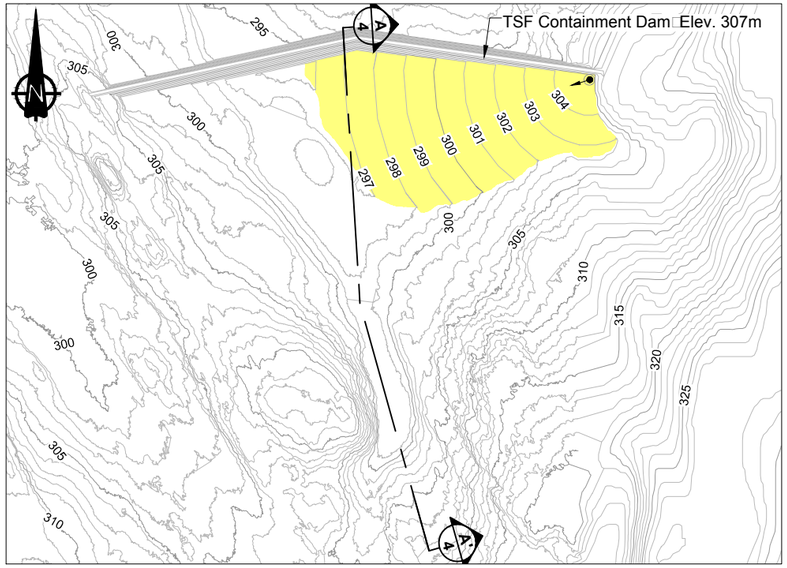
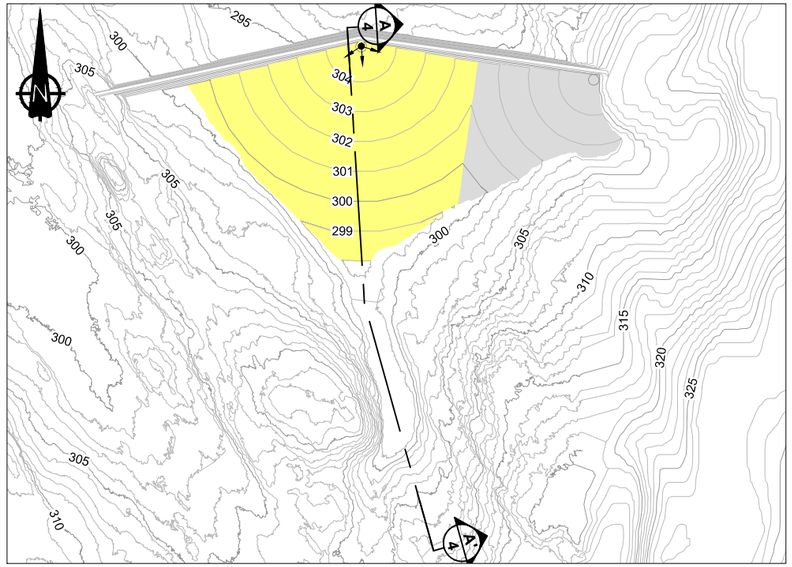


DEPOSITION PERIOD 1 (Year 2019-2020)

Spigot Elevation: 305.0m
Deposited Tailings: 1.06Mm³
Duration: Months
Pond Capacity: 5.7Mm³



DEPOSITION PERIOD 2 (Year 2020 - 2021)

Spigot Elevation: 305.0m
Deposited Tailings: 1.44Mm³
Cumulative Tailings: 2.5Mm³
Duration: 1 Months
Pond Capacity: 4.3Mm³

LEGEND

- Deposition Spigot Location
- Current Period Tailings
- Previously Placed Tailings
- Pond Elev. 305.0m (Ma Operating Level)

NOTES

1. Deposition durations are appro imate and were based on an average production rate o :
   - 1,000m³/day January to April 2019;
   - 1,750m³/day April to July 2019;
   - 2,500m³/day July 2019 to April 2023; and
   - accounts or ice entrainment
2. Assumed an average deposited tailings beach slope o 1.0 .
3. Deposited tailings dry density 1.2 t/m³ (based on laboratory testing).
4. Ice entrainment was assumed at 20 o production.
5. Total storage requirement: 4.4Mm³; (Tailings 3.7Mm³ + Ice Entrainment 0.7Mm³)
6. Available pond capacities were based on a ma imum operating level at elevation 305.0 m.
7. Deposition plan is preliminary and durations o periods 1 2 and 3 should be modi ied to maintain a tailings beach against the dam (i.e. reduce duration times o periods 1 and 2 and increase period 3).
8. Contours shown at 1.0 m interval.

REFERENCE

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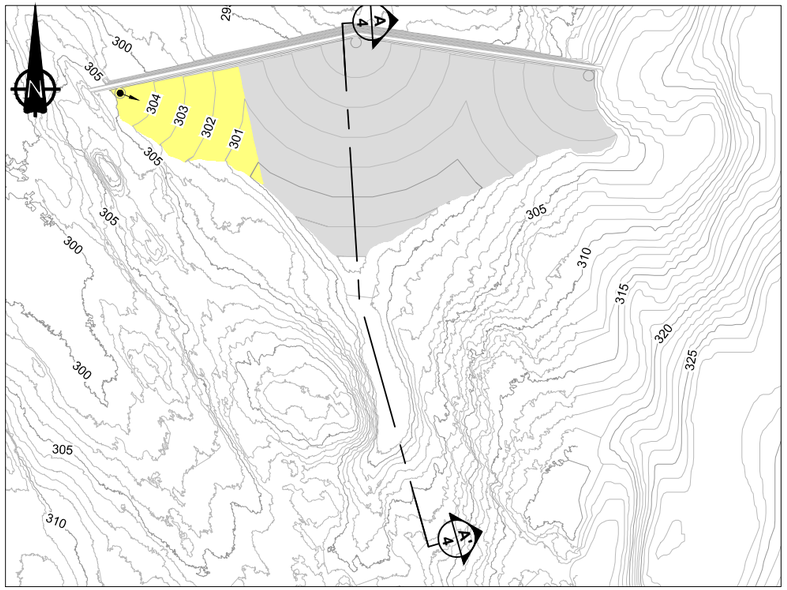
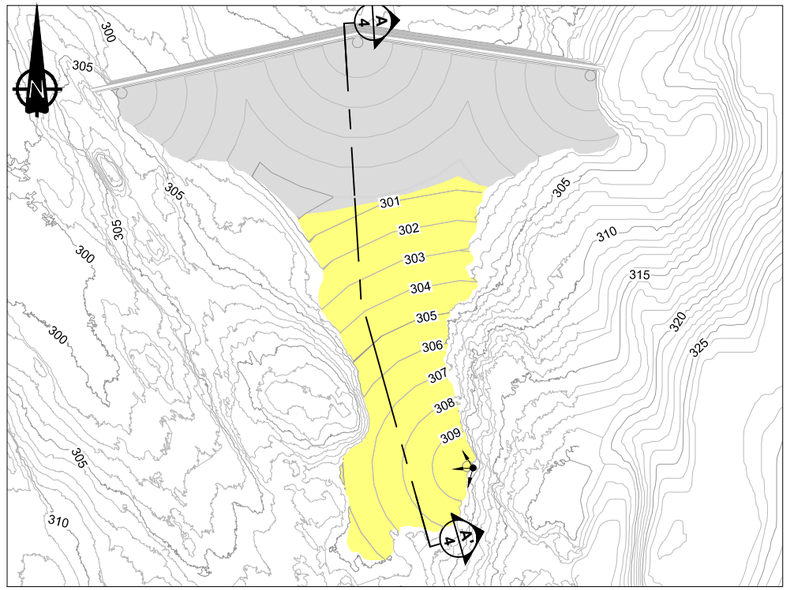


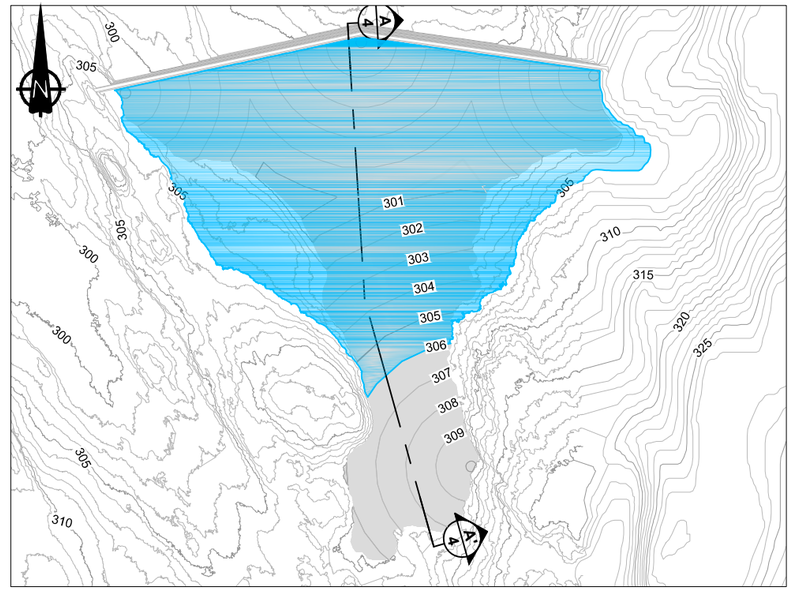
DEPOSITION PERIOD 3 (Year 2021)

Spigot Elevation: 305.0m
Deposited Tailings: 0.2Mm³
Cumulative Tailings: 2.7Mm³
Duration: 2 Months
Pond Capacity: 4.1Mm³



DEPOSITION PERIOD 4 (Year 2021 - 2023)

Spigot Elevation: 310.0m
Deposited Tailings: 1.7Mm³
Cumulative Tailings: 4.4Mm³
Duration: 19 Months
Pond Capacity: 2.9Mm³



FINAL CONFIGURATION (Year 2023)

Pond Elevation: 305.0m
Pond Capacity: 2.9Mm³
Ma Depth: 4.5m

0m 200 400 00 800

srk consulting

SRK OB NO.: 1CS020.008
FILE NAME: 1CS020.00 3400 - Tailings DepositionO1.dwg

Sabina GOLD & SILVER CORP

BACK RIVER PRO ECT

FEASIBILITY LEVEL TSF DESIGN

North and South Deposition Plan (Option 1)

DATE:	APPROVED:	FIG RE:
Sept. 2015	TPP	2

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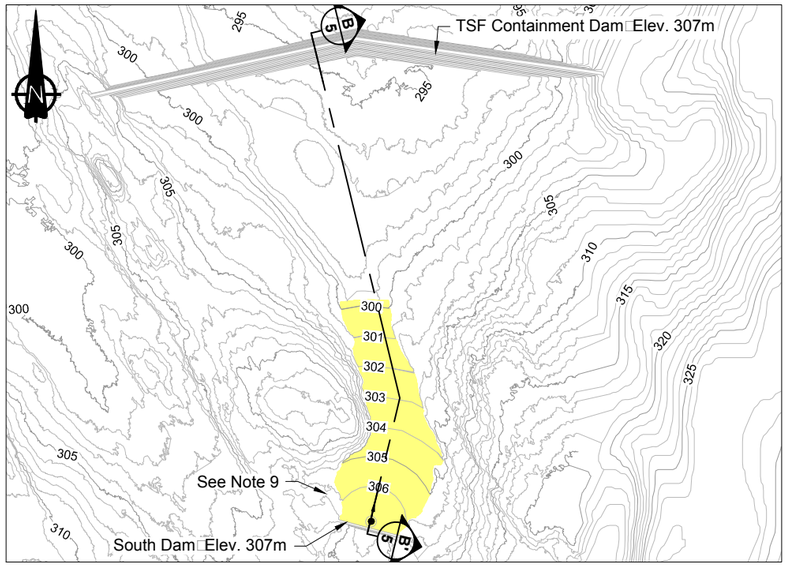
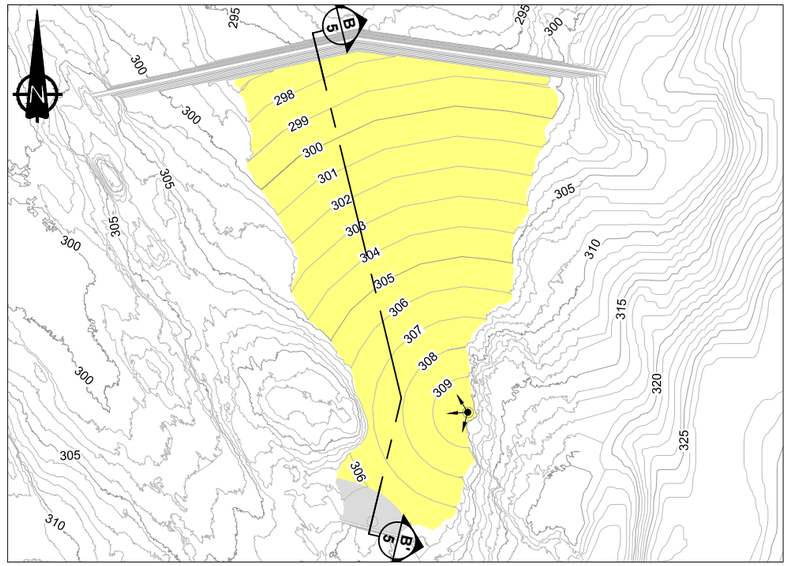


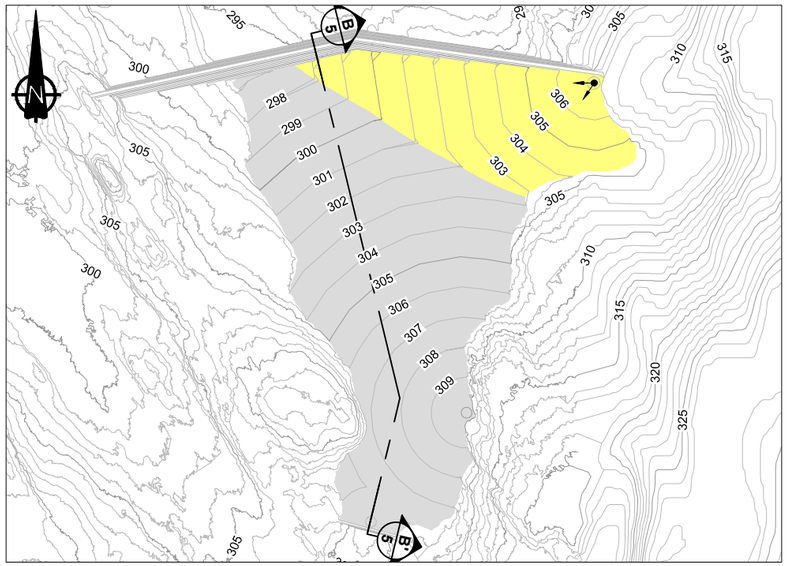
DEPOSITION PERIOD 1 (Year 2019)

Spigot Elevation: 307.0m
Deposited Tailings: 0.4Mm³
Duration: 7 Months
Available Pond Capacity: 6.4Mm³



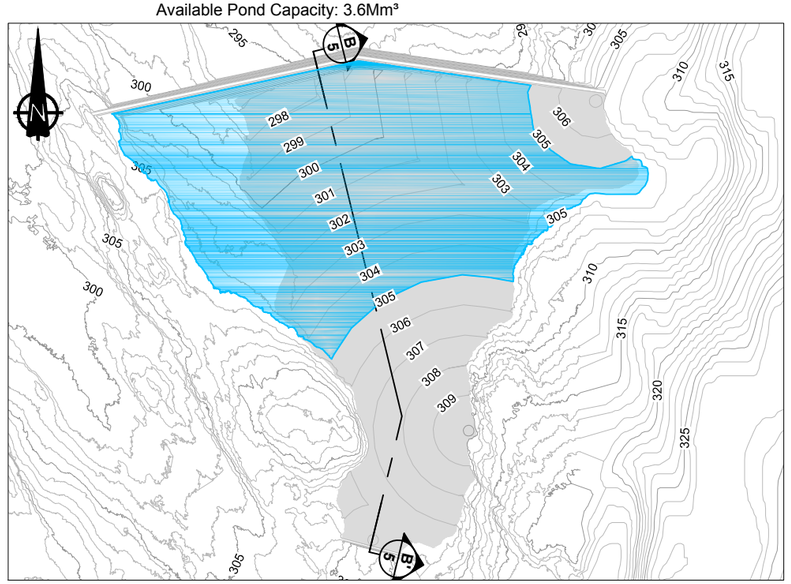
DEPOSITION PERIOD 2 (2019 - 2022)

Spigot Elevation: 310.0m
Deposited Tailings: 3.3Mm³
Cumulative Tailings: 3.7Mm³
Duration: 3 Months
Available Pond Capacity: 3.6Mm³



DEPOSITION PERIOD 3 (Year 2022-2023)

Spigot Elevation: 307.0m
Deposited Tailings: 0.7Mm³
Cumulative Tailings: 4.4Mm³
Duration: 8 Months
Available Pond Capacity: 2.9Mm³



FINAL CONFIGURATION

Pond Elevation: 305.0m
Pond Capacity: 2.9Mm³
Ma Depth: 8.0m

LEGEND

- Deposition Spigot Location
- Current Period Tailings
- Previously Placed Tailings
- Pond Elev 305.0m (Ma Operating Level)

NOTES

1. Deposition durations are appro imate and were based on an average production rate o :
   - 1,000m³/day Jan to April 2019;
   - 1,750m³/day April to July 2019;
   - 2,500m³/day July 2019 to April 2023; and
   - accounts or ice entrainment
2. Assumed an average deposited tailings beach slope o 1.0 .
3. Deposited tailings dry density 1.2 t/m³ (based on laboratory testing).
4. Ice entrainment was assumed at 20 o production.
5. Dam crest elevations at 307.0 m or all deposition periods.
6. Total storage requirement: 4.4Mm³; (Tailings 3.7Mm³ + Ice Entrainment 0.7Mm³)
7. Available pond capacities were based on a ma imum operating level at elevation 305.0 m.
8. Contours shown at 1.0 m interval.
9. A saddle dyke may be re uired or containment and should be con irmed in the ield.

REFERENCE

NAD83 TM one 13

0m 200 400 00 800

srk consulting

SRK OB NO.: 1CS020.008
FILE NAME: 1CS020.00 3400 - Tailings DepositionO2.dwg

Sabina GOLD & SILVER CORP.

BACK RIVER PRO ECT

PRELIMINARY TSF DESIGN

South Deposition Plan (Option 2)

DATE:	APPROVED:	FIG RE:
Sept. 2015	TPP	3

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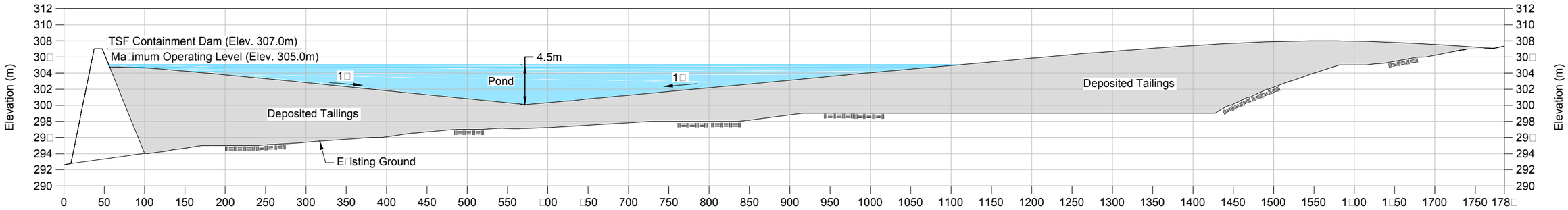

AA'
2

PROFILE SECTION

0m 5 10 15 20 Vertical

0m 50 100 150 200 Hori□ontal

NOTES

1. Ma□imum height o□pond is appro□imately 4.5m□which is located 550m south o□the TSF Containment Dam.
2. Available pond capacity at the end of operations is 2.9Mm³.

srk consulting

SRK □OB NO.: 1CS020.008

FILE NAME: 1CS020.00□3400 - Tailings DepositionO1.dwg

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BACK RIVER PRO□ECT

PRELINMINARY TSF DESIGN

Cross Section A-A□

DATE: Sept. 2015 | APPROVED: TPP | FIG. □RE: 4

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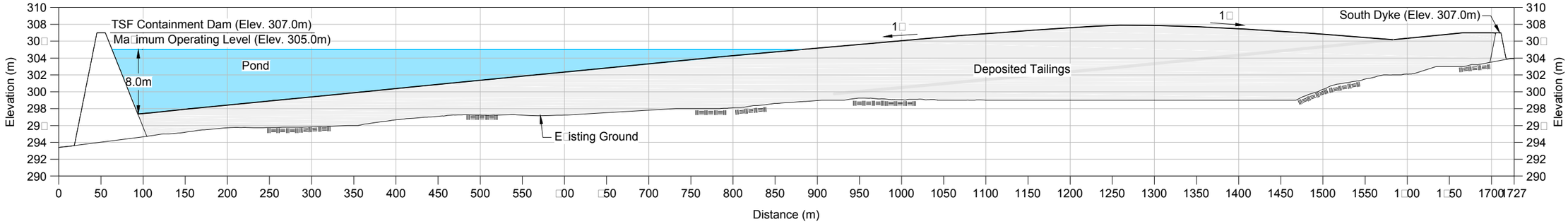

BB' 3 **PROFILE SECTION**

0m 5 10 15 20 Vertical

0m 50 100 150 200 Horizontal

NOTES

1. Maximum depth of pond is approximate 8.0m which is located at the west abutment of the TSF Containment dam.
2. Available pond capacity at the end of operations is 2.9Mm³.

srk consulting	Sabina GOLD & SILVER CORP.	PRELIMINARY TSF DESIGN
SRK JOB NO.: 1CS020.008	BACK RIVER PROJECT	Cross Section B-B'
FILE NAME: 1CS020.003400 - Tailings DepositionO2.dwg		DATE: Sept. 2015 / APPROVED: TPP / FIGURE: 5

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Appendix D - TSF Containment Dam Wave Run-up and Freeboard Assessment

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Memo

To:	Project File	**Client:**	Sabina Gold & Silver Corp.
From:	Samantha Barnes	**Project No:**	1CS020.008
Cc:	Iozsef Miskolczi, SRK Victor Munoz, SRK	**Date:**	September 27, 2015
Subject:	TSF Containment Dam Wave Run-up and Freeboard Assessment - Final		

1 Introduction

As part of the larger Final Environmental Impact Study (FEIS) for the Back River Project (the Project) in Nunavut, SRK Consulting (Canada) Inc. was retained by Sabina Gold & Silver Corp. to complete the preliminary design of the Tailings Management System (TMS) for the Project and its associated containment dam.

The proposed dam will be located in the Goose area, about 2 km south of the Goose Main pit. The facility will be in operation for just over two years before decommissioning. The preliminary design will encompass a relatively low profile structure with a maximum height of about 14 m, constructed primarily of run-of-mine (ROM) rock fill. The dam slopes will be 4H:1V on the upstream side and 2H:1V on the downstream, with a crest width of 10 m. An impermeable liner (LLDPE geomembrane) will be incorporated into the structure of the dam. Tailings beach development will result in the supernatant pond being located directly against the dam structure.

This memo documents the estimation of the required freeboard for the TSF Containment Dam. The freeboard estimate was completed under the assumption that the consequence classification of the tailings dam is characterized as High based on the 2007 Canadian Dam Association (CDA) Dam Safety Guidelines. A wind and wave analysis was performed to ensure that the crest of the dam is protected against extreme storm events.

No consideration for climate change is included.

2 Background Information

Topographical information for the Project site consists of LiDAR and was provided by Sabina Gold and Silver Corp. The preliminary dam alignment and the proposed tailings storage facility (TSF) bathymetry was used to estimate the fetch length and average water depth of the reservoir.

Hourly wind data was obtained from Environment Canada (EC 2014) for five stations; Robertson Lake, Hanbury River, Fort Reliance, Fort Reliance (AUT) and Cape Peel West.

Required hydrological inputs such as rainfall depth at the Back River Mine were obtained from the SRK Back River Hydrology Report (2014).

3 Methodology

A wind and wave analysis was performed to ensure that the crest of the dam is protected against the most critical of the following two cases (CDA 2007):

- Normal freeboard: No overtopping by 95% of the waves caused by the most critical wind with a frequency of 1 in 1,000 year when the reservoir is at its maximum normal elevation; and

- Minimum freeboard: No overtopping by 95% of the waves caused by the most critical wind associated with the annual exceedance probability event, when the reservoir is at its maximum extreme level during the passage of the inflow design flood.

For a dam with a High consequence classification, the wind annual exceedance probability is defined as the 2-year event and the Inflow Design Flood (IDF) is defined to be 1/3 between the 1,000-year event and the probable maximum flood (PMF) event (CDA 2007). However the TSF Containment Dam will not have an emergency spillway, and will therefore need to contain the PMF. To account for this, the PMF depth was added to the most critical of the two cases listed above.

The following sections describe the estimations of the normal freeboard and minimum freeboard.

4 Normal Freeboard

The normal freeboard estimation is the sum of the wind set-up and the wave run-up, which are based on the wind speed of a 1,000-year event, and the characteristics of the tailings dam geometry. The following subsections describe the estimation of each parameter.

4.1 Wind Setup

The wind setup is defined as the vertical water height above the static water level which may result from wind stress over the water surface. The US Army Corps of Engineers (USACE 1989) estimates the wind setup relative to the supply water level (SWL) using the following expression:

$$S = \frac{U^2 F}{1400 d} \qquad \text{(Eq. 1)}$$

Where:

S is the wind setup relative to the SWL (ft);
U is the wind speed (mph);
F is the effective fetch length (miles); and
d is the average water depth over the fetch (ft).

4.1.1 Wind Speed

The wind speed for each return period was estimated using a combination of local site data and ERA global meteorological data.

The Back River Property consists of three local meteorological stations, including one station at the Goose Property, one at the George Property, and one at the Bathurst Inlet. Monthly maximum instantaneous wind speed has been reported each year since 2004 at Goose and George, and since 2007 at Bathurst Inlet. A total of 10 years of data exists for Goose and George, which is insufficient to perform a frequency analysis for events including the 1000 year return period.

Daily wind gust data from ERA was downloaded for the location of the Property. The measured site records presented higher maximum annual wind speeds than the ERA data, however a correlation was established using the George meteorological data, which presented the highest wind speeds than Goose and Bathurst Inlet. The ERA annual maximum wind gust data was corrected using a linear regression for the George station, creating a 36 year record.

A frequency analysis was performed on the patched record, with results presented in Table 1.

Table 1: Maximum Instantaneous Wind Speed for the Property

Station Name	# of Yrs of Data	Max Wind Speed (m/s)						
		Return Period (yrs)						
		1000	100	50	20	10	5	2
George Station (patched)	15	38.4	34.2	32.9	31.2	29.9	28.5	26.4

Based on the results of the frequency analysis, the 1,000-year return period wind speed was determined to be 38.4 m/s.

4.1.2 Fetch Length

The TSF ultimate footprint was used to determine the maximum fetch length. Based on the configuration of the pond, as presented in Figure 1, the maximum fetch length was determined to be 1.74 km, (1.08 miles).

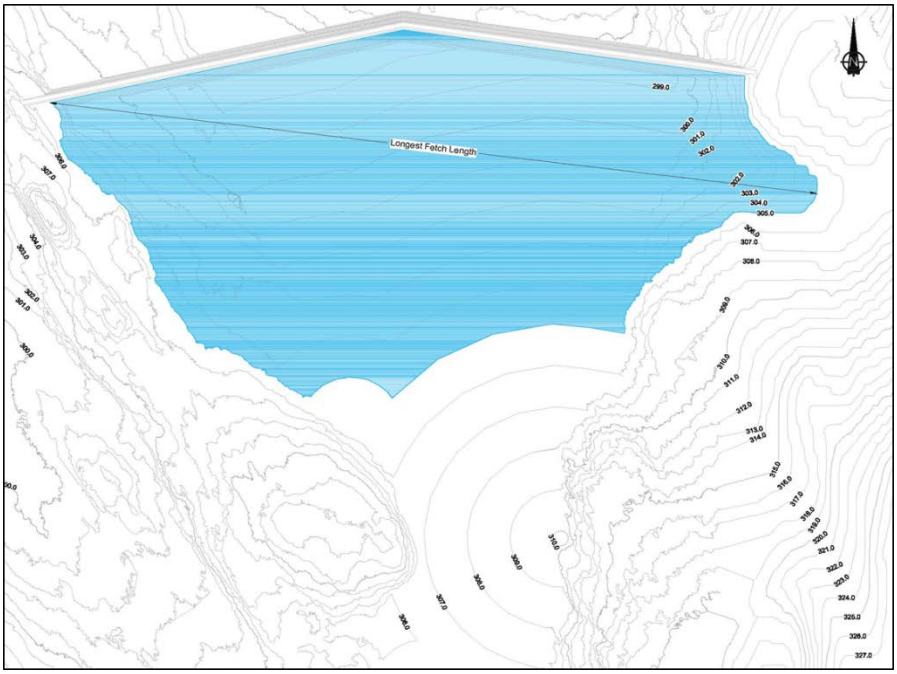


Figure 1: Fetch Length for TSF

4.1.3 Wind Speed Correction over Water

USBR (1981) and USACE (1997) suggest corrections for meteorological wind speed over water. These correction factors are based on the considered fetch length, and are presented in Table 2. Based on a maximum fetch length of 1.74 km (1.08 miles), the correction factor used in the analysis is 1.15. This correction factor was applied to the maximum wind speed calculated in Section 2.1.1 to obtain an over-water wind speed of 44.1 m/s.

Table 2: Wind Over Water Correction Factors

Fetch km (miles)	Wind Ratio Over Water/Over Land
0.8 (0.5)	1.08
1.6 (1)	1.13
3.2 (2)	1.21
4.8 (3)	1.26
6.4 (4)	1.28
8.0 (5)	1.30

Source: USACE (1997)

4.1.4 Average Water Depth over Fetch

It is expected that the depth of water in the reservoir will be shallow above the layer of placed tailings. The average depth was assumed to be 4.4 m based on the planned tailings deposition.

4.1.5 Resultant Wind Setup

The resultant wind setup calculated for an over-water wind speed of 44.1 m/s, an average water depth of 4.4 m, and a maximum fetch length of 1.7 km was approximately 0.16 m.

4.2 Wave Run-up

Wave run-up is defined as the maximum vertical extent of a wave uprush on a beach or structure. The estimation of the wave run-up is dependent on the wave height.

4.2.1 Wave Height Estimation

The wave height was estimated based on figures presented in the USACE shoreline protection manual (USACE 1984) for shallow water wave propagation. The manual presents relationships between the wind stress factor and the fetch length, for reservoirs of varying average depths. The wind stress factor is calculated based on the maximum wind speed, using Equation 2.

$$U_A = 0.71 \times U^{1.23} \quad \text{(Eq. 2)}$$

Where U_A is the wind-stress factor, and U is the maximum wind speed in m/s. Based on Equation 2, the wind-stress factor for the 1000 year return period wind event is 63.1 m/s. The significant wave height was estimated to be 1.21 m based on the relationship presented in Figure 2.

.

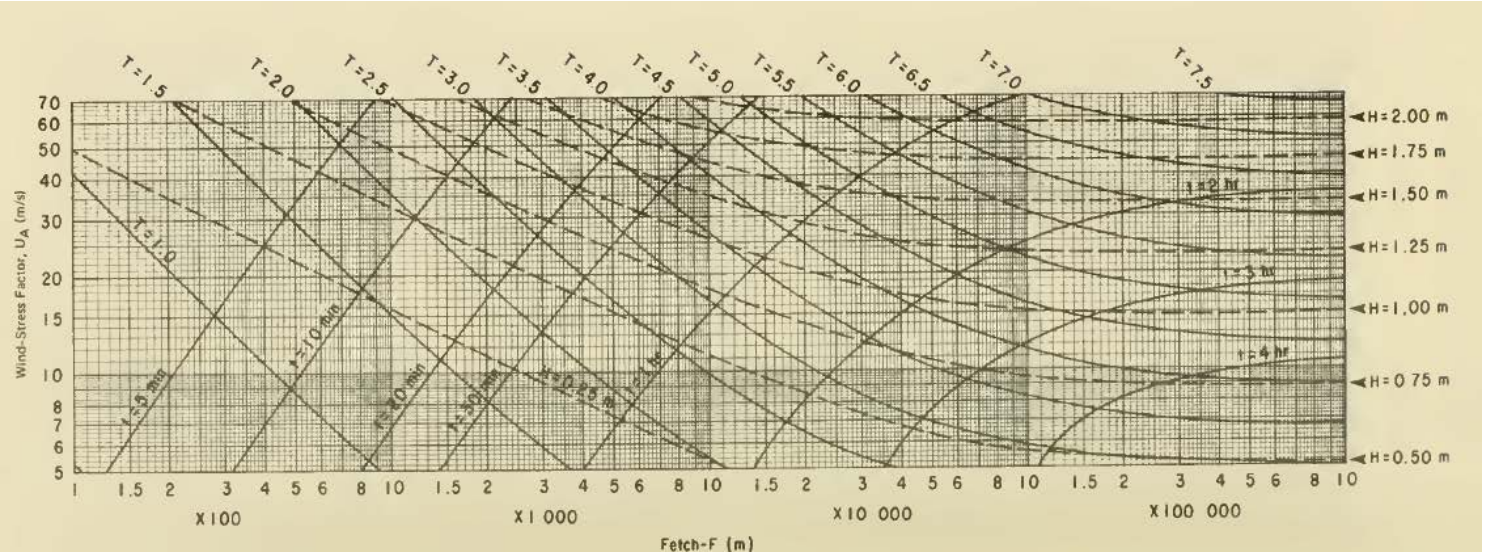


Figure 2: Significant Wave Height, Wave Period and Duration for pond depth of 4.5m (USACE, 1984)

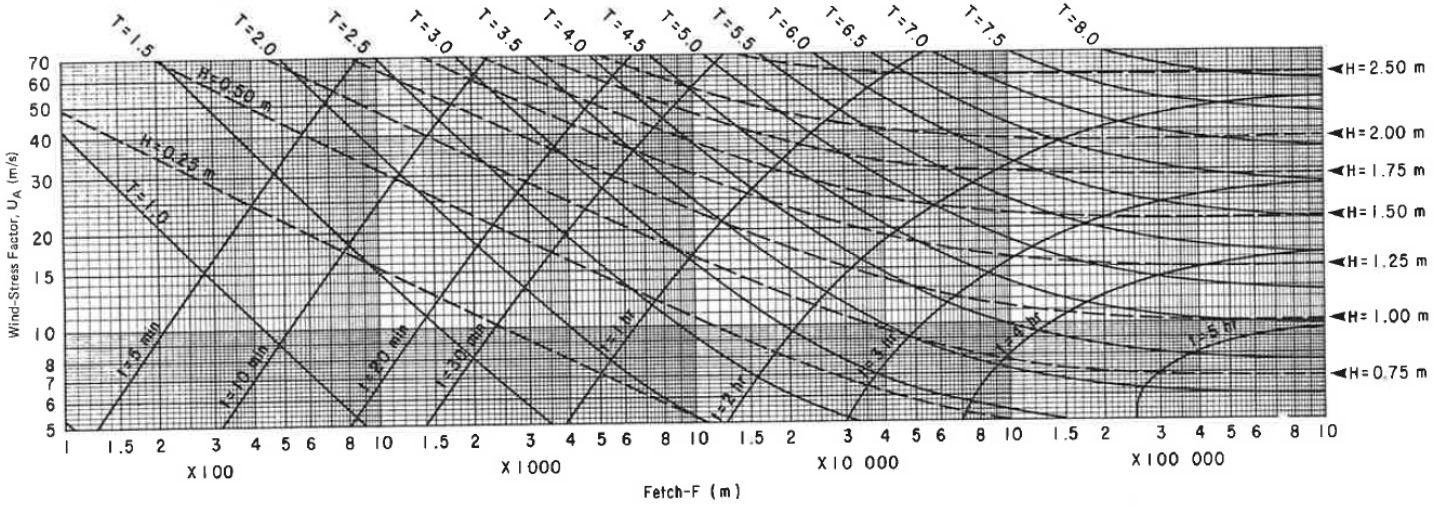
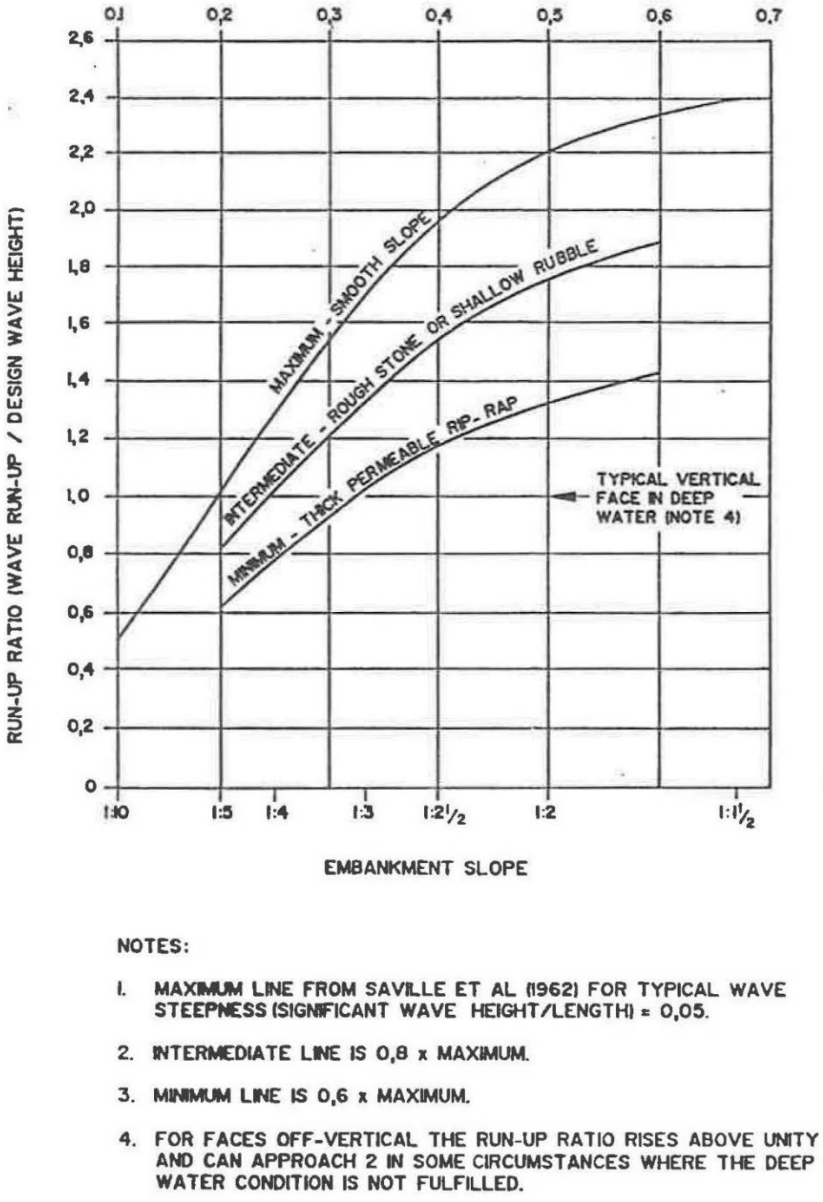


Figure 3: Significant Wave Height, Wave Period and Duration for pond depth of 6 m (USACE, 1984)

4.2.2 Wave Run-up Estimation

The wave run-up was calculated as described in SANCOLD (1990).

SANCOLD (1990) presents a relationship between the wave height, the embankment slope and the embankment protection. The wind run-up ratio is obtained from Figure 4. Based on 4 to 1 side slopes (horizontal to vertical) and a combination of rough stone and riprap, the run-up ratio was approximated to be 0.9. This factor is then multiplied by the wave height, resulting in a wave run-up of 1.1 m over the full supply level, for the 1000 year wind event.



NOTES:

1. MAXIMUM LINE FROM SAVILLE ET AL (1962) FOR TYPICAL WAVE STEEPNESS (SIGNIFICANT WAVE HEIGHT/LENGTH) = 0,05.
2. INTERMEDIATE LINE IS 0,8 x MAXIMUM.
3. MINIMUM LINE IS 0,6 x MAXIMUM.
4. FOR FACES OFF-VERTICAL THE RUN-UP RATIO RISES ABOVE UNITY AND CAN APPROACH 2 IN SOME CIRCUMSTANCES WHERE THE DEEP WATER CONDITION IS NOT FULFILLED.

Figure 4: Wave Run-up Estimation from SANCOLD (1990)

4.3 Normal Freeboard Estimate

The normal freeboard for the Back River tailings dam was determined to be approximately 1.3 m for a wind setup of 0.16 m and a wave run-up of 1.1 m for a 1,000-year wind storm.

5 Minimum Freeboard

The minimum freeboard is described as the required freeboard to protect against the IDF and the wave run-up from wind storm corresponding to return period of a two years. The water level in the pond is therefore equal to the full supply level plus the IDF depth. The following subsections describe the estimation of each parameter.

5.1 Inflow Design Flood

As previously described, the IDF for the tailings dam is defined to be 1/3 between the 1,000-year flood and PMF, however due to lack of an engineered emergency spillway the entire volume of the PMF event will be stored in the TSF.

Considering that the watershed upstream of the tailings dam is less the 7 km^2, a rainfall-runoff approach was used to determine the PMF.

The catchment area upstream of the dam was determined to be approximately 3.3 km^2, while the PMP rainfall depth was determined to be 221 mm. This results in a volume of runoff of about 729,000 m3, which would raise the water level in the TSF from FSL (305.0 masl) by about 0.5m.

5.2 Wind Setup

Using the results presented in Section 4 and Table 1, the 2-year wind set-up was calculated based on a wind speed of 26.4 m/s. After applying the correction factor for wind over water, the wind speed was increased to 30.3 m/s. The average water depth in this case is equal to 4.9 m, due to the 0.5 m increase caused by the IDF. The wind set-up based on these parameters was estimated to be 0.07 m.

5.3 Wave Run-up

Since the average water depth is increased to 4.9 m in this case, the wave height corresponding to the 2-year wind speed requires an interpolation between Figure 2 and Figure 3. Using Equation 2 the wind-stress factor was calculated to be 39.8 m/s.

Based on the relationships presented in Figure 2 and Figure 3 **Error! Reference source not found.**, the significant wave height for the Back River Main tailings dam based on a depth of 4.9 m was interpolated to be 0.75 m for the 2 year wind event.

Using a wave run-up correction factor of 0.9, from Figure 4, the wave run-up for the 2 year wind event is equal to 0.68 m.