APPENDIX F RASCAL STREAM WEST CROSSING CONSTRUCTION SUMMARY REPORT

REPORT

Rascal Stream West Crossing Construction Summary Report

Back River Project (B2Gold Back River Corp.)

Submitted to:

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Submitted by:

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22567626-163-R-Rev0-8000

10 July 2024

Study Limitations

WSP Canada Inc. (WSP) has prepared this document in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this document. No warranty, express or implied, is made.

This document, including all text, data, tables, plans, figures, drawings, and other documents contained herein, has been prepared by WSP for the sole benefit of B2Gold Back River Corp. (B2Gold Nunavut). It represents WSP's professional judgement based on the knowledge and information available at the time of completion. WSP is not responsible for any unauthorized use or modification of this document. All third parties relying on this document do so at their own risk.

The factual data, interpretations, suggestions, recommendations, and opinions expressed in this document pertain to the specific project, site conditions, design objective, development and purpose described to WSP by B2Gold, and are not applicable to any other project or site location. In order to properly understand the factual data, interpretations, suggestions, recommendations, and opinions expressed in this document, reference must be made to the entire document.

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TABLES

APPENDICES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder), now WSP Canada Inc. (WSP), was engaged by B2Gold Nunavut Back River Corp. (B2Gold Nunavut, formerly Sabina Gold and Silver Corp.) to provide IFC drawings (WSP document no. 20412211-2000-2670-Rev0), construction support, field reviews, construction summary reporting, and record drawings for the Rascal Stream West Reach 1 (RSW Reach 1) culvert crossing for the project (the Project).

The scope of WSP's services described in this report is limited to the civil and hydrotechnical engineering input and does not include structural engineering, environmental, or regulatory permitting aspects. In addition to the civil IFC drawings prepared by WSP, Armtec prepared structural IFC drawings for the twin arch culverts main crossing (Project #19-463-B submitted October 26, 2021).

This report shall be read in conjunction with the preceding Study Limitations. The reader's attention is specifically drawn to this information as it is essential that it is followed for the proper use and interpretation of this Report.

2.0 CONSTRUCTION SCHEDULE AND SITE CONDITIONS

Construction was completed according to the schedule shown in Table 1, as documented by WSP and indicated by B2Gold Nunavut (Richards 2023).

Table 1: Construction Schedule

Construction Milestone	Start Date	End Date	Construction Activities
Excavation – Main Channel and Secondary Channel	i) April 15, 2023 ii) July 30, 2023	i) May 11, 2023 ii) August 4, 2023	i) Site preparation, site isolation ii) Main channel excavation after instream works resumed
Secondary Channel Culvert Installation[(a)]	April 15, 2023	September 7, 2023[(a)]	Placement of bedding material, CSP segments, backfill material, embedment material, and road construction material
Main Channel Culvert Installation	August 4, 2023	September 7, 2023	Placement of bedding material, twin multiplate culvert segments, backfill material, embedment material, and road construction material

(a) Secondary Culvert construction activities paused after instream work was paused on May 17, 2023. The start date to complete the construction works on September 7, 2023, is unknown.

The target construction schedule was completion prior to the 2023 freshet period, under frozen watercourse conditions. However, due to early season melt conditions resulting in rapid snow and ice melt, flow conditions, and site isolation issues, all instream work was paused on May 17, 2023 due to unfrozen conditions and observation of Arctic Grayling (*Thymallus arcticus*) in RSW (WSP 2023). Construction resumed in August 2023 during a period of late summer low flow conditions.

2.1 WSP Presence at the Site

WSP provided on-site representation as outlined in Table 2.

Table 2: WSP Field Support Schedule

Purpose	Support Period	Representation[(a)]	Construction Activities
Construction	10 May to 16 May 2023	Daniel Mullen	Site preparation, site isolation, material delivery, secondary CSP installation
Construction	5 to 6 August 2023	Canny Tung	Excavation, site preparation, placement of CSP bottom plates
Post-Construction Review	17 September 2023	Daniel Mullen	Survey, photo documentation

(a) Served as delegate to the Design Engineer.

3.0 QUALITY ASSURANCE

Quality Assurance (QA) was the responsibility of B2Gold Nunavut. B2Gold Nunavut completed and subcontracted QA activities for the Project including but not limited to:

- Surveying (Inland Surveying)
- Construction progress photos (Appendix D)

WSP completed activities supporting QA for the Project including, but not limited to:

- Preparation of the design and specifications
- Field reviews and reporting (Appendix B)
- Construction photographs (Appendix D)
- Technical review of sieve analysis for bedding material
- Visual inspections of the engineered backfill
- Technical review of post-construction survey data and record drawings (Appendix A)
- Select environmental monitoring services, including water sampling (not included in this report). Environmental monitoring was completed by others (WSP 2023)

4.0 QUALITY CONTROL

Quality Control (QC) was the responsibility of B2Gold Nunavut. QC activities included but were not limited to:

- Particle size analysis of the bedding material (Appendix C)

WSP was not responsible for QC activities supporting QC for the Project.

5.0 CONSTRUCTION MATERIAL

The construction materials used in the works for the RSW Crossing summarized below were observed and documented by WSP in Daily Inspection Reports (Appendix B), provided in RSW Construction Details (WSP 2024), or as indicated by B2Gold Nunavut (Richards 2023 and 2024).

The main channel twin multiplate arch culvert installation works were constructed using the following:

- Non-woven geotextile: TenCate Mirafi E1200 (Appendix C)
- Riprap: esker material (design specification 10 kg class)
- Backfill: unknown material specification (design specification: 75 mm minus backfill)
- Bedding: 2-inch clear crush (design specification: 25 mm minus granular material)
- Channel Substrate: esker material (design specification: excavated channel substrate)

The secondary channel single corrugated steel pipe (CSP) culvert installation works were constructed using the following:

- Riprap: esker material (design specification 10 kg class)
- Backfill: 2-inch clear crush and esker material (design specification: 75 mm minus backfill)
- Bedding: 1-inch crushed aggregate (design specification: 25 mm minus granular material)
- Channel Substrate: esker material (design specification: excavated channel substrate)

Further details of construction materials are provided in Sections 8.1 and 8.2 of this report

6.0 SURVEYS

B2Gold Nunavut provided survey data for the main channel culverts construction (Richards 2023) and the secondary channel culvert construction (Richards 2024) to WSP. The survey data received is summarized in Sections 6.1, 6.2, and 6.3.

6.1 Pre-construction

Pre-construction survey of the existing ground and channel bed alignment was not provided to WSP. Pre-construction survey files received were consistent with the drill hole plan layout for the main channel and secondary channel culvert.

6.2 Intermediate

B2Gold Nunavut provided the following intermediate construction survey data of the main channel culverts to WSP on November 16, 2023 (Richards 2023):

- Excavation limits
- Bedding
- Culvert inlet and outlet inverts
- Backfill

B2Gold Nunavut provided the following intermediate construction survey data of the secondary channel culvert to WSP on February 17, 2024 (Richards 2024):

- Excavation limits

6.3 Completion Survey

No completion survey was provided to WSP. The constructed culvert slope was estimated through the survey data available and presented on the record drawings.

7.0 RECORD DRAWINGS

Record drawings were prepared using the survey data discussed in Section 6.0 and are provided in Appendix A. The record drawings were prepared by WSP based on the following:

- Issued for Construction Drawings by Golder (2021).
- Post-construction survey data provided by B2Gold Nunavut (Richards 2023 and 2024).
- WSP field review observations.

The record drawings provide the elevations, culvert slope, and material layer thickness of the constructed main channel and secondary channel culvert, where possible, along with observations of embedment thickness and apron length and slope. The drill hole plan data was not included in the record drawings.

The design information contained in these drawings accurately reflects the original design (Golder 2021) and material design changes made during construction that were brought to WSP's attention. These record drawings are intended to incorporate addenda, change orders, and other material design changes, but not necessarily all site instructions or changes. Material design changes brought to WSP's attention are summarized in the combination of the records drawings and Section 8.0 of this report, and therefore, record drawings shall not be considered as a standalone record of known as-constructed information. WSP does not warrant or guarantee, nor accept any responsibility for, the accuracy or completeness of the as-constructed information supplied by others contained in these record drawings.

8.0 CONSTRUCTION MODIFICATIONS AND DEFICIENCIES

Modifications and deficiencies of the construction compared to the design were documented by WSP during the field reviews in May, August, and September 2023, and as indicated by B2Gold Nunavut (Richards 2023, 2024). Modifications and deficiencies of the construction material used and the construction sequence for the main channel are summarized in Table 3 and the secondary channel are summarized in Table 4. Further details of the modifications are provided in Section 8.1 and construction deficiencies are detailed in Section 8.2.

Table 3: Main Channel Twin Multiplate Culverts Design Modifications

Item	Design Specification	As-Built	WSP Acceptance / Recommendation
Culvert Alignment	Existing channel alignment	Field-fit to align with existing channel	The installed alignment ties into the existing channel.
Non-woven geotextile	IFC Drawing package, drawing C-006, note 4.1.1	TenCate Mirafi E1200 (Appendix C) exceeds design specification	The installed geotextile exceeds the minimum design specifications.
Bedding	25 mm minus, well graded with angular grains (Armtec Project #19-463-B, drawing 003, note 7)	2-inch clear crush	B2Gold Nunavut to confirm with Armtec design engineer. Recommend monitoring for culvert deformation.
Backfill	75 mm minus, well graded with angular grains (Armtec Project #19-463-B, drawing 003, note 7)	Unknown material properties. Field observations indicate a 1-inch crushed aggregate.	B2Gold Nunavut to confirm with Armtec design engineer. Recommend monitoring of culvert for potential deformation and road subsidence.
Backfill compaction	95% standard proctor (Armtec Project #19-463-B, drawing 003, note 7.9.2)	Unknown	B2Gold Nunavut to confirm with Armtec design engineer. Recommend monitoring of culvert for potential deformation and road subsidence.
Culvert embedment depth	890 mm with shallow V-swale depth of 250 mm (IFC Drawing package drawings C-002 and C-003)	454 mm to 594 mm with V-swale depth between 5 mm and 26 mm[(a)]	Monitor channel substrate and repair as required.
Culvert channel substrate	Excavated channel substrate (IFC Drawing package, Drawing C-006, note 4.3)	Esker material	Monitor channel substrate and repair as required.
Culvert boulder clusters	Rock sizes of 250 mm to 300 mm	Approximate D_{50} of 150 mm	Monitor boulder clusters and repair as required
Riprap	10 kg class (IFC Drawing package, Drawing C-006, note 4.2)	Esker material[(b)]	Monitor installed riprap for mobilization or damage and repair as required.

(a) Measurements completed by WSP during September 17, 2023 survey.

(b) Visual observations of esker material were completed May 11, 2023 by WSP. Esker material was deemed suitable replacement for 10 kg Class (BC MOTI 2020) riprap if large particles (greater than 350 mm) were removed prior to placement. Visual observations on September 17, 2023 of the esker material placed did not match the esker material observed May 11, 2023.

IFC = Issued for Construction; D_{50} = median rock diameter

Table 4: Secondary Channel CSP Culvert Design Modifications

Item	Design Specification	As-Built	WSP Acceptance / Recommendation
Culvert alignment and apron slope	Existing channel alignment	Field-fit to align with existing channel	The installed alignment ties into the existing channel.
Backfill	75 mm minus, well graded with angular grains (IFC Drawing package, drawing C-006, note 4.4.1)	2-inch clear crush to 1500 mm above culvert invert. Raw esker from 1500 mm above culvert invert to 600 mm above culvert crest.(a)	Recommend monitoring of culvert for potential deformation and road subsidence.
Backfill compaction	95% standard proctor (IFC Drawing package, drawing C-006, note 4.4.1)	Unknown	Recommend monitoring of culvert for potential deformation and road subsidence.
Channel substrate / embedment layer thickness	960 mm (IFC Drawing package, Drawing C-005)	310 mm at culvert inlet 500 mm at culvert outlet(b)	Monitor channel substrate and repair as required.
Riprap	10 kg class (IFC Drawing package, Drawing C-006, note 4.2)	Esker material(c)	Monitor installed riprap for mobilization or damage and repair as required.
Non-woven geotextile	IFC Drawing package, drawing C-006, note 4.1.1	Omitted	Monitor inlet and outlet apron and repair as required.

(a) Observed and documented by WSP May 13 and May 14, 2023.

(b) Measurements completed by WSP during September 17, 2023 survey.

(c) Visual observations of esker material were completed May 11, 2023 by WSP. Esker material was deemed suitable replacement for 10 kg Class (BC MOTI 2020) riprap if large particles (greater than 350 mm) were removed prior to placement. Visual observations on September 17, 2023 of the esker material placed did not match the esker material observed May 11, 2023.

IFC = Issued for Construction

8.1 Construction Modification Details

Construction modifications of the main channel culverts and secondary channel culvert construction were documented by WSP during the field reviews in May, August, and September, 2023 are summarized in Sections 8.1.1 to 8.1.5.

8.1.1 Non-woven Geotextile

Main Channel Culverts

WSP did not field verify the specifications of the non-woven geotextile used in the construction of the main channel culverts (not available during field reviews). Information for the installed geotextile was provided by B2Gold Nunavut (Richards 2024), provided in Appendix C. The non-woven geotextile used in the construction of the main channel culverts deviates from the IFC Design specifications, however the properties of the geotextile used for construction exceed the IFC Design specification requirements, therefore, no adverse consequences are foreseen by WSP due to this modification.

8.1.2 Bedding Material

Main Channel Culverts

The bedding material according to Armtec's design drawing package (Armtec Project #19-463-B) shall consist of well graded granular material with angular grains that meet the following requirements:

- Maximum particle size shall not exceed 25 mm
- Coefficient of Curvature (C_C): $1 \leq C_C \leq 3$, where $C_C = D_{30}^2 / (D_{10} \times D_{60})$
- Coefficient of Uniformity (C_U): $C_U \geq 7$, where $C_U = D_{60} / D_{10}$

The bedding material used for the main channel culvert construction, 2-inch clear crush, is a modification from the design specifications. Based on visual observations, the material is poorly graded with no fines, and the maximum particle size exceeds 25 mm. The gradation of the 2-inch clear crush was not provided to WSP for approval. The modification from the design specifications may result in modified foundation loading from the culvert to the design from Armtec. WSP recommends notification to Armtec and monitoring for culvert deformation.

Secondary Channel Culvert

The bedding material used for the secondary channel culvert, 1-inch crushed aggregate, meets the design specifications.

8.1.3 Backfill

Main Channel Culverts

The backfill material for the main channel culverts according to Armtec's design drawing package (Armtec Project #19-463-B) shall consist of well graded granular material with angular grains that meet the following requirements:

- Maximum particle size shall not exceed 75 mm.
- Coefficient of Curvature (C_C): $1 \leq C_C \leq 3$, where $C_C = D_{30}^2 / (D_{10} \times D_{60})$
- Coefficient of Uniformity (C_U): $C_U \geq 7$, where $C_U = D_{60} / D_{10}$

The specifications for the backfill material used for the main channel culvert construction were not provided to WSP. Based on photographs provided by B2Gold Nunavut, the material appears to be 1-inch crushed aggregate, however, based on information received from B2Gold Nunavut (Richards 2023), the material used was 2-inch clear crush, which is a modification from the design specifications. The modification from the design specification may result in unsatisfactory material compaction and load bearing. WSP recommends notification to Armtec and monitoring for culvert deformation and road subsidence.

Secondary Channel Culvert

The backfill material specifications for the secondary culvert were aligned with the backfill specifications for the main channel culverts. The backfill material used for the secondary channel culvert construction was 2-inch clear crush and is a modification from the design specifications. Based on visual observations, the material is poorly graded with no fines (the gradation of the 2-inch clear crush was not provided to WSP). The modification from the design specification may result in unsatisfactory material compaction and load bearing. WSP recommends monitoring for culvert deformation and road subsidence.

8.1.4 Culvert Embedment Depth

Main Channel Culverts

The channel embedment depth for the main channel culverts was specified to be 890 mm with shallow V-swale depth of 250 mm. The constructed embedment depth was observed to be approximately 500 mm with V-swale depth less than specified on September 17, 2023, and is a modification from the design specifications. This is not anticipated to adversely affect the conveyance capacity of the main channel culverts and concentrated flow was observed along the centerline. However, the shallow V-swale depth may adversely affect fish migration through the culverts during low-flow conditions. WSP recommends fisheries monitoring and monitoring the channel substrate for channel migration and erosion within the culverts and completing repairs as required.

Secondary Channel Culvert

The channel embedment depth for the secondary channel culvert was specified to be 960 mm. The constructed embedment depth was observed to be approximately 310 mm on September 17, 2023 and is a modification from the design specifications. This is not anticipated to adversely affect the conveyance capacity of the secondary channel culvert. However, WSP recommends including the secondary channel culvert in future fish monitoring programs.

8.1.5 Channel Substrate and Boulder Clusters

Channel substrate for the main channel culverts and secondary channel culvert was specified to be excavated native channel substrate. The excavated channel substrate was deemed unsuitable for the culvert channel substrate due to high saturation and esker material was substituted. The esker material placed was observed to be undersized gravelly cobbles with an approximate D_{50} of 75 mm and is a modification from the design specifications. WSP recommends monitoring the channel substrate for channel migration and erosion within the main channel culverts and secondary channel culvert and completing repairs as required.

The boulder clusters for the main channel culverts were specified to be composed of rock sizes from 250 mm to 300 mm. The boulder clusters placed were observed to be undersized with an approximate D_{50} of 150 mm and is a modification from the design specifications. WSP recommends monitoring the boulder clusters for particle migration and completing repairs as required with rock sizes of 250 to 300 mm.

8.2 Construction Deficiencies

Deficiencies of the main channel culverts and secondary channel culvert construction were documented by WSP during the field reviews in May, August, and September 2023, and as indicated by B2Gold Nunavut (Richards 2023, 2024). The deficiencies are summarized below in Sections 8.2.1 to 8.2.3.

8.2.1 Backfill Compaction

According to Armtec's design drawing package (Armtec Project #19-463-B), backfill for the culvert construction was specified to be compacted to 95% standard proctor. No backfill compaction testing was completed during the construction of the culverts. WSP acknowledges that 95% standard proctor compaction of the backfill may have been achieved, however, because there was no compaction testing and documentation, the actual compaction achieved is unknown and deemed a potential deficiency. The potential for unsatisfactory compaction of the backfill material may result in culvert deformation and road subsidence of the culverts, which WSP recommends be included in a monitoring program.

8.2.2 Secondary Channel Culvert Non-woven Geotextile

WSP did not observe or document the placement of the geotextile for the secondary channel culvert during the installation of the secondary culvert and B2Gold Nunavut did not provide documentation supporting the installation of the geotextile. Therefore, the geotextile is installation was not confirmed and is considered a potential deficiency. WSP recommends monitoring the secondary channel culvert inlet, outlet, and aprons for channel migration and erosion and completing repairs as required with material that meets the design specifications or has been approved by WSP.

8.2.3 Riprap

The specified riprap for placement within the culvert aprons consisted of well graded, hard, durable, and angular 10 kg Class (BC MOTI 2020) which meets the following physical and gradation requirements in Table 5.

Table 5: Specified 10 kg Class Riprap Gradation

Percent Smaller than Intermediate Dimension	Specified Intermediate Dimension (mm)
15	90
50	200
80	285
100	350

The material used for the construction of the main channel culverts and secondary channel culvert riprap aprons was esker material and is a modification from the design specifications. Based on visual observations, the esker material placed for the culvert aprons is undersized gravelly cobbles with an approximate D_{50} of 75 mm. Gradation of the esker material placed within the culvert aprons was not provided. There is potential for erosion of the embankments and at the culverts inlet and outlet due to undersized riprap material. WSP recommends riprap aprons be included in a monitoring program.

9.0 MONITORING AND MAINTENANCE RECOMMENDATIONS

Monitoring considerations for the Back River Project water course crossings are provided in B2Gold Nunavut's Road Management Plan (2021) and the Water Management Plan (Water License 2AM-BRP1831). Controls and mitigations associated with fish and fish habitat and passage for the Rascal Stream West 1 crossing are provided in the June 20, 2022 (date of submission) DFO Request for Review submission which was subsequently approved on July 15, 2022 under a DFO Letter of Advice from DFO (File# 18-HCAA-00185).

In addition to, or as part of, the above commitments, WSP recommends the following activities be undertaken by B2Gold Nunavut:

- Annual inspection of the culverts that includes, but is not limited to the following:
  - Channel alignment:
    - Inlet is maintaining even distribution of flow into each culvert of main channel.
    - Outlet discharge is contained within the historical stream channel.
  - Channel substrate and embedment material:

  - Shallow V-swale cross-sectional shape for main channel culverts remains for improved fish passage under low-flow conditions.
  - Inspect boulder clusters after freshet and replace displaced boulders as required.
- Embankment, inlet and outlet riprap erosion, as well as bed and banks erosion near the culverts.
- Debris accumulation:
  - Remove debris as required to maintain designed culvert capacity.
- Structural monitoring of the culverts (deformation) and haul road subsidence inspection.

In addition, WSP recommends inspecting the culverts after large flow events (i.e., freshet or 25+ mm daily rainfall event) for riprap condition, channel erosion or scour, channel migration (alignment), and debris. If any deficiencies are documented during monitoring, WSP recommends that B2Gold Nunavut make timely repairs.

10.0 CONCLUSIONS

WSP certifies that the as-constructed information, if accurate and complete, is anticipated to provide an as-constructed system which substantially complies with the original design intent. The future performance of the culverts to meet the design intent require monitoring and maintenance and discussed in this construction summary report.

11.0 CLOSURE

We trust this document meets your present requirements. Please direct any questions, comments, or concerns to the undersigned.

WSP Canada Inc.

REGISTERED PROFESSIONAL ENGINEER
C.T. VANWERKHOVEN
LICENSEE
NT/NU

10-JUL-2024

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https://wsponline.sharepoint.com/sites/gtd-158863/project files/6 deliverables/01 working/22567626-163-r-rev0-8000-raw construction summary report/22567626-163-r-rev0-8000-raw construction summary report_10jul_24.docx

PERMIT TO PRACTICE
WSP Canada Inc.
Signature
Date 2024-07-10
PERMIT NUMBER: P407
NT/NU Association of Professional Engineers and Geoscientists

12.0 REFERENCES

Armtec (Armtec Inc.). 2021. Gander – Primary Channel Pipe Arch, Western Kitikmeot Region of Nunavut. Armtec Project No. 19-463-B. Submitted to Sabina Gold and Silver Corp. August 17, 2021.

B2Gold Back River Corp. (B2Gold Nunavut). 2021. Back River Project Road Management Plan. March 2021.

BC MOTI (British Columbia, Ministry of Transportation and Infrastructure). 2020. 2020 Standard Specifications for Highway Construction. Volume 1. ISBN 978-0-7726-7953-6. Adopted November 1, 2020.

Golder (Golder Associates Ltd). 2021. Culvert Crossings at the Rascal Stream West Reach 1 – Detailed Design. Golder Document No. 20412211-2000-2670-Rev0. Submitted to Sabina Gold and Silver Corp. October 26, 2021.

Richards J. 2023. Manager Open Pit, B2Gold Back River Corp. (B2Gold Nunavut). Request for Information: RSW Construction Summary Report. Information shared to Principalli D, Lead Project Manager, WSP. November 8, 2023.

Richards J. 2024. Manager Open Pit, B2Gold Corp. Request for Information: RSW Construction Summary Report. Information shared to Principalli D, Lead Project Manager, WSP. February 17, 2024.

WSP (WSP Canada Inc.). 2023. Rascal Stream West Culvert Installation Construction Monitoring Report. B2Gold Back River Project. Document No. 22567626-152-R-RevA. November 2023.

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APPENDIX A

Record Drawings

B2GOLD BACK RIVER CORP
BACK RIVER PROJECT
CULVERT CROSSINGS AT THE RASCAL STREAM WEST REACH 1
CONSTRUCTION RECORD

KEY MAP
SCALE: NTS

DRAWING LIST

DRAWING NUMBER	DRAWING TITLE	REVISION NUMBER	ISSUE PURPOSE
G-001	COVER SHEET	1	CONSTRUCTION RECORD
C-002	PRIMARY CULVERTS - PLAN AND PROFILE	1	CONSTRUCTION RECORD
C-004	SECONDARY CULVERT - PLAN AND PROFILE	1	CONSTRUCTION RECORD

NOTE: DRAWING NUMBERS CONSISTENT WITH IFC DESIGN PACKAGE REV0. SELECT DRAWINGS, AS INCLUDED IN DRAWING LIST, WERE PREPARED AS REV1 RECORD DRAWINGS TO DOCUMENT AVAILABLE AS-CONSTRUCTED INFORMATION.

REVIEW OF THIS DRAWING CERTIFIES THAT THE DESIGN INFORMATION CONTAINED ACCURATELY REFLECTS THE ORIGINAL DESIGN AND THE MATERIAL DESIGN CHANGES MADE DURING CONSTRUCTION THAT WERE BROUGHT TO THE REVIEWERS ATTENTION, ARE IN COMBINATION PRESENTED IN THIS DRAWING AND IN THE ACCOMPANYING CONSTRUCTION SUMMARY REPORT. THIS DRAWING AND THE CONSTRUCTION SUMMARY REPORT ARE INTENDED TO INCORPORATE ADDENDA, CHANGE ORDERS, AND OTHER MATERIAL DESIGN CHANGES, BUT NOT NECESSARILY ALL SITE INSTRUCTIONS. THE UNDERSIGNED DOES NOT WARRANT OR GUARANTEE, NOR ACCEPT ANY RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE AS-CONSTRUCTED INFORMATION SUPPLIED BY OTHERS CONTAINED IN THIS DRAWING AND THE CONSTRUCTION SUMMARY REPORT.

RECORD DRAWING

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2024-07-10	CONSTRUCTION RECORD	D.MULLEN	L.ROQUE	D.MULLEN	C.VANWERKHOVEN
0	2021-10-26	ISSUED FOR CONSTRUCTION	N.GUO	M.HEAL	C.VANWERKHOVEN	N.SCHMIDT

CLIENT
B2GOLD BACK RIVER CORP

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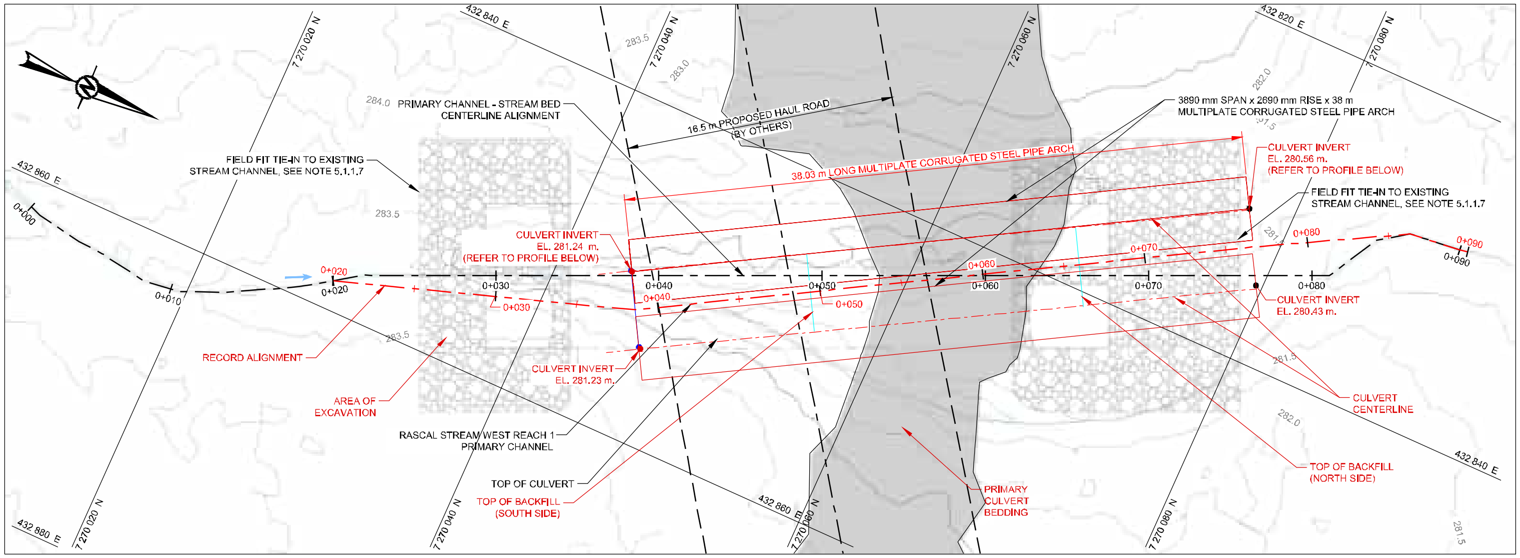
PROJECT
BACK RIVER PROJECT
CULVERT CROSSINGS AT THE RASCAL STREAM WEST REACH 1

TITLE
CONSTRUCTION RECORD
COVER SHEET

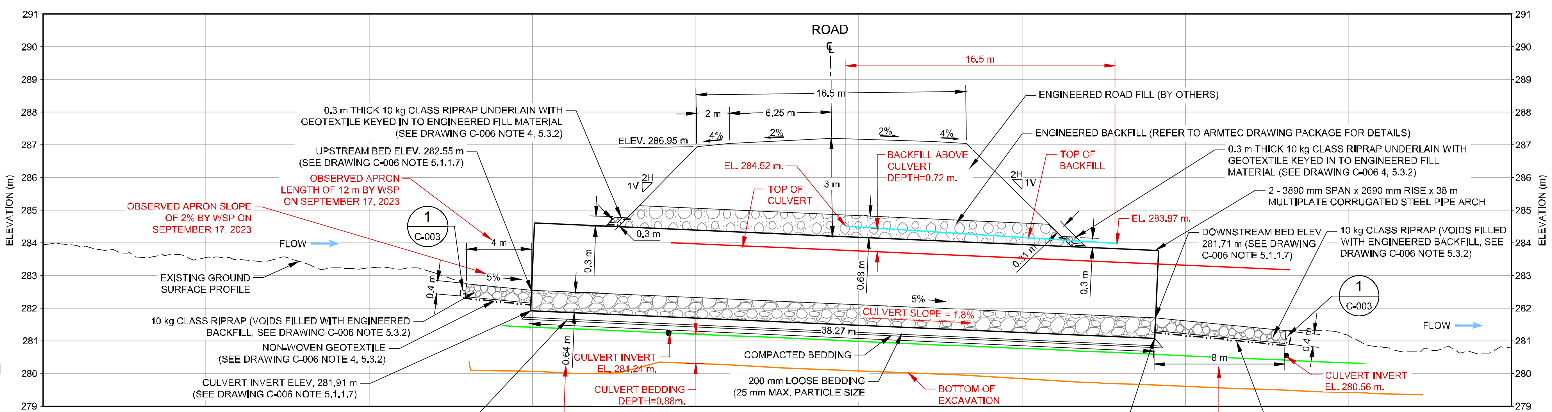
PROJECT NO.	PHASE/TASK	REV.		DRAWING
22567626	8000/130	1	1 of 3	G-001



PRIMARY CHANNEL - STREAM BED CENTERLINE ALIGNMENT
FIELD FIT TIE-IN TO EXISTING STREAM CHANNEL, SEE NOTE 5.1.1.7
16.5 m PROPOSED HAUL ROAD (BY OTHERS)
38.03 m LONG MULTIPLATE CORRUGATED STEEL PIPE ARCH
3890 mm SPAN x 2690 mm RISE x 38 m MULTIPLATE CORRUGATED STEEL PIPE ARCH
CULVERT INVERT EL. 280.56 m. (REFER TO PROFILE BELOW)
FIELD FIT TIE-IN TO EXISTING STREAM CHANNEL, SEE NOTE 5.1.1.7
CULVERT INVERT EL. 281.24 m. (REFER TO PROFILE BELOW)
CULVERT INVERT EL. 280.43 m.
RECORD ALIGNMENT
AREA OF EXCAVATION
CULVERT INVERT EL. 281.23 m.
RASCAL STREAM WEST REACH 1 PRIMARY CHANNEL
TOP OF CULVERT
TOP OF BACKFILL (SOUTH SIDE)
CULVERT CENTERLINE
TOP OF BACKFILL (NORTH SIDE)
PRIMARY CULVERT BEDDING

PLAN - PRIMARY CULVERT CROSSING

SCALE 1:150 m



ROAD
16.5 m
ENGINEERED ROAD FILL (BY OTHERS)
ENGINEERED BACKFILL (REFER TO ARMTEC DRAWING PACKAGE FOR DETAILS)
0.3 m THICK 10 kg CLASS RIPRAP UNDERLAIN WITH GEOTEXTILE KEYED IN TO ENGINEERED FILL MATERIAL (SEE DRAWING C-006 NOTE 4, 5.3.2)
UPSTREAM BED ELEV. 282.55 m (SEE DRAWING C-006 NOTE 5.1.1.7)
OBSERVED APRON LENGTH OF 12 m BY WSP ON SEPTEMBER 17, 2023
OBSERVED APRON SLOPE OF 2% BY WSP ON SEPTEMBER 17, 2023
ELEV. 286.95 m
EL. 284.52 m.
TOP OF CULVERT
BACKFILL ABOVE CULVERT DEPTH=0.72 m.
TOP OF BACKFILL
EL. 283.97 m.
2 - 3890 mm SPAN x 2690 mm RISE x 38 m MULTIPLATE CORRUGATED STEEL PIPE ARCH
DOWNSTREAM BED ELEV. 281.71 m (SEE DRAWING C-006 NOTE 5.1.1.7)
10 kg CLASS RIPRAP (VOIDS FILLED WITH ENGINEERED BACKFILL, SEE DRAWING C-006 NOTE 5.3.2)
EXISTING GROUND SURFACE PROFILE
FLOW
NON-WOVEN GEOTEXTILE (SEE DRAWING C-006 NOTE 4, 5.3.2)
CULVERT INVERT ELEV. 281.91 m (SEE DRAWING C-006 NOTE 5.1.1.7)
CULVERT EMBEDMENT (FILL WITH CHANNEL SUBSTRATE, SEE DRAWING C-006 NOTE 5.3.4)
OBSERVED EMBEDMENT DEPTH APPROXIMATELY 500 mm BY WSP ON SEPTEMBER 17, 2023
CULVERT INVERT EL. 281.24 m.
CULVERT BEDDING DEPTH=0.88m.
COMPACTED BEDDING
200 mm LOOSE BEDDING (25 mm MAX. PARTICLE SIZE
CULVERT SLOPE = 1.8%
38.27 m
BOTTOM OF EXCAVATION
CULVERT INVERT ELEV. 281.07 m (SEE DRAWING C-006 NOTE 5.1.1.7)
OBSERVED APRON LENGTH OF 9 m BY WSP ON SEPTEMBER 17, 2023
CULVERT INVERT EL. 280.56 m.
ELEVATION (m)
CHAINAGE DISTANCE (m)

PROFILE - PRIMARY CULVERT CROSSING

HORIZONTAL SCALE 1:150 m
VERTICAL SCALE 1:75 m

LEGEND

- AUGUST 2012 LIDAR EXISTING GROUND CONTOURS (0.5 m INTERVAL)
- APPROXIMATE EXISTING STREAM
- EXISTING GROUND SURFACE PROFILE
- ENGINEERED BACK FILL
- EXISTING STREAM BED MATERIAL
- 10 kg CLASS RIPRAP

NOTES

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM ZONE 13, HORIZONTAL DATUM IS NAD83 CSRS, VERTICAL DATUM IS CGVD28.
3. REFER TO DRAWING C-006 FOR CONSTRUCTION AND MATERIAL SPECIFICATIONS.
4. ENVIRONMENTAL MANAGEMENT AND EROSION AND SEDIMENT CONTROL ARE THE RESPONSIBILITY OF THE OWNER. CONSTRUCTION SPECIFICATIONS FOR ENVIRONMENTAL PROTECTION SHALL BE COMPLETED BY OTHERS.

REFERENCE(S)

1. AUGUST 2012 EXISTING GROUND LIDAR SURVEY CONDUCTED BY FUGRO GEOSERVICES LTD., FLOWN 26-31 AUGUST, 2012. PROVIDED BY SABINA GOLD AND SILVER, RECEIVED: 31 AUGUST 2012.
2. HYDROLOGY LAYERS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED, MODIFIED BY GOLDER ASSOCIATES LTD.

REVIEW OF THIS DRAWING CERTIFIES THAT THE DESIGN INFORMATION CONTAINED ACCURATELY REFLECTS THE ORIGINAL DESIGN AND THE MATERIAL DESIGN CHANGES MADE DURING CONSTRUCTION THAT WERE BROUGHT TO THE REVIEWERS ATTENTION, ARE IN COMBINATION PRESENTED IN THIS DRAWING AND IN THE ACCOMPANYING CONSTRUCTION SUMMARY REPORT. THIS DRAWING AND THE CONSTRUCTION SUMMARY REPORT ARE INTENDED TO INCORPORATE ADDENDA, CHANGE ORDERS, AND OTHER MATERIAL DESIGN CHANGES, BUT NOT NECESSARILY ALL SITE INSTRUCTIONS. THE UNDERSIGNED DOES NOT WARRANT OR GUARANTEE, NOR ACCEPT ANY RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE AS-CONSTRUCTED INFORMATION SUPPLIED BY OTHERS CONTAINED IN THIS DRAWING AND THE CONSTRUCTION SUMMARY REPORT.

RECORD DRAWING

0 2.5 5 1:75 METRES

0 5 10 1:150 METRES

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2024-07-10	RECORD DRAWING	D.MULLEN	L.ROQUE	D.MULLEN	C.VANWERKHOVEN
0	2021-10-26	ISSUED FOR CONSTRUCTION	N.GUO	M.HEAL	C.VANWERKHOVEN	N.SCHMIDT

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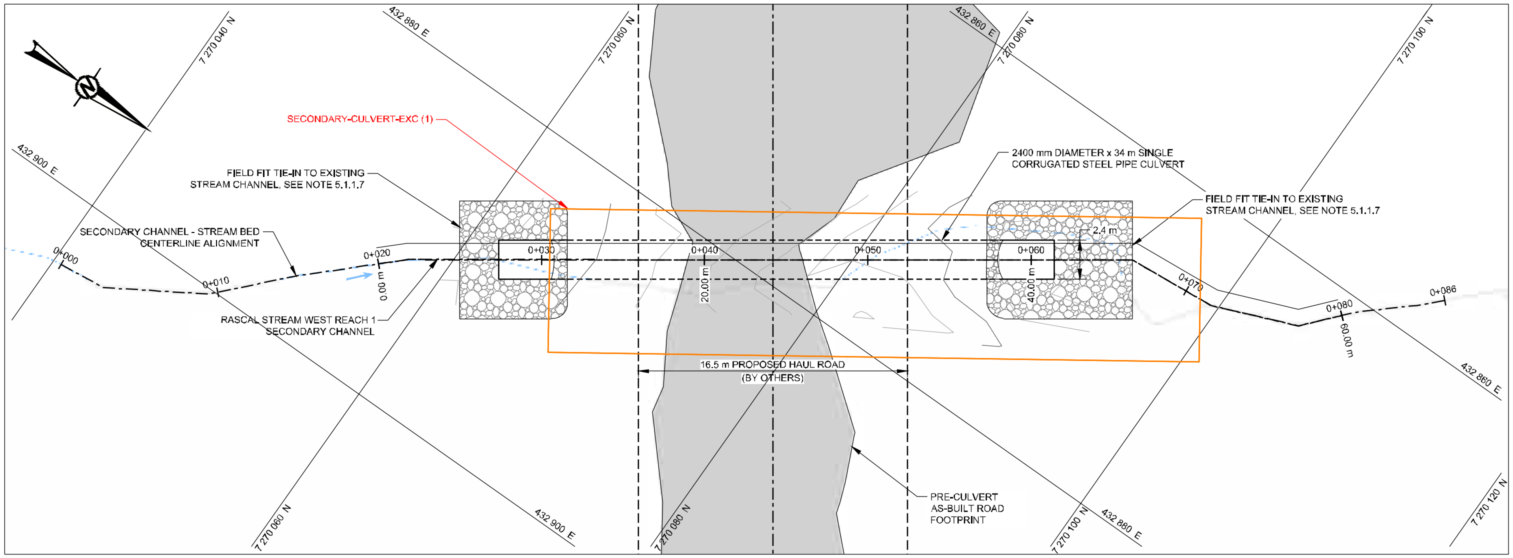
PROJECT
BACK RIVER PROJECT
CULVERT CROSSINGS AT THE RASCAL STREAM WEST REACH 1

TITLE
CONSTRUCTION RECORD
PRIMARY CULVERTS - PLAN AND PROFILE

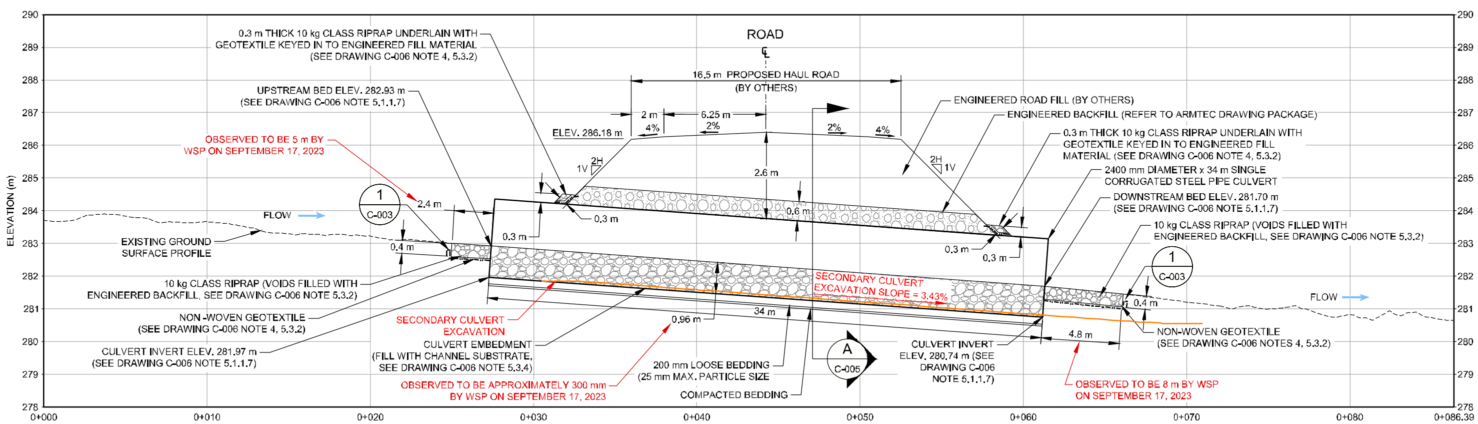
PROJECT NO.	PHASE/TASK	REV.		DRAWING
22567626	8000/130	1	2 of 3	C-002



SECONDARY-CULVERT-EXC (1)
FIELD FIT TIE-IN TO EXISTING STREAM CHANNEL, SEE NOTE 5.1.1.7
SECONDARY CHANNEL - STREAM BED CENTERLINE ALIGNMENT
RASCAL STREAM WEST REACH 1 SECONDARY CHANNEL
2400 mm DIAMETER x 34 m SINGLE CORRUGATED STEEL PIPE CULVERT
FIELD FIT TIE-IN TO EXISTING STREAM CHANNEL, SEE NOTE 5.1.1.7
16.5 m PROPOSED HAUL ROAD (BY OTHERS)
PRE-CULVERT AS-BUILT ROAD FOOTPRINT
2.4 m
0+000
0+010
0+020
0+030
0+040
0+050
0+060
0+070
0+080
0+086
0.00 m
20.00 m
40.00 m
60.00 m
7 270 040 N
7 270 060 N
7 270 080 N
7 270 100 N
7 270 120 N
432 880 E
432 900 E
432 860 E

PLAN - SECONDARY CULVERT CROSSING

SCALE 1:150 m



ROAD
16.5 m PROPOSED HAUL ROAD (BY OTHERS)
0.3 m THICK 10 kg CLASS RIPRAP UNDERLAIN WITH GEOTEXTILE KEYED IN TO ENGINEERED FILL MATERIAL (SEE DRAWING C-006 NOTE 4, 5.3.2)
UPSTREAM BED ELEV. 282.93 m (SEE DRAWING C-006 NOTE 5.1.1.7)
OBSERVED TO BE 5 m BY WSP ON SEPTEMBER 17, 2023
ELEV. 286.18 m
2 m
4%
6.25 m
2%
2%
4%
2H
1V
2.6 m
0.6 m
0.3 m
2.4 m
0.4 m
FLOW
EXISTING GROUND SURFACE PROFILE
10 kg CLASS RIPRAP (VOIDS FILLED WITH ENGINEERED BACKFILL, SEE DRAWING C-006 NOTE 5.3.2)
NON-WOVEN GEOTEXTILE (SEE DRAWING C-006 NOTE 4, 5.3.2)
CULVERT INVERT ELEV. 281.97 m (SEE DRAWING C-006 NOTE 5.1.1.7)
SECONDARY CULVERT EXCAVATION
CULVERT EMBEDMENT (FILL WITH CHANNEL SUBSTRATE, SEE DRAWING C-006 NOTE 5.3.4)
OBSERVED TO BE APPROXIMATELY 300 mm BY WSP ON SEPTEMBER 17, 2023
0.96 m
34 m
200 mm LOOSE BEDDING (25 mm MAX. PARTICLE SIZE
COMPACTED BEDDING
SECONDARY CULVERT EXCAVATION SLOPE = 3.43%
ENGINEERED ROAD FILL (BY OTHERS)
ENGINEERED BACKFILL (REFER TO ARMTEC DRAWING PACKAGE)
0.3 m THICK 10 kg CLASS RIPRAP UNDERLAIN WITH GEOTEXTILE KEYED IN TO ENGINEERED FILL MATERIAL (SEE DRAWING C-006 NOTE 4, 5.3.2)
2400 mm DIAMETER x 34 m SINGLE CORRUGATED STEEL PIPE CULVERT
DOWNSTREAM BED ELEV. 281.70 m (SEE DRAWING C-006 NOTE 5.1.1.7)
10 kg CLASS RIPRAP (VOIDS FILLED WITH ENGINEERED BACKFILL, SEE DRAWING C-006 NOTE 5.3.2)
NON-WOVEN GEOTEXTILE (SEE DRAWING C-006 NOTES 4, 5.3.2)
CULVERT INVERT ELEV. 280.74 m (SEE DRAWING C-006 NOTE 5.1.1.7)
OBSERVED TO BE 8 m BY WSP ON SEPTEMBER 17, 2023
4.8 m
1
C-003
A
C-005
ELEVATION (m)
CHAINAGE DISTANCE (m)
0+000
0+010
0+020
0+030
0+040
0+050
0+060
0+070
0+080
0+086.39
278
279
280
281
282
283
284
285
286
287
288
289
290

PROFILE - SECONDARY CULVERT CROSSING

HORIZONTAL SCALE 1:150 m
VERTICAL SCALE 1:75 m

LEGEND

- AUGUST 2012 LIDAR EXISTING GROUND CONTOURS (0.5 m INTERVAL)
- APPROXIMATE EXISTING STREAM
- EXISTING GROUND SURFACE PROFILE
- ENGINEERED BACK FILL
- EXISTING STREAM BED MATERIAL
- 10 kg CLASS RIPRAP

NOTES

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM ZONE 13, HORIZONTAL DATUM IS NAD83 CSRS, VERTICAL DATUM IS CGVD28.
3. REFER TO DRAWING C-006 FOR CONSTRUCTION AND MATERIAL SPECIFICATIONS.
4. ENVIRONMENTAL MANAGEMENT AND EROSION AND SEDIMENT CONTROL ARE THE RESPONSIBILITY OF THE OWNER, CONSTRUCTION SPECIFICATIONS FOR ENVIRONMENTAL PROTECTION SHALL BE COMPLETED BY OTHERS.

REFERENCE(S)

1. AUGUST 2012 EXISTING GROUND LIDAR SURVEY CONDUCTED BY FUGRO GEOSERVICES LTD., FLOWN 26-31 AUGUST, 2012. PROVIDED BY SABINA GOLD AND SILVER, RECEIVED: 31 AUGUST 2012.
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RECORD DRAWING

0 2.5 5 — 1:75 METRES

0 5 10 — 1:150 METRES

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2024-07-10	RECORD DRAWING	D.MULLEN	L.ROQUE	D.MULLEN	C.VANWERKHOVEN
0	2021-10-26	ISSUED FOR CONSTRUCTION	M.HEAL	N.GUO	C.VANWERKHOVEN	N.SCHMIDT

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PROJECT
BACK RIVER PROJECT
CULVERT CROSSINGS AT THE RASCAL STREAM WEST REACH 1

TITLE
CONSTRUCTION RECORD
SECONDARY CULVERT - PLAN AND PROFILE

PROJECT NO.	PHASE/TASK	REV.		DRAWING
22567626	8000/130	1	3 of 3	C-004

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

25 mm

APPENDIX B

WSP Daily Inspection Reports

DAILY INSPECTION REPORT

Project No.: 22567626, Visit Date: 5 Aug 2023

Project Name:	Back River Project – RSW Culvert Installation		
Project No:	22567626	**Visit Date:**	5 Aug 2023
Arrived on Site:	8:30	**Report Date:**	10 Aug 2023
Departed Site:	9:30	**Weather:**	Cloudy
Total hours:	1 h	**Temperature:**	8 °C to 12°C

B2Gold (formerly Sabina Gold & Silver Corp.) requested that WSP Canada Inc. (WSP) as the Design Engineer support B2Gold during the construction of the Rascal Stream West (RSW) Culvert installation (the Site) based on the design submitted to Sabina on 26 October 2021 (the IFC Design; document no.: 20412211-091-TR-Rev0-2670- IFC Drawings 26OCT_21). It is noted that construction of the secondary culvert was substantially completed in May 2023 and that current works are associated with the main crossing's twin arch culverts.

Representatives present on site:

- Client: Jamie Richards - B2Gold
- Design Engineer's Representative: Canny Tung (WSP)

HEALTH AND SAFETY

- WSP completed a Field Level Risk Assessment and discussed H&S with B2Gold.

ISSUES / CONCERNS / OUTSTANDING ITEMS

- Excavated channel material from May 2023 was identified as saturated and not unsuitable for culvert embedment substrate material. The stockpile of excavated channel material was also substantially washed away during recent storm events. B2Gold proposes to place esker material as a substitute.
- Maximum particle size for bedding shall not exceed 25 mm. Oversized particles may result in water flowing beneath the culvert. The coefficient of curvature ($C_c = D_{30}^2/(D_{10} \times D_{60})$) should range from 1 to 3 ($1<=C_c<=3$), and the coefficient of uniformity ($C_u = D_{60} / D_{10}$) should be at least 7 ($C_u >= 7$).
- The proposed culvert slope as per the design drawing was 2.19%, but actual site condition may vary.

OBSERVATIONS

- The culvert is intended to be construed in segments. The downstream segment area has been excavated and bedding material was placed, WSP took photographs of the current site condition.
- Photos of esker material proposed to be placed as culvert embedment material, and of natural material in the channel upstream of the culvert location were taken for comparison. There is a discrepancy in size range between the two materials based on visual observations. Sieve analysis data was requested for the esker material to approve use of this material for culvert embedment material.
- WSP took photos of the placed culvert bedding material and identified oversized material with particle sizes up to 35 mm. Thickness of the layer was designed to be 200 mm thick, and the placed thickness ranges from

150 to 300 mm, which was confirmed by B2Gold. Sieve analysis will also be reviewed when received to determine if additional measures are required to inhibit water from flowing into bedding.

- According to the Gander survey completed by Inline Group Inc. (Inline Group) on 5thaugust, 2023, the bedding material slope along the proposed culverts centreline was approximately 1.67% and 0.99% respectively, which is lower than the proposed slope (2.19%) in design drawing.
- The culvert plates were partially assembled prior to installation outside of the final culvert location, to be lifted in place.

CONSTRUCTION SURVEYS

- Gander survey completed by Inline Group Inc. (Inline Group) on 5th August, 2023 on the bedding elevations of the prepared segment was provided.

RECOMMENDATIONS

- Provide sieve analysis data for both the bedding material and the esker material to approve use of these materials.
- Allowance for deviation between natural channel material obtained in the upstream and proposed embankment material should be confirmed with the design engineer, alternative material may be required.
- Final placed culvert slope to be provided to WSP to confirm acceptable conveyance capacity of the design event. The deviation between design and surveyed slopes should be confirmed with the design engineer.
- Culvert assembly of plates is recommended to be completed in-place, to avoid lifting segments of the culvert.

DISTRIBUTION

B2Gold

WSP

Prepared	Canny Tung, B.A.Sc. Junior Water Resources Specialist
Approved (Professional of Record)	Curtis VanWerkhoven, M.A.Sc., P.Eng. Lead Water Resources Engineer

INSPECTION PHOTOGRAPHY

Photo 1: Natural Channel Upstream of The Culvert Location at 09:00

Photo 2: Proposed Substitute Material for Channel Substrate 09:30.

Photo 3: Prepared Segment of The Culvert Bedding at 08:40.

Photo 4: Measurement of The Bedding Material

Photo 5: Partially Assembled Culvert Plates

DAILY INSPECTION REPORT

Project No.: 22567626, Visit Date: 6 Aug 2023

Project Name:	Sabina Back River Project – RSW Culvert Installation		
Project No:	22567626	**Visit Date:**	6 Aug 2023
Arrived on Site:	08:30	**Report Date:**	10 Aug 2023
Departed Site:	17:30	**Weather:**	Mix of sun and cloud
Total hours:	9 h	**Temperature:**	5 °C to 8°C

B2Gold (formerly Sabina Gold & Silver Corp.) requested that WSP Canada Inc. (WSP) as the Design Engineer support B2Gold during the construction of the Rascal Stream West (RSW) Culvert installation (the Site) based on the design submitted to Sabina on 26 October 2021 (the IFC Design; document no.: 20412211-091-TR-Rev0-2670- IFC Drawings 26OCT_21). It is noted that construction of the secondary culvert was substantially completed in May 2023 and that current works are associated with the main crossing's twin arch culverts.

Representatives present on site:

- Client: Jamie Richards - B2Gold
- Design Engineer's Representative: Canny Tung (WSP)
- Contractor: Ryan Whale (Nahanni Construction)

HEALTH AND SAFETY

- WSP completed a Field Level Risk Assessment.

ISSUES / CONCERNS / OUTSTANDING ITEMS

- The culvert alignment shall be inline with the natural channel alignment.
- It is important that the designed shape of the arch culverts be maintained at all stages of construction. Dimension of assembled culvert shape after torquing and prior to backfilling shall be within +/- 1% of the design dimensions.
- A 0.64m culvert embedment layer and boulder clusters shall be placed after the bottom plate and prior to the top plate installation.
- Proper installation of channel substrate and riprap apron for the secondary culvert is to be confirmed.

OBSERVATIONS

- Surveyors were on site to provide centreline alignments for the culverts.
- WSP took photographs of the site and the upstream of culvert. The culvert centreline appears to be inline with the natural channel alignment.
- Bottom plates of both culverts were lifted into place for the downstream segment. Parts of the top plates were installed.
- No culvert embedment material or boulder cluster was placed prior to the top plates' installation.

- Non-woven geotextile was extended 2 m beneath the culvert ends.
- Culvert bottom plate of the downstream segment on the east side (right downstream) was deformed when being lifted.
- The measured span and rise for the culvert were 3.94 m and 2.67 m respectively at selected location, after assembling and prior to backfilling, both are within allowable assembly tolerance limits as per design drawings provided by Armtec (Armtec drawing reference:19-463-B).
- The excavated area extends 2.7 m from the edge of the culvert on the west side, which does not provide sufficient spacing for the required 3.89 m of riprap placement at the outlet.
- No channel substrate was identified inside the secondary culvert.
- No geotextile was identified underneath riprap apron of the secondary culvert.
- Outlet of the secondary culvert was partially submerged under low flows with backwater effects observed at the outlet.

CONSTRUCTION SURVEYS

- Surveyors were on site to collect culvert centreline alignment.

RECOMMENDATIONS

- Provide sieve analysis data for both the bedding material and the esker material to approve use of these materials.
- Allowance for deviation between natural channel material obtained in the upstream and proposed embankment material should be confirmed with the design engineer, alternative material may be required.
- Final placed culvert slope to be provided to WSP to confirm acceptable conveyance capacity of the design event. The deviation between design and surveyed slopes should be confirmed with the design engineer.
- Provide photos and survey of placed culvert embedment material and boulder cluster after top plate installation.
- Excavation should be extended from the edge of the culvert outlet on the west side to accommodate riprap apron placement.
- Armtec's designer, S.J. Macrae, who provided the culvert structural design (Armtec drawing reference:19-463-B) should be notified about the culvert bottom plate deformation when being lifted to confirm structural integrity of the arch culverts under the haul road. Assessment, recommendations and potential remedial actions to be completed by Armtec.
- Potential back water effect at the submerged outlet of the secondary culvert should be discussed with design engineer.
- Placement of channel substrate, geotextile, and the riprap aprons should be completed for the secondary culvert as per the design.

DISTRIBUTION

B2Gold

WSP

Prepared Canny Tung, B.A.Sc.
Junior Water Resources Specialist

Approved (Professional of Record) Curtis VanWerkhoven, M.A.Sc., P.Eng.
Lead Water Resources Engineer

INSPECTION PHOTOGRAPHY

Photo 1: Natural Channel Upstream of The Culvert Location

Photo 2: Non-woven geotextile extents 2 m beneath culvert

Photo 3: Top plate assembly began prior to placement of embankment material and boulder cluster

Photo 4: Culvert bottom plate of the downstream segment on the east side (right downstream) was deformed when being lifted

Photo 5: The excavated area extends 2.7 m form edge of the culvert on the west side

Photo 6: Minimal channel substrate was identified inside the secondary culvert

	
Photo 7: Outlet of the secondary culvert was partially submerged under low-flow condition	**Photo 8: No non-woven geotextile was identified at the inlet and the outlet secondary culvert**

DAILY INSPECTION REPORT

Project No.: 22567626, Visit Date: 10 May 2023

Project Name:	Sabina Back River Project – RSW Culvert Installation		
Project No:	22567626	**Visit Date:**	10 May 2023
Arrived on Site:	6:00	**Report Date:**	11 May 2023
Departed Site:	16:00	**Weather:**	Flurries
Total hours:	12 h	**Temperature:**	-2 °C to 2°C

B2Gold (formerly Sabina Gold & Silver Corp.) requested that WSP Canada Inc. (WSP) support B2Gold as the Design Engineer during the construction of the Rascal Stream West (RSW) Culvert installation (the Site) based on the design submitted to Sabina on 26 October 2021 (the IFC Design; document no.: 20412211-091-TR-Rev0-2670- IFC Drawings 26OCT_21).

Representatives present on site:

- Client: Clinton Wakefield - B2Gold
- Design Engineer's Representative: Daniel Mullen (WSP)
- Contractor: Scott - Ledcor Group [Ledcor]
- Environmental Monitor: Daniel Mullen (WSP)
- Surveyor: Andrew - Inland Surveying (Inland)
- Water Management: Ledcor

HEALTH AND SAFETY

- WSP completed an Field Level Risk Assessment and discussed H&S with Ledcor . PPE, potential hazards, and the day's activities were discussed in the meeting.

ISSUES / CONCERNS / OUTSTANDING ITEMS

- Rapid melt of snow and overland flow into construction area causing a change in the culvert installation plan. To expedite culvert installation, B2Gold proposed placing 50 mm clear crush for bedding below the culverts. B2Gold indicates 50 mm clear crush compacts better and faster than 25 mm minus.
- Water from rapid snow melt is in the construction zone. B2Gold plans to install secondary corrugated steel pipe culvert without embedment material to divert and manage water for installation of twin multiplate culvert.
- Potential elevated turbidity levels due to water flow in excavated construction area.
- Water is located in downstream half of secondary culvert excavation and Ledcor could not get dewatering pump operational today.
- Packer will not be able to access bedding layer for secondary culvert. B2Gold to bucket pack bedding layer for secondary culvert.

OBSERVATIONS

- WSP took photographs of the Site.

CONSTRUCTION SURVEYS

- Inland on the Site and supporting construction.

QUALITY ASSURANCE

- No additional QA notes.

RECOMMENDATIONS

- Confirm deviation from specified bedding material is approved by Armtec. WSP recommends placing 150 mm layer of 25 mm crush at the culvert interface above 50 mm clear crush bedding.
- Prior to activation of secondary corrugated steel pipe culvert, engineered backfill should be placed within the downstream end of culvert to ease the transition to the downstream riprap apron.
- Install fish screens on the pump inlets and isolate work area from fish passage.

DISTRIBUTION

B2Gold

WSP

Prepared	Daniel Mullen, B.A.Sc., Junior Water Resources Specialist
Approved **(Professional of Record)**	Curtis VanWerkhoven, M.A.Sc., P.Eng. Lead Water Resources Engineer

INSPECTION PHOTOGRAPHY

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

Photo 2: Lower pond seeping into twin multiplate excavation through temporary road.

Photo 3: Dewatering pump discharge downstream of secondary culvert excavation

Photo 4: Temporary culverts discharging twin multiplate culvert excavation

DAILY INSPECTION REPORT

Project No.: 22567626, Visit Date: 11 May 2023

Project Name:	Sabina Back River Project – RSW Culvert Installation		
Project No:	22567626	**Visit Date:**	11 May 2023
Arrived on Site:	6:00	**Report Date:**	12 May 2023
Departed Site:	16:15	**Weather:**	Mix sun and cloud
Total hours:	12.25 h	**Temperature:**	-4 °C to 2°C

B2Gold (formerly Sabina Gold & Silver Corp.) requested that WSP Canada Inc. (WSP) support B2Gold as the Design Engineer during the construction of the Rascal Stream West (RSW) Culvert installation (the Site) based on the design submitted to Sabina on 26 October 2021 (the IFC Design; document no.: 20412211-091-TR-Rev0-2670- IFC Drawings 26OCT_21).

Representatives present on site:

- Client: Clinton Wakefield - B2Gold
- Design Engineer's Representative: Daniel Mullen (WSP)
- Contractor: Scott - Ledcor Group (Ledcor)
- Environmental Monitor: Daniel Mullen (WSP)
- Surveyor: Andrew - Inland Surveying (Inland)
- Water Management: Ledcor

HEALTH AND SAFETY

- WSP completed a Field Level Risk Assessment and discussed H&S with Ledcor. PPE, potential hazards, and the day's activities were discussed in the meeting.

ISSUES / CONCERNS / OUTSTANDING ITEMS

- Rapid melt of snow and overland flow into construction area causing a change in the culvert installation plan. To expedite culvert installation, B2Gold proposed placing 50 mm clear crush, or larger material, for bedding below the culverts. B2Gold indicates 50 mm clear crush compacts better and faster than 25 mm minus.
- Water from rapid snow melt is in the construction zone. B2Gold plans to install secondary corrugated steel pipe culvert without embedment material to divert and manage water for installation of twin multiplate culvert.

OBSERVATIONS

- WSP took photographs of the Site and photos of construction material for analysis.
- Transition layer (larger material) was placed below the secondary culvert rather than the 50 mm clear crush.

CONSTRUCTION SURVEYS

- Inland on the Site and supporting construction.

QUALITY ASSURANCE

- No additional QA notes.

RECOMMENDATIONS

- Confirm deviation from specified bedding material is approved by Armtec. WSP recommends placing 150 mm layer of 25 mm crush at the culvert interface above 50 mm (or larger) clear crush bedding.
- Confirm unexcavated native material at the culvert inlet and outlet inverts is suitable for a barrier to inhibit water from flowing into the bedding layer. If determined to be unsuitable, consideration of a clay, concrete, or bentonite plug shall be considered.
- Removal of excess water and saturated foundation material within the excavation for adequate compaction.
- Prior to activation of secondary corrugated steel pipe culvert, engineered backfill should be placed within the downstream end of culvert to ease the transition to the downstream riprap apron.
- Install fish screens on the pump inlets and isolate work area from fish passage.

DISTRIBUTION

B2Gold

WSP

Prepared	Daniel Mullen, B.A.Sc., Junior Water Resources Specialist
Approved (Professional of Record)	Curtis VanWerkhoven, M.A.Sc., P.Eng. Lead Water Resources Engineer

INSPECTION PHOTOGRAPHY

Photo 1: Secondary culvert excavation with bedding placed looking upstream at 8:23.

Photo 2: Secondary culvert excavation with bedding placed looking downstream at 8:24.

Photo 3: Secondary culvert placement with 4 sections looking upstream at 16:09.

Photo 4: Twin multiplate culvert excavation at 16:10.

DAILY INSPECTION REPORT

Project No.: 22567626, Visit Date: 12 May 2023

Project Name:	Sabina Back River Project – RSW Culvert Installation		
Project No:	22567626	**Visit Date:**	12 May 2023
Arrived on Site:	7:15	**Report Date:**	15 May 2023
Departed Site:	16:45	**Weather:**	Clear
Total hours:	9.5 h	**Temperature:**	-1 °C to 20°C

B2Gold (formerly Sabina Gold & Silver Corp.) requested that WSP Canada Inc. (WSP) support B2Gold as the Design Engineer during the construction of the Rascal Stream West (RSW) Culvert installation (the Site) based on the design submitted to Sabina on 26 October 2021 (the IFC Design; document no.: 20412211-091-TR-Rev0-2670- IFC Drawings 26OCT_21).

Representatives present on site:

- Client: Clinton Wakefield - B2Gold
- Design Engineer's Representative: Daniel Mullen (WSP)
- Contractor: Scott - Ledcor Group (Ledcor)
- Environmental Monitor: Daniel Mullen (WSP)
- Surveyor: Andrew - Inland Surveying (Inland)
- Water Management: Ledcor

HEALTH AND SAFETY

- WSP completed a Field Level Risk Assessment and discussed H&S with Ledcor. PPE, potential hazards, and the day's activities were discussed in the meeting.

ISSUES / CONCERNS / OUTSTANDING ITEMS

- Rapid melt of snow and overland flow into construction area causing a change in the culvert installation plan. To expedite culvert installation, B2Gold proposed placing 50 mm clear crush, or larger material, for bedding below the culverts. B2Gold indicates 50 mm clear crush compacts better and faster than 25 mm minus.
- Placement of "transition layer" as bedding below secondary culvert with maximum particle size of 100 mm may allow for water flow beneath the secondary culvert. Sieve analysis received at end of day will be reviewed to determine if additional measures are required to inhibit water from flowing into bedding.
- Water from rapid snow melt is in the construction zone. B2Gold plans to install secondary corrugated steel pipe culvert without embedment material to divert and manage water for installation of twin multiplate culvert.
- Saturated foundation due to standing water in the excavations after dewatering.
- Sieve analysis required for backfill material to confirm compliance with Armtec's IFC drawings.

OBSERVATIONS

- WSP took photographs of the Site and photos of backfill material.
- Riprap material has oversized particles.
- Backfill material being packed by jumping jack tamper. Vibrating plate tamper on standby.

CONSTRUCTION SURVEYS

- Inland on the Site and supporting construction.

QUALITY ASSURANCE

- No additional QA notes.

RECOMMENDATIONS

- Confirm deviation from specified bedding material is approved by Armtec. WSP recommends placing 150 mm layer of 25 mm crush at the culvert interface above 50 mm (or larger) clear crush bedding.
- Confirm unexcavated native material at the culvert inlet and outlet inverts is suitable for a barrier to inhibit water from flowing into the bedding layer. If determined to be unsuitable, consideration of a clay, concrete, or bentonite plug shall be considered.
- Removal of excess water and saturated foundation material within the excavation for adequate compaction.
- Prior to activation of secondary corrugated steel pipe culvert, engineered backfill should be placed within the downstream end of culvert to ease the transition to the downstream riprap apron.
- Install fish screens on the pump inlets and isolate work area from fish passage.
- Oversized riprap material should be removed from riprap material and may be suitable for boulder clusters within the culverts.
- Complete a sieve analysis on the backfill material for approval.

DISTRIBUTION

B2Gold

WSP

Prepared	Daniel Mullen, B.A.Sc., Junior Water Resources Specialist
Approved **(Professional of Record)**	Curtis VanWerkhoven, M.A.Sc., P.Eng. Lead Water Resources Engineer

INSPECTION PHOTOGRAPHY

Photo 1: Secondary culvert placement with 6 sections looking upstream at 7:32.

Photo 2: Secondary culvert placement with 6 sections looking downstream at 7:28.

Photo 3: Secondary culvert backfill placement on left downstream bank looking upstream at 16:40.

Photo 4: Twin multiplate culvert excavation at 16:38.

DAILY INSPECTION REPORT

Project No.: 22567626, Visit Date: 13 May 2023

Project Name:	Sabina Back River Project – RSW Culvert Installation		
Project No:	22567626	**Visit Date:**	13 May 2023
Arrived on Site:	7:30	**Report Date:**	15 May 2023
Departed Site:	17:15	**Weather:**	Showers
Total hours:	9.75 hrs	**Temperature:**	5 °C to 2°C

B2Gold (formerly Sabina Gold & Silver Corp.) requested that WSP Canada Inc. (WSP) support B2Gold as the Design Engineer during the construction of the Rascal Stream West (RSW) Culvert installation (the Site) based on the design submitted to Sabina on 26 October 2021 (the IFC Design; document no.: 20412211-091-TR-Rev0-2670- IFC Drawings 26OCT_21).

Representatives present on site:

- Client: Clinton Wakefield - B2Gold
- Design Engineer's Representative: Daniel Mullen (WSP)
- Contractor: Scott - Ledcor Group (Ledcor)
- Environmental Monitor: Daniel Mullen (WSP)
- Surveyor: Andrew - Inland Surveying (Inland)
- Water Management: Ledcor

HEALTH AND SAFETY

- WSP completed a Field Level Risk Assessment and discussed H&S with Ledcor. PPE, potential hazards, and the day's activities were discussed in the meeting.

ISSUES / CONCERNS / OUTSTANDING ITEMS

- Rapid melt of snow and overland flow into construction area causing a change in the culvert installation plan. To expedite culvert installation, B2Gold placed "transition layer" material, for bedding below the culverts. Sieve analysis was received for "transition layer" called 4" Crushed Aggregate. Not in compliance with bedding material specifications.
- Placement of "transition layer" as bedding below secondary culvert with maximum particle size of 100 mm may allow for water flow beneath the secondary culvert. Sieve analysis received at 12 May 2023 will be reviewed to determine if additional measures are required to inhibit water from flowing into bedding.
- Backfill compaction for secondary corrugated steel pipe culvert completed by jack tamper. B2Gold indicates 50 mm clear crush compacts better well with jack tamper and cannot be overly packed due to lack of fine grain material.

- Water from rapid snow melt is in the construction zone. B2Gold plans to install secondary corrugated steel pipe culvert without embedment material to divert and manage water for installation of twin multiplate culverts.
- Saturated foundation due to standing water in the excavations after dewatering.
- B2Gold to place raw esker material as backfill above secondary culvert crest. Sieve analysis has not been provided. Based on visual inspection, trace particles larger than 75 mm and therefore not in compliance with backfill material specifications.
- Inlet of secondary corrugated steel pipe culvert was raised to correct the vertical alignment. After raising the inlet, the backfill material partially sloughed under the culvert. As a result, the inlet section of the culvert is not fully supported underneath.

OBSERVATIONS

- WSP took photographs of the Site and photos of backfill material.
- Riprap material has oversized particles.
- Backfill material being packed by jumping jack tamper. Vibrating plate tamper on standby.
- Secondary corrugated steel pipe culvert marked with 0.3 m increments for each lift of backfill. Backfill completed to 1.2 m on left downstream back side and 1.5 m on right downstream bank side.

CONSTRUCTION SURVEYS

- Inland on the Site and supporting construction.

QUALITY ASSURANCE

- No additional QA notes.

RECOMMENDATIONS

- Confirm deviation from specified bedding material is approved by Armtec. WSP recommends placing 150 mm layer of 25 mm crush at the culvert interface above 50 mm (or larger) clear crush bedding.
- Confirm unexcavated native material at the culvert inlet and outlet inverts is suitable for a barrier to inhibit water from flowing into the bedding layer. If determined to be unsuitable, consideration of a clay, concrete, or bentonite plug shall be considered.
- Removal of excess water and saturated foundation material within the excavation for adequate compaction.
- Prior to activation of secondary corrugated steel pipe culvert, engineered backfill should be placed within the downstream end of culvert to ease the transition to the downstream riprap apron.
- Install fish screens on the pump inlets and isolate work area from fish passage.
- Oversized riprap material should be removed from riprap and may be suitable for boulder clusters within the culverts.
- Removal of particles greater than 75 mm from raw esker material backfill around secondary corrugated steel pipe culvert.

- Placement of 25 mm crush bedding material underneath raised inlet section of the secondary corrugate steel pipe culvert.

DISTRIBUTION

B2Gold

WSP

Prepared	Daniel Mullen, B.A.Sc., Junior Water Resources Specialist
Approved **(Professional of Record)**	Curtis VanWerkhoven, M.A.Sc., P.Eng. Lead Water Resources Engineer

INSPECTION PHOTOGRAPHY

Photo 1: Secondary culvert placement with 6 sections looking upstream at 7:56.

Photo 2: Secondary culvert placement with 6 sections looking downstream at 7:58.

Photo 3: Secondary culvert inlet section raised without bedding underneath looking downstream at 16:52.

Photo 4: Twin multiplate culvert excavation at 16:40.

DAILY INSPECTION REPORT

Project No.: 22567626, Visit Date: 14 May 2023

Project Name:	Sabina Back River Project – RSW Culvert Installation		
Project No:	22567626	**Visit Date:**	14 May 2023
Arrived on Site:	7:45	**Report Date:**	19 May 2023
Departed Site:	16:45	**Weather:**	Showers
Total hours:	9 h	**Temperature:**	-1 °C to 6°C

B2Gold (formerly Sabina Gold & Silver Corp.) requested that WSP Canada Inc. (WSP) support B2Gold as the Design Engineer during the construction of the Rascal Stream West (RSW) Culvert installation (the Site) based on the design submitted to Sabina on 26 October 2021 (the IFC Design; document no.: 20412211-091-TR-Rev0-2670- IFC Drawings 26OCT_21).

Representatives present on site:

- Client: Clinton Wakefield - B2Gold
- Design Engineer's Representative: Daniel Mullen (WSP)
- Contractor: Scott - Ledcor Group (Ledcor)
- Environmental Monitor: Daniel Mullen (WSP)
- Surveyor: Andrew - Inland Surveying (Inland)
- Water Management: Ledcor

HEALTH AND SAFETY

- WSP completed a Field Level Risk Assessment and discussed H&S with Ledcor. PPE, potential hazards, and the day's activities were discussed in the meeting.

ISSUES / CONCERNS / OUTSTANDING ITEMS

- Rapid melt of snow and overland flow into construction area causing a change in the culvert installation plan. To expedite culvert installation, B2Gold placed "transition layer" material, for bedding below the culverts. Sieve analysis was received for "transition layer" called 4" Crushed Aggregate.
- Placement of "transition layer" as bedding below secondary culvert with maximum particle size of 100 mm may allow for water flow beneath the secondary culvert.
- Water from rapid snow melt is in the construction zone. B2Gold plans to install secondary corrugated steel pipe culvert without embedment material to divert and manage water for installation of twin multiplate culverts.
- Saturated foundation due to standing water in the excavations after dewatering.

- 50 mm clear crush does not meet Armtec's backfill specifications. Compaction of backfill for secondary corrugated steel pipe culvert completed by jack tamper in 300 mm lifts. B2Gold indicates 50 mm clear crush compacts better well with jack tamper and cannot be overly packed due to lack of fine grain material.
- B2Gold placed raw esker material as backfill above 1.5 m secondary culvert invert. Sieve analysis has not been provided. Based on visual inspection, trace particles larger than 75 mm and well graded with no fines. WSP took photos of material 14 May 2023. Raw esker material was compacted by jack tamper in 0.3 m lifts. The last lift to 0.6 m above secondary culvert crest was not observed to be compacted and packed by dozer tracks only.
- Backfill lifts did not meet Armtec design drawing specifications of 200 mm lifts and exceeded 400 mm height differential on each side of the pipe.
- Inlet of secondary corrugated steel pipe culvert was raised to correct the vertical alignment. After raising the inlet, the backfill material partially sloughed under the culvert. As a result, the inlet section of the culvert is not fully supported underneath.
- Vibrating plate tamper is out of commission, all compaction completed by bucket tamping, track packing, or jack tamper. No compaction testing has been completed.

OBSERVATIONS

- WSP took photographs of the Site and photos of backfill material (raw esker).
- Riprap material has oversized particles.
- Backfill material being packed by jack tamper and dozer tracks.
- Secondary corrugated steel pipe culvert marked with 0.3 m increments for each lift of backfill. Backfill completed to 0.6 m above the culvert crest with raw esker material. Run of Quarry (RoQ) material placement began overtop of raw esker material (outside of engineered backfill envelop).

CONSTRUCTION SURVEYS

- Inland on the Site and supporting construction.

QUALITY ASSURANCE

- No additional QA notes.

RECOMMENDATIONS

- Confirm deviation from specified bedding material is approved by Armtec. WSP recommends placing 150 mm layer of 25 mm crush at the culvert interface above 50 mm (or larger) clear crush bedding.
- A clay, concrete, or bentonite plug shall be installed at the inlet and outlet of the secondary culvert to reduce water flow through the bedding and backfill material.
- Confirm deviation from specified backfill material is approved by Armtec. Transition layer material (4" Crushed Aggregate) is most similar to Armtec's specification for engineered backfill. WSP recommends using 4" Crushed Aggregate material as backfill and removing large particles greater than 75 mm.

- Removal of excess water and saturated foundation material within the excavation for adequate compaction.
- Prior to activation of secondary corrugated steel pipe culvert, engineered backfill should be placed within the downstream end of culvert to ease the transition to the downstream riprap apron.
- Install fish screens on the pump inlets and isolate work area from fish passage.
- Oversized riprap material should be removed from riprap aprons and may be suitable for boulder clusters within the culverts.
- Complete compaction to design scpecifications by vibrating roller or vibrating plate tamper to improve compaction and complete standard proctor testing to ensure compaction is achieving Armtec design specifications.
- WSP recommends adhering to specifications from Armtec drawing package 19-463-B (Drawing 8, section 2, 3, and 4) and receiving approval from Armtec if deviating from material specifications.
- Backfill lifts shall meet Armtec design drawing specifications of 200 mm lifts and maximum of 400 mm height differential on each side of the pipe during backfill.

DISTRIBUTION

B2Gold

WSP

Prepared	Daniel Mullen, B.A.Sc., Junior Water Resources Specialist
Approved **(Professional of Record)**	Curtis VanWerkhoven, M.A.Sc., P.Eng. Lead Water Resources Engineer

INSPECTION PHOTOGRAPHY

Photo 1: Secondary culvert raw esker backfill 0.3 m above culvert crest looking upstream at 8:59.

Photo 2: Secondary culvert raw esker backfill 0.6 m above culvert crest looking upstream at 14:38.

Photo 3: RoQ placement above raw esker backfill looking downstream at 16:52.

Photo 4: Twin multiplate culvert excavation at 16:15.

DAILY INSPECTION REPORT

Project No.: 22567626, Visit Date: 15 May 2023

Project Name:	Sabina Back River Project – RSW Culvert Installation		
Project No:	22567626	**Visit Date:**	15 May 2023
Arrived on Site:	7:45	**Report Date:**	19 May 2023
Departed Site:	16:45	**Weather:**	Showers
Total hours:	9 h	**Temperature:**	3 °C to 7°C

B2Gold (formerly Sabina Gold & Silver Corp.) requested that WSP Canada Inc. (WSP) support B2Gold as the Design Engineer during the construction of the Rascal Stream West (RSW) Culvert installation (the Site) based on the design submitted to Sabina on 26 October 2021 (the IFC Design; document no.: 20412211-091-TR-Rev0-2670- IFC Drawings 26OCT_21).

Representatives present on site:

- Client: Clinton Wakefield - B2Gold
- Design Engineer's Representative: Daniel Mullen (WSP)
- Contractor: Scott - Ledcor Group (Ledcor)
- Environmental Monitor: Daniel Mullen (WSP)
- Surveyor: Andrew - Inland Surveying (Inland)
- Water Management: Ledcor

HEALTH AND SAFETY

- WSP completed a Field Level Risk Assessment and discussed H&S with Ledcor. PPE, potential hazards, and the day's activities were discussed in the meeting.

ISSUES / CONCERNS / OUTSTANDING ITEMS

- Rapid melt of snow and overland flow into construction area causing a change in the culvert installation plan. To expedite culvert installation, B2Gold placed "transition layer" material, for bedding below the culverts. Sieve analysis was received for "transition layer" called 4" Crushed Aggregate.
- Placement of "transition layer" as bedding below secondary culvert with maximum particle size of 100 mm may allow for water flow beneath the secondary culvert.
- B2Gold plans to install secondary corrugated steel pipe culvert without embedment material to divert and manage water for installation of twin multiplate culverts.
- Saturated foundation due to standing water in the excavations after dewatering.
- 50 mm clear crush material placed as backfill to 1.5 m above culvert invert. 50 mm clear crush material does not meet Armtec's backfill specifications. Compaction of backfill for secondary corrugated steel pipe culvert

completed by jack tamper in 300 mm lifts. B2Gold indicates 50 mm clear crush compacts well with jack tamper and cannot be overly packed due to lack of fine grain material.

- B2Gold placed raw esker material as backfill above 1.5 m secondary culvert invert. Sieve analysis has not been provided. Based on visual inspection, trace particles larger than 75 mm and well graded with no fines. WSP took photos of material 14 May 2023. Raw esker material was compacted by jack tamper in 0.3 m lifts. The last lift to 0.6 m above secondary culvert crest was not observed to be compacted and packed by dozer tracks only.
- Backfill lifts did not meet Armtec design drawing specifications of 200 mm lifts and exceeded 400 mm height differential on each side of the pipe.
- Inlet of secondary corrugated steel pipe culvert was raised to correct the vertical alignment. After raising the inlet, the backfill material partially sloughed under the culvert. As a result, the inlet section of the culvert is not fully supported underneath. 15 May 2023, backfill material was placed and packed below culvert inlet and covered by temporary riprap apron by night shift.
- Vibrating plate tamper required repair until 15 May 2023. All prior compaction completed by bucket tamping, track packing, or jack tamper. No compaction testing has been completed.

OBSERVATIONS

- WSP took photographs of the Site and photos of backfill material (raw esker).
- Riprap material has oversized particles.
- 300 mm layer of 25 mm clear crushed material placed as bedding below secondary corrugated steel pipe culvert (confirmed by J. Richards, B2Gold).
- Secondary corrugated steel pipe culvert marked with 0.3 m increments for each lift of backfill. Backfill completed to 0.6 m above the culvert crest with raw esker material. Run of Quarry (RoQ) material placement completed to 0.3 m above raw esker material (outside of engineered backfill envelope). Backfill material packed by jack tamper and dozer tracks.
- Temporary inlet apron constructed for secondary corrugated steel pipe culvert completed by night shift.
- Temporary road downstream of secondary corrugated steel pipe culvert revomed. RSW dewatering flowing through secondary corrugated steel pipe culvert.
- Diversion dam completed to divert RSW main channel through secondary corrugated steel pipe culvert isolating twin multiplate culvert excavation.

CONSTRUCTION SURVEYS

- Inland on the Site and supporting construction.

QUALITY ASSURANCE

- No additional QA notes.

RECOMMENDATIONS

- Confirm deviation from specified backfill material is approved by Armtec. Transition layer material (4" Crushed Aggregate) is most similar to Armtec's specification for engineered backfill. WSP recommends using 4" Crushed Aggregate material as backfill and removing large particles greater than 75 mm.
- No sieve analysis results for placed backfill material; 50 mm clear crush and raw esker material. Sieve analysis results are required for assessing material characteristics and applicability as backfill.
- 25 mm clear crush (1" Crushed Aggregate) material characteristics meet all Armtec design specifications as bedding material.
- Transition layer (4" Crushed Aggregate) material characteristics would be suitable as backfill material and meet Armtec design specifications with the removal of particles larger than 75 mm.
- A clay, concrete, or bentonite plug shall be installed at the inlet and outlet of the secondary culvert to reduce water flow through the bedding and backfill material.
- Removal of excess water and saturated foundation material within the excavation for adequate compaction.
- Install fish screens on the pump inlets and isolate work area from fish passage.
- Oversized riprap material should be removed from riprap aprons and may be suitable for boulder clusters within the culverts.
- Complete compaction to design specifications by vibrating roller or vibrating plate tamper to improve compaction and complete standard proctor testing to ensure compaction is achieving Armtec design specifications.
- WSP recommends adhering to specifications from Armtec drawing package 19-463-B (Drawing 8, section 2, 3, and 4) and receiving approval from Armtec if deviating from material specifications.
- Backfill lifts shall meet Armtec design drawing specifications of 200 mm lifts and maximum of 400 mm height differential on each side of the pipe during backfill.

DISTRIBUTION

B2Gold

WSP

Prepared	Daniel Mullen, B.A.Sc., Junior Water Resources Specialist
Approved **(Professional of Record)**	Curtis VanWerkhoven, M.A.Sc., P.Eng. Lead Water Resources Engineer

INSPECTION PHOTOGRAPHY

Photo 1: Secondary culvert receiving diverted flow from RSW main channel looking from RDB to LDB at 15:58.

Photo 2: Secondary culvert discharging RSW over temporary riprap apron looking downstream at 14:11.

Photo 3: Temporary diversion dam isolating twin multiplate excavation looking upstream at 16:13.

Photo 4: Twin multiplate culvert excavation at 15:49.

DAILY INSPECTION REPORT

Project No.: 22567626, Visit Date: 16 May 2023

Project Name:	Sabina Back River Project – RSW Culvert Installation		
Project No:	22567626	**Visit Date:**	16 May 2023
Arrived on Site:	9:15	**Report Date:**	19 May 2023
Departed Site:	11:15	**Weather:**	Clear
Total hours:	2 h	**Temperature:**	3 °C to 7°C

B2Gold (formerly Sabina Gold & Silver Corp.) requested that WSP Canada Inc. (WSP) support B2Gold as the Design Engineer during the construction of the Rascal Stream West (RSW) Culvert installation (the Site) based on the design submitted to Sabina on 26 October 2021 (the IFC Design; document no.: 20412211-091-TR-Rev0-2670- IFC Drawings 26OCT_21).

Representatives present on site:

- Client: Clinton Wakefield - B2Gold
- Design Engineer's Representative: Daniel Mullen (WSP)
- Contractor: Scott - Ledcor Group (Ledcor)
- Environmental Monitor: Daniel Mullen (WSP)
- Surveyor: Andrew - Inland Surveying (Inland)
- Water Management: Ledcor

HEALTH AND SAFETY

- WSP completed a Field Level Risk Assessment and discussed H&S with Ledcor. PPE, potential hazards, and the day's activities were discussed in the meeting.

ISSUES / CONCERNS / OUTSTANDING ITEMS

- Placement of "transition layer" as bedding below secondary culvert with maximum particle size of 100 mm may allow for water flow beneath the secondary culvert.
- Water from rapid snow melt is in the construction zone. B2Gold plans to install secondary corrugated steel pipe culvert without embedment material to divert and manage water for installation of twin multiplate culverts.
- Saturated foundation due to standing water in the excavations after dewatering.
- 50 mm clear crush material placed as backfill to 1.5 m above culvert invert. 50 mm clear crush material does not meet Armtec's backfill specifications. Compaction of backfill for secondary corrugated steel pipe culvert completed by jack tamper in 300 mm lifts. B2Gold indicates 50 mm clear crush compacts well with jack tamper and cannot be overly packed due to lack of fine grain material.

- B2Gold placed raw esker material as backfill above 1.5 m secondary culvert invert. Sieve analysis has not been provided. Based on visual inspection, trace particles larger than 75 mm and well graded with no fines. WSP took photos of material 14 May 2023. Raw esker material was compacted by jack tamper in 0.3 m lifts. The last lift to 0.6 m above secondary culvert crest was not observed to be compacted and packed by dozer tracks only.
- Backfill lifts did not meet Armtec design drawing specifications of 200 mm lifts and exceeded 400 mm height differential on each side of the pipe.

OBSERVATIONS

- WSP took photographs of the Site and photos of backfill material (raw esker).
- Riprap material has oversized particles.
- 300 mm layer of 25 mm clear crushed material placed as bedding below secondary corrugated steel pipe culvert (confirmed by J. Richards, B2Gold).
- Secondary corrugated steel pipe culvert marked with 0.3 m increments for each lift of backfill. Backfill completed to 0.6 m above the culvert crest with raw esker material. Run of Quarry (RoQ) material placement completed to 0.3 m above raw esker material (outside of engineered backfill envelop). Backfill material packed by jack tamper and dozer tracks.
- Temporary inlet apron constructed for secondary corrugated steel pipe culvert completed by night shift.
- Temporary road downstream of secondary corrugated steel pipe culvert removed. RSW dewatering flowing through secondary corrugated steel pipe culvert.
- Diversion dam completed to divert RSW main channel through secondary corrugated steel pipe culvert isolating twin multiplate culvert excavation.
- Temporary road within the twin multiplate excavation was removed in preparation to re-excavate to competent foundation material.

CONSTRUCTION SURVEYS

- Inland on the Site and supporting construction.

QUALITY ASSURANCE

- No additional QA notes.

RECOMMENDATIONS

- Confirm deviation from specified bedding material is approved by Armtec. WSP recommends placing 150 mm layer of 25 mm crush at the culvert interface above 50 mm (or larger) clear crush bedding.
- A clay, concrete, or bentonite plug shall be installed at the inlet and outlet of the secondary culvert to reduce water flow through the bedding and backfill material.
- No sieve analysis results for placed backfill material; 50 mm clear crush and raw esker material. Sieve analysis results are required for assessing material characteristics and applicability as backfill.

- Confirm deviation from specified backfill material is approved by Armtec. Transition layer material (4" Crushed Aggregate) is most similar to Armtec's specification for engineered backfill. WSP recommends using 4" Crushed Aggregate material as backfill and removing large particles greater than 75 mm to meet Armtec design specifications.
- Removal of excess water and saturated foundation material within the excavation for adequate compaction.
- If the secondary culvert is to be used to convey all Rascal Stream flows, the riprap aprons at the secondary culvert inlet and outlet shall be completed immediately and no embedment material shall be placed within the secondary culvert until activation of the main channel culverts.
- Install fish screens on the pump inlets and isolate work area from fish passage.
- Oversized riprap material should be removed from riprap aprons and may be suitable for boulder clusters within the culverts.
- Complete compaction to design specifications by vibrating roller or vibrating plate tamper to improve compaction and complete standard proctor testing to ensure compaction is achieving Armtec design specifications.
- WSP recommends adhering to specifications from Armtec drawing package 19-463-B (Drawing 8, section 2, 3, and 4) and receiving approval from Armtec if deviating from material specifications.
- Backfill lifts shall meet Armtec design drawing specifications of 200 mm lifts and maximum of 400 mm height differential on each side of the pipe during backfill.

DISTRIBUTION

B2Gold

WSP

Prepared	Daniel Mullen, B.A.Sc., Junior Water Resources Specialist
Approved (Professional of Record)	Curtis VanWerkhoven, M.A.Sc., P.Eng. Lead Water Resources Engineer

INSPECTION PHOTOGRAPHY

Photo 1: Secondary culvert receiving diverted flow from RSW main channel looking from RDB to LDB at 10:50.

Photo 2: Secondary culvert receiving diverted flow from RSW main channel looking upstream at 10:49.

Photo 3: Secondary culvert discharging diverted RSW main channel over temporary outlet riprap apron looking upstream at 12:05.

Photo 4: Twin multiplate culvert excavation at 9:53.

APPENDIX C

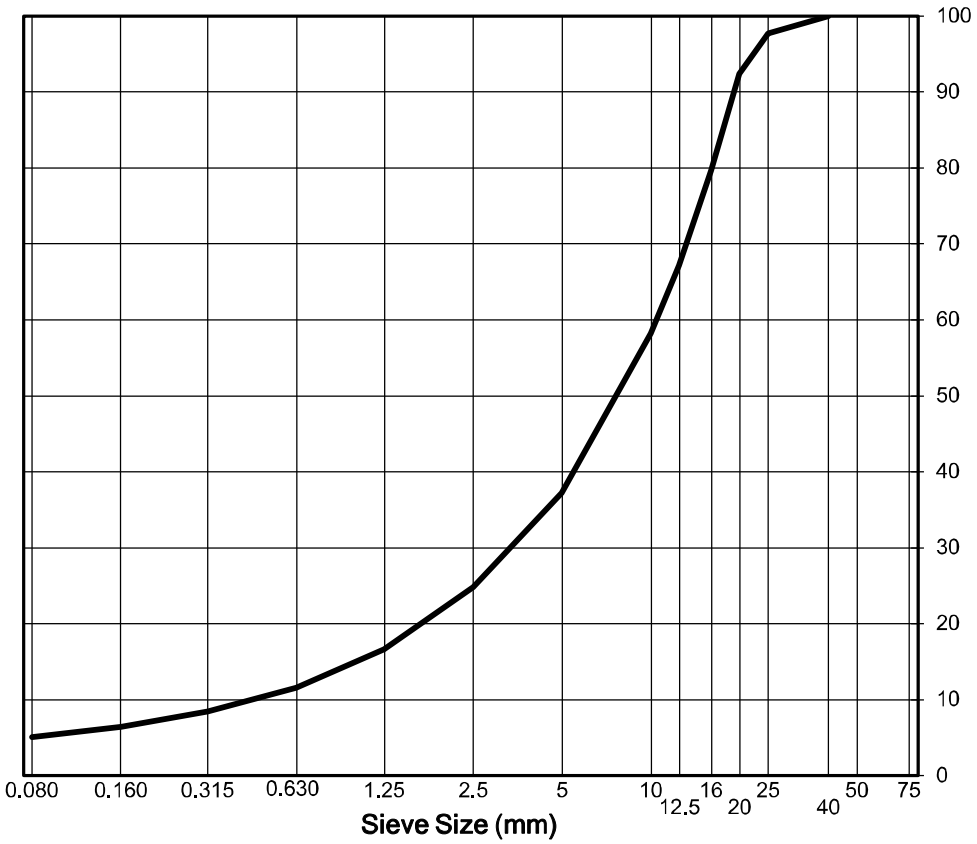
Quality Control Documents

SIEVE ANALYSIS REPORT

Washed Sieve: ASTM C136 and C117

Project No.:	704-ENG.YARC03539-01	Sample No.:	1027-F
Project:	Materials Testing for Sabina	Date Received:	April 28, 2023
Client:	Sabina Gold & Silver Corp.	Sampled by:	Client
Attention:	Jamie Richards	Date Tested:	April 30, 2023
Email:	jrichards@sabinagoldsilver.com	Tested by:	SI Office: Yellowknife
Description:	1" Crushed Aggregate (GRAVEL, sandy, trace fines)	Moisture Content (as received):	2.5%
		No. Crushed Faces:	Two (2) or Three (3)
Source:	Not Reported	By Particle Mass:	
Supplier:	Sabina Gold & Silver Corp.		
Sample Location:	Not Reported		
Specification:			

Sieve Size	Percent Passing
40	100
25	98
20	92
16	80
12.5	67
10	58
5	37
2.5	25
1.25	17
0.630	12
0.315	8
0.160	6
0.080	5.1

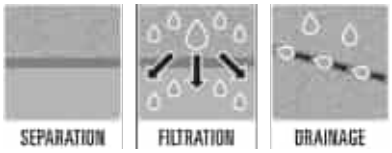


Distribution:

Remarks: Client Sample Numbers 175546, 175547, 175548

Reviewed By: ISSUED FOR REVIEW P.Eng.

TENCATE Mirafi®



Mirafi® E1200

Mirafi® E1200 is a needlepunched nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Mirafi® E1200 is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

TenCate Geosynthetics Americas Laboratories are accredited by Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP).

MECHANICAL PROPERTIES	TEST METHOD	UNIT	MINIMUM ROLL VALUE
Weight	ASTM D5261	oz/yd2 (g/m2)	12.0 (407)
Grab Tensile Strength	ASTM D4632	lbs (N)	320 (1424)
Grab Tensile Elongation	ASTM D4632	%	50
Trapezoid Tear Strength	ASTM D4533	lbs (N)	125 (556)
CBR Puncture Strength	ASTM D6241	lbs (N)	900 (4005)
			Maximum Opening Size
Apparent Opening Size (AOS)	ASTM D4751	U.S. Sieve (mm)	100 (0.15)
			Minimum Roll Value
MECHANICAL PROPERTIES	**TEST METHOD**	**UNIT**	**MINIMUM ROLL VALUE**
Permittivity	ASTM D4491	sec^{-1}	0.7
Permeability	ASTM D4491	cm/sec	0.13
Flow Rate	ASTM D4491	gal/min/ft² (l/min/m²)	50 (2037)
			Minimum Test Value
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	80

PHYSICAL PROPERTIES	UNIT	TYPICAL ROLL VALUE
Roll Dimensions (width x length)	ft (m)	15 x 300 (4.5 x 91)
Roll Area	yd^2 (m^2)	500 (418)
Roll Weight	lb (kg)	400 (181)

FGS000825
ETQR2

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NTPEP GMA TENCATE GEOSYNTHETICS

APPENDIX D

Construction Photos

B2Gold Rascal Stream West Crossing Construction Supplemental Photographs

Photograph 1: Main Channel Excavation Extents and Bedding Layer Looking Upstream. Taken August 5, 2023

Photograph 2: Main Channel Geotextile Placement at Downstream End and Bedding Layer. Taken August 6, 2023

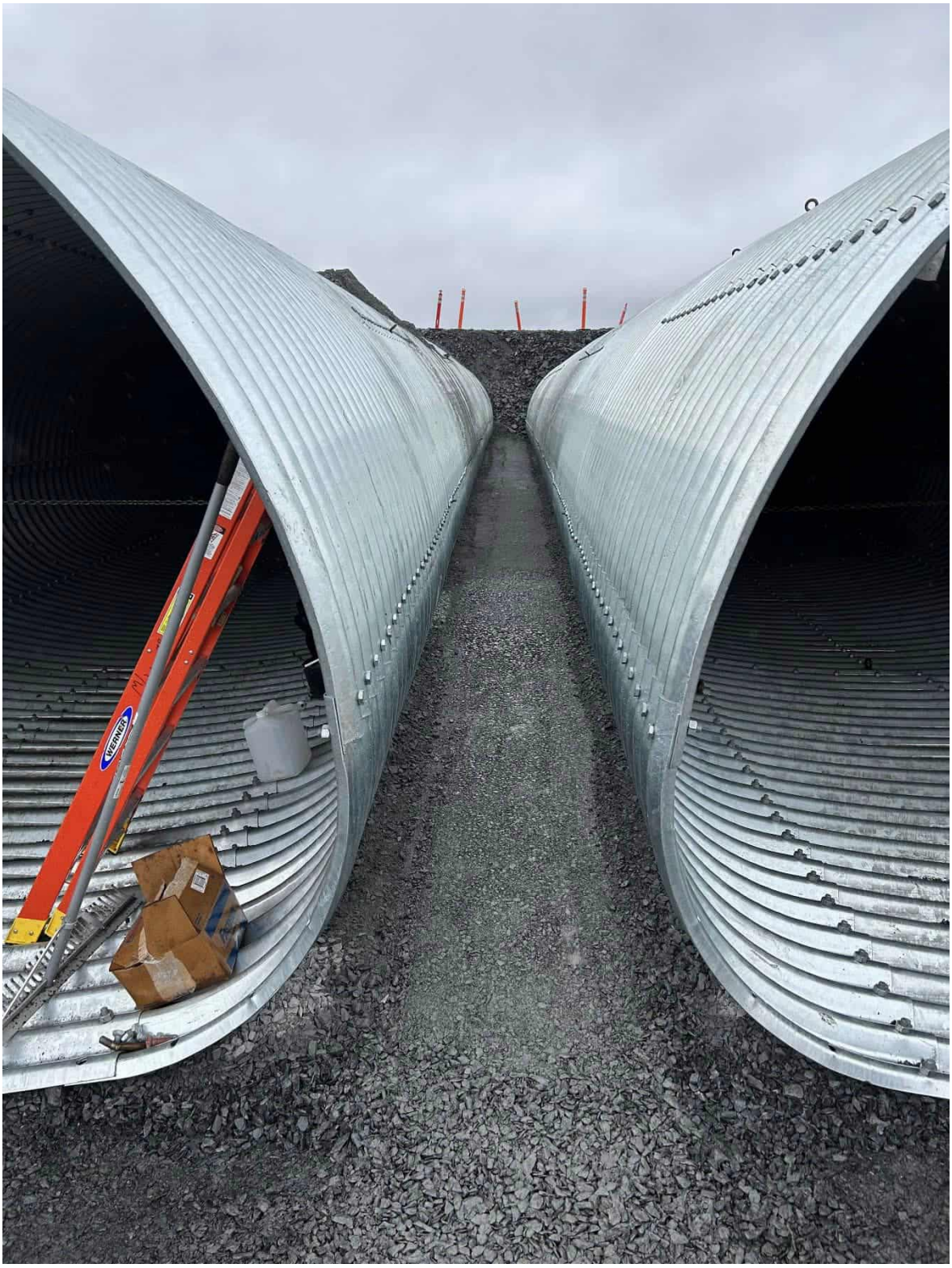
Photograph 3: Main Channel Culverts Assembly on Bedding Layer Looking Downstream. Taken August 6, 2023

Photograph 4: Main Channel Culverts Assembly on Bedding Layer Looking Upstream. Taken August 6, 2023

Photograph 5: Start of Backfill Placement for Main Channel Culverts. Taken August 21, 2023 (Provided by B2Gold)

Photograph 6: Geotextile Placed Below Main Channel Cuvlerts and Backfill at Culvert Inlets. Taken August 21, 2023 (Provided by B2Gold)

Photograph 7: Main Channel Culverts Backfill Placement and Compaction to Approximately 900 mm Above Culvert Invert. Taken August 22, 2023 (Provided by B2Gold)



Photograph 8: Backfill Placement and Compaction Between the Main Channel Culverts. Taken August 22, 2023 (Provided by B2Gold).

Photograph 9: Main Channel Culvert Left Barrel Backfill Placement and Compaction to Approximately 900 mm. Taken August 22, 2023 (Provided by B2Gold).

Photograph 10: Main Channel Culvert Right Barrel Backfill Placement and Compaction to Approximately 900 mm. Taken August 22, 2023 (Provided by B2Gold).

Photograph 11: Main Channel Culverts Inlets and Backfill Placement and Compaction. Taken August 23, 2023 (Provided by B2Gold).

Photograph 12: Main Channel Culverts Backfill Placement and Compaction to Approximately 2400 mm Looking Upstream. Taken August 24, 2023 (Provided by B2Gold).

Photograph 13: Main Channel Culverts Looking Upstream from Downstream Apron, Taken September 17, 2023

Photograph 14: Main Channel Culverts Looking Downstream from Upstream Apron, Taken September 17, 2023

Photograph 15: Main Channel East Barrel Channel Substrate Looking Upstream from Culvert Outlet, Taken September 17, 2023

Photograph 16: Main Channel West Barrel Channel Substrate Looking Upstream from Culvert Outlet, Taken September 17, 2023

Photograph 17: Main Channel Culverts Typical Boulder Cluster and 1 m Scale Bar, Taken September 17, 2023

Photograph 18: Main Channel Apron Material and 1 m Scale Bar, Taken September 17, 2023

Photograph 19: Secondary Channel Culvert Outlet Placement on Bedding Material, Taken May 11, 2023

Photograph 20: Secondary Channel Culvert Inlet Placement on Bedding Material, Taken May 11, 2023

Photograph 21: Secondary Channel Culvert Backfill Placement with Approximately 900 mm on Left Downstream Wall From Outlet at Left Downstream Bank, Taken May 13, 2023

Photograph 22: Secondary Channel Culvert Backfill Placement with Approximately 1500 mm on Right Downstream Wall From Outlet at Right Downstream Bank, Taken May 13, 2023

Photograph 23: Secondary Channel Culvert Looking Upstream from Downstream Apron, Taken September 17, 2023

Photograph 24: Secondary Channel Culvert Looking Downstream from Upstream Apron, Taken September 17, 2023

Photograph 25: Secondary Channel Culvert Substrate and Embedment Material Looking Downstream from Culvert Inlet, Taken September 17, 2023

Photograph 26: Secondary Channel Culvert Substrate and 1 m Scale Bar at Inlet, Taken September 17, 2023

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