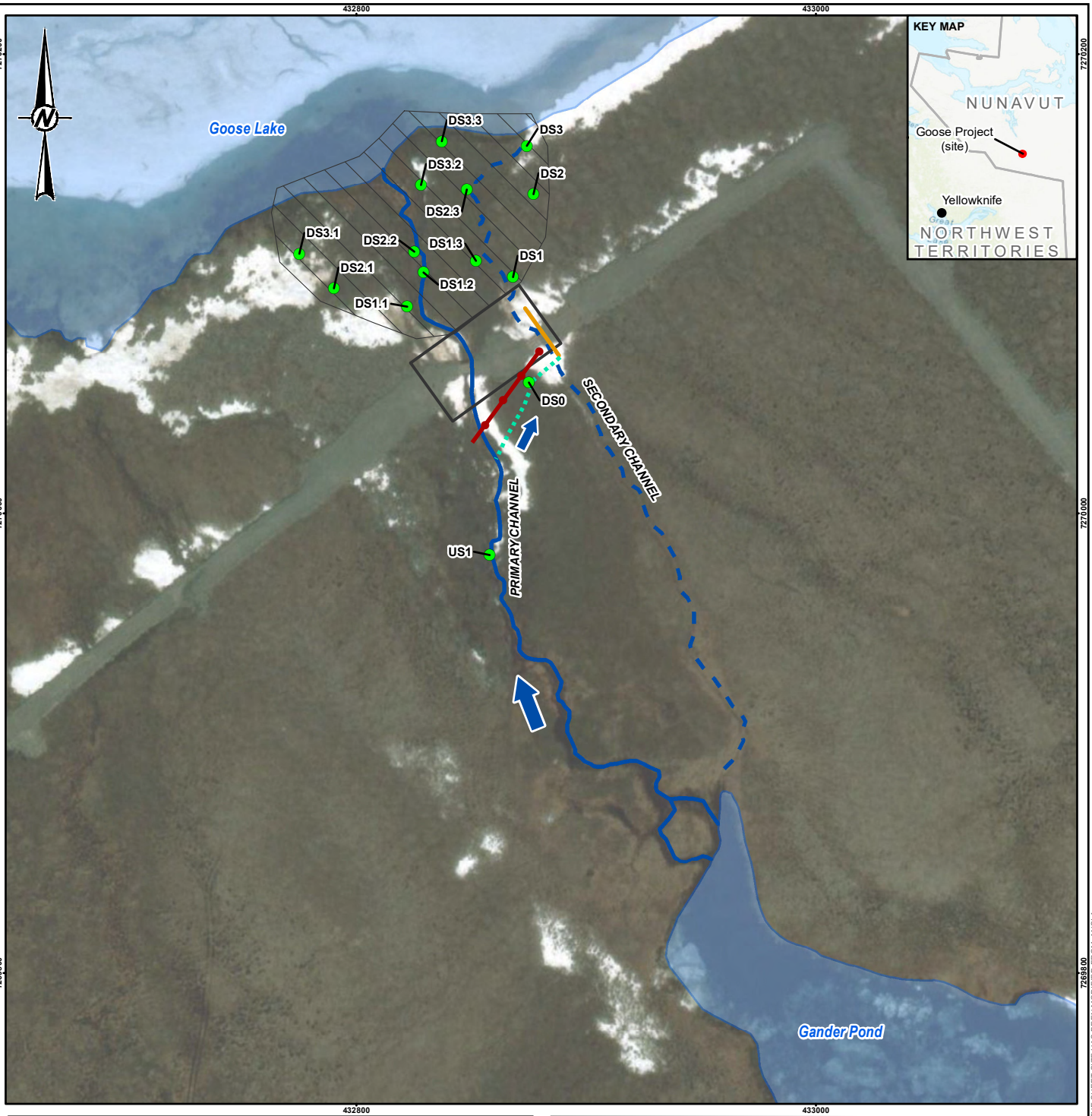
2.1 Turbidity Monitoring

Turbidity monitoring was conducted during in-channel construction (10 to 17 May 2023) and after construction (17 to 25 May 2023). The turbidity (NTU) parameter was used during this program as NTU measurements can be calculated in the field using portable instrumentation, providing measurements for comparisons to guidelines made in real time. Sampling was conducted upstream and downstream from the crossing construction area in the primary and secondary channels of RSW (Figure 2-1).

A background (US - upstream) station was established approximately 50 m above of the crossing construction instream work. Sampling stations downstream of instream work were located approximately 20 m and 50 m downstream of the work, and at the Goose Lake confluence, where the shoreline of Goose Lake was approximately 100 m downstream of the work area. Downstream sampling was conducted at stations in both the primary and secondary channels of Rascal Stream West. Sampling stations were adjusted throughout the program based on flow rate and water level. Photos of each monitoring station are provided in Appendix A.

During instream construction works, turbidity water quality grab-samples were collected at, approximately, two-hour intervals at well-mixed centre point transect locations from upstream and downstream sampling stations. Sampling was completed once per day after instream construction work concluded and downstream turbidity conditions returned to background. Turbidity samples were collected in 1.2 L plastic bottles at 60% stream depth from a well-mixed, representative location at the sampling station. A 20 mL subsample was decanted from each sample bottle and transferred into a test vial. Turbidity measurements were taken in triplicate from each test vial using a LaMotte 2020TI portable turbidity meter. Please see Appendix C for turbidity monitoring quality assurance and quality control (QAQC) procedures and results.

In the event of a downstream measurement that was elevated above guidelines (e.g., downstream turbidity conditions were over 8 NTU greater than upstream conditions), sampling frequency was increased, and the B2Gold Site Supervisor was notified so the construction crew could be instructed to implement mitigation. The field crew provided recommended mitigation measures when necessary. If turbidity conditions at a downstream station was over 10-times larger than the upstream station, the B2Gold Site Supervisor was notified, and it was recommended to stop work until suitable mitigation can be applied.



LEGEND

- FLOW DIRECTION
- CULVERT
- DIVERSION CHANNEL
- DIVERSION BERM
- GANDER POND OUTFLOW SIDE CHANNEL
- WATERCOURSE
- CONSTRUCTION FOOTPRINT AREA
- BRAIDED CHANNEL AREA
- WATERBODY

0 50 100

1:2,500 METRES

REFERENCE(S)

1. HYDROLOGY LAYERS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED, REVISED BY WSP.
2. IMAGERY COPYRIGHT © 20200616 ESRI AND ITS LICENSORS. SOURCE: VIVID MAXAR. USED UNDER LICENSE, ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 13 DATUM: NAD 83

CLIENT
B2GOLD

PROJECT
BACK RIVER PROJECT - RASCAL STREAM WEST CROSSING UPGRADE

TITLE
TURBIDITY MONITORING SAMPLING STATIONS ON RASCAL STREAM WEST

CONSULTANT

wsp

YYYY-MM-DD	2023-09-13
DESIGNED	TD
PREPARED	SP
REVIEWED	CC
APPROVED	CS

PROJECT NO.	PHASE	REV.	FIGURE
2256726		A	**2-1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

25mm

0

PATH: I:\CLIENTS\SABINA_SILVER\256726\Mapping\04_Fisheries_Hydrology\Fig2-1_256726 RSW_Turbidity_Sampling_RevA.mxd

2.2 Fish Rescues

Three emergency fish rescues were completed in RSW. DFO granted authorization for WSP to proceed with fishing effort on RSW on 16 March 2023, via email communication. Prior to conducting any fishing effort, the section of channel that required a fish rescue was isolated by installing block nets (5 mm mesh) positioned upstream and downstream, if required. Fishing rescues were completed on the following dates:

- 6 May 2023 – a fish rescue was completed, using a beach seine, in the primary channel culvert excavation pond.
- 17 May 2023 – a fish rescue was initiated, using backpack electrofishing, in the primary channel between the diversion berm and Gander Pond.
- 31 August 2023 – a fish rescue was completed, using backpack electrofishing, in an isolated pool located in the primary channel and just above the diversion berm.

Fish sampling followed standard methods for inventories for small watercourses (Golder 1999; Bonar 2009). To the extent practical, fishing effort was conducted until all fish from the isolated area had been rescued. The following information was recorded for each fishing effort:

- UTM coordinates for sampling location boundaries
- dates
- gear type and electrofishing settings
- effort
- species and fork length of each fish captured

2.3 Fish Passage Assessment

After construction paused on 17 May 2023, the field crew remained on site to assess and document fish passage from Goose Lake to Gander Pond, specifically for Arctic Grayling. This assessment included a fish habitat and crossing assessment (including discharge measurements), daily visual surveys, and kick net surveys.

A fish habitat assessment was conducted on 20 May 2023 to document watercourse habitat features of the secondary channel from the confluence of Goose Lake to the secondary culvert, the diversion channel from the secondary culvert to the primary channel upstream of the construction area, and the primary channel upstream of the construction area to Gander Pond. The section of RSW downstream from the road crossing and culvert had dispersed flow with multiple braided channels before entering Goose Lake. The habitat assessment for this section was completed in the deepest and most defined channel.

Fish habitat survey methods were consistent with habitat mapping procedures for Watercourse Crossings in Alberta (Government of Alberta 2009), as well as internal technical procedures (Golder 2005). In addition, the field crew collected daily depth and current velocity measurements to calculate discharge from 20 to 25 May 2023. The measurement was collected at a suitable location where flows were confined and within the vicinity of the crossing location. Discharge was calculated using the velocity-area method. A tape measure was extended across the length of the cross-section during the measurement event. Streamflow velocities and corresponding water depths were collected at varying intervals along the cross section depending on the width of the channel. Current velocities were recorded with a Hach meter at 60% of the total water depth.

2.3.1 Visual Surveys

Systematic visual surveys for spawning fish were conducted daily from 17 May to 25 May 2023. Stationary visual surveys were conducted by remaining in one location along the stream bank and documenting the presence and passage of any fish. Walking visual surveys were conducted by walking the length of the stream segment and documenting any fish observations.

Visual surveys were conducted in the following downstream locations:

- along the Goose Lake shoreline between the primary and secondary channel outflows
- along the primary channel confluence with Goose Lake to the road
- along the secondary channel confluence with Goose Lake to the newly installed culvert

Visual surveys were also conducted in the following upstream locations:

- along the diversion channel from the secondary culvert to the primary channel upstream of the construction area
- along the primary channel from the construction area to Gander Pond

Arctic Grayling age was estimated based on the following size classes (McPherson et al. 2022).

- Young-of-Year: 0 to 80 mm
- Juvenile: 80 to 170 mm
- Adult: >170 mm

2.3.2 Kick Net Surveys

Kick net surveys were completed on 24 May 2023 using a D-shaped kick net (305 mm by 254 mm net opening and a 500 µm mesh size) to determine the presence or absence of Arctic Grayling eggs. Kick netting was completed at locations with suitable spawning habitat (i.e., patches of gravel in a riffle or run habitat, or run-riffle transition area); the net was placed downstream of the area to be kicked (1 m^2), so that when substrate was disturbed, any eggs that were deposited in the substrate would drift downstream into the net. The number of sampling plots kicked per location of spawning gravels reflected the size of that area (one to five plots per area, spaced at least 1 m apart). As soon as eggs were documented in an area, no more kicks were conducted so impact to eggs was minimized.

Arctic Grayling eggs are small, ranging from 2 to 3 mm in diameter prior to fertilization, 2.7 mm on average when water hardened, and swell for 3 to 4 days to reach 3.5 to 4 mm in diameter (Northcote 1993).

The following information was recorded for each sampling effort:

- UTM coordinates for sampling locations
- dates
- start and end time
- net dimensions

- water depth
- general habitat description and dominant substrate types
- area sampled
- number and diameter of eggs captured

3.0 RESULTS

3.1 Construction Monitoring

Construction monitoring began on 10 May 2023 after rapid snow and ice melt caused flooding of the construction zone. Upon WSP's arrival at the Site, the twin culvert excavation for the primary channel crossing had paused because the work area filled with water. However, the single culvert excavation in the secondary channel was progressing, with extents completed on 10 May 2023. Upon the final stages of the installation of the secondary channel crossing on 15 May 2023, a temporary earth dam was constructed in the primary channel of Rascal Stream West to divert flows from the primary channel into the new corrugated steel culvert in the secondary channel. Site photos and a log of construction activities are provided in Appendix A and B, respectively.

Turbidity monitoring in RSW was conducted during instream construction activities from 10 to 18 May 2023, and continued for approximately one week after construction. Table 3-1 provides an overview of which sites were sampled on specific dates of the monitoring program. A total of 313 samples (i.e., not including QA/QC samples) were collected among downstream and upstream sampling sites (Appendix D).

Table 3-1: Overview of Where and When Turbidity Samples were Collected on RSW

Site ID	Date (May 2023)															
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Primary Channel																
US1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DS1.1	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-
DS1.2	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DS2.1	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-
DS2.2	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DS3.1	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-
DS3.2	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DS3.3	-	-	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Diversion Channel																
DS0	-	-	-	-	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓
Secondary Channel																
DS1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DS2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DS3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DS1.3	-	-	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DS2.3	-	-	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

✓ = turbidity sampling completed; - = no turbidity sampling completed.

Turbidity conditions at downstream sites were elevated, relative to the guidelines (CCME 2002), during the following events:

- 10 May: in the afternoon, the turbidity level at downstream site DS2 was 10.0 NTU, which was elevated above the upstream turbidity level by more than 8 NTU. The DS2 turbidity level returned to background levels by the next morning, within 24 hours of the elevated reading. This short-term elevation was attributed to water flowing through the secondary channel excavation area.
- 11 May: in the afternoon, turbidity levels at downstream sites DS1, DS2, DS3, and DS1.1 ranged from 15.5 to 78.1 NTU and were elevated above the upstream turbidity level by greater than 8 NTU. This elevation was attributed to flow from pumps in the excavation work area, which was recently disturbed. The pump inlets were relocated upstream of the temporary earth dam to decrease turbidity levels downstream; downstream turbidity level returned to background levels by the next morning (i.e., within 24 hours).
- 12 May: in the afternoon, turbidity levels at downstream sites DS1.2, DS2.2, and DS3.2 ranged from 23.9 to 67.1 NTU and were elevated above the upstream turbidity levels by greater than 8 NTU. The turbidity level returned to background levels by the next morning. This short-term elevation was attributed to downstream flow seeping through the temporary road.
- 13 May: in the afternoon, the turbidity level at site DS2 and DS2.2 was 9.0 and 9.2, respectively, and elevated above the upstream turbidity level by greater than 8 NTU. The DS2 turbidity level returned to background levels later that afternoon and the DS2.2 turbidity level returned to background levels by the next morning. The elevation at DS2.2 was attributed to downstream flow seeping through the temporary road.
- 15 May: in the morning, turbidity levels at downstream sites DS1.2, DS2.2, and DS3.2 ranged from 27.1 to 117 NTU and were elevated above the upstream turbidity levels by greater than 8 NTU. Turbidity levels at sites DS1.2 and DS2.2 continued to be elevated above guideline until the morning of 19 May. Turbidity levels at site DS3.2 returned to background levels on the morning of 17 May, but were elevated again by 18 May, before returning to background on 19 May.
- During the afternoon of 15 May, turbidity levels at other downstream sites DS3, DS3.1, and DS1.1 ranged from 10.3 to 50.7 NTU and were elevated above the upstream turbidity levels by greater than 8 NTU. DS3 turbidity levels returned to background by the next morning; however, DS3.1 and DS1.1 remained elevated until the morning of 17 May.

The elevated NTU levels from 15 to 19 May were attributed to the following construction activities:

- 15 May: excavation work downstream of the secondary culvert and the construction of the diversion dam
- 16 May: excavator working in excavation pond during pump-out, resulting in very high turbidity levels downstream. Pump outlets were then moved to a position further upstream, to allow sediment to settle prior to reaching Goose Lake. The excavator was also moved out of the lower pond.
- 17 to 19 May: seepage through road. On 18 May, a silt fence was installed to mitigate downstream transfer of sediment.

The elevated turbidity levels were reported to the B2Gold Site Supervisor to discuss the implementation of mitigation solutions. Mitigations included attempting to speed up the pace of construction, re-positioning pump outlets to allow sediment to settle prior to Goose Lake, the installation of additional silt fences, and re-positioning the excavator to reduce in-water disturbances.

3.1.1 Fish Rescues

A summary of the fishing effort is provided in Table 3-1. Six seine net efforts were conducted in the excavation pond on 16 May 2023, no fish were captured, and as such, the pond was considered unlikely to support fish at the time of monitoring. One pass of backpack electrofishing was conducted in the primary channel of Rascal Stream West on 17 May 2023 between the installed block nets (i.e., from upstream of the installed diversion berm to Gander Pond) (Table 3-1). Three adult Arctic Grayling with a fork length and weight ranging between 240 and 290 mm and 156 to 272 g, respectively, were captured and released in Gander Pond. Additional fish rescue efforts were not conducted after the first electrofishing pass, as B2Gold, in consultation with WSP and DFO, made the decision to pause construction until later in the season to minimize disruption to spawning Arctic Grayling in RSW.

In advance of construction that was re-initiated in late August, a fish rescue was conducted within a pool of water that refilled the area above the berm following late summer precipitation events. A total of eleven passes were conducted over the wetted area (i.e., within the small pond or pool) immediately above the diversion berm. Total catch was 336 fish (202 young-of-year Arctic Grayling, and 134 Ninespine Stickleback). The first past yielded the highest catch of 84 young of year Arctic Grayling and 10 Ninespine Stickleback, with the catch consistently declining through subsequent passes and the final pass yielding no fish. Length of captured Arctic Grayling ranged from 55 to 95 mm, and Ninespine Stickleback ranged from 22 to 40 mm. All fish were released immediately upon capture downstream of the work area near the confluence with Goose Lake.

Table 3-1: Summary of Project Fish Rescue Effort Completed in the Lower Reach of RSW, 2023

Date (2023)	Location	Method	UTM Coordinates (Zone 13W, UTM NAD83)				Total Distance (m)	# of Passes	Total Effort
			Start Location		End Location				
			Easting	Northing	Easting	Northing			
16-May	Excavation Isolation Pond	Seining[(a)]	432844	7270078	432829	7270069	15	6	405 m^2
17-May	Primary Channel Upstream	E-fishing[(b)]	432870	7270014	432957	7279858	150	1	1,244 seconds
31-Aug.	Primary Channel Upstream Pool	E-fishing[(c)]	432860	7270009	432854	7270028	21	11	5,587 seconds

(a) Seine dimensions = 4.6 x 1.5 m with a mesh size of 5 mm.

(b) Backpack electrofishing settings = 30 hertz (frequency), 830 volts (output voltage), 3.6 ampere (current), 12 milliseconds (pulse width).

(c) Backpack electrofishing settings = 60 hertz (frequency), 500 volts (output voltage), 3.6 ampere (current), 15 milliseconds (pulse width).

UTM = Universal Transverse Mercator; NAD83 = North American Datum of 1983; E-fishing = backpack electrofishing.

3.2 Fish Passage Assessment

Discharge measurements were collected daily from 20 to 25 May 2023. Mean discharge over this period was 0.129 m^3/s. Flow discharge in RSW was highest on 22 May (0.162 m^3/s) before decreasing gradually during subsequent days. Discharge on 25 May was 0.099 m^3/s. Water temperature was recorded in the secondary channel just downstream of the culvert on 24 May, measuring 7.2°C.

A fish habitat assessment of the entire stream section from the secondary channel outflow at Goose Lake to Gander Pond was conducted on 20 May 2023 (Table 3-2). Detailed results are provided in Appendix E.

Table 3-2: Summary of Fish Habitat Assessment, 20 May 2023

Location	Channel Unit #	Length (m)	Habitat Type[a]	Maximum Water Depth (m)	Average Wetted Width (m)	Average Bankfull Width (m)	Substrate [b]	
							Dominant	Subdominant
Secondary Channel	1	78	Run 3	0.6	15	1.3	Sa	Or, Si
	2	10	Riffle	0.3	15	1.2	Bo	Co
	3	10	Run 3	1.0	5.5	5.5	Gr	Si, Sa, Co, Bo
Diversion Channel	4	40	Run 3	0.6	1.4	1.8	Bo	Co, Gr
Primary Channel	5	30	Pool	>1.5	22	22	Or	Si
	6	50	Riffle	0.5	1.2	1.4	Bo	Co, Gr
	7	50	Run 3	0.7	3.0	3.5	Or	Bo, Si, Sa
	8	50	Run 2	2.0	3.0	3.4	Bo, Or	Si, Sa
	9	50	Run 3	0.8	2.5	3.0	Or	Si, Sa

(a) As defined by O'Neil and Hildebrand (1986). Run 3 is a shallow (<0.75 m deep) moderate velocity area with low instream cover; Riffle is a shallow (<0.5 m deep), high velocity and gradient area dominated by coarse substrate; Pool is a discrete portion of channel with increased depth and reduced velocity compared to run habitat; Run 2 is a 0.75 to 1.0 m deep, moderate to high velocity area with moderate to high instream cover.

(b) Or = Organics; Si = Silt (<0.06 mm); Sa = Sand (0.06-2 mm); Gr = Gravel (2-64 mm); Co = Cobble (64-256 mm); Bo = Boulder (>256 mm).

Under the diverted flow condition, the secondary channel was primarily shallow run habitat, with a short riffle section over a ledge of cobble and boulders. This section was largely flooded, with a wetted and bankfull width ranging from 5.5 to 15 m and 1.2 to 5.5 m, respectively. The dominant substrate in the downstream portion (closest to Goose Lake) was sand and the dominant substrate upstream from the crossing was gravel. The diversion channel was shallow run habitat, with boulder, cobble, and gravel substrate. A deep pool (greater than 1.5 m depth) formed in the primary channel just above the diversion berm, the substrate in this pool consisted of fines (i.e., silt and organics). The section of habitat in the primary channel extending from the pool to Gander Pond consisted of riffle and run habitat. The wetted and bankfull width ranged from 1.2 to 3 m and 1.4 to 3.5 m, respectively. The dominate substrate was boulder in the riffle habitat and organic material in the run habitat.

A qualitative assessment of fish passage was conducted to determine whether Arctic Grayling were able to move up through the secondary culvert, through the diversion channel, and into the natural primary channel for spawning. The main concern was a natural ledge of boulder and cobble substrate just downstream of the secondary culvert that may create a fish barrier during lower flows. On 21 May, the field crew rearranged boulders and cobble to create a deeper channel over the rock ledge, decreasing the chance of a fish barrier in the future. The field crew did not identify any barriers when departing from site on 25 May. Spot velocity measurements were taken along the secondary channel, in the culvert, and in the diversion channel (Table 3-3).

Table 3-3: Spot Velocity Measurements in Secondary Channel and Diversion Channel, 23 May 2023

Location	UTM Coordinates (Zone 13W, UTM NAD83)		Habitat Type[(a)]	1/4 Width		1/2 Width		3/4 Width	
	Easting	Northing		Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)
Secondary Channel	432853	7270125	Run 3	0.25	0.541	0.24	0.451	0.18	0.693
Secondary Channel	432863	7270105	Riffle	0.08	1.307	0.06	1.090	0.06	1.017
Secondary Channel	432864	7270101	Run 3	0.12	0.054	0.10	0.063	0.20	0.112
Culvert	432880	7270074	Run 3	0.12	0.233	0.10	0.338	0.11	0.463
Diversion Channel	432884	7270060	Run 3	0.12	0.550	0.25	0.247	0.25	0.927

(a) As defined by O'Neil and Hildebrand (1986). Run 3 is a shallow (<0.75 m deep) moderate velocity area with low instream cover; Riffle is a shallow (<0.5 m deep), high velocity and gradient area dominated by coarse substrate.

UTM = Universal Transverse Mercator; NAD83 = North American Datum of 1983.

3.2.1 Visual Surveys

The distribution of Arctic Grayling throughout Rascal Stream West from Gander Pond to Goose Lake as documented by visual observations is summarized in Table 3-4. No fish were observed prior to 17 May, likely due to the presence of an ice shelf in Goose Lake preventing upstream migration of fish that overwinter in Goose Lake. The presence of the ice shelf was identified by B2Gold using a drone to collect aerial imagery and was later confirmed by a WSP field technician on 11 May.

In total, 108 Arctic Grayling observations were made during visual surveys, of which 78 were adults and 30 were juveniles. Two Lake Trout (*Salvelinus Namaycush*) were observed in Goose Lake near the secondary channel outflow, 15 Ninespine Stickleback (*Pungitius pungitius*), one Slimy Sculpin (*Cottus cognatus*), and five unidentified fish were observed in the primary channel and secondary channel near Goose Lake. All visual survey data is provided in Appendix E.

Multiple visual surveys were conducted during the day; therefore, total counts may not be representative of number of fish in the stream as fish were likely counted more than once. Much of the secondary channel downstream of the culvert was obscured by overhanging vegetation, and submerged branches of overhanging vegetation created turbulence, decreasing visibility into the stream.

On 19 May, strong winds and increased turbidity levels both upstream and downstream of the construction area caused low visibility in the stream. On the morning of 20 May, there was a thin layer of ice on the shoreline of Goose Lake, on the pools in the stream, and on Gander Pond.

Table 3-4: Arctic Grayling Observations Made During Visual Surveys

Date	Number of Arctic Grayling Observed			
	Goose Lake	Secondary Channel (below culvert)	Diversion Channel	Primary Channel (above diversion)
17-May	0	0	0	9 (adult)
18-May	0	0	0	0
19-May	0	3 (juvenile)	0	0
20-May	0	1 (juvenile)	0	6 (adult)
21-May	1 (adult)	2 (adult) 3 (juvenile)	0	4 (adult)
22-May	0	1 (adult) 4 (juvenile)	0	1 (adult)
23-May	1 (adult)	5 (adult) 6 (juvenile)	3 (adult)	18 (adult) 2 (juvenile)
24-May	3 (adult)	8 (adult) 8 (juvenile)	1 (adult) 1 (juvenile)	14 (adult) 2 (juvenile)
25-May	0	0	0	1 (adult)

3.2.2 Kick Net Surveys

Kick net surveys were conducted at all potential Arctic Grayling spawning habitat identified between Goose Lake and Gander Pond (Table 3-5). Arctic Grayling eggs were captured in the secondary and diversion channel (Table3-5; Appendix A, Photo 37). No Arctic Grayling eggs were observed in the primary channel.

Table 3-5: Kick Net Survey Data, 24 May 2023

Location	Coordinates (Zone 13W, UTM NAD83)		Max. Depth (m)	Total Area Kicked (m^2)	Habitat Type[a]	Substrate[b]	Species	No. Eggs	Average Egg Diameter (mm)
	Easting	Northing							
Secondary Channel	432862	7270105	0.2	2	R3	Co/Gr/Bo/Sa	ARGR	5	4
Diversion Channel	432875	7270057	0.3	2	R3	Gr/Co/Bo	-	0	-
Diversion Channel	432873	7270055	0.4	4	R3	Gr/Sa/Co/Bo	-	0	-
Diversion Channel	432872	7270047	0.3	5	R3	Co/Bo/Gr	ARGR	2	4
Diversion Channel	432866	7270042	0.2	1	R3	Gr/Co	ARGR	7	4
Primary Channel	432860	7269989	0.3	4	Rf	Gr/Co	-	0	-
Primary Channel	432864	7269973	0.3	5	Rf	Bo/Co/Gr	-	0	-
Primary Channel	432884	7269935	0.4	3	R3	Bo/Co/Sa/Or	-	0	-
Primary Channel	432867	7269955	0.3	2	R3	Co/Bo/Gr/Sa	-	0	-

(a) As defined by O'Neil and Hildebrand (1986). Run 3 is a shallow (<0.75 m deep) moderate velocity area with low instream cover; Riffle is a shallow (<0.5 m deep), high velocity and gradient area dominated by coarse substrate.

(b) Or = Organics; Sa = Sand (0.06-2 mm); Gr = Gravel (2-64 mm); Co = Cobble (64-256 mm); Bo = Boulder (>256 mm).

UTM = Universal Transverse Mercator; NAD83 = North American Datum of 1983; ARGR = Arctic Grayling; - = not applicable.

4.0 SUMMARY

WSP provided environmental monitoring services for the Project from 10 to 25 May 2023. Monitoring services included turbidity sampling, fish rescues and fish passage assessments.

Turbidity conditions in Rascal Stream West were monitored at upstream and downstream sampling locations relative to the crossing construction area. Overall, there were instances when turbidity conditions at some of the downstream stations were elevated above guidelines, relative to background; however, these elevations were typically short in duration (i.e., less than 24-hours) and mitigated with the implementation of erosion and sediment controls. A longer duration (i.e., more than 24-hours) turbidity elevation was observed at a subset of downstream sampling locations starting on 15 May. These readings were largely attributed to water seepage through work area, and under or through the temporary road. To mitigate potential effects, B2Gold and their Contractor attempted to speed up the pace of construction, re-positioned pump outlets to allow sediment to settle prior to entering Goose Lake, installed additional silt fences, and re-positioned the heavy mobile equipment to reduce sedimentation into the watercourse.

Construction on the secondary channel culvert was completed on 15 May. Flow from the primary channel (i.e., upstream from the construction area) was directed into the secondary channel culvert by a diversion berm. High flows on 16 May resulted in surface water flowing over the diversion berm and into the isolated construction work area of the primary channel. Construction was subsequently paused on 17 May due to a combination of excessive seepage into the work area and the presence of spawning Arctic Grayling moving through the Project area. WSP remained on-site until 25 May to monitor turbidity and to collect additional fish and fish habitat information. During which time adult Arctic Grayling were observed moving from Goose Lake to upstream spawning habitat in Rascal Stream West. The observations suggest that adults were successful in navigating through the newly constructed secondary channel culvert and diversion channel to upstream spawning habitat.

Construction on the primary channel culvert resumed by the end of August during late summer baseflow conditions. A successful fish rescue was conducted on 31 August, prior to any instream work, in pool habitat in the primary channel located just upstream from the diversion berm. Young of year Arctic Grayling and Ninespine Stickleback were removed from the pool and relocated downstream from the construction area (near the confluence with Goose Lake). The primary channel culverts were then installed in the dry, within the isolated section of watercourse, in early September. Subsequent field studies are scheduled during the spring and summer of 2024 to assess the suitability of Arctic Grayling spawning and rearing habitat in RSW. Results from this study will, in part, help determine if Arctic Grayling are able to access RSW habitat upstream from the culvert construction areas.

Signature Page

WSP Canada Inc.

Tamara Derkowski, BSc
Intermediate, Aquatic Biologist

Cam Stevens, MSc, PhD, PBiol, RPBio
Principal, Senior Aquatic Ecologist

Chris Chesworth, MSc, PBiol
Experienced, Aquatic Biologist

TD/CS/CC

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APPENDIX A

Rascal Stream West Culvert Construction Photographs

Photo 1: Dewatering pumps in upper pond and lower pond upstream of twin multiplate culvert excavation, 10 May 2023.

Photo 2: Lower pond seeping into twin multiplate excavation through temporary road, 10 May 2023.

Photo 3: Dewatering pump discharge downstream of secondary culvert excavation, facing Goose Lake, 10 May 2023.

Photo 4: Temporary culverts discharging twin multiplate culvert excavation, facing Goose Lake, 10 May 2023.

Photo 5: Secondary culvert excavation with bedding placed, looking downstream, 11 May 2023.

Photo 6: Twin multiplate culvert excavation, 11 May 2023.

Photo 7: Checking for ice shelf in Goose Lake, 11 May 2023.

Photo 8: View of the D/S pump outlet, facing Goose Lake, 12 May 2023.

Photo 9: View of seepage under the road, facing Goose Lake, 12 May 2023.

Photo 10: View of the twin multiplate excavation, facing Goose Lake, 12 May 2023.

Photo 11: View of the RSW inflow upper pond and pump set up, 12 May 2023.

Photo 12: View of the downstream pump outlet, facing Goose Lake, 14 May 2023.

Photo 13: View of secondary culvert outlet, facing Goose Lake, 15 May 2023.

Photo 14: View of the downstream temporary culvert outlet, facing Goose Lake, 15 May 2023.

Photo 15: View of the downstream side of the diversion berm, facing upstream, 15 May 2023.

Photo 16: View of the diversion dam and diversion channel, facing downstream, 15 May 2023.

Photo 17: View of the excavation pond, facing Goose Lake, 16 May 2023.

Photo 18: View of the RSW secondary channel showing flooding on tundra, facing upstream, 16 May 2023.

Photo 19: View of the pump discharge downstream of temporary culvert, facing Goose Lake, 16 May 2023.

Photo 20: Excavator working in excavation pond, 16 May 2023.

Photo 21: Very turbid water at monitoring station DS2.2, 16 May 2023.

Photo 22: Block net installed in the primary channel just downstream of Gander Pond, facing upstream, 17 May 2023.

Photo 23: Three adult Arctic Grayling observed in the primary channel, 17 May 2023.

Photo 24: Block net installed downstream of the primary channel, facing upstream, 17 May 2023.

Photo 25: Block net filling with debris, facing upstream, 17 May 2023.

Photo 26: Arctic Grayling captured electrofishing, 17 May 2023.

Photo 27: Turbidity monitoring station DS1, looking upstream, 17 May 2023.

Photo 28: Turbidity monitoring station DS2, looking upstream, 17 May 2023.

Photo 29: Turbidity monitoring station DS3, looking upstream, 17 May 2023.

Photo 30: Turbidity monitoring station DS1.3, looking upstream, 17 May 2023.

Photo 31: Turbidity monitoring station DS2.3, looking upstream, 17 May 2023.

Photo 32: Turbidity monitoring station DS3.3, looking downstream, 17 May 2023.

Photo 33: Turbidity monitoring station DS1.2, looking upstream, 17 May 2023.

Photo 34: Turbidity monitoring station DS 2.2, looking upstream, 17 May 2023.

Photo 35: Turbidity monitoring station DS3.2, looking downstream, 17 May 2023.

Photo 36: Turbidity monitoring station US1, looking downstream, 17 May 2023.

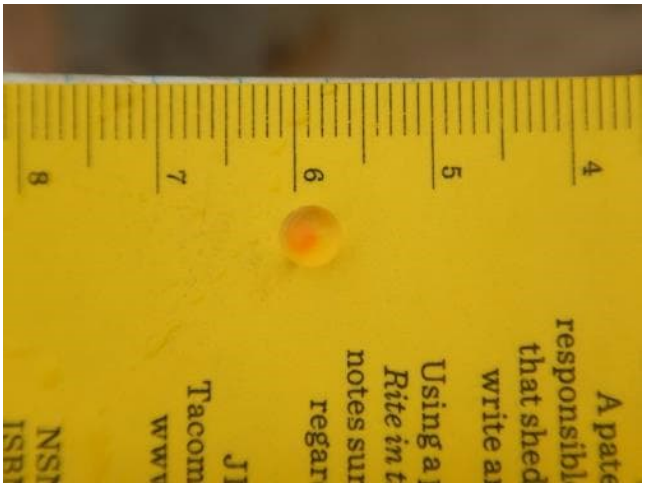

Photo 37: Arctic Grayling egg captured from Rascal Stream West during kick net surveys, 24 May 2023.

Photo 38: Completed twin steel culverts in the primary channel of RSW, facing upstream, 17 September 2023.

APPENDIX B

Construction Log

Table B-1: Construction Log, 10 May to 25 May 2023

Date	Time	Construction Activity
10-May-23	12:00	Water from rapid snow melt and overland flow into construction zone. Water located in downstream half of secondary culvert excavation and dewatering pump not operational.
10-May-23	15:00	Secondary culvert excavation at excavation extents
11-May-23	8:00	Only one pump operational, resulting in reduced flows. No flow exiting temporary culverts.
11-May-23	12:30	Four pumps operating with increased flow. Flow discharging through temporary culverts.
11-May-23	16:00	Flow from temporary culverts decreased and discharge passing into riprap, interstitial flows. Discharge from pumps is visibly turbid.
11-May-23	16:45	WSP recommended relocation of pump inlets upstream of temporary earth dam to decrease turbidity.
11-May-23	16:45	Placed transition layer, bedding layer, and secondary corrugated steel culvert.
12-May-23	7:20	50 mm clear crush stockpiled for backfill for secondary culvert. Three pumps running, keeping flow out of lower excavation pond. Minimal water in twin excavation. Some water in downstream end of secondary culvert excavation.
12-May-23	8:45	WSP recommended adjustments to pump discharge hoses to remove kinks. Three pumps maintaining flow. No flow into lower pond; all flow upstream of temporary earth dam.
12-May-23	9:45	WSP recommended placing riprap at pump outlets. Erosion occurring in natural surface material. Construction crew placed riprap at pump outlets.
12-May-23	11:45	Four pumps maintaining flow through culverts.
12-May-23	12:25	Excavator in place to begin backfill.
12-May-23	13:45	One pump removed from upper pond and relocated to dewater secondary culvert excavation. Flow overtopping earth dam weir and flowing into lower pond.
12-May-23	14:15	Dewatering of secondary excavation begun. Plate tamper delivered to site for compacting backfill. Plate tamper was damaged.
12-May-23	15:00	Twin excavation slowly filling with water.
12-May-23	15:15	Two pumps dewatering RSW as hoses are being realigned for excavator access. All pumps dewatering and water level below weir top.
12-May-23	16:40	Backfill material placed on left downstream side to 0.3 m above secondary culvert invert.
13-May-23	7:30	Four pumps operational. Flow overtopping earth dam weir. Sheen visible around downstream pump. Notified Ledcor. Cause is likely from refuelling pump. Sheen is flowing into lower pond. WSP recommended placing spill pads. Crew continued backfilling overnight (0.3 m fill on LDB, 0.9 m fill on RDB).
13-May-23	8:45	Spill pads and socks placed at location of sheen. Sheen not proceeding downstream.
13-May-23	11:00	Corrected misaligned upper section of culvert. Backfill compaction for secondary corrugated steel pipe culvert completed by jack tamper. Backfill is clear crush, very poorly graded, no fines.
13-May-23	15:00	Water levels increased in lower pond. Sheen visible in twin excavation. WSP recommended placing an absorbent sock boom in twin excavation to corral the sheen. Sheen continues to flow into lower pond despite absorbent beds and socks.
13-May-23	16:15	Sock boom installed. Some sheen seepage at knots in boom. WSP recommended relocating leaking pump hose away from spill location and adding more spill pads. Leaking hose relocated, created diversion for water around sheen location. Added more spill pads.
13-May-23	17:00	1.2 m backfill clear crush placed on LDB. 1.5 m on RDB. Sheen ceased entering lower pond.
14-May-23	8:45	Four pumps operational. Flow overtopping earth dam weir. Backfill complete to 0.3 m above top of culvert. Max particle size 75-100 mm. Large particles on top, smaller below (25 mm). Compaction with jack tamper. Some sheen visible at downstream end of twin excavation downstream of sock boom. Sheen does not appear to be re-entering stream in lower pond. Improved around pumps.
14-May-23	12:30	Culvert at 3.7% with raised inlet.
14-May-23	14:30	Flow slowly increased in RSW. Four pumps at maximum capacity unable to maintain flow below temporary earth dam weir. Flow discharging through temporary culvert from twin excavation.

Table B-1: Construction Log, 10 May to 25 May 2023

Date	Time	Construction Activity
14-May-23	15:15	Observed sheen on ground around pumps. WSP recommended wiping fuel hose with absorbent pad after refueling pumps.
14-May-23	16:00	Sheen was observed flowing into lower excavation pond below temporary earth dam.
14-May-23	16:30	Backfill completed to 0.6 m above the culvert crest with raw esker material. Track packed by dozer. Clear crush backfilled to 1.5 m on both sides of culvert. Raw esker material placed above to 0.6 m above crest. Last lift track packed. RoQ (Run of Quarry) material placed above track-packed raw esker material.
15-May-23	7:45	Backill material, raw esker placed upstream of secondary culvert. Backfill and plug was set below and in front of culvert inlet prior to placing raw esker.
15-May-23	9:45	Secondary culvert ready for receiving diverted flow. Road breached/excavated downstream of secondary culvert. Large release of sediment and increase in turbidity. Dewatering pumps discharging into inlet of secondary culvert. Excavator widening and increasing depth of secondary culvert downstream channel. Large apron in place to reduce erosion of ground surface.
15-May-23	12:30	Construction of upstream diversion berm on RDB begins. Introducing sediment and turbidity into upper pond, lower pond, and pump discharge through secondary culvert.
15-May-23	14:00	Increase in turbidity due to diversion dam construction.
15-May-23	14:50	Temporary earth dam weir plugged. RSW pooling behind temporary earth dam.
15-May-23	15:30	Diversion dam complete. High turbidity flowing through secondary culvert. Temporary apron undersized for flow and eroding. WSP recommended placing large riprap to reduce energy and erosion on LDB. Pumps shut down.
15-May-23	16:00	Turbidity levels reducing as flow continues and approaches steady state.
16-May-23	9:30	Night shift removed temporary road through twin excavation. Prepping to remove sediment and saturated soil. Lower pond is fully isolated upstream and downstream.
16-May-23	9:45	Water pumped out of lower pond to downstream of primary culvert area. WSP recommended to pump upstream and let it settle to decrease turbidity downstream.
16-May-23	10:50	Potential fish sighting in lower pond. WSP recommended Ledcor stop pumping and install end-of-pipe screens on pump. Pumping stopped.
16-May-23	11:45	Ledcor used mosquito netting to make a temporary screen for pump and started pumping again.
16-May-23	13:00	WSP completed four seine net passes in lower pond. No fish caught or observed. Installed a block net in front of pump.
16-May-23	13:45	Excavator working in lower pond. High turbidity downstream of pump out. WSP recommended Ledcor stop pumping or move the pump outlet further upstream to allow the sediment to settle.
16-May-23	14:00	Pump-out stopped.
16-May-23	14:30	Pump outflow moved further upstream.
16-May-23	14:45	No flow downstream of primary culvert location as pumpout has stopped.
16-May-23	15:00	Excavator moved out of lower pond. Pump moved to deeper location in lower pond.
16-May-23	16:45	WSP completed two more seine net passes in lower pond. No fish caught or observed.
17-May-23	7:05	Water in lower pond. Flow is breaching dam at the same rate as it is pumped out. Two pumps in pond.
17-May-23	8:00	WSP recommended a screen on the second pump.
17-May-23	8:30	Ledcor plans to divert water at the outlet of Gander Pond directly into secondary channel and add another berm across the primary channel at the Gander Pond outlet.
17-May-23	9:45	WSP installed one block net at Gander Pond outflow.
17-May-23	10:45	WSP observed three adult Arctic Grayling in primary channel of RSW. WSP recommended diversion held off until the stream can be isolated and fished out.
17-May-23	13:00	All block nets installed by WSP.
17-May-23	14:00	WSP conducted one backpack electrofishing pass. Three adult Arctic Grayling captured and relocated upstream of block nets in Gander Pond. Five more adult Arctic Grayling observed.

Table B-1: Construction Log, 10 May to 25 May 2023

Date	Time	Construction Activity
17-May-23	15:30	B2Gold consulting with WSP and decided to pause construction due to high flows making it difficult to manage water in the excavation area.
17-May-23	16:00	All block nets removed.
18-May-23	7:00	Pumps gone. Lower pond backfilled in the middle, creating two ponds. Seepage coming through backfill increasing turbidity downstream.
18-May-23	10:00	WSP recommended a silt fence to decrease turbidity downstream of excavation ponds.
18-May-23	13:00	Haul truck and bulldozer on site backfilling the excavation pond that is further upstream.
18-May-23	15:00	Crane on site removing culvert pieces. Dozer levelling and flattening new road.
18-May-23	15:30	Silt fence installed.
19-May-23	9:00	Roller compacting road.

APPENDIX C

Turbidity Monitoring Data: Quality Assurance and Quality Control

INTRODUCTION

Quality assurance and quality control (QA/QC) practices determine data integrity and are relevant to all aspects of a study, from sample collection to data analysis and reporting. QA encompasses management and technical practices designed to ensure that the data generated are of consistent and acceptable quality. QC is an aspect of QA and consists of the procedures used to measure and evaluate data quality, and the corrective actions to be taken when data quality objectives are not met. This appendix describes QA/QC practices applied during this study, evaluates QC data, and describes the implications of QC results to the interpretation of study results and incorporates best practices described by PMEC 2006.

QUALITY ASSURANCE

QA applicable to this study cover three areas of internal management, as described below.

Field Staff Training and Operations

WSP field staff are trained to be proficient in standardized field sampling procedures, data recording, and equipment operations applicable to water quality sampling. Field work was completed according to approved specific work instructions (SWIs) to the field crew and established WSP technical procedures. SWIs describe exact sampling locations and provide specific sampling instructions, equipment needs and calibration requirements. They also provide specific guidelines for field record keeping.

Field work was completed by following the SWI and a Project Risk Assessment and Safety Plan (PRASP). This field program was preceded by a pre-field meeting attended by the field crew and the project manager, during which the purpose of the field program was discussed, roles of crew members were specified, questions regarding the SWI were addressed, and equipment needs, field logistics, and contingency plans were discussed. During field work, field data were recorded on standardized field data sheets or in a bound field book, according to established field record-keeping procedures. In addition, field crews checked-in with the project manager regularly to provide an update on work completed.

Sample Handling and Meter Calibration

Turbidity samples were collected in 1.2 L plastic bottles at 60% stream depth; bottles were triple rinsed with stream water at their respective site before the sample was collected to the potential of cross-contamination. A 20 mL subsample was decanted from each well-mixed sample bottle and transferred into a test vial; each test vial was triple rinsed with sample water before the actual sample was transferred. Turbidity from each subsample was measured using a LaMotte 2020TI portable turbidity meter. The precision for the LaMotte 2020TI is two decimal points for levels between 0.00 to 10.99 NTU, one decimal points for levels between 11.0 to 109.9 NTU and no decimal points for levels between 110 to 1100 NTU. The meter was calibrated daily with a 0 and 10 or 100 NTU standards to ensure accuracy and the calibrations were logged. If any turbidity measurements were more than 5% above or below the known turbidity level for each standard solution, the meter was calibrated using the blank (0 NTU) and the standard solution closest to the turbidity levels measured in the field. Before the subsample was measured, the outside of the test vial was dried with paper towel before being wiped clean with ultra-low lint tissues to eliminate false readings caused by diffraction of light away from the turbidity meter sensor. The test vial was then inverted three times to ensure even mixing before triplicate readings were taken.

Office Operations

Office-related QA consisted of using appropriately trained personnel for each task and senior review of work products at appropriate milestones, use of standardized data manipulation/summary tools, filing of data and project information according to standardized protocols, and establishment of a data management system for an organized and consistent system of data storage, QC, and retrieval.

QUALITY CONTROL

QC applicable to this study cover three areas of internal management, as described below.

Field QC Procedures

For sample collection procedures, QC sampling consisted of the collection of replicate and split samples. Split and replicate QC samples collected during the field program accounted for approximately 8% of the total number of samples collected. Each QC sample type is described below:

- Split samples consist of a single sample divided into three portions. The samples were then processed and analyzed in succession. The split samples were used to assess meter precision among subsamples.
- Replicate sampling consisted of the collection of three discrete turbidity grab-samples in quick succession. The samples were then processed in succession. The replicate samples were used to assess sampling precision.

Furthermore, a triplicate reading was recorded for each sample (i.e., QC and non-QC samples). Triplicate measurements consisted of taking three consecutive readings with the same subsample. Triplicate measurements were used to assess meter precision for each subsample.

Office QC Procedures

Relevant fundamentals of office-based QC included the following:

- comparing sample data entered into the project database against field reports to verify accuracy of data transcription
- creating backup files before each major operation as data were being manipulated
- verifying the accuracy of calculations performed to generate summary statistics
- checking split and replicate samples for evidence of unacceptable variation (see next section)
- checking field-collected data for completeness, and unexpected values and trends

Data Quality Evaluation

Split and replicate QC samples were evaluated for meter and sampling precision. Differences between concentrations measured in QC samples were calculated as the relative standard deviation (RSD) and the relative percent difference (RPD).

The RSD was calculated using the following formula:

$$RSD = (\text{standard deviation among QC split or replicate samples}/\text{mean}) \times 100$$

The RSD data were reviewed to check that calculated levels were less than 18% (PMEC 2006).

The RPD was calculated using the following formula:

$$RPD = (|\text{difference in concentration between split samples}| / \text{mean concentration}) \times 100$$

The RSD data were reviewed to check that calculated levels were less than 25% (PMEC 2006).

Quality Control Results

In total, 348 grab-samples were collected for turbidity analysis, with 29 (8%) of these samples being split or replicate samples. In general, 97.1% of the triplicate samples (i.e., 338 of 348 samples) had RSDs within QA/QC guidelines (PMEC 2006). Split sample RSD and RPD resulted in 67% and 100%, respectively, of acceptable quality relative to the QC guidelines. Replicate sample RSD and RPD resulted in 100% and 78%, respectively, of acceptable quality relative to the QC guidelines. Approximately 94% of the split samples (i.e., 16 of 17 samples) and 83% of replicate samples (i.e., 10 of 12 samples) had RPDs and RSDs within QA/QC guidelines. This result suggests there was moderate precision within and among split and replicate sample readings, respectively. Overall, this result is likely a reflection of the low number of QC samples collected rather than sampling or metre precision related issues, and therefore, the turbidity data was deemed to be of acceptable quality.

APPENDIX D

Turbidity Monitoring Data

Table D-1: Turbidity Readings in Rascal Stream West, 10 to 25 May 2023

Date	Time	Location	Sample ID	Reading 1	Reading 2	Reading 3	Average [(a)]	QA/QC
10-May	13:00	US1	1	1.5	1.6	1.6	1.6	-
10-May	13:15	DS3	2	5.2	5.3	5.5	5.3	-
10-May	13:15	DS2	3	7.3	7.3	6.9	7.2	-
10-May	13:15	DS1	4	9.6	10.7	9.7	10.0	-
10-May	14:00	DS3.1	5	6.9	6.8	6.7	6.8	-
10-May	14:00	DS2.1	6	3.8	3.5	3.5	3.6	-
10-May	14:00	DS1.1	7	3.3	2.9	2.8	3.0	-
11-May	7:30	DS3	8	3.1	3.1	3.2	3.1	-
11-May	7:35	DS2	9	3.3	3.0	3.3	3.2	-
11-May	7:40	DS1	10	3.4	3.5	3.6	3.5	-
11-May	8:00	US1	11	1.7	1.9	1.9	1.8	-
11-May	15:40	DS3.1	12	4.2	4.4	4.4	4.3	-
11-May	15:45	DS2.1	13	6.0	5.8	5.5	5.7	-
11-May	15:45	DS1.1	14	15.5	15.4	15.5	15.5	-
11-May	16:00	US1	15	3.0	3.0	2.9	3.0	-
11-May	16:05	DS3	16	39.7	39.9	39.3	39.6	-
11-May	16:05	DS2	17	57.8	59.8	60.8	59.5	-
11-May	16:05	DS1	18	79.9	80.6	73.7	78.1	-
12-May	7:45	US1	19	1.2	1.1	1.1	1.1	-
12-May	7:50	DS3	20	4.4	3.9	3.6	4.0	-
12-May	7:55	DS2	21	6.7	5.9	6.1	6.2	-
12-May	8:00	DS1	22	2.7	3.0	2.6	2.8	-
12-May	10:05	US1	23	2.4	2.5	2.4	2.4	-
12-May	10:10	DS3	24	2.6	2.5	2.6	2.5	-
12-May	10:15	DS2	25	3.3	3.2	3.1	3.2	-
12-May	10:20	DS1	26	4.3	3.7	4.2	4.1	-
12-May	14:35	US1	27	1.9	1.4	1.7	1.6	-
12-May	14:40	DS3	28	2.1	2.1	2.0	2.1	-
12-May	14:45	DS2	29	2.5	2.3	2.2	2.3	-
12-May	14:50	DS1	30	2.1	1.9	2.2	2.0	-
12-May	15:25	DS3.2	31	53.7	54.1	52.5	53.4	-
12-May	15:30	DS2.2	32	56.8	56.2	56.8	56.6	-
12-May	15:35	DS1.2	33	66.3	67.4	67.6	67.1	-
12-May	16:15	US1	34	3.1	3.0	3.0	3.0	-
12-May	16:20	DS3	35	4.9	4.8	4.7	4.8	-
12-May	16:25	DS2	36	3.3	3.7	3.3	3.4	-
12-May	16:30	DS1	37	1.8	1.9	2.0	1.9	-
12-May	16:35	DS3.2	38	25.2	23.9	25.1	24.7	-
12-May	16:40	DS2.2	39	23.4	23.6	24.6	23.9	-
12-May	16:45	DS1.2	40	24.3	25.0	23.8	24.4	-
13-May	8:15	US1	41	0.9	1.0	1.0	1.0	-

Table D-1: Turbidity Readings in Rascal Stream West, 10 to 25 May 2023

Date	Time	Location	Sample ID	Reading 1	Reading 2	Reading 3	Average [(a)]	QA/QC
13-May	8:17	DS3	42	1.6	1.4	1.4	1.5	-
13-May	8:19	DS2	43	1.2	1.3	1.2	1.2	-
13-May	8:21	DS1	44	1.0	1.0	1.0	1.0	-
13-May	8:23	DS3.2	45	5.5	5.8	5.8	5.7	-
13-May	8:25	DS2.2	46	6.4	5.8	6.6	6.3	-
13-May	8:27	DS1.2	47	6.5	5.9	5.8	6.1	-
13-May	12:15	US1	48	0.9	1.0	1.0	1.0	-
13-May	12:17	DS3	49	4.4	4.2	4.2	4.3	Split 1
13-May	12:19	DS3	50	3.5	3.3	3.2	3.4	Split 2
13-May	12:21	DS3	51	2.5	2.1	2.1	2.3	Split 3
13-May	12:23	DS2	52	9.0	9.0	8.9	9.0	-
13-May	12:25	DS1	53	2.7	2.1	2.1	2.3	-
13-May	12:27	DS3.2	54	8.2	8.7	8.3	8.4	-
13-May	12:29	DS2.2	55	2.0	1.9	1.7	1.8	-
13-May	12:31	DS1.2	56	6.9	7.5	7.4	7.3	-
13-May	15:15	US1	57	1.6	1.5	1.4	1.5	Replicate 1
13-May	15:17	US1	58	1.6	1.5	1.3	1.5	Replicate 2
13-May	15:19	US1	59	1.3	1.4	1.4	1.4	Replicate 3
13-May	15:21	DS3	60	1.5	1.5	1.5	1.5	-
13-May	15:23	DS2	61	1.8	1.6	1.2	1.6	-
13-May	15:25	DS1	62	1.3	1.9	1.3	1.5	-
13-May	15:27	DS3.2	63	8.2	8.6	9.0	8.6	-
13-May	15:29	DS2.2	64	8.8	9.3	9.4	9.2	-
13-May	15:31	DS1.2	65	8.7	8.6	8.7	8.7	-
14-May	9:00	US1	66	0.7	0.7	0.7	0.7	-
14-May	9:10	DS3	67	1.4	1.1	1.3	1.2	-
14-May	9:12	DS2	68	1.1	0.8	0.8	0.9	-
14-May	9:14	DS1	69	1.1	1.1	1.1	1.1	Split 1
14-May	9:14	DS1	70	1.3	1.0	0.9	1.1	Split 2
14-May	9:14	DS1	71	1.1	1.0	1.0	1.1	Split 3
14-May	9:16	DS3.2	72	3.5	3.5	3.4	3.5	-
14-May	9:18	DS2.2	73	3.6	3.5	3.4	3.5	-
14-May	9:20	DS1.2	74	3.4	3.4	3.4	3.4	-
14-May	15:00	US1	75	1.1	1.0	1.2	1.1	Replicate 1
14-May	15:00	US1	76	1.1	1.1	1.0	1.0	Replicate 2
14-May	15:00	US1	77	1.2	1.2	1.2	1.2	Replicate 3
14-May	15:05	DS3	78	0.9	0.9	0.9	0.9	-
14-May	15:07	DS2	79	0.8	0.9	0.8	0.8	-
14-May	15:09	DS1	80	1.3	1.3	1.4	1.3	-
14-May	15:11	DS3.2	81	4.8	4.7	4.7	4.7	-
14-May	15:13	DS2.2	82	5.5	5.6	5.5	5.5	-

Table D-1: Turbidity Readings in Rascal Stream West, 10 to 25 May 2023

Date	Time	Location	Sample ID	Reading 1	Reading 2	Reading 3	Average [(a)]	QA/QC
14-May	15:15	DS1.2	83	6.3	6.2	6.3	6.3	-
14-May	15:17	DS3.1	84	2.9	2.9	3.1	3.0	-
14-May	15:19	DS2.1	85	2.4	2.5	2.6	2.5	-
14-May	15:21	DS1.1	86	1.9	1.9	1.9	1.9	-
15-May	8:30	US1	87	1.8	1.8	1.9	1.8	-
15-May	8:40	DS3	88	1.3	1.2	1.2	1.2	Replicate 1
15-May	8:40	DS3	89	1.5	1.5	1.5	1.5	Replicate 2
15-May	8:40	DS3	90	1.2	1.2	1.1	1.1	Replicate 3
15-May	8:42	DS2	91	1.0	0.9	0.9	0.9	-
15-May	8:44	DS1	92	1.2	1.3	1.1	1.2	-
15-May	8:46	DS3.2	93	3.1	3.2	3.1	3.1	-
15-May	8:48	DS2.2	94	3.2	3.2	3.0	3.2	-
15-May	8:50	DS1.2	95	3.4	3.5	3.3	3.4	-
15-May	8:52	DS3.1	96	2.3	2.3	2.2	2.3	-
15-May	8:54	DS2.1	97	1.9	1.9	2.1	2.0	-
15-May	8:56	DS1.1	98	2.0	2.1	2.1	2.1	-
15-May	8:58	DS3.2	99	91	94	89	91	-
15-May	9:00	DS2.2	100	122	121	109	117	-
15-May	9:02	DS1.2	101	25.0	28.1	28.1	27.1	-
15-May	14:00	US1	102	1.31	1.37	1.31	1.33	-
15-May	14:10	DS3	103	10.3	10.3	10.1	10.3	-
15-May	14:12	DS2	104	8.3	8.3	8.3	8.3	-
15-May	14:14	DS1	105	2.5	2.5	2.4	2.5	-
15-May	14:16	DS3.2	106	79.5	72.9	71.5	74.6	-
15-May	14:18	DS2.2	107	73.2	75.5	75.5	74.7	-
15-May	14:20	DS1.2	108	72.3	70.5	69.7	70.8	-
15-May	14:22	DS3.1	109	55.0	49.0	48.0	50.7	Split 1
15-May	14:22	DS3.1	110	44.0	43.0	42.0	43.0	Split 2
15-May	14:22	DS3.1	111	46.0	43.0	47.0	45.3	Split 3
15-May	14:24	DS2.1	112	42.0	40.0	45.0	42.3	-
15-May	14:26	DS1.1	113	45.7	48.2	48.2	47.4	-
16-May	10:05	DS3	114	8.2	8.2	7.8	8.1	-
16-May	10:10	DS2	115	6.3	6.8	6.7	6.6	-
16-May	10:15	DS1	116	10.1	10.1	10.1	10.1	-
16-May	10:25	DS3.2	117	35.0	33.9	32.7	33.9	-
16-May	10:30	DS2.2	118	54.3	64.7	62.3	60.4	-
16-May	10:32	DS1.2	119	51.7	56.9	53.4	54.0	-
16-May	10:33	DS3.1	120	70.2	79.0	77.1	75.4	-
16-May	10:35	DS2.1	121	105	103	101	103	-
16-May	10:37	DS1.1	122	51.0	86.4	92.0	76.5	-
16-May	11:35	US1	123	0.6	0.7	0.7	0.7	-

Table D-1: Turbidity Readings in Rascal Stream West, 10 to 25 May 2023

Date	Time	Location	Sample ID	Reading 1	Reading 2	Reading 3	Average [a]	QA/QC
16-May	12:00	DS3	124	5.7	7.6	6.7	6.6	-
16-May	12:02	DS2	125	11.3	11.1	12.3	11.6	-
16-May	12:04	DS1	126	16.7	14.8	13.4	15.0	-
16-May	12:15	DS3.2	127	1357	1367	1355	1360	-
16-May	12:18	DS2.2	128	3183	3179	3111	3158	Split 1
16-May	12:22	DS2.2	129	2952	2939	2944	2945	Split 2
16-May	12:28	DS1.2	130	2216	2211	2209	2212	-
16-May	12:31	DS3.1	131	70.9	78.6	77.5	75.7	-
16-May	12:35	DS2.1	132	1166	1181	1180	1176	-
16-May	12:40	DS1.1	133	3891	3921	3928	3913	-
16-May	12:18	US1	134	1.1	1.2	1.1	1.2	-
16-May	14:15	DS3	135	10.6	11.0	10.2	10.6	-
16-May	14:18	DS2	136	11.3	11.7	11.4	11.5	-
16-May	14:20	DS1	137	13.1	12.7	11.0	12.3	-
16-May	14:35	DS3.2	138	1104	1117	1115	1112	-
16-May	14:37	DS2.2	139	2377	2375	2376	2376	-
16-May	14:39	DS1.2	140	2408	2458	2464	2443	-
16-May	14:50	DS3.1	141	119	102	104	108	-
16-May	15:00	US1	142	0.9	0.9	0.9	0.9	-
16-May	15:50	DS3	143	61	57	55	58	-
16-May	15:52	DS2	144	63	59	53	58	-
16-May	15:53	DS1	145	59	64	67	63	-
16-May	16:00	DS3.3	146	60	65	63	63	-
16-May	16:02	DS2.3	147	66	63	62	64	-
16-May	16:06	DS1.3	148	80	78	82	80	-
16-May	16:20	DS1.2	149	181	186	186	184	-
16-May	16:25	DS2.2	150	626	626	624	625	Split 1
16-May	16:25	DS2.2	151	628	632	631	630	Split 2
16-May	16:30	DS3.2	152	47.3	45.6	45.2	46.0	-
16-May	16:40	US1	153	0.8	0.8	0.7	0.8	Split 1
16-May	16:40	US1	154	0.8	0.8	0.8	0.8	Split 2
17-May	7:33	DS3	155	3.2	3.5	3.9	3.5	-
17-May	7:35	DS2	156	3.4	3.9	4.2	3.8	-
17-May	7:37	DS1	157	3.2	3.3	3.2	3.3	-
17-May	7:42	DS3.3	158	5.4	4.7	4.6	4.9	-
17-May	7:43	DS2.3	159	4.4	4.7	4.3	4.5	-
17-May	7:45	DS1.3	160	2.7	2.8	2.9	2.8	-
17-May	7:55	DS3.2	161	2.9	2.9	3.1	3.0	-
17-May	7:56	DS2.2	162	10.9	11.1	11.0	11.0	-
17-May	7:59	DS1.2	163	17.0	16.3	16.9	16.7	-
17-May	8:15	US1	164	0.8	0.8	0.7	0.8	Replicate 1

Table D-1: Turbidity Readings in Rascal Stream West, 10 to 25 May 2023

Date	Time	Location	Sample ID	Reading 1	Reading 2	Reading 3	Average [(a)]	QA/QC
17-May	8:15	US1	165	0.4	0.4	0.4	0.4	Replicate 2
18-May	7:15	DS1	166	3.3	3.1	3.1	3.1	-
18-May	7:19	DS2	167	2.6	2.8	2.8	2.7	-
18-May	7:20	DS3	168	3.2	2.9	2.7	2.9	-
18-May	7:11	DS1.2	169	41.1	38.6	39.6	39.8	-
18-May	7:08	DS2.2	170	42.8	39.0	39.3	40.4	-
18-May	7:06	DS3.2	171	23.1	24.5	24.4	24.0	Replicate 1
18-May	7:06	DS3.2	172	24.7	26.4	27.4	26.2	Replicate 2
18-May	7:48	DS1.3	173	2.1	2.2	2.1	2.1	-
18-May	7:46	DS2.3	174	2.5	2.4	2.4	2.4	-
18-May	7:44	DS3.3	175	2.9	2.8	2.9	2.9	Split 1
18-May	7:44	DS3.3	176	2.7	2.7	2.6	2.7	Split 2
18-May	7:55	US1	177	1.9	2.1	2.1	2.0	-
18-May	7:50	DS0	178	1.4	1.5	1.6	1.5	-
18-May	10:15	DS1	179	1.0	1.0	1.0	1.0	-
18-May	10:17	DS2	180	1.9	1.5	1.4	1.6	-
18-May	10:19	DS3	181	1.3	1.2	1.2	1.3	-
18-May	10:22	DS1.2	182	16.4	16.3	16.6	16.4	-
18-May	10:24	DS2.2	183	15.7	16.1	16.3	16.0	-
18-May	10:26	DS3.2	184	11.3	11.3	11.2	11.3	-
18-May	10:22	DS1.3	185	1.2	2.2	2.3	1.9	-
18-May	10:24	DS2.3	186	1.1	1.3	1.5	1.3	Replicate 1
18-May	10:26	DS2.3	187	1.1	1.1	1.1	1.1	Replicate 2
18-May	10:24	DS3.3	188	1.2	1.2	1.3	1.3	-
18-May	10:45	DS0	189	1.1	1.1	1.0	1.1	Split 1
18-May	10:45	DS0	190	1.1	1.2	1.2	1.1	Split 2
18-May	13:00	DS3.2	191	8.2	8.4	8.1	8.2	-
18-May	13:02	DS2.2	192	12.2	12.0	12.1	12.1	-
18-May	13:03	DS1.2	193	13.7	13.6	14.1	13.8	-
18-May	13:00	DS1	194	1.6	1.6	1.6	1.6	-
18-May	13:02	DS2	195	2.2	2.5	2.4	2.4	Split 1
18-May	13:04	DS2	196	2.5	2.4	2.6	2.5	Split 2
18-May	13:10	DS3	197	2.0	2.2	2.0	2.1	-
18-May	13:11	DS3.3	198	1.7	1.5	1.8	1.6	-
18-May	13:12	DS2.3	199	2.4	2.7	2.6	2.6	-
18-May	13:40	DS1.3	200	1.3	1.2	1.2	1.3	-
18-May	13:42	US1	201	1.2	1.2	1.2	1.2	-
18-May	13:02	DS0	202	7.5	7.8	7.9	7.8	-
18-May	15:28	DS0	203	1.2	1.5	1.3	1.3	Replicate 1
18-May	15:28	DS0	204	1.1	1.0	0.9	1.0	Replicate 2
18-May	15:30	US1	205	0.5	0.6	0.9	0.7	-

Table D-1: Turbidity Readings in Rascal Stream West, 10 to 25 May 2023

Date	Time	Location	Sample ID	Reading 1	Reading 2	Reading 3	Average [(a)]	QA/QC
18-May	15:30	DS1	206	1.1	0.9	0.9	1.0	-
18-May	15:32	DS2	207	1.6	1.6	1.5	1.6	-
18-May	15:34	DS3	208	1.6	1.6	1.7	1.6	-
18-May	15:42	DS3.2	209	34.4	37.1	37.4	36.3	-
18-May	15:43	DS2.2	210	52.1	56.5	58.3	55.6	-
18-May	15:44	DS1.2	211	53.8	55.2	55.9	55.0	Split 1
18-May	15:44	DS1.2	212	58.9	56.2	57.4	57.5	Split 2
18-May	15:36	DS3.3	213	1.2	1.2	1.3	1.2	-
18-May	15:38	DS2.3	214	2.1	2.0	2.1	2.1	-
18-May	15:39	DS1.3	215	1.7	1.8	2.0	1.8	-
19-May	7:00	DS1	216	1.6	1.4	1.4	1.4	-
19-May	7:02	DS2	217	2.7	2.8	2.6	2.7	-
19-May	7:04	DS3	218	2.6	2.6	2.4	2.5	-
19-May	7:06	DS1.2	219	11.9	11.1	10.5	11.2	-
19-May	7:08	DS2.2	220	11.1	11.1	10.6	10.9	-
19-May	7:10	DS3.2	221	6.9	6.8	6.7	6.8	-
19-May	7:12	DS1.3	222	8.4	8.0	8.0	8.1	-
19-May	7:14	DS2.3	223	1.5	1.6	1.5	1.6	-
19-May	7:16	DS3.3	224	1.4	1.6	1.7	1.6	Replicate 1
19-May	7:18	DS3.3	225	1.3	1.1	1.2	1.2	Replicate 2
19-May	7:20	US1	226	1.8	2.1	2.1	2.0	-
19-May	7:22	DS0	227	2.0	2.0	2.0	2.0	-
19-May	9:10	DS1	228	2.7	2.7	2.7	2.7	-
19-May	9:12	DS2	229	3.6	3.8	3.7	3.7	-
19-May	9:14	DS3	230	2.7	2.4	2.6	2.5	Split 1
19-May	9:14	DS3	231	2.4	2.5	2.4	2.5	Split 2
19-May	9:16	DS1.2	232	7.8	8.1	8.0	8.0	-
19-May	9:18	DS2.2	233	8.5	8.4	8.4	8.4	-
19-May	9:20	DS3.2	234	5.9	5.6	5.7	5.7	Replicate 1
19-May	9:28	DS3.2	235	6.3	6.3	6.4	6.3	Replicate 2
19-May	9:22	DS1.3	236	2.7	3.0	2.8	2.9	-
19-May	9:24	DS2.3	237	2.8	2.6	2.5	2.6	-
19-May	9:26	DS3.3	238	1.8	1.7	1.8	1.8	-
19-May	9:30	US1	239	1.1	1.2	1.2	1.2	-
19-May	9:32	DS0	240	1.2	1.3	1.3	1.3	-
19-May	13:15	DS1	241	8.2	7.2	6.7	7.4	-
19-May	13:17	DS2	242	7.2	6.9	6.9	7.0	-
19-May	13:19	DS3	243	4.4	4.8	4.7	4.6	-
19-May	13:21	DS1.2	244	10.4	9.7	9.9	10.0	-
19-May	13:23	DS2.2	245	11.2	10.6	10.7	10.8	-
19-May	13:25	DS3.2	246	7.0	7.3	7.3	7.2	-

Table D-1: Turbidity Readings in Rascal Stream West, 10 to 25 May 2023

Date	Time	Location	Sample ID	Reading 1	Reading 2	Reading 3	Average [(a)]	QA/QC
19-May	13:27	DS1.3	247	4.7	4.9	4.9	4.8	Split 1
19-May	13:27	DS1.3	248	3.9	5.0	4.3	4.4	Split 2
19-May	13:29	DS2.3	249	4.4	4.3	4.7	4.4	-
19-May	13:31	DS3.3	250	3.4	3.7	3.7	3.6	-
19-May	13:33	US1	251	5.4	4.9	4.8	5.0	-
19-May	13:35	DS0	252	4.5	4.3	4.6	4.5	-
19-May	15:15	DS1	253	4.4	5.3	5.3	5.0	-
19-May	15:17	DS2	254	3.9	3.9	4.1	4.0	-
19-May	15:19	DS3	255	3.9	3.9	3.8	3.9	-
19-May	15:21	DS1.2	256	6.5	6.5	6.7	6.6	-
19-May	15:23	DS2.2	257	7.9	7.6	7.3	7.6	-
19-May	15:25	DS3.2	258	5.0	5.0	5.1	5.1	-
19-May	15:27	DS1.3	259	5.4	5.4	5.5	5.4	Split 1
19-May	15:29	DS1.3	260	4.2	4.9	4.6	4.6	Split 2
19-May	15:31	DS2.3	261	4.9	4.9	5.3	5.0	-
19-May	15:33	DS3.3	262	4.7	4.5	4.4	4.5	-
19-May	15:35	US1	263	3.6	4.5	4.5	4.2	-
19-May	15:37	DS0	264	3.7	3.9	4.5	4.0	-
20-May	7:00	DS1	265	2.6	2.5	2.5	2.5	-
20-May	7:02	DS2	266	3.4	3.5	3.5	3.5	-
20-May	7:04	DS3	267	2.7	2.7	2.7	2.7	-
20-May	7:06	DS1.2	268	4.1	3.9	4.1	4.0	-
20-May	7:08	DS2.2	269	3.8	3.9	3.9	3.9	-
20-May	7:10	DS3.2	270	3.8	3.9	3.9	3.9	-
20-May	7:12	DS1.3	271	2.9	3.2	3.1	3.1	-
20-May	7:14	DS2.3	272	2.4	2.4	2.4	2.4	-
20-May	7:16	DS3.3	273	3.1	3.2	3.2	3.1	Split 1
20-May	7:18	DS3.3	274	4.4	3.8	3.9	4.0	Split 2
20-May	7:20	US1	275	1.7	1.7	1.8	1.7	-
20-May	7:22	DS0	276	2.7	2.8	2.7	2.7	-
20-May	13:30	DS1	277	1.8	1.8	1.8	1.8	-
20-May	13:32	DS2	278	3.3	3.6	3.5	3.5	-
20-May	13:34	DS3	279	2.5	2.7	2.6	2.6	-
20-May	13:36	DS1.2	280	4.2	4.4	4.3	4.3	-
20-May	13:38	DS2.2	281	4.3	4.1	4.1	4.2	Split 1
20-May	13:40	DS2.2	282	4.1	4.2	4.2	4.1	Split 2
20-May	13:42	DS3.2	283	3.9	3.4	3.4	3.5	-
20-May	13:44	DS1.3	284	2.5	2.3	2.1	2.3	-
20-May	13:46	DS2.3	285	2.0	2.0	2.1	2.0	-
20-May	13:48	DS3.3	286	2.1	2.1	2.2	2.1	-
20-May	13:50	US1	287	1.5	1.7	1.4	1.5	-

Table D-1: Turbidity Readings in Rascal Stream West, 10 to 25 May 2023

Date	Time	Location	Sample ID	Reading 1	Reading 2	Reading 3	Average [a]	QA/QC
20-May	13:52	DS0	288	1.5	1.6	1.7	1.6	-
21-May	8:15	DS1	289	1.1	1.1	1.1	1.1	-
21-May	8:17	DS2	290	2.2	2.2	2.2	2.2	-
21-May	8:19	DS3	291	1.7	1.6	1.6	1.6	-
21-May	8:21	DS1.2	292	4.8	4.8	4.8	4.8	-
21-May	8:23	DS2.2	293	4.5	4.9	4.9	4.8	-
21-May	8:25	DS3.2	294	3.8	4.0	3.8	3.9	-
21-May	8:27	DS1.3	295	1.4	1.5	1.6	1.5	Replicate 1
21-May	8:27	DS1.3	296	2.0	1.8	1.8	1.9	Replicate 2
21-May	8:29	DS2.3	297	1.4	1.6	1.4	1.5	-
21-May	8:31	DS3.3	298	1.6	1.6	1.5	1.6	-
21-May	8:33	US1	299	1.4	1.4	1.4	1.4	-
21-May	8:35	DS0	300	1.5	1.5	1.4	1.4	-
22-May	8:15	DS1	301	1.2	1.1	1.1	1.1	-
22-May	8:17	DS2	302	1.9	1.8	1.8	1.9	-
22-May	8:19	DS3	303	1.6	1.7	1.5	1.6	-
22-May	8:21	DS1.2	304	4.1	4.1	3.9	4.0	-
22-May	8:23	DS2.2	305	4.4	4.6	4.5	4.5	-
22-May	8:25	DS3.2	306	4.9	4.8	4.6	4.7	-
22-May	8:27	DS1.3	307	1.4	1.3	1.4	1.4	-
22-May	8:29	DS2.3	308	3.6	3.3	3.2	3.4	Replicate 1
22-May	8:29	DS2.3	309	3.0	3.0	3.1	3.1	Replicate 2
22-May	8:31	DS3.3	310	2.1	1.9	2.0	2.0	-
22-May	8:33	US1	311	1.1	0.9	0.9	1.0	-
22-May	8:35	DS0	312	1.0	1.1	1.0	1.0	-
23-May	8:00	DS1	313	1.2	1.2	1.1	1.2	-
23-May	8:02	DS2	314	1.8	1.7	1.8	1.8	-
23-May	8:04	DS3	315	1.3	1.8	1.6	1.5	-
23-May	8:06	DS1.2	316	3.4	3.4	3.4	3.4	-
23-May	8:08	DS2.2	317	4.0	3.5	3.4	3.6	Split 1
23-May	8:08	DS2.2	318	3.9	3.8	3.7	3.8	Split 2
23-May	8:12	DS3.2	319	3.9	4.3	4.0	4.1	-
23-May	8:14	DS1.3	320	1.8	1.3	1.2	1.4	-
23-May	8:16	DS2.3	321	2.8	2.6	1.9	2.5	-
23-May	8:18	DS3.3	322	3.1	3.0	3.0	3.0	-
23-May	8:20	US1	323	1.0	1.2	0.9	1.0	-
23-May	8:22	DS0	324	1.7	1.5	1.3	1.5	-
24-May	8:00	DS1	325	1.0	1.1	1.0	1.0	-
24-May	8:02	DS2	326	2.4	2.6	2.5	2.5	-
24-May	8:04	DS3	327	1.4	1.6	1.3	1.4	-
24-May	8:06	DS1.2	328	5.3	5.3	5.2	5.3	-

Table D-1: Turbidity Readings in Rascal Stream West, 10 to 25 May 2023

Date	Time	Location	Sample ID	Reading 1	Reading 2	Reading 3	Average [(a)]	QA/QC
24-May	8:08	DS2.2	329	1.6	1.5	1.5	1.5	-
24-May	8:10	DS3.2	330	4.5	4.5	4.4	4.4	-
24-May	8:12	DS1.3	331	1.2	1.3	1.3	1.3	Split 1
24-May	8:12	DS1.3	332	1.1	1.1	1.0	1.1	Split 2
24-May	8:16	DS2.3	333	3.2	2.3	2.2	2.6	-
24-May	8:18	DS3.3	334	1.6	1.4	1.5	1.5	-
24-May	8:20	US1	335	1.4	1.1	1.3	1.3	-
24-May	8:22	DS0	336	0.8	0.9	0.8	0.8	-
25-May	7:00	DS1	337	1.6	1.7	1.5	1.6	-
25-May	7:02	DS2	338	1.8	1.9	1.8	1.9	-
25-May	7:04	DS3	339	1.7	1.6	1.5	1.6	-
25-May	7:06	DS1.2	340	4.0	4.0	4.0	4.0	-
25-May	7:08	DS2.2	341	3.6	3.6	3.6	3.6	Replicate 1
25-May	7:08	DS2.2	342	4.1	3.9	3.9	4.0	Replicate 2
25-May	7:10	DS3.2	343	3.9	3.8	3.8	3.8	-
25-May	7:12	DS1.3	344	1.8	1.7	2.3	1.9	-
25-May	7:16	DS2.3	345	1.3	1.8	1.7	1.6	-
25-May	7:18	DS3.3	346	1.7	1.6	1.6	1.7	-
25-May	7:20	US1	347	1.4	1.3	1.3	1.3	-
25-May	7:22	DS0	348	1.3	1.3	1.2	1.3	-

(a) Highlighted cells indicate an exceedance in turbidity level guidelines (CCME 2002).

QA/QC = Quality Assurance and Quality Control.

APPENDIX E

Fish Passage Assessment Data

Table E-1: Habitat Assessment Data in Rascal Stram West, 20 May 2023

Location	Unit ID Starting From Goose Lake	Coordinates (Zone 13W, UTM NAD83)		Direction From Culvert	Habitat Type [a]	Length (m)	Water Depth (m)			Wetted Width (m)			Bankfull Width (m)			Substrate (% Area) [c]							Instream Cover (% Area)						Unstable Banks (%)	
		Easting	Northing				Max	Mean Max	ΔB-W [b]	Min	Max	Mean	Min	Max	Mean	Or	Si	Sa	Gr	Co	Bo	Be	SUB	WD	D/T	AV	OV	UC	LBD	RDB
Secondary Channel	1	432875	7270163	Downstream	Run 3	78	0.6	0.4	0	5.3	20	15	0.5	1.8	1.3	20	10	60	2	5	3	0	10	0	30	5	50	12	0	0
Secondary Channel	2	432853	7270107	Downstream	Riffle	10	0.3	0.2	0	15	15	15	0.4	1.3	1.2	0	0	0	10	40	50	0	20	0	5	0	50	5	50	0
Secondary Channel	3	432863	7270105	Downstream	Run 3	10	1	0.5	0	5.2	12	5.5	5.2	5.8	5.5	0	20	20	30	20	10	0	10	0	0	0	0	0	100	100
Diversion Channel	4	432886	7270075	Upstream	Run 3	40	0.6	0.5	0.2	1.2	2	1.4	1.3	2.5	1.8	0	5	5	20	30	40	0	20	0	0	0	0	0	100	0
Primary Channel	5	432867	7270037	Upstream	Pool	30	1.5	1	0	20	30	22	20	30	22	40	30	0	10	10	10	0	2	0	20	0	0	0	30	0
Primary Channel	6	432864	7270005	Upstream	Riffle	50	0.5	0.3	0.1	1	1.5	1.2	1.2	1.7	1.4	0	0	0	20	30	50	0	20	0	30	0	10	5	0	0
Primary Channel	7	432867	7269955	Upstream	Run 3	50	0.7	0.5	0.1	2	4.5	3	2.4	5	3.5	30	20	20	0	5	25	0	5	0	5	0	5	0	0	0
Primary Channel	8	432892	7269916	Upstream	Run 2	50	2	1	0.1	0.8	5.5	3	2	6	3.4	30	20	20	0	0	30	0	10	0	30	10	5	0	0	0
Primary Channel	9	432923	7269892	Upstream	Run 3	50	0.8	0.3	0.1	0.8	3.5	2.5	1.5	4	3	45	30	20	0	0	5	0	0	0	0	10	0	0	0	0

(a) As defined by O'Neil and Hildebrand (1986). Run 3 is a shallow (<0.75 m deep) moderate velocity area with low instream cover; Riffle is a shallow (<0.5 m deep), high velocity and gradient area dominated by coarse substrate; Pool is a discrete portion of channel with increased depth and reduced velocity compared to run habitat; Run 2 is a 0.75 to 1.0 m deep, moderate to high velocity area with moderate to high instream cover.

(b) Vertical difference between current water surface elevation and bankfull elevation.

(c) Or = Organics; Si = Silt (<0.06 mm); Sa = Sand (0.06-2 mm); Gr = Gravel (2-64 mm); Co = Cobble (64-256 mm); Bo = Boulder (>256 mm).

UTM = Universal Transverse Mercator; NAD83 = North American Datum of 1983; SUB = Substrate; WD = Woody Debris; D/T = Depth/Turbulence; AV = Aquatic Vegetation; OV = Overhanging Vegetation; UC = Undercut Banks; LDB = Left Downstream Bank; RDB = Right Downstream Bank.

Table E-2a: Crossing Assessment Upstream and Downstream of Culvert Location in Rascal Stream West, 20 May 2023

Location	Coordinates (Zone 13W, UTM NAD83)		Watercourse Characteristics						Riparian composition				Bank Description									
									Within 3 m of Bank		Within 3-25 m of Bank		LDB					RDB				
	Easting	Northing	Pattern	Confinement	Channel Form	Stage	Groundwater Seepage	Stream Type	LDB	RDB	LDB	RDB	Slumping	UCB	Vegetated	Stability	Height (m)	Slumping	UCB	Vegetated	Stability	Height (m)
Downstream of Culvert	432870	7270100	Broad	Unconfined	Open	Flooded	No	Small Permanent	90% Bare, 10% Tundra	90% Bare, 10% Tundra	90% Bare, 10% Tundra	90% Bare, 10% Tundra	No	No	No	Low	2	No	No	No	Low	2
Upstream of Culvert	432888	7270070	Winding	Unconfined	Irregular	High	No	Small Permanent	Bare	Bare	50% Bare, 50% Tundra	Bare	No	No	No	Low	1	No	No	No	Moderate	0.2

UTM = Universal Transverse Mercator; NAD83 = North American Datum of 1983; LDB = Left Downstream Bank; RDB = Right Downstream Bank; UCB = Undercut Banks.

Table E-2b: Crossing Assessment Upstream and Downstream of Culvert Location in Rascal Stream West, 20 May 2023

Location	Coordinates (Zone 13W, UTM NAD83)		Substrate (% Area) [a]							Substrate (% Area) [a]							Substrate (% Area) [a]							Sensitivity to Construction
			Bed							LDB							RDB							
	Easting	Northing	Or	Cl	Si	Sa	Gr	Co	Bo	Or	Cl	Si	Sa	Gr	Co	Bo	Or	Cl	Si	Sa	Gr	Co	Bo	
Downstream of Culvert	432870	7270100	0	0	10	70	20	0	0	0	0	0	10	40	20	30	0	0	0	10	50	30	10	High
Upstream of Culvert	432888	7270070	0	0	0	5	25	20	50	0	0	0	20	20	10	50	0	0	0	0	30	50	20	High

(a) Or = Organics; Si = Silt (<0.06 mm); Sa = Sand (0.06-2 mm); Gr = Gravel (2-64 mm); Co = Cobble (64-256 mm); Bo = Boulder (>256 mm).

UTM = Universal Transverse Mercator; NAD83 = North American Datum of 1983; LDB = Left Downstream Bank; RDB = Right Downstream Bank; UCB = Undercut Banks.

Table E-3: Visual Survey Data from Rascal Stream West, 17 to 25 May 2023

Date	Time	Survey Type	Observation Location	Coordinates (Zone 13W, UTM NAD83)		Fish Count					
						ARGR		LKTR	NNST	SLSC	UNK SBF
				Easting	Northing	Adult	Juvenile	Adult	UNK	Adult	UNK
17-May	10:45	Walking	Primary channel, 80 m downstream of Gander Pond	432895	7269915	3	0	0	0	0	0
17-May	12:00	Incidental	Primary channel at Gander Pond	432949	7269854	1	0	0	0	0	0
17-May	14:00	Incidental	Primary channel, 25 m downstream of Gander Pond	432937	7269877	5	0	0	0	0	0
19-May	13:00	Walking	Secondary channel, pool just downstream of rock ledge	432851	7270106	0	1	0	0	0	0
	15:00	Walking	Secondary channel, pool just downstream of rock ledge	432851	7270106	0	1	0	0	0	0
	17:00	Walking	Secondary channel, pool just downstream of rock ledge	432851	7270106	0	1	0	0	0	0
20-May	7:00	Walking	No observations	-	-	0	0	0	0	0	0
	9:30	Walking	No observations	-	-	0	0	0	0	0	0
	11:30	Walking	Diversion channel, at pool created by berm	432867	7270037	2	0	0	0	0	0
			Primary channel, 40 m downstream of Gander Pond	432930	7269882	2	0	0	0	0	0
	16:00	Walking	Secondary channel, pool just downstream of rock ledge	432851	7270106	0	1	0	0	0	0
			Diversion channel, at pool created by berm	432867	7270037	2	0	0	0	0	0
21-May	8:30	Walking	No observations	-	-	0	0	0	0	0	0
	10:30	Walking	Original primary channel, just upstream of Goose Lake	432826	7270153	0	0	0	0	0	1
			Secondary channel, pool just downstream of rock ledge	432851	7270106	1	1	0	0	0	0
			Secondary channel, just downstream of culvert	432868	7270103	0	1	0	0	0	0
	13:55	Stationary	Secondary channel, just downstream of culvert	432868	7270103	1	0	0	0	0	0
	15:00	Walking	Goose Lake, near secondary channel outflow	432875	7270166	1	0	0	0	0	0
			Secondary channel, pool just downstream of rock ledge	432851	7270106	0	1	0	0	0	0
			Primary channel, just below chute	432859	7270010	2	0	0	0	0	0
			Primary channel, 130 m downstream of Gander Pond	432868	7269957	1	0	0	0	0	0
			Primary channel, 25 m downstream of Gander Pond	432937	7269877	1	0	0	0	0	0
22-May	8:20	Walking	Secondary channel, pool just downstream of rock ledge	432851	7270106	1	1	0	0	0	0
	10:30	Walking	Secondary channel, pool just downstream of rock ledge	432851	7270106	0	1	0	0	0	0
	11:15	Stationary	Diversion channel	432881	7270064	0	0	0	0	0	0
	13:45	Walking	No observations	-	-	0	0	0	0	0	0
	14:15	Stationary	Diversion channel	432881	7270064	0	0	0	0	0	0
	15:15	Walking	Side channel of secondary channel, near Goose Lake	432835	7270164	0	0	0	0	1	0
			Secondary channel, pool just downstream of rock ledge	432851	7270106	0	2	0	0	0	0
			Primary channel, 120 m downstream of Gander Pond	432870	7269948	1	0	0	0	0	0

Table E-3: Visual Survey Data from Rascal Stream West, 17 to 25 May 2023

Date	Time	Survey Type	Observation Location	Coordinates (Zone 13W, UTM NAD83)		Fish Count					
						ARGR		LKTR	NNST	SLSC	UNK SBF
				Easting	Northing	Adult	Juvenile	Adult	UNK	Adult	UNK
23-May	8:20	Walking	Primary channel, 40 m downstream of Gander Pond	432930	7269882	2	0	0	0	0	0
	9:55	Stationary	Secondary channel, just downstream of culvert	432868	7270103	0	1	0	0	0	0
	11:00	Walking	Diversion channel, at pool created by berm	432867	7270037	1	0	0	0	0	0
			Primary channel, just below chute	432859	7270010	3	0	0	0	0	0
	13:25		Original primary channel, just upstream of Goose Lake	432826	7270153	0	0	0	4	0	0
	13:25	Walking	Goose Lake, near secondary channel outflow	432875	7270166	1	0	0	0	0	0
			Secondary channel, just downstream of culvert	432868	7270103	3	1	0	0	0	0
			Diversion channel, at pool created by berm	432867	7270037	1	0	0	0	0	0
			Primary channel, just below chute	432859	7270010	1	2	0	0	0	0
			Primary channel, 130 m downstream of Gander Pond	432868	7269957	1	0	0	0	0	0
			Primary channel, 90 m downstream of Gander Pond	432886	7269920	2	0	0	0	0	0
			Primary channel, 40 m downstream of Gander Pond	432930	7269882	1	0	0	0	0	0
			Primary channel, 30 m downstream of Gander Pond	432929	7269873	2	0	0	0	0	0
	14:00	Stationary	Secondary channel, just downstream of culvert	432868	7270103	2	3	0	0	0	0
	15:30	Walking	Original primary channel, just upstream of Goose Lake	432826	7270153	0	0	0	1	0	0
			Secondary channel, pool just downstream of rock ledge	432851	7270106	0	0	0	0	0	1
			Secondary channel, just downstream of culvert	432868	7270103	0	1	0	0	0	0
			Diversion channel	432873	7270050	1	0	0	0	0	0
			Primary channel, 120 m downstream of Gander Pond	432870	7269948	1	0	0	0	0	0
			Primary channel, 70 m downstream of Gander Pond	432897	7269898	1	0	0	0	0	0
			Primary channel, 40 m downstream of Gander Pond	432930	7269882	4	0	0	0	0	0

Table E-3: Visual Survey Data from Rascal Stream West, 17 to 25 May 2023

Date	Time	Survey Type	Observation Location	Coordinates (Zone 13W, UTM NAD83)		Fish Count					
						ARGR		LKTR	NNST	SLSC	UNK SBF
				Easting	Northing	Adult	Juvenile	Adult	UNK	Adult	UNK
24-May	8:00	Walking	Original primary channel, just upstream of Goose Lake	432826	7270153	0	0	0	4	0	0
			Secondary channel, 35 m downstream of culvert outflow	432855	7270121	0	1	0	0	0	0
			Secondary channel, just downstream of culvert	432868	7270103	1	0	0	0	0	0
			Primary channel, just below chute	432859	7270010	0	1	0	0	0	0
			Primary channel, just above chute	432860	7269989	1	0	0	0	0	0
			Primary channel, 130 m downstream of Gander Pond	432868	7269957	0	1	0	0	0	0
			Primary channel, 70 m downstream of Gander Pond	432897	7269898	2	0	0	0	0	0
			Primary channel, 25 m downstream of Gander Pond	432937	7269877	3	0	0	0	0	0
	9:00	Stationary	Secondary channel, just downstream of culvert	432868	7270103	1	0	0	0	0	0
	10:00	Walking	Goose Lake, near secondary channel outflow	432875	7270166	0	0	1	0	0	0
			Secondary channel, 35 m downstream of culvert outflow	432855	7270121	0	1	0	0	0	0
			Secondary channel, pool just downstream of rock ledge	432851	7270106	0	2	0	0	0	0
			Primary channel, just above chute	432860	7269989	1	0	0	0	0	0
	13:25	Walking	Side channel of secondary channel, near Goose Lake	432859	7270162	0	0	0	0	0	1
			Diversion channel, at pool created by berm	432867	7270037	0	1	0	0	0	0
			Original primary channel, just upstream of Goose Lake	432826	7270153	0	0	0	4	0	0
			Secondary channel, pool just downstream of rock ledge	432851	7270106	0	2	0	0	0	0
			Secondary channel, just downstream of culvert	432868	7270103	1	0	0	0	0	0
			Primary channel, 50 m downstream of Gander Pond	432913	7269896	1	0	0	0	0	0
			Primary channel, 40 m downstream of Gander Pond	432930	7269882	1	0	0	0	0	0
	14:05	Stationary	Secondary channel, just downstream of culvert	432868	7270103	1	0	0	0	0	0
	16:05	Walking	Goose Lake, near secondary channel outflow	432875	7270166	3	0	0	0	0	0
			Side channel of secondary channel, near Goose Lake	432859	7270162	0	0	0	0	0	1
			Side channel of secondary channel, near Goose Lake	432835	7270164	0	0	0	0	0	1
			Goose Lake, near original primary channel outflow	432827	7270164	0	0	1	0	0	0
			Original primary channel, just upstream of Goose Lake	432826	7270153	0	0	0	2	0	0
			Secondary channel, 60 m downstream of culvert outflow	432852	7270149	2	0	0	0	0	0
			Secondary channel, 35 m downstream of culvert outflow	432855	7270121	1	0	0	0	0	0
			Secondary channel, pool just downstream of rock ledge	432851	7270106	0	2	0	0	0	0
			Secondary channel, just downstream of culvert	432868	7270103	1	0	0	0	0	0
			Diversion channel	432876	7270058	1	0	0	0	0	0
			Primary channel, 130 m downstream of Gander Pond	432868	7269957	3	0	0	0	0	0
			Primary channel, 50 m downstream of Gander Pond	432913	7269896	2	0	0	0	0	0
25-May	7:00	Walking	Primary channel, 130 m downstream of Gander Pond	432868	7269957	1	0	0	0	0	0

UTM = Universal Transverse Mercator; NAD83 = North American Datum of 1983; ARGR = Arctic Grayling; LKTR = Lake Trout; NNST = Ninespine Stickleback; SLSC = Slimy Sculpin; UNK = Unknown; SBF = Small-bodied Fish; - = not applicable.

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APPENDIX B: SEWAGE TREATMENT PLANT OPERATIONS MANUAL