GOOSE PROJECT

BACK RIVER GOLD DISTRICT NUNAVUT

Emergency Discharge Pond Berm

Design Report and Drawings

Sabina Document #SBR6SDE-00-C-RPT-0002

Revision	Date	Revised by	Change Log	Approval
0	June 23, 2021	KS/TZ	Issued for Construction	

PERMIT TO PRACTICE
SACRE-DAVEY ENGINEERING INC.
Signature
Date 2021.06.24
PERMIT NUMBER: P551
The Association of Professional Engineers, Geologists and Geophysicists NWT/NU

GOOSE PROJECT
BACK RIVER GOLD DISTRICT NUNAVUT

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1. Introduction

The Back River Project (the 'Project') is a gold project owned by Sabina Gold & Silver Corp. ('Sabina') within the West Kitikmeot region of south-western Nunavut. It is situated approximately 400 kilometres (km) southwest of Cambridge Bay, 95 km southeast of the southern end of Bathurst Inlet, and 520 km northeast of Yellowknife, Northwest Territories. The Project is located predominantly within the Queen Maud Gulf Watershed (Nunavut Water Regulations, Schedule 4).

The Project is comprised of two main areas with interconnecting winter ice roads: Goose Property and the Marine Laydown Area (MLA) situated along the western shore of southern Bathurst Inlet. The majority of annual resupply will be completed using the MLA, and an approximately 160 km long winter ice road will interconnect these sites.

1.1 Purpose Of the Report

This report is intended to present the design basis and considerations, engineering design and drawings related to the Goose Plant site Emergency Discharge Pond berm that will be installed for the Back River Project.

In accordance with Sabina's Type A Water Licence (No. 2AM-BRP1831), Sabina shall submit to the Nunavut Water Board (the Board) for review, at least sixty (60) days prior to Construction, final design and Construction drawings accompanied with a detailed report for the pond (Part D, Item 2c). The detailed reports referred to in Part D, Item 2 shall include:

a) Design rationale, requirements, criteria, parameters, standards, analysis methods, assumptions and limitations;

b) Site specific data and analysis to support the design and management decisions;

c) Geochemical analysis of Waste Rock and fill, demonstrating their Acid Rock Drainage and Metal Leaching characteristics;

d) Construction methods and procedures regarding how infrastructure will be put in place, including quality assurance and quality control measures and equipment to be used;

e) Technical specifications for sedimentation, erosion control and bank stabilization measures, including proposed materials, location and extent, place methods and quantities required;

f) Timetable for submission, including date of Construction and proposed date of commissioning of infrastructure; and

g) Where required, signature and seal by the appropriately qualified Engineer.

1.2 Scope of Work

Sabina has retained Sacre-Davey Engineering to design the civil\earthworks components of the Goose Plant Site Emergency Discharge Pond berm.

The report includes an overview of the Codes and Regulations that apply, the design criteria and construction details as well as site-specific considerations for the following facilities:

- Plant site Emergency Discharge Pond facility, construction to occur in summer/fall 2021, consisting of one (1) 4,000 m3 volume, fully lined pond.
- Berms/roads required to define the boundaries of the pond.

Sabina will submit to the Board for review, within ninety (90) days of completion of the pond construction, a Construction Summary Report prepared by a qualified Engineer(s) in accordance with Schedule D, Item 1 of 2AM-BRP1831.

1.3 Schedule

The construction and installation of the pond facility will proceed in summer 2021, with completion expected in fall 2021.

1.4 Engineering Documents

Table 1. Engineering Documents List

Engineering documents	
Civil / Earthworks	Emergency Discharge Pond Plan/Layout
	Emergency Discharge Pond Sections and Details Sheet 1
	Emergency Discharge Pond Sections and Details Sheet 2

2. Compliance

The pond facility design complies with the Water Management Plan for the Back River Project, which governs the design of such facilities. Additionally, the facility complies with the latest editions of the Codes and Standards relating to this project (Federal, Territorial, Municipal, NBCC, NFCC, CEC, CSA, NFPA, and API) as well as the directives of the authorities having jurisdiction over this project. Specific codes and standards as: Canadian Council of Ministers of Environment (CCME), R-125-95 NWT and Nunavut Mine Health and Safety Regulations (Mine Health and Safety Act) shall apply.

3. Design

3.1 General

This section describes the criteria, methods, data, analysis and specifications used to design the Emergency Discharge Pond.

3.2 Design rationale, requirements, criteria, parameters, standards, analysis methods, assumptions and limitations

The pond facility is designed for retention of emergency waste water discharges produced by the plant site.

The emergency discharge pond is designed to be fully lined with excess capacity available to redirect material (saline water, tailings, etc) as needed in emergency situations.

3.3 Geochemical analysis of waste rock and fill, demonstrating their acid rock drainage and metal leaching characteristics

Sabina is committed to using only non-potentially acid generating (NPAG) rock for the construction of the berm forming part of the pond facility. A summary of the acid rock drainage (ARD) and metal leaching characteristics for potential quarry rock and waste rock sources is provided below, along with the associated geochemical segregation criteria and requisite confirmatory sampling.

Quarry Rock at the Goose Property

Detailed geochemical characterization studies to assess the metal leaching (ML) and acid rock drainage (ARD) potential of quarry and waste rock sources at the Goose Property was carried out as part of the Final Environmental Impact Statement. Over 700 samples from the Goose Property were analyzed, including acid base accounting (ABA) and trace element analyses, during this characterisation study; details of this sampling program and the subsequent results can be found in the Geochemical Characterization Report (MAD Appendix E-3).

Sabina has identified multiple appropriate NPAG material sources at the Goose Property, including the Airstrip Quarry, Goose Plant Site, as well as others. For any potential quarry source, Sabina will adhere to the same geochemical criteria, sampling requirements, and reporting commitments outlined below.

Consistent with the waste rock classification criteria in the WRMP, the criteria that will be used to classify NPAG material to be used for construction from any quarry source will be a neutralization potential/acid generation potential (NP/AP) ratio of greater than 3, or a sulphur content of less than 0.15%. The classification criteria is supported by the results of ABA, net acid generation (NAG) testing, and kinetic testing, and provides an appropriate level of conservatism; additional details on these testing programs and criteria rationale described in the Geochemical Characterization Report (MAD Appendix E-3).

As stipulated in the Project Certificate Terms and Conditions, Sabina will develop site-specific quarry operation and management plans in advance of the development of any potential quarry site or borrow pit (PC No. 007, TC#16). This plan will be submitted to the Nunavut Impact Review Board (NIRB) and the Kitikmeot Inuit Association (KIA) at least 30 days prior to the use of borrow or quarry sites for review.

Information regarding Sabina's fulfillment of this Term and Condition and the identification of any amendments to existing site-specific quarry operation and management plans will also be provided annually in Sabina's annual report to the NIRB. In addition, Sabina will continue to provide site-specific quarry operation and management plans to the NIRB and the KIA at least 30 days prior to the use of borrow or quarry sites for review. Any amendments to existing site-specific quarry operation and management plans shall be provided in Sabina's annual report to the NIRB.

Quarry Monitoring

The following quarry monitoring activities will be completed during construction to verify the effectiveness of the geochemical segregation criteria outlined above:

- Quantities of the NPAG quarry rock produced during quarry operations, and the amounts placed in each of the infrastructure components will be recorded on a daily basis and a monthly summary will be provided in the Annual Report. Quantities of PAG excavated and deposited in the WRSAs will also be recorded.
- Geochemical monitoring will be completed to confirm that all of the quarry rock used for construction is NPAG. Confirmatory samples will be taken at a rate of one sample per 100,000 tonnes of mined material from NPAG areas within the quarries. The collected samples will be sent to an accredited commercial laboratory for ABA tests (with NP determination using the Modified Sobek method) and NAG tests.

Quarry development and results of sampling will be provided in summary form will be reported to the Nunavut Water Board (NWB) through the Water Licence Annual Report (2AM-BRP1831, Schedule B). Additional details on quarry monitoring are outlined in the QMP, and details on other water monitoring related to the quarries are included in the EMPP.

3.4 Construction Methods and Procedures Regarding How Infrastructure Will Be Put In Place, Including Quality Assurance And Quality Control Measures And Equipment To Be Used

The Engineering Drawings for the pond can be found in Appendix A. Materials shall be placed and tested in accordance with the technical specification documentation provided in the geotechnical report. Refer to Section 4.

3.5 Technical Specifications for Sedimentation, Erosion Control And Bank Stabilization Measures, Including Proposed Materials, Location And Extent, Place Methods And Quantities Required

The following management and mitigation measures will be adhered to during the construction of the pond facility; refer to the Type A Water License Road Management Plan for additional details.

Mitigation by Erosion and Sediment Control

- The area of landscape disturbance will be minimized, and restoration will occur as soon as possible in order to minimize erosion potential.

- Silt fences will be used in areas of cuts and excavations, downslope from exposed or erodible areas to prevent sedimentation of water bodies.
- Site isolation measures (e.g., silt boom or silt curtain) will be used to contain suspended sediment where in-water work is required.
- Regular inspection and maintenance of erosion and sediment control measures and structures will be conducted during the course of construction.

Mitigation by Shoreline/bank re-vegetation and stabilization

- Clearing of riparian vegetation will be kept to a minimum to avoid disturbance to the riparian vegetation and prevent soil compaction.
- If replacement rock reinforcement / armouring is required to stabilize eroding or exposed areas, appropriately-sized, clean rock will be installed at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment.
- Exposed landscape surfaces will be protected, where possible, by the installation of covering material like riprap, aggregate, or rolled erosion control products.
- Decommissioning of the roads will involve restoring natural drainages, and stabilizing any slopes where there is potential for erosion; stabilization measures may require pulling back of side-cast fills on locally steep slopes or buttressing and/or re-contouring of steepened slopes using non acid generating material.

Mitigation by Operation of Machinery

- All heavy machinery used during construction will stay above the high-water mark to the greatest extent possible.
- Temporary crossings may be utilized if necessary to limit fording of watercourses.
- All machinery will arrive on site in a clean condition and maintained free of fluid leaks, invasive species and noxious weeds.
- All fueling will be done away from watercourses and water bodies, and a spill protocol will be in place.

Following the installation of the pond infrastructure, inspections and monitoring will be performed prior to and during the spring freshet. Inspections will include daily visual assessments of ice blockages prior to the spring freshet, followed by visual assessments for erosion and sedimentation for the duration of the spring freshet. For fish-bearing crossings, turbidity levels will be monitored weekly during spring conditions or periods with high flow for the first year of operation of the ponds.

3.6 Timetable For Submission Including Date Of Construction And Proposed Date Of Commissioning Of Infrastructure

Refer to Section 1.2.

3.7 Signed And Sealed Documents

Refer to the drawings in Appendix B.

4. Earthworks

4.1 Construction Material Quantities

The table below presents the estimated in-place material quantities for the construction of the pond facility.

Table 2. Material Estimated In-Place Quantities for The Construction Of The Pond Facility

Item	
General Fill (m^3)	10,000
Crush Fill (m^3)	2,000
SOLMAX Liner (m^2)	7,000
Total Fill Material Volume (m^3)	**12,000**

4.2 Construction Material Specifications

The general requirements for the materials are specified below. The requirements for each of the materials can vary slightly for a specific earth structure to meet specific design intents.

Preliminary geochemical characterization was completed on surface outcrop samples, deep bedrock, and sandy gravel representing quarry material that will be excavated during construction of the MLA Fuel Storage Area (MLA Quarry). These samples were described as weathered quartzite conglomerate, quartz arenite/quartzite (sandstone), and sandy gravel. The test results showed that these materials have a negligible potential for ML/ARD. additional deep bedrock sampling and testing was completed in 2018 during quarry blasting; results reported low sulphur content and ARD potential.

4.2.1 Levelling Fill

The levelling fill material shall consist of competent, non-acid-generating material from the quarries or foundation excavations and that is free from organic matter, frozen soil, snow and ice.

The material shall have a particle size distribution falling within the limits presented in Table 3.

Table 3. Levelling Fill – Particle Size Distribution Limits

Particle size (mm)	% Passing
200	100
100	60 - 100
50	40 – 70
20	20 – 50
10	0 - 30
5	0 -10

4.2.2 Crush Fill

Crush Fill shall consist of competent non-acid-generating rock from the quarries or foundation excavations, and that is free of organic matter, frozen soil, snow and ice.

The material shall have a particle size distribution falling within the limits presented in Table 4.

Table 4. Crush Fill – Particle Size Distribution Limits

Particle size (mm)	% Passing
19.0	100
16.0	80 - 100
5.0	40 - 70
2.0	25 – 55
0.43	15 – 30
0.08	8 - 15

4.2.3 General Fill (Run of Quarry)

Run-of-Quarry (ROQ) material shall consist of competent non-acid generating rock sourced from the quarries or foundation excavations, and that is free of organic matter, frozen soil, snow and ice.

ROQ material shall be well-graded, containing sufficient quantities of unfrozen gravel, sand and silt sized material to allow the material to be compacted. In areas where the overall ROQ fill thickness is less than 0.85 m, the maximum boulder size shall not exceed 500 mm, as measured in any direction. In areas where the overall ROQ fill thickness is greater than 0.85 m, the maximum boulder size shall not exceed 900 mm as measured in any direction.

Basic screening, or crushing and screening may be used to achieve the desired gradation.

The ROQ material shall be washed to remove blast residue, unless otherwise directed.

4.2.4 Liner – SOLMAX HDPE

An impervious SOLMAX HDPE geomembrane will be placed on granular material of varying thickness in order to provide impermeability to the berms and base of the pond segments, as required. The liner will be a continuous membrane to ensure its imperviousness. The geomembrane is HDPE based in combination with a non-woven geotextile for mechanical resistance and specifically designed to guarantee waterproofing, chemical resistance and ageing behaviour.

Table 5. Geomembrane Specifications

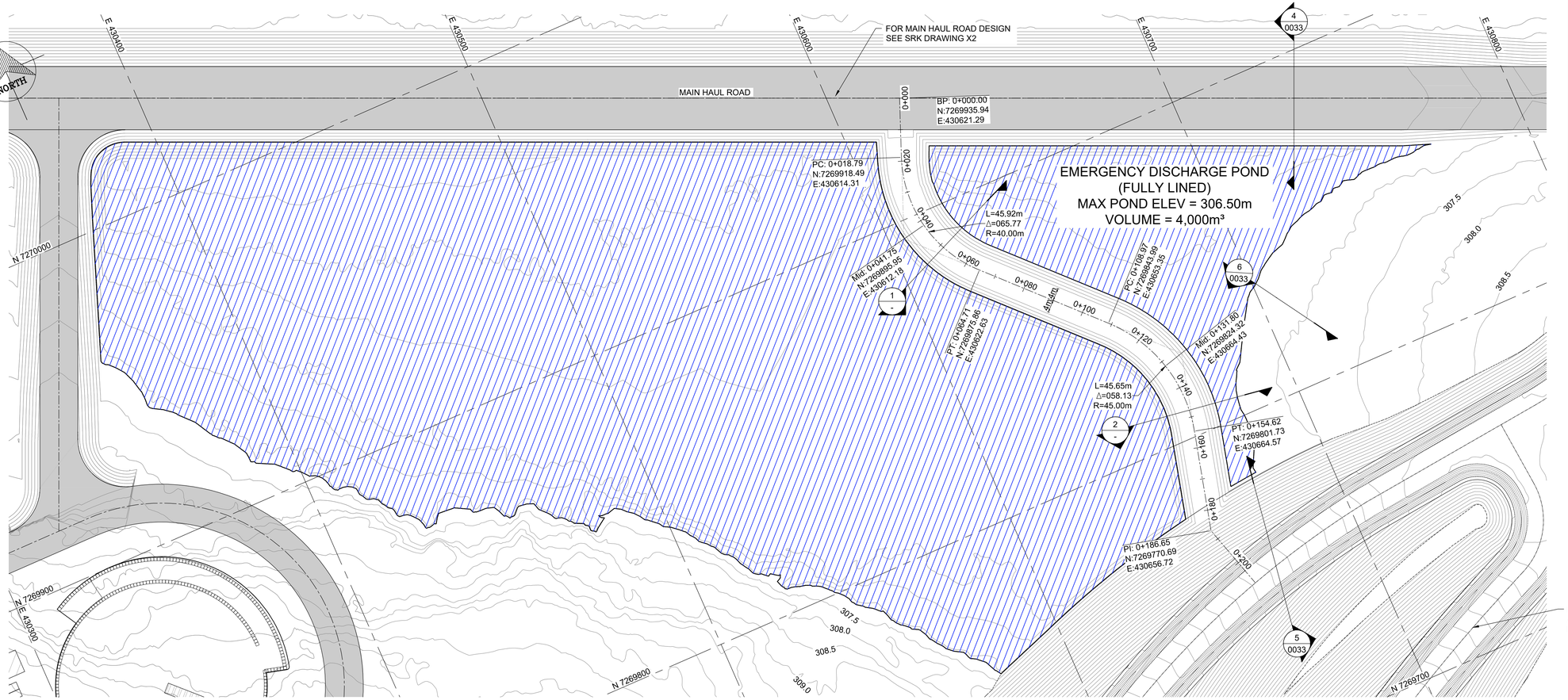
Characteristics				Tolerance	
	Standard	Units	Values	Min	Max
Thickness (on finished product)	ASTM D 5994	mm	1.5	1.28	-
Resistance to Puncture	ASTM D 4833	N	535	535	-
Resistance to tearing	ASTM D 1004	N	200	200	-
Tensile properties: strength at yield	ASTM D 6693	kN/m	-	23	-
Tensile properties: elongation at yield		%	13	-	-
Tensile properties: strength at break		kN/m	-	23	-
Tensile properties: elongation at break		%	150	-	-
Dimensional Stability	ASTM D 1204	%	-	-2	+2
Low Temperature Brittleness	ASTM D 746	°C	-77	-	
Stress Crack Resistance	ASTM D 5397	hr	500	-	
UV Resistance	ASTM D 5885	%	50	-	

Appendix A - Engineering Drawings List

The following list of drawings covers the technical requirements for this package.

Drawing	Title	Rev
SBR6SDE-00-C-PLN-0049	Emergency Discharge Pond Plan	R0
SBR6SDE-00-C-DET-0033	Emergency Discharge Pond Details & Sections Sheet 1	R0
SBR6SDE-00-C-DET-0034	Emergency Discharge Pond Details & Sections Sheet 2	R0

Appendix B - Engineering Drawings



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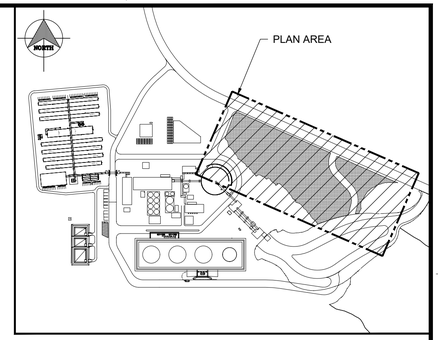
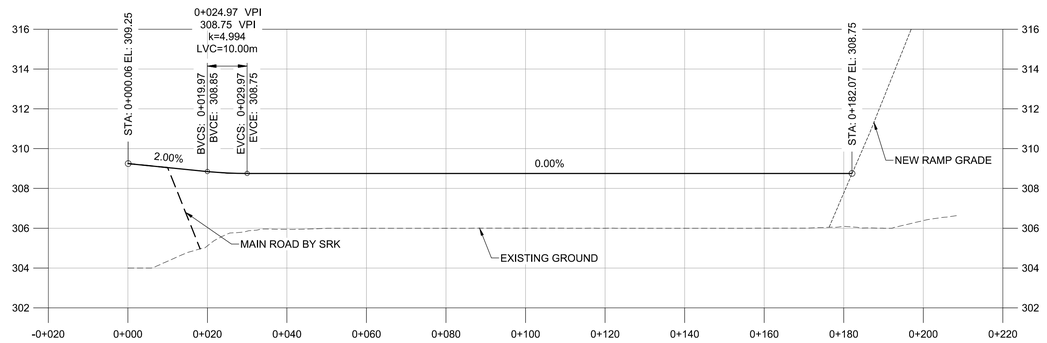


KEY PLAN
SCALE: N. T. S.

NOTES:

1. MAIN HAUL ROAD TO BE RAISED AS NOTED ON THIS DRAWING.
2. LINER TO BE 1.5mm (60 mil) HDPE BLACK SMOOTH BY SOLMAX OR APPROVED EQUAL.
3. GEOTEXTILE TO BE 540 g/m² NON-WOVEN.
4. SEAMS OF THE LINER SHALL BE FIELD-MANUFACTURED USING DOUBLE WEDGE WELDING IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND SPECIFICATIONS.
5. ROAD/BERM FILL TO BE KEYED INTO FILL FOR MAIN HAUL ROAD AND DUMP POCKET ACCESS ROAD.



BERM ROAD- PROFILE
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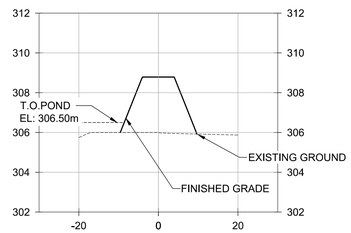

SECTION STA 0+050.00

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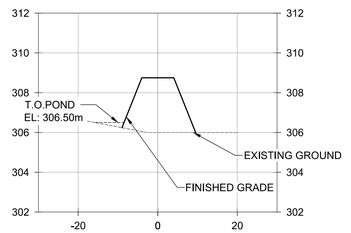

SECTION STA 0+150.00

SECTION 2
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COORDINATE SYSTEM: NAD 1983 UTM ZONE 13N
PROJECTION: TRANSVERSE MORCATOR
DATUM: NORTH AMERICAN 1983

ISSUED FOR CONSTRUCTION

DWG. NO.	REFERENCE DRAWINGS
00-C-PLN-0036	ACCESS ROAD TO DUMP POCKET – PLAN & PROFILE SH.1
00-C-DET-0033	EMERGENCY DISCHARGE POND – SECTIONS & DETAILS SH.1

REGISTERED PROFESSIONAL ENGINEER
K.A. SAVAGE
LICENSEE
NT/NU
2021-06-24

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0		ISSUED FOR CONSTRUCTION	23JUN21	TM

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DESIGNED BY:	T.M.U	23JUN21
DRAWN BY:	T.M.U	23JUN21
CHECKED BY:	D.T.H	23JUN21
APPROVED BY:		

Sacré-Davey ENGINEERING INC.
315 MOUNTAIN HIGHWAY
NORTH VANCOUVER, BC
SACRE-DAVEY.COM

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GOOSE PROJECT
BACK RIVER GOLD DISTRICT NUNAVUT
EMERGENCY DISCHARGE POND
PLAN

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
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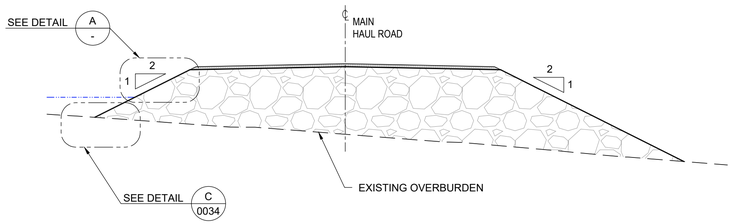

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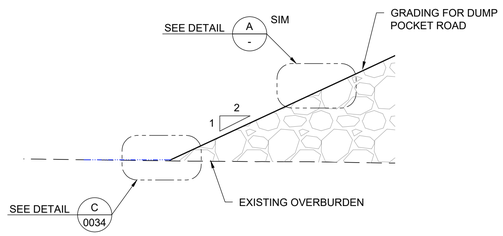

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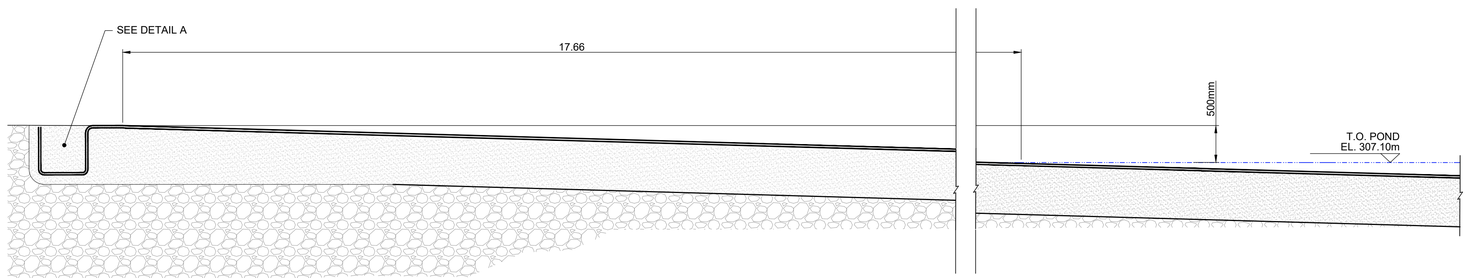
LEGEND

- EXISTING GROUND SURFACE
- ROM (OR ROQ)
- ENGINEERED FILL
- SURFACING MATERIAL



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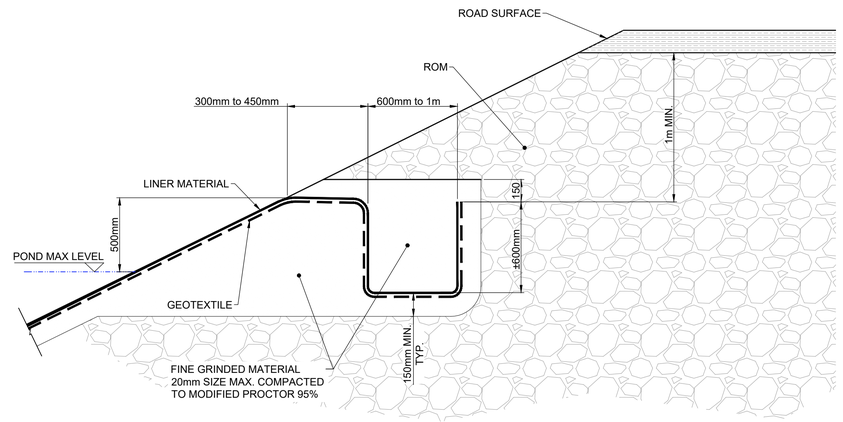

LINER ANCHOR DETAIL

DETAIL A - SCALE: 1:20

NOTE: USE SAND BAGS AS GEOMEMBRANE WEIGHTS IN TRENCH DURING GEOMEMBRANE INSTALLATION

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DWG. NO.	REFERENCE DRAWINGS
00-C-DET-0034	EMERGENCY DISCHARGE POND – SECTIONS & DETAILS SH.2
00-C-PLN-0049	EMERGENCY DISCHARGE POND – PLAN

REGISTERED PROFESSIONAL ENGINEER — K.A. SAVAGE — LICENSEE — NT/NU — 2021-06-24

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DRAWN BY:	K.L.I	23JUN21
CHECKED BY:	D.T.H	23JUN21
APPROVED BY:		

Sacré-Davey ENGINEERING INC.
315 MOUNTAIN HIGHWAY
NORTH VANCOUVER, BC
SACRE-DAVEY.COM

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GOOSE PROJECT

BACK RIVER GOLD DISTRICT NUNAVUT

EMERGENCY DISCHARGE POND
SECTIONS & DETAILS SH.1

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
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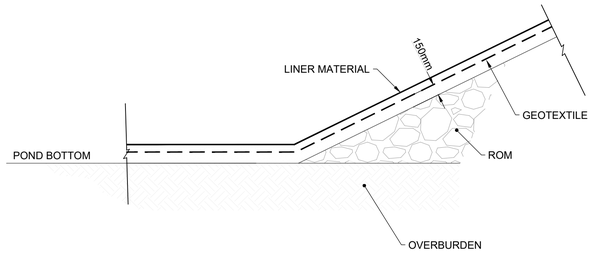

NOTE

1. SEAMS OF THE LINER SHALL BE FIELD-MANUFACTURED USING DOUBLE WEDGE WELDING.
2. FIELD LOCATE
   - IN MAIN HAUL ROAD FOR EMERGENCY DISCHARGE POND

LEGEND

- EXISTING GROUND SURFACE
- ROM (OR ROQ)
- ENGINEERED FILL
- SURFACING MATERIAL

POND BOTTOM LINEAR DETAIL

DETAIL C/0033
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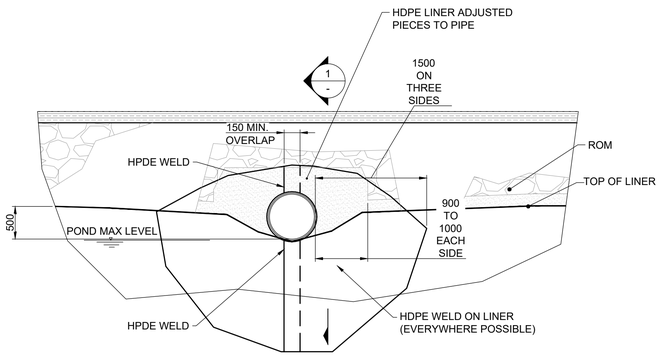

POND OVERFLOW DETAIL - FIELD LOCATE (NOTE 2)

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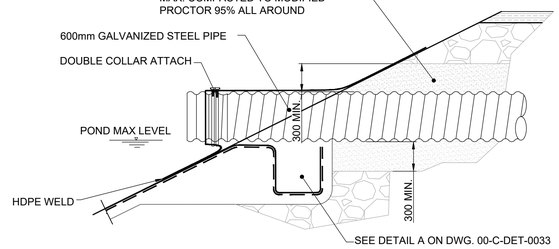

SECTION 1/-
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APPROVED BY:		

Sabina GOLD & SILVER CORP.

GOOSE PROJECT

BACK RIVER GOLD DISTRICT NUNAVUT

EMERGENCY DISCHARGE POND
SECTIONS & DETAILS SH.2

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
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